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## 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.: 215-8231  
SRP Section: 03.05.03 – Barrier Design Procedures  
Application Section: 3.5.3  
Date of RAI Issue: 09/15/2015

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### **Question No. 03.05.03-1**

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criterion (GDC) 2, "Design bases for protection against natural phenomena," states in part that structures, systems, and components (SSCs) important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami and seiches without loss of capability to perform their functions including consideration of the most severe of natural phenomena that have been historically reported for a site and appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena. Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criterion (GDC) 4, "Environmental and dynamic effects design bases," states in part that structures, systems, and components (SSCs) important to safety shall be protected against environmental and dynamic effects, including the effects of missiles, that may result from equipment failure. Standard Review Plan (SRP) 3.5.3, Section II.2, provides the guidance on the analysis and design of the barriers for safety related structures. It states that after it has been demonstrated that the missile will not penetrate the barrier, an equivalent static load concentrated at the impact area should then be determined, from which the global structural response, in conjunction with other design loads, can be evaluated using conventional design methods.

The staff reviewed Section 3.5.3.2, "Overall Damage Prediction," and noted that additional information is needed in order to better understand the overall effects of concrete and steel barriers subjected to missile impact loads. Therefore, In order for the staff to determine whether the APR1400 design of structures, shields and barriers can withstand the effect of environmental and natural phenomena, per 10 CFR 50, GDCs 2, and 4; and SRP 3.8.3, the applicant is requested describe in DCD Tier 2 Section 3.5.3.2 "Overall Damage Prediction," the methodology used to assess the flexural, shear and buckling effects on the overall damage predictions for the concrete as well as the steel barriers.

**Response**

For steel barriers, KHNP responded to a similar question in a previous submittal; Refer to Issue #6 in Enclosure 3 of MKD/NW-15-0111L, submitted on October 28, 2015. In that response, it was stated that there are no steel barriers used in the APR1400 design. A DCD markup was provided as part of the response to delete the requirements for steel barriers from sections 3.5.3.1.2, 3.5.3.2 and Table 3.5-5.

The global response of concrete slabs and walls is determined by using the inelastic single-degree-freedom dynamic analysis methodologies described in ASCE 58 as follows:

- Determine the missile forcing function (duration and peak force)
- Determine the fundamental period and resistance of the barrier
- Determine the failure mode by considering the shape of the structure, boundaries, and location of the missile
- Determine the ductility ratio using charts provided in ASCE 58 Figure 6.8
- Check the allowable ductility ratio provided in Table 3.5-5

The failure mode results from the flexural behavior of the structure.

In the case of a hard missile, including a pipe, it is not necessary to check punching shear if the perforation thickness is satisfied.

In the case of a soft missile, such as an automobile, punching shear is checked in accordance with the shear provision in ACI 349.

Reaction shear on edge is also checked in accordance with the shear provision in ACI 349.

Buckling effects for slabs or walls are also checked in accordance with the provision in ACI 349.

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**Impact on DCD**

There is no impact on the DCD.

**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, or Environmental Reports.