

## **Bi-weekly Seismic Call Minutes**

**Date:** 2016-04-20

**NRC Attendance:** John Vera, Vaughn Thomas, Robert Roche, Ata Istar, Joseph Braverman, Jinsuo Nie

**KHNP Attendance:** Erin Wisler

**KEPCO E&C Attendance:** Jinwoo Lee, Jaewan Park, Joohyung Kang, Hoonin Cho, Youngsun Lee, Donghyun Yoo, Kyeongjin Jeong, Daejoong Kim, Jinho Cho, Yeonghun Kim, Kwanghoon Koh

**Public Attendance:** None

### **Topics:**

1. RAI 199-8223, Question 03.08.01-11

KHNP is to determine if the information included in the 2016-03-23 teleconference agenda can be included in the RAI response and the DCD, and communicate a new draft due date.

**KHNP Input**

The information included in the 2016-03-23 teleconference agenda has been reflected in the revised RAI response and the DCD markup, as shown in the materials provided on April 19.

**Discussion:**

Due to materials not being provided until the day before the call, there was insufficient time for the NRC staff to review the materials provided. The issue will be discussed during the 2016-05-04 bi-weekly call.

2. RAI 199-8223, Question 03.08.01-13

The NRC staff is to comment on the acceptability of the draft response provided on 2016-03-18 and the appropriateness of using the prestressing system's vendor name in the DCD. KHNP is to translate the Korean version of the VSL brochure into English and describe what information is applicable to the APR1400.

**KHNP Input**

The translation of the VSL Korea brochure was provided on April 19. The English version of the VSL brochure is summarized in the Korean version. The Korean version provides only one option of material properties without any other options. In this process, the different material was used to consider the local conditions.

The dimensions in certain anchorage types may vary with material properties including concrete compressive strength, yield strength of reinforcing steel and tendon stressing force. The dimensions which do not match between the VSL International and Korean brochures come from the difference of material properties applied in both brochures.

In general, dimensions of anchorage assemblies in the VSL brochures are standard detailing recommended by VSL. However, the dimensions of anchorage assemblies used in APR 1400 are calculated by the supplier to consider the actual material properties applied in the APR 1400. The actual material properties are described in DCD 3.8A.1.2.

**Discussion:**

The NRC staff stated that the OGC had indicated that it is permissible to include in the DCD the name of a vendor, and the NRC staff stated there is precedence with providing the name of prestressing systems in other applications. The NRC staff stated that KHNP can resolve the issue described in the RAI by either including in DCD Tier2, Section 3.8.1.6.3 the name of the vendor and the product name, or include in the DCD a COL item which specifies the COLA is to demonstrate that the tendon and anchorage system selected for prestressing the containment is of the same configuration as that which is assumed in the DCD. KHNP stated that DCD Tier 2, Section 3.8.1.6.3 would be revised to include the vendor name and product designation. Because the translated VSL brochure was not provided to the NRC staff until the day before the call, no feedback could be provided regarding whether the material provided satisfied concerns expressed during the 2016-04-06 bi-weekly conference call. Discussion regarding the translated brochure is to take place during the 2016-05-04 bi-weekly call.

**ACTION: KHNP is to provide to the NRC a markup of DCD Tier 2, Section 3.8.1.6.3 which specifies the manufacturer and product designation of the tendon and anchorage system. A date by which the draft response is to be provided is to be communicated with the NRC staff.**

3. RAI 252-8299, Question 03.07.02-9

KHNP is still examining the cause of the abnormal ISRS for the S05 profile. KHNP anticipates the supplemental response can be produced by 2016-05-27. KHNP is to report any progress regarding determining the cause of the EDGB & DFOT S5 behavior.

**KHNP Input**

KHNP has investigated whether numerical error exists in the EDGB and DFOT SSI analysis model for the S5 soil case, but no numerical error has been identified.

KHNP has performed the SSI analyses using separated superstructure models for the EDGB and DFOT, respectively, to find the cause of abnormal responses in the ISRS for S5 soil case. The results of the separated SSI analysis using only the EDGB model are reasonable, but the results using only the DFOT model are still abnormal. Thus, KHNP has

performed an additional SSI analysis using only the DFOT model with some modifications. These modifications include changing of backfill properties from structural fill granular to lean concrete and changing of the mesh configuration of the entire backfill from irregular to regular. The results of the additional SSI analyses using modified DFOT model are found to be reasonable.

Since EDGB and DFOT structures are adjacent to NI structure and their embedment depths are different from each other, the backfill mesh configurations of the coupled EDGB and DFOT model are irregular and complex, while the backfill mesh configuration of the NI structure model is regular and simple. Therefore, KHNP assumed that mesh configuration and properties of the backfill model in the coupled model are the major causes of the abnormal ISRS.

According to this assumption, KHNP is first performing two cases of SSI analyses for the DFOT model (by itself) with partially changed backfill. One is a model using lean concrete as properties of EDGB side backfill. The other is a model using a modified mesh configuration for the backfill. KHNP expects that a main cause of the abnormal response can be identified after those two analyses are completed. Then, KHNP will perform SSI analyses using a coupled EDGB and DFOT model which has modified backfill properties or mesh configurations of backfill, according to the above results of the SSI analyses.

#### **Discussion:**

Due to materials not being provided until the day before the call, there was insufficient time for the NRC staff to review the materials provided. The issue will be discussed during the 2016-05-04 bi-weekly call.

#### **4. RAI 252-8299, Question 03.07.02-7 and 10**

##### **Question 03.07.02-7**

KHNP is to revise the response to address the concerns expressed by the NRC staff during the 2016-04-06 call regarding the exclusion of 25% of the live loads and to provide a detailed description of slab modeling in the seismic and structural design models. KHNP is to provide a summary of the response approach and a proposed draft due date.

##### **KHNP Input**

The response to the concerns expressed by the NRC staff during the 2016-04-06 call have been provided to the NRC staff (April 19) in support of this call. Item 2 of the provided information (2. Seismic Live Load and Slab Modeling in RCB Seismic Analysis Model) will be added to the revised response to RAI 252-8299, Question 03.07.02-7. However, KHNP proposes that Item 1 (1. Slab Modeling in RCB Structural Analysis Model), which is not related to RAI 252-8299, Question 03.07.02-7, such as slab modeling in the structural analysis model and the connection details of structural steel beam supporting the slabs, not

be added to the revised response. The draft revised response will be provided by April 29, if the response approach is accepted by NRC staff.

#### **Discussion:**

The NRC staff stated that it was unclear how slabs other than those between the secondary shield wall (SSW) and the containment shell were modeled, if those other slabs had 25% of the live loads applied to them, and if those other slabs had been included in KHNP's evaluation of the effects of including 25% of the live loads in slabs. KHNP stated that there were horizontal surfaces which KHNP does not define as slabs due to the span of the elements being short. The NRC staff referred to DCD Tier 2, Figure 1.2-2, "General Arrangement Reactor Containment Building Section A-A" on page 1.2-48 to provide examples of slabs other than those between the SSW and the containment shell whose treatment should be described in the response. The NRC staff stated that regardless of a horizontal element's span or stiffness, it is considered to be a slab. KHNP stated that a review of the live load study would need to be conducted to determine if the study included slabs other than those between the SSW and the containment shell. KHNP stated that the NRC staff would be informed as to whether those other slabs are included in the study, and if not, a fixed based study would be performed which includes the slabs. The NRC staff stated that applying a fixed based condition for the study seemed appropriate. KHNP stated that the response would be revised to include descriptions of the modeling of slabs which were not between the SSW and the containment and the loads which are applied to those slabs. KHNP indicated understanding that for any slabs which do not have 25% of the live loads applied a justification for exclusion of that load must be provided.

**ACTION: KHNP is to determine what slabs have been included in the live load study, re-perform the study if all slabs have not been included, and revise the RAI response to describe the modeling of all slabs and discuss the treatment of live loads with regard to those slabs (justify if excluded).**

Question 03.07.02-10

During the 2016-04-06 call, the NRC staff stated that KHNP's response approach was not satisfactory. KHNP is to provide a summary of the response approach and a proposed draft due date.

#### **KHNP Input**

To provide additional information, a study will be performed as follows:

1. The auxiliary building walls, which have fundamental frequencies lower than 50 Hz, will be identified using classical plate vibration formulas.
2. For identified walls, which have fundamental frequencies lower than 50 Hz, the modal analyses will be performed using ANSYS fine and coarse partial wall models.
3. Frequencies, dimensions, and the mesh sizes of those partial wall models will be summarized.

The draft revised response will be provided by May 31, if the response approach is accepted by NRC staff.

**Discussion:**

The NRC staff stated that the response approach is aligned with the staff's expectations.

**ACTION: KHNP is to provide a draft response by 2016-05-31.**

5. RAI 183-8197, Question 03.07.02-4

KHNP is to provide a date by which the response will be revised to include the EDGB & DFOT and provided to the NRC.

**KHNP Input**

The revised response will be provided by April 29.

**Discussion:**

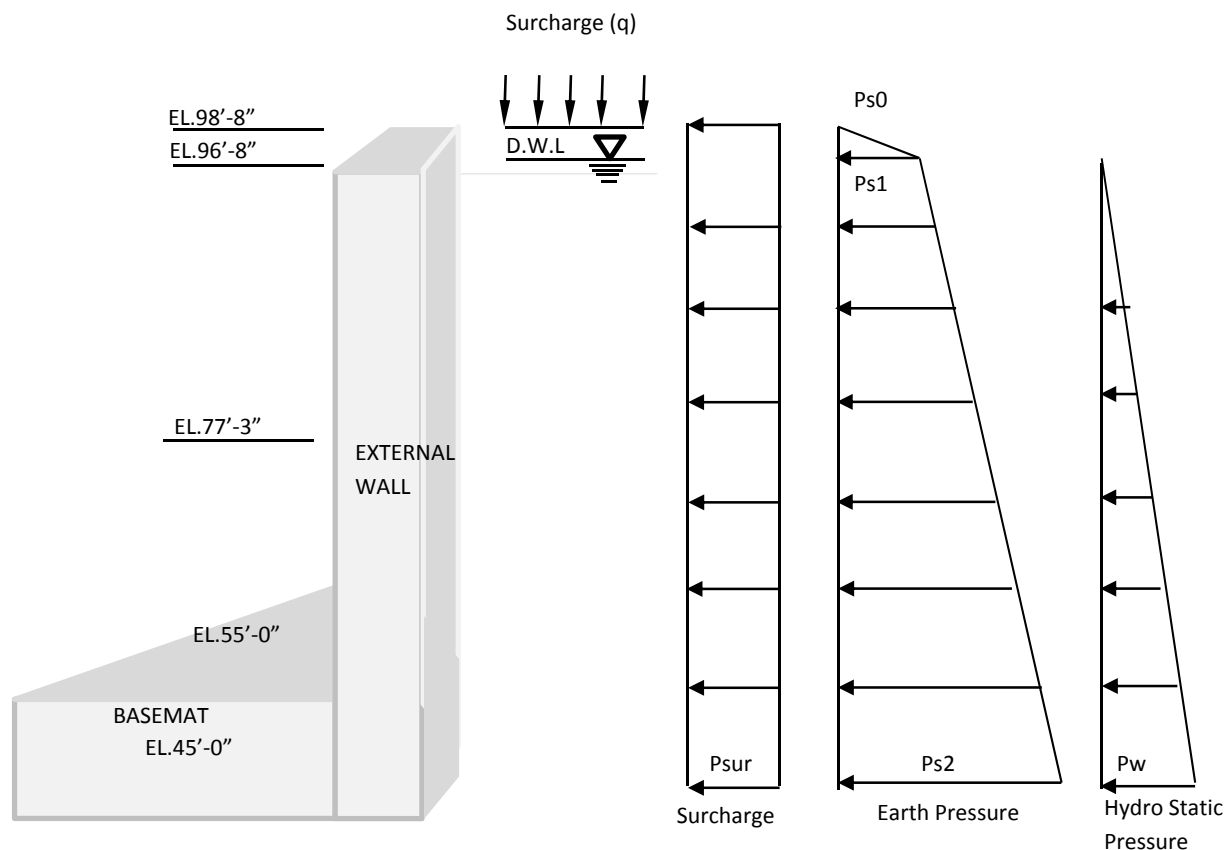
The NRC acknowledged KHNP's revised schedule.

6. RAI 227-8274, Q 03.08.04-4

KHNP is to explain why  $L_g$  is only applied up to two feet below grade.

**KHNP Input**

The soil and surcharge load ( $L_g$ ) include hydrostatic pressure, surcharge load and earth pressure.



The hydrostatic pressure is applied up to two feet below grade. Earth pressures are applied up to the grade level.

#### **Discussion:**

Due to materials not being provided until the day before the call, there was insufficient time for the NRC staff to review the materials provided. The issue will be discussed during the 2016-05-04 bi-weekly call.

#### **7. RAI 199-8223, Q 03.08.01-9**

During the 2016-04-06 call the NRC staff stated that the response should provide a markup for DCD Section 3.8.2.7 which provides similar information to what had already been included in the response. KHNP stated the feedback would be considered. KHNP is to communicate if the NRC staff's feedback will be incorporated and provide a date by which the revised draft response will be provided.

#### KHNP Input

As shown the draft revised RAI response (April 19), the markup of DCD section 3.8.2.7 has been added in the revised response.

#### **Discussion:**

Due to materials not being provided until the day before the call, there was insufficient time for the NRC staff to review the materials provided. The issue will be discussed during the 2016-05-04 bi-weekly call.

#### 8. Time History Seed Records

KHNP is to provide the NRC staff with the time history seed records for Northridge and Nahanni.

#### KHNP Input

The time histories of the seed motion for the CSDRS and HRHF have been provided via e-mail (April 19).

#### **Discussion:**

The NRC staff stated that the time histories had been received and that they would be reviewed and possibly discussed at a later date.

#### **KHNP Added**

#### 9. RAI 255-8285, Question 03.08.05-7

#### KHNP INPUT

KHNP would like to discuss the response approach for RAI 255-8285 Question 03.08.05-7 regarding the work scope of the evaluation of settlement due to construction sequences.

1. Under the site properties in DCD Table 3.7A-1, the construction sequence analysis will not affect the design of the basemat and superstructure. Because the settlement is dependent on the amount of applied load when considering sand characteristics, the settlement during construction will be smaller than the settlement under the as-built condition described in the technical report.
2. If the construction sequence is necessary to check the item 1, KHNP plans to execute the construction sequence analysis based on the following assumptions. Confirmation that the NRC staff agrees that the assumptions are reasonable before work begins is desired.
  - 1) The site properties described in DCD 3.7A-1 are used in the construction sequence analysis.
  - 2) Based on assumption 1), the short-term settlement will be checked and considered.

- 3) The analysis will use the construction sequence of Shin-Kori units 3,4 instead of the actual construction sequence which would be specified by a COLA.
- 4) If the settlement for the construction sequence does not exceed the allowable settlement presented in DCD Table 2.0-1, the effects on the design for the seismic category I structures due to the construction sequence analysis will not be accounted for.

**Discussion:**

Due to materials not being provided until the day before the call, there was insufficient time for the NRC staff to review the materials provided. The issue will be discussed during the 2016-05-04 bi-weekly call. However, the NRC staff did stated that Questions 03.08.05-7, 9, and 18 are interrelated and should be responded to in concert, and that the questions are with regards to SRP Section 3.8.5.II.4.e, j, and k.

10. RAI 255-8285, Question 03.08.05-16

**KHNP INPUT**

KHNP has provided a draft revised response to address issues regarding the static elastic modulus, as discussed during the December 2015 meeting. KHNP would like to hear any feedback the NRC staff might have to offer.

**Discussion:**

Due to materials not being provided until the day before the call, there was insufficient time for the NRC staff to review the materials provided. The issue will be discussed during the 2016-05-04 bi-weekly call.

11. RAI 182-8160, Question 03.07.01-3 and RAI 255-8285, Questions 03.08.05-8, 11, 12 schedules.

RAI	Question	Due Date	Revised Due Date	Reason of change
182-8160	03.07.01-3	2016-04-30	2016-06-30	At this time, KHNP anticipates the re-evaluation of the PSD will take approximately 12 weeks.
255-8285	03.08.05-8	2016-04-22	2016-05-13	KHNP anticipates the foundation re-analysis to reflect required changes discussed in the public meeting will take until the end of this month. Accordingly, KHNP will
255-8285	03.08.05-11	2016-03-18	2016-05-13	
255-8285	03.08.05-12	2016-04-	2016-05-	



		15	13	need to revise RAI responses to describe the changes in the foundation re-analysis.
255-8285	03.08.05-16	2016-04-15	2016-06-03	KHNP needs more time to consider the approach to be taken to calculate the soil elastic modulus.

### **Discussion:**

The NRC staff stated that the multiple slips in schedule for RAI 182-8160, Question 03.07.01-3 are concerning since the work is upstream of many other evaluations and analyses. The NRC staff requested that KHNP indicate the current level of confidence in a positive outcome and acknowledge the increased level of risk due to potential reanalysis. KHNP stated that the schedule slip was due to resourcing issues and that an assessment of the level of confidence in a positive outcome would be determined and communicated. The NRC staff pointed out that the table of schedule slips indicates RAI 255-8285, Q 03.08.05-16 will be provided by 2016-06-03 while a draft was provided on 2016-04-19. KHNP stated the issues would be investigated and clarity would be provided to the staff.

**ACTION: KHNP is to determine the level of confidence in a positive outcome, the risks associated with a negative outcome (body of work to be performed and schedule of that work should there be a negative outcome). KHNP is to determine why a revised due date of 2016-06-03 has been provided for RAI 255-8285, Q 03.08.05-16 when a draft was provided to the NRC on 2016-04-19.**

Feedback regarding Questions 03.07.01-1 and 2 had been provided by the NRC staff ahead of the call. The feedback had been distributed to KHNP. Discussion regarding the feedback is to take place during the 2016-05-04 bi-weekly call.

The NRC staff stated that feedback regarding Questions 03.08.01-2 and 5 would be provided to KHNP. After the call, the feedback was provided by the NRC staff and distributed within KHNP.

### **Outstanding Draft RAI Responses**

RAI	Question	Draft Due Date	Draft Provided	Feedback Provided	Action With
182-8160	03.07.01-4	N/A	4/6/2016	N	NRC
252-8299	03.07.02-7	7/31/2016	N	N/A	KHNP
252-8299	03.07.02-7 item a.)i.)	4/29/2016	N	4/20/2016	KHNP
252-8299	03.07.02-9	5/27/2016	N	N/A	KHNP
252-8299	03.07.02-10	5/31/2016	N	4/20/2016	KHNP
252-8299	03.07.02-11	7/31/2016	N	N/A	KHNP
252-8299	03.07.02-12	N/A	3/22/2016	3/31/2016	KHNP (to be submitted)
129-8085	03.08.01-1	N/A	2/19/2016	N	NRC
129-8085	03.08.01-4	N/A	4/20/2016	N	NRC

226-8235	03.07.02-5	4/18/2016	N	N/A	KHNP
226-8235	03.07.02-6	8/12/2016	N	N/A	KHNP
183-8197	03.07.02-1	8/12/2016	N	N/A	KHNP
183-8197	03.07.02-4	4/29/2016	N	4/6/2016	KHNP
199-8223	03.08.01-8	4/29/2016	N	N/A	KHNP
199-8223	03.08.01-9	N/A	4/19/2016	N	NRC
199-8223	03.08.01-10	4/18/2016	N	N/A	KHNP
199-8223	03.08.01-11	N/A	4/19/2016	N	NRC
199-8223	03.08.01-13	TBD	N/A	4/20/2016	KHNP
200-8225	03.08.02-2	N/A	4/4/2016	N	NRC
227-8274	03.08.04-1	N/A	3/4/2016	4/6/2016	KHNP (to be submitted)
227-8274	03.08.04-3	N/A	3/23/2016	N	NRC
227-8274	03.08.04-4	TBD	N	4/6/2016	KHNP
227-8274	03.08.04-9	N/A	3/4/2016	4/6/2016	KHNP (to be submitted)
267-8301	03.07.03-1	4/18/2016	N	N/A	KHNP
267-8301	03.07.03-3	N/A	3/30/2016	N	NRC
255-8285	03.08.05-7	N/A	4/4/2016	N	NRC
255-8285	03.08.05-16	N/A	4/19/2016	N	NRC
255-8285	03.08.05-18	N/A	3/21/2016	N*	NRC
253-8300	03.07.01-5	N/A	3/30/2016	N	NRC
253-8300	03.07.01-8	N/A	4/4/2016	N	NRC

John Vera, NRC, indicated that the draft response to 3.7.3-1 had not been received although it is indicated above as submitted on 4/18/2016. Erin Wisler, KHNP, agreed to check his email for possible bouncing back and to resend it.