

**COMPUTER PROGRAM CODES AS PART OF THE APR1400 DESIGN CONTROL
DOCUMENT AUDIT**

AUGUST 3, 2015 – AUGUST 4, 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 the audit is to confirm that the design calculations performed in support of the Advanced Power Reactor 1400 (APR1400) design certification calculation are consistent with the descriptions of the computer codes in Tier 2, Section 3.9.1, "Special Topics for Mechanical Components," of the APR1400 design control document (DCD). Specifically, the NRC staff will audit the revisions and related documents of the verification and validation (V&V) reports, to confirm that applicant incorporated the June-July Audit 2015 staff's audit findings

Background:

On March 5, 2015, the U.S. Nuclear Regulatory Commission (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 DCD, in lieu of requests for additional information (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.

From June 29, 2015, through July 2, 2015, the NRC staff performed the regulatory audit of the computer codes in support of its reviews of the SRP Section 3.9.1. Based on this audit, there were several staff's observations identified in the audit report, the resolution of which will be confirmed in a follow-up audit:

- The applicant will revise the record of revision for the ASHP and CESHOCK software V&V reports.
- The applicant will provide two sensitivity reports pertaining to the cut stress plane for fatigue calculation and mesh density size modeling.
- The applicant will provide procedures as references in the calculations and V&V reports.

Regulatory Audit Basis:

The audit basis is to verify that the design analyses follow the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, as required by Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a, and are consistent with the descriptions in the DCD. Supporting information on V&V of computer programs is provided in the ASME Nuclear Quality Assurance (NQA)-1 standard, which is referenced in the DCD. 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.

Regulatory Audit Scope:

The primary scope of this audit is to review computer programs that are used for static, dynamic, and hydraulic transient analyses as they relate to the APR1400 component and piping design. Particularly, the audit will confirm that the computer program codes that are used in the design of APR1400 are being employed consistent with the guidance in Standard Review Plan (SRP) Sections 3.9.1, "Special Topics for Mechanical Components," guidance and the information in the DCD. The review scope of this follow-up audit will be focused to:

- Confirm the updates of the ASHP and CESHOCK software V&V reports.
- Review sensitivity reports pertaining to the cut stress plane for fatigue calculation and mesh density size modeling.
- Confirm procedures as references in the calculations and V&V reports.

The staff will conduct this audit in accordance with the guidance provided in NRO-REG-108, "Regulatory Audits" (Reference 3).

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. The revised ASHP and CESHOCK software V&V reports.
2. Sensitivity reports pertaining to the cut stress plane for fatigue calculation and mesh density size modeling.

3. The revised V&V reports.

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

Audit Team:

Tuan Le, NRO Mechanical Engineer, Audit Lead
Luis Betancourt, NRO, Project Manager

Applicant Contacts:

Steven Mannon (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 3, 2015, and August 4, 2015, from 7:30 a.m. to 3:30 p.m. The audit entrance meeting will start at 7:30 a.m. on August 3, 2015, and will conclude with an exit meeting at 7:30 a.m. on August 4, 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 3 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. ASME Boiler and Pressure Vessel Code, NQA-1 "Quality Assurance Requirements for Nuclear Facility Applications."
3. NRO-REG-108, "Regulatory Audits," ADAMS Accession Number ML081910260, issued April 2, 2009.
4. APR 1400 Design Control Document, Revision 0, issued December 2014.