

**SOURCE TERM CALCULATIONS AS PART OF THE APR1400 DESIGN CONTROL
DOCUMENT AUDIT**

AUGUST 10, 2015 – AUGUST 14, 2015

**Korea Hydro and Nuclear Power Co., Ltd. (KHNP) and
Korea Electric Power Corporation (KEPCO)**

**APR1400 DESIGN CERTIFICATION
Docket No. 52-046**

Location: NRC Headquarters
Two White Flint North
11545 Rockville Pike
Rockville, MD 20852-2738

KHNP Washington DC Center
8100 Boone Blvd. Suite 620
Vienna, VA 22182

Purpose:

The purpose of this audit is to review and resolve technical issues related to source term calculations associated with ARP1400 Chapter 12, "Radiation Protection," and to assist the U.S. Nuclear Regulatory Commission (NRC) staff in resolving various requests for additional information (RAIs) associated with source terms including RAI 13-7856, Question 12.02-2 and RAI 103-7998.

Background:

On March 5, 2015, the NRC accepted the design certification application for docketing for the APR1400 submitted by Korea Electric Power Corporation (KEPCO) and Korea Hydro & Nuclear Power Co., Ltd. (KHNP) (Reference 1). The NRC staff initiated Phase 1 of the application design certification review on March 9, 2015.

The NRC staff determined that efficiency gains would be realized by auditing the documents supporting the design calculations presented in the Design Control Document (DCD), in lieu of RAIs, and that the applicant docket the calculation files. The purpose of this audit is to allow the NRC technical staff to gain an understanding of the supporting design calculations to better focus the staff's inquiries to the applicant. During the audit and interactions with the applicant, there may be detailed NRC requests for information developed, which would be part of a future formal correspondence.

In RAI 7856, Question 12.02-2, the staff requested that the applicant provide the methods, models, and assumptions used as the basis for the source terms in FSAR Section 12.2, "Radiation Sources." The audit is needed in order for the staff to evaluate the methods, models, and assumptions used by the applicant to develop the source terms for all components downstream of the reactor coolant system in order for the staff to reach a conclusion that the

radioactive source terms are acceptable for use in the shielding analysis, determining airborne concentrations, and other aspects of radiation protection in Final Safety Analysis Report (FSAR) Chapter 11, "Radioactive Waste Management," and Chapter 12.

Regulatory Audit Basis:

The audit basis is to ensure that the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52.47(a)(5) and 10 CFR Part 50, Appendix A, General Design Criteria (GDC) 61, "Fuel Storage and Handling and Radioactivity Control," are met. 10 CFR 52.47(a)(5) requires that the FSAR contain the kinds and quantities of radioactive material and the means for controlling and limiting radioactive effluents and radiation exposures within the limits set forth in 10 CFR Part 20, "Standards for Protection Against Radiation." GDC 61 requires in part that the fuel storage and handling, radioactive waste, and other systems which may contain radioactivity be designed to assure adequate safety under normal and postulated accident conditions, with suitable shielding for radiation protection, and with appropriate containment, confinement, and filtering systems. This audited information provides an additional level of detail that will support the NRC staff's availability to determine the acceptability of the APR1400 design certification application.

The NRC staff must have sufficient information to ensure that acceptable risk and adequate assurance of safety can be documented in the NRC staff's SER.

Regulatory Audit Scope:

The primary scope of this audit is to review the applicant's calculations and assumptions used in calculating normal operation source terms, in FSAR Section 12.2 and associated FSAR sections, for components downstream of the reactor coolant system and airborne concentration source terms. This includes assumptions made for input pathways and flowrates to components, output flow rates from components, holdup times, removal efficiencies, assumed operational times, and other assumptions or calculations made in developing input to nuclide transport codes used for normal operation source term development. The NRC staff will confirm that the assumptions made for calculating normal operation source terms are consistent, reasonable, or conservative when compared to system design information and parameters provided in relevant FSAR sections regarding expected normal operation of the reactor with an assumed 0.25 percent failed fuel fraction, as indicated in standard review plan Section 12.2. The NRC staff may also evaluate the codes used to determine source terms for tanks, pumps, ion exchangers, filters, tanks, and other components as part of this audit, including the applicant's use of the Shield APR and DIJESTER computer codes. The scope of the audit is not to evaluate plant shielding, but is to determine that sources used in the shielding analysis were adequately developed.

The NRC staff will focus on the most significant sources for plant shielding, such as Chemical and Volume Control System (CVCS) filters and ion exchangers, the volume control tank, the spent resin storage tank, and charcoal delay beds, as well as the most significant outdoor sources which could be significant for public exposure, such as CVCS tanks located outdoors. The level of detail staff reviews information associated with other sources will be based on the acceptability of the information provided for the more significant sources and the adequacy of the high level information reviewed. Information used by the staff will include supporting system design information and parameters from the FSAR, as well as the standard review plan.

The staff will conduct this audit in accordance with the guidance provided in NRO-REG-108, "Regulatory Audits" (Reference 2).

Documents and Information Necessary for the Audit:

The following documents are to be made available to the NRC staff, either at the KHNP Washington, DC Center, or in the electronic reading room:

1. Detailed reports, and supporting source term calculations associated with APR 1400 Chapter 12, "Radiation Protection."

Appropriate handling and protection of proprietary information shall be acknowledged and observed throughout the audit.

Audit Team:

Edward Stutzcage, NRO Health Physicist, Audit Lead
Luis Betancourt, NRO, Project Manager

Applicant Contacts:

Christopher Tyree (AECOM)
Harry Chang (KHNP)

Special Requests:

The NRC staff requests that KHNP provide searchable electronic copies of the documents listed above.

Audit Activities and Deliverables:

The NRC audit team review will cover the technical areas identified in the Regulatory Audit Scope 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 audit is scheduled between August 10, 2015, and August 14, 2015, from 7:30 a.m. to 3:30 p.m. The audit entrance meeting will start at 7:30 a.m. on August 10, 2015, and will conclude with an exit meeting at 7:30 a.m. on August 14, 2015.

The audit will be conducted from the NRC Headquarters via KHNP's electronic reading room; however the audit may also be carried out at KHNP's facilities in Vienna, VA, if the technical information is only retained in hard copy.

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. It 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 45 days that will be declared and entered as an official agency record in the NRC's Agencywide 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, and it will assist the NRC staff in the issuance of RAIs (if necessary) for the licensing review of APR1400 DCD Chapter 12 and any related information provided in other chapters, in preparation of the NRC staff's Safety Evaluation Report.

If necessary, any circumstances related to the conductance of the audit will be communicated to Luis Betancourt (NRC) at 301-415-6145 or Luis.Betancourt@nrc.gov.

References:

1. "Letter to Korea Hydro and Nuclear Power Co., Ltd., and Korea Electric Power Corporation – Acceptance of the Application for Standard Design Certification of the Advanced Power Reactor 1400," ADAMS Accession Number ML15041A455, issued March 4, 2015.
2. NRO-REG-108, "Regulatory Audits," ADAMS Accession Number ML081910260, issued April 2, 2009.
3. APR 1400 Design Control Document, Revision 0, issued December 2014.