

## **KHNPDCDRAIsPEm Resource**

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**From:** Ward, William  
**Sent:** Friday, September 25, 2015 6:13 PM  
**To:** apr1400rai@khnp.co.kr; KHNPDCDRAIsPEm Resource; Harry (Hyun Seung) Chang; Andy Jiyong Oh; Erin Wisler (erin.wisler@aecom.com)  
**Cc:** Lee, Samuel; Roche, Robert; Xu, Jim; Betancourt, Luis; Thomas, Vaughn  
**Subject:** APR1400 Design Certification Application RAI 226-8235 (03.07.02 - Seismic System Analysis)  
**Attachments:** APR1400 DC RAI 226 SEB1 8235.pdf

KHNP,

The attachment contains the subject request for additional information (RAI). This RAI was sent to you in draft form. Your licensing review schedule assumes technically correct and complete responses within 30 days of receipt of RAIs. However, KHNP requests, and we grant, 60 days to respond to this RAI. We may adjust the schedule accordingly.

Please submit your RAI response to the NRC Document Control Desk.

Thank you,

**William R. Ward, P.E.**  
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**Received Date:** 9/25/2015 6:12:45 PM  
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United States Nuclear Regulatory Commission

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## REQUEST FOR ADDITIONAL INFORMATION 226-8235

Issue Date: 09/25/2015  
Application Title: APR1400 Design Certification Review – 52-046  
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.  
Docket No. 52-046  
Review Section: 03.07.02 - Seismic System Analysis  
Application Section: 3.7.2

### QUESTIONS

#### 03.07.02-5

10 CFR 50 Appendix S requires that the safety functions of structures, systems, and components (SSCs) must be assured during and after the vibratory ground motion associated with the safe shutdown earthquake (SSE) ground motion through design, testing, or qualification methods. In accordance with 10 CFR 50 Appendix S, the staff reviews the adequacy of the seismic analysis methods used to demonstrate that SSCs can withstand seismic loads and remain functional. In Sections 3.2.5, 3.2.7, and 4.2.9 in APR1400-E-S-NR-14002-P, the applicant discusses that the weight of the RCS, the hydrodynamic masses of IRWST (i.e. both impulsive and convective masses), and hydrodynamic masses for the AFW and FHA tanks that are included in the finite element models (FEMs) for use in SSI analysis. However, in contrast with the information in APR1400-E-S-NR-14002-P, in Section 6.1 of APR1400-E-S-NR-14003-P the applicant states that the RCS masses and the convective (sloshing) hydrodynamic masses for the first and second horizontal sloshing modes of IRWST were not included in the maximum building seismic response forces and moments obtained from the SSI analysis. This section also states that, for the structural design, the maximum seismic response RCS support reaction forces and moments and the maximum hydrodynamic pressures generated from the maximum seismic response of the horizontal sloshing modes of IRWST, AFW and FHA tanks are added to the maximum building seismic response forces and moments that are computed.

To assist the staff in evaluating whether the aforementioned masses and their effect have been adequately considered in the seismic analysis and design, the staff requests the applicant to clarify if these masses are included in or excluded from the FEMs used in the SSI analyses. If the hydrodynamic masses were included in the FEMs used in the SSI analyses, describe the process used to estimate the slosh height. If the masses described in the paragraph above are excluded from the FEMs used in the SSI analyses, describe the process (including a numerical example) for developing design loads that correspond to these masses and how these loads are combined with the seismic design loads. Additionally and as necessary, correct any inconsistencies between the aforementioned technical reports.

## REQUEST FOR ADDITIONAL INFORMATION 226-8235

### 03.07.02-6

10 CFR 50 Appendix S requires that the safety functions of structures, systems, and components (SSCs) must be assured during and after the vibratory ground motion associated with the safe shutdown earthquake (SSE) ground motion through design, testing, or qualification methods. In accordance with 10 CFR 50 Appendix S, the staff reviews the adequacy of the seismic analysis methods used to demonstrate that SSCs can withstand seismic loads and remain functional. Per SRP Sections 3.7.2.II.8 and 3.7.2.II.14 the staff reviews (1) the design and analysis criteria to ensure no adverse interaction between seismic Category I and non-seismic Category I structures and (2) the adequacy of the determination of design structure-to-soil pressures beneath and along sidewalls of the foundation. This requires that the effects of structure-soil-structure interaction (SSSI) between these structures be accounted for to determine its significance.

The applicant has documented their evaluation of potential SSSI effects in report APR1400-E-S-NR-14005-P, Rev.0. This report states that the coupled structure-soil-structure interaction model is developed assuming a surface-supported foundation condition. However, the staff notes that use of surface-founded models can only account for coupling between foundation elements of adjacent structures. Additional coupling can occur through soils placed between the bases of these structures acting on the embedded sidewalls of the adjacent structures. The magnitude and phasing of this coupling is dependent on inertial properties as well as the difference in elevation of the foundation of these adjacent structures. Because of this, the responses generated from the use of surface-founded models can underestimate the magnitude of the interaction effects as well as the peak demands computed for pressures and pressure distributions on the embedded walls.

Therefore, to assist the staff in evaluating the adequacy of the surface founded assumption implemented in the SSSI analyses, the staff requests the applicant to provide analysis results with consideration of embedment and a representation of adjacent structures that demonstrates no adverse impact of the interaction effects on the response of the structures as well as the peak demands computed for wall pressures and their distributions. If the SSSI analysis results from the above assessment are determined to control the design, the staff requests the applicant to address such SSSI effects/demands in the seismic design loads.