August 22, 2017

MEMORANDUM TO: Michael D. McCoppin, Chief
Licensing Branch 2
Division of New Reactor Licensing
Office of New Reactors

FROM: Tomeka Terry, Project Manager ***/RA/***
Licensing Branch 2
Division of New Reactor Licensing
Office of New Reactors

SUBJECT: REGULATORY AUDIT PLAN OF STRUCTURAL AND SEISMIC DESIGN SUPPORTING CHAPTER 3, "DESIGN OF STRUCTURES, SYSTEMS, COMPONENTS, AND EQUIPMENT," OF THE ADVANCED POWER REACTOR 1400 DESIGN CONTROL DOCUMENT

On March 4, 2015, the U.S. Nuclear Regulatory Commission (NRC) accepted the design certification application for docketing of the Advanced Power Reactor 1400 (APR1400) submitted by Korea Electric Power Corporation and Korea Hydro & Nuclear Power Co., Ltd.

The NRC staff determined that efficiency gains would be realized by auditing the documents and design calculations presented in the APR1400 design control document supporting responses to requests for additional information that have not been resolved. The purpose of this audit is to review the seismic analysis and structural design of the APR1400 foundation and to confirm the design approach used by KHNP. The audit will be conducted from August 24 - 25, 2017, and August 28 - 29, 2017, at KHNP's facilities in Vienna, Virginia.

Enclosed is the audit plan.

Docket No.: 52-046

Enclosure:
Audit Plan

cc w/encl: See next page

CONTACT: Tomeka Terry, NRO/DNRL
301-415-1488

SUBJECT: REGULATORY AUDIT PLAN OF STRUCTURAL AND SEISMIC DESIGN SUPPORTING CHAPTER 3, "DESIGN OF STRUCTURES, SYSTEMS, COMPONENTS, AND EQUIPMENT," OF THE ADVANCED POWER REACTOR 1400 DESIGN CONTROL DOCUMENT DATE: AUGUST 22, 2017

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U.S. NUCLEAR REGULATORY COMMISSION REGULATORY AUDIT

OF SECTION 3.8 OF THE ADVANCE POWER REACTOR 1400

DESIGN CONTROL DOCUMENT

ADVANCE POWER REACTOR 1400

DESIGN CERTIFICATION DOCKET NO. 52-046

AUDIT PLAN

APPLICANT:	Korea Hydro and Nuclear Power Co., Ltd. (KHNP) and Korea Electric Power Corporation (KEPCO)
APPLICANT CONTACT:	Dave Wagner, AECOM
DURATION:	An audit will be conducted from August 24 - 25, 2017, and August 28 - 29, 2017, at the Westinghouse Electric Co. (WEC) facilities in Rockville, Maryland. Audit activities at the U.S. Nuclear Regulatory Commission (NRC) Headquarters via KHNP's electronic reading room (or at KHNP's facilities in Vienna, Virginia) may be necessary at various times, and the audit may be extended to accommodate these activities.
LOCATIONS:	KHNP Washington DC Center 8100 Boone Blvd. Suite 620 Vienna, VA 22182
AUDIT TEAM:	Ata Istar, NRC, Structural Design Vaughn Thomas, NRC, Structural Design Joseph Braverman, NRC Consultant, Structural Design Luissette Candelario, NRC Geotechnical Engineer Tomeka Terry, NRC, Project Manager

ENCLOSURE

1.0 BACKGROUND

The NRC staff reviewed KHNP's information contained in the APR1400 Design Control Document (DCD) along with KHNP's responses to the NRC staff's request for additional information (RAI) regarding the structural and seismic design of the KHNP application. To gain a better understanding of the foundation design and analysis approach used by KHNP, the NRC staff will audit the applicant's design and analysis reports for the basic design of its foundation. This audit will also assist the NRC staff in completing its technical review of Section 3.8.5 of the application.

2.0 PURPOSE

The purpose of this audit is to review the seismic analysis and structural design of the APR1400 foundation. The APR1400 foundation for the nuclear island (NI) common basemat supports the Reactor Containment Building which consists of the Pre-stressed Concrete Containment Vessel Containment Internal Structures, and Auxiliary Building. Other APR foundations consist of the Emergency Diesel Generator Building and the Diesel Fuel Oil Tank building. The staff intends to audit the related documentation and supporting calculations for the seismic analysis and structural design of the APR1400 foundation in order to address outstanding technical issues associated with:

(1) The consideration of construction sequence and settlements.

(2) The different methods of analysis used (response spectra analysis and equivalent static).

(3) The loads and load combinations used and how the transition region is designed.

(4) The determination of differential displacements.

The staff intends to review and evaluate the design and analysis methods for the common basemat and confirm its performance in accordance with Section 3.8.5 of the APR1400 DCD Tier 2.

This audit follows the guidelines in the Office of New Reactors (NRO) Office Instruction, NRO-REG-108 (Revision 0), "Regulatory Audits" (Reference 1).

3.0 REGULATORY BASES

- DCD Tier 2, Section 3.8 is being reviewed by the NRC staff in accordance with the relevant requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) 52.47(a)(9); and 10 CFR Appendix B.

- In addition, the acceptance criteria associated with the relevant requirements of the NRC regulations General Design Criteria 1, 2, 4 and 5 of Appendix A to 10 CFR Part 50; Appendix S to 10 CFR Part 50, and Appendix A to 10 CFR Part 100.23.

- Implementing guidance such as the Standard Review Plan NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Regulatory Guides, and Interim Staff Guidance, along with cited codes and standards, informs the staff review and represents an acceptable technical approach for demonstrating compliance with the regulations.

4.0 REGULATORY AUDIT SCOPE AND METHODOLOGY

Details regarding the seismic analysis and structural design of the APR1400 foundation will be reviewed by staff and used to support the evaluation of Section 3.8.5 of the DCD application. Design reports* along with calculations supporting the applicant's RAI responses to staff RAIs will also be reviewed. In particular, the staff plans to audit calculations supporting the applicant's response to the following RAI questions:

RAIs	Questions	Subject
255-8285	03.08.05-7	Construction sequence and settlement evaluation
255-8285	03.08.05-8	Load combinations, phasing of seismic loading from superstructures, linear and nonlinear (considering uplift) analysis, and directional combination method for seismic
255-8285	03.08.05-12	Seismic analysis approach for NI basemat design and calculation of maximum soil bearing pressure
255-8285	03.08.05-13	Loads and load combinations for design of the foundation
255-8285	03.08.05-16	Soil media modeling for seismic analyses and stability evaluation
255-8285	03.08.05-17	Calculation of settlements for developing settlement criteria

*Review of the design reports including:

a) drawings (plan and section views) and descriptions that reflect the design results, including reinforcing steel bars, of the structure

b) assumptions of the analysis and design methods used to reach the design results, as shown in the drawings

5.0 INFORMATION AND DOCUMENTS NECESSARY FOR THE AUDIT

The NRC staff requests KHNP to provide the design technical reports, calculations and related documents discussed in the audit scope. KHNP is also requested to identify other documents, which the applicant deems as necessary to support the NRC staff's audit (e.g., drawings, QA requirements) and any other documents or calculations referenced by the various reports and related documents. KHNP is also requested to prepare a list of the documents that will be

made available during the audit, including the document titles, identifying numbers, and revisions/dates.

All material subject to the site visit (hard copy or electronic) will be left at the site. If any documentation is required to support the staff's regulatory findings, the staff will identify it in an RAI.

KHNP is requested to make available personnel who are knowledgeable in the seismic analysis and structural design of the APR1400 along with the associated technical reports. KHNP should also have the ability to make available modeling/analysis information as necessary to support the audit.

6.0 LOGISTICS

The NRC staff and the applicant have agreed that the audit will be conducted from August 24 - 25, 2017, and August 28 - 29, 2017, at KHNP's facilities in Vienna, Virginia. In support of this audit, the applicant has agreed to make knowledgeable staff available, along with relevant documentation, to support staff review and discussion of the material. The NRC staff will have internal meetings throughout the audit to discuss preliminary findings. The team will audit documents and discuss its observations with the applicant as appropriate throughout the audit. An exit meeting will be conducted to summarize the staff findings at the end of the audit.

7.0 AUDIT ACTIVITIES AND DELIVERABLES

The NRC audit team review will cover the technical areas identified in the Regulatory Audit Scope and Methodology section of this audit plan. Depending upon how much effort is needed in a given area, the NRC team members may be reassigned to ensure adequate coverage of important technical elements. The NRC Project Manager will coordinate with KHNP in advance of audit activities to verify specific documents and identify any changes to the audit schedule and requested documents.

The NRC staff acknowledges the proprietary nature of the information requested and the information will be handled appropriately throughout the audit. While the NRC staff will take notes, the NRC staff will not remove hard copies or electronic files from the audit site(s).

At the completion of the audit, the audit team will issue an audit summary within 90 days that will be declared and entered as an official agency record in the NRC's Agency wide Documents Access and Management System (ADAMS) records management system. The audit outcome may be used to identify any additional information to be submitted for making regulatory decisions.

If necessary, any circumstances related to the conductance of the audit will be communicated to Tomeka Terry, NRC Project Manager at 301-415-1488 or via email at Tomeka.Terry@nrc.gov.

A summary report of the audit will be prepared and issued in accordance with NRO-REG-108.

8.0 REFERENCES

- NRO Office Instruction NRO-REG-108 (Revision 0), “Regulatory Audits.”