

**Regulatory Audit Plan for Topical Report APR1400-F-A-TR-12004-P,  
“Realistic Evaluation Methodology for Large Break LOCA of the APR1400”**

**August 17, 2015 to September 30, 2015**

**Korea Hydro and Nuclear Power, Ltd  
Docket No. 52-046**

**Location:** KHNP Office  
8100 Boone Blvd. Suite 620  
Vienna, VA 22182

**Applicant Contact:** Christopher Tyree, KHNP  
Harry Chang, KHNP

**Purpose:**

The purpose of the audit is for the staff to review the calculations and other supporting documentation used by Korea Hydro and Nuclear Power, Ltd (KHNP) in preparation of input to the RELAP5/MOD3.3 and CONTEMPT4/MOD5 computer codes, which are employed in the analyses of large break loss-of-coolant accidents (LOCA). The review is intended to ensure that the code input adequately reflects the Advanced Power Reactor 1400 (APR1400) design and that assumptions made are consistent with the regulations. Additionally, the staff would like to review a representative CAREM code calculation for overall uncertainty.

The expected outcome of the audit is for the staff (1) to gain a better understanding of how the APR1400 design meets U.S. Nuclear Regulatory Commission (NRC) regulations, including margins to account for uncertainties, (2) to develop requests for additional information in areas not adequately covered in the topical report documentation, and (3) to identify supplemental information that should be added to the topical report which the staff will rely on to make its safety finding.

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

**Background:**

By letter dated January 7, 2013, Korea Hydro and Nuclear Power Co., LTD (KHNP) submitted for U.S. Nuclear Regulatory Commission (NRC) staff review Topical Report APR1400-F-A-TR-12004-P, Rev. 0, “Realistic Evaluation Methodology for Large-Break LOCA of the APR1400 Revision 0,” (ML13023A078). The NRC issued an acceptance for review letter dated June 27, 2013 (ML13175A401). On March 5, 2015, the NRC accepted the design certification application for docketing for the APR1400.

**Regulatory Audit Scope:**

The primary scope of this audit is to review design calculations and other supporting documents that form the basis of the applicant’s large break LOCA design analyses which support Design Certification Document Section 15.6.5. The NRC staff must have sufficient information to ensure

Enclosure

that acceptable risk and adequate assurance of safety can be documented in the NRC staff's safety evaluation report (SER) Regulatory Audit Basis.

**Regulatory Basis:**

1. Title 10 of the *Code of Federal Regulations* (CFR) Part 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors"
2. 10 CFR 50, Appendix A, General Design Criteria 10 "Reactor Design"

Relevant guidance is provided in the following documents:

- a. Regulatory Guide (Reg. Guide) 1.157, "Best-Estimate Calculations of Emergency Core Cooling System Performance,"
- b. Standard Review Plan (SRP) 15.0.2, "Review of Transient and Accident Analysis Method,"
- c. SRP 15.6.5, "Loss-of-Coolant Accidents Resulting From Spectrum of Postulated Piping Breaks Within the Reactor Coolant Pressure Boundary,"
- d. SRP 15.0.2, "Review of Transient and Accident Analysis Method,"
- e. 10 CFR Part 50, Appendix K, "ECCS Evaluation Models," and
- f. NUREG/CR-5249, "Quantifying Reactor Safety Margins"

**Audit Team:**

The NRC Office of New Reactors staff from the Division of New Reactor Licensing (DNRL), and Division of Safety Systems and Risk Assessment (DSRA), Reactor Systems, Nuclear Performance, and Code Review Branch (SRSB) and the Office of Research (RES) will comprise the audit team.

- James Gilmer, Technical Reviewer, NRO/DSRA/SRSB
- William Krotiuk, Senior Reactor Systems Engineer, RES/DSA/RSAB
- Morgan Libby, Energy Research Incorporated
- Mohsen Khatib-Rabhar, Energy Research Incorporated
- James Steckel, Project Manager, NRO/DNRL/LB2

**Information and Other Materials Necessary for the Audit:**

Topical Report references which are not available to the NRC, including:

1. "Performance Verification Test for APR1400 Fluidic Device," A03NJ02, KAERI, February 2005.
2. "Phenomena Identification and Ranking Tabulation Korean Next Generation Reactor Large Break Loss of Coolant Accident," KINS/INEEL, 2001.
3. Topical Report, "The Best Evaluation Methodology for the Emergency Core Cooling System," TR-KHNP-002, KEPRI/KHNP, December 2002.
4. "Development of PCT Uncertainty Quantification Methodology, Assessment of Separate Models and Construction of Thermal-Hydraulic Data Banks for Establishment of the Korean ECCS Evaluation Model," KINS/GR-011, December 1990.

Additionally, the following documents will be examined during the audit:

1. Large Break LOCA Design Calculation Documentation used in development of the topical report;
2. Software specifications and validation documents for RELAP5 and CONTEMPT; and
3. Other supporting references used to prepare the topical report.

**Logistics:**

The audit will consist of two parts: 1) review of the documentation placed in the electronic reading room; and 2) face-to-face meeting at KHNP's Vienna, Virginia office over several consecutive days. The date and time is to be determined after KHNP has had sufficient time to review the issues and determine the appropriate personnel needed to address the issues. The staff requests that the applicant identify the primary and supporting documents prior to the audit and make it available for NRC review at least three weeks prior to the face-to-face meeting. The NRC requests that the documentation remain available for access until the summary report is issued.

The face-to-face audit will be scheduled for an agreed upon number of days within the August 17, 2015, through September 30, 2015, audit duration, and between 9:00 a.m. and 5:00 p.m., concluding with an exit teleconference at 4:30 p.m. each day to provide the applicant with a summary of the preliminary audit findings. The NRC staff will have an internal meeting between 4:00 pm and 4:30 p.m. each day to summarize the preliminary findings.

Any supporting information that addresses the issues should be made available for review in the electronic reading room, so that the face-to-face discussions can be most effective.

**Deliverables:**

A summary report of the audit will be prepared and issued in accordance with NRO-REG-108 (Reference 1) within 45 days following completion of the audit.

**References:**

1. NRO Office Instruction NRO-REG-108 (Revision 0), "Regulatory Audits."
2. Letter dated January 7, 2013, Korea Hydro & Nuclear Power Co., LTD (KHNP), submitted for U.S. Nuclear Regulatory Commission (NRC) staff review Topical Report APR1400-F-A-TR-12004-P, Rev. 0, "Realistic Evaluation Methodology for Large-Break LOCA of the APR1400, Revision 0," (ML13023A078).
3. Acceptance for the Review of Topical Report APR1400-F-A-TR-12004, Revision 0, "Realistic Evaluation Methodology for Large-Break Loss-of-Coolant Accident (LOCA) of the APR1400," (ML13175A401).

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