

**ASME CLASS 1, 2 AND 3 COMPONENTS, COMPONENT SUPPORTS, AND CORE
SUPPORT STRUCTURES AS PART OF THE APR1400 DESIGN CONTROL DOCUMENT
AUDIT**

AUGUST 24 – 27, 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, Maryland 20852-2738

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

Purpose:

The purpose of the audit is to verify that the component design and qualification in support of the Advanced Power Reactor 1400 (APR1400) design certification (DC) application are being performed in accordance with the methodology and criteria described in the APR1400 final safety analysis report (FSAR).

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.

In 2014, KHNP submitted a DC application for the APR1400 design. Subsequently, KHNP provided a list of components for which the design and procurement specifications would be completed and available for the NRC audit. The lists are included in the KHNP Letter 52-046 MKD/NW-15-0020L, "Submittal of APR1400 Responses to Action Items from April 14-15 MEB Public Meeting," dated June 1, 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.

Regulatory Audit Basis:

The audit basis is to confirm that the APR1400 component design and qualification are being performed consistent with the commitments made in the APR1400 DC application and American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel* (BPV) Code.

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," Section 47, "Contents of Applications; Technical Information," states the following:

The application must contain a level of design information sufficient to enable the Commission to judge the applicant's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted. The information submitted for a design certification must include performance requirements and design information sufficiently detailed to permit the preparation of acceptance and inspection requirements by the NRC, and procurement specifications and construction and installation specifications by an applicant. The Commission will require, before design certification, that information normally contained in certain procurement specifications and construction and installation specifications be completed and available for audit if the information is necessary for the Commission to make its safety determination.

In NRC Standard Review Plan (SRP) Section 3.9.3, "ASME Code Class 1, 2, and 3 Components and Component Supports, and Core Support Structures," Section 7 of Appendix A provides guidance that the staff may request the submission of the Code-required design documents (such as design specifications, design reports, load capacity data sheets, or other related material or portion thereof), in order to establish that the design criteria, analytical methods, and functional capability satisfy the guidance provided by SRP Section 3.9.3. This includes verification that the design information described in the design control document (DCD) was adequately translated into documentation for each of the components designed to ASME BPV Code, Section III, Class 1, 2, and 3 requirements.

In addition, the NRC staff will review the design, equipment qualification and procurement specifications for selected components in support of its reviews of the following SRP sections:

- Section 3.2.1, "Seismic Classification,"
- Section 3.2.2, "System Quality Group Classification"
- Section 3.9.6, "Functional Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints"
- Section 3.10, "Seismic and Dynamic Qualification of Mechanical and Electrical Equipment"

- Section 3.11, “Environmental Qualification of Mechanical and Electrical Equipment”

In conducting the review of the APR1400 DC application, the NRC staff requested that the applicant make available the design, equipment qualification, and procurement specifications, as well as documentation of component quality groups and classification (e.g., piping and instrumentation diagrams (P&IDs) and equipment classification documents) for the NRC staff to confirm the implementation of the APR1400 DCD provisions for the design and qualification of these components.

Regulatory Audit Scope:

The primary scope of this audit is the review of design, equipment qualification, and procurement specifications for components categorized as ASME BPV Code, Section III, Class 1, 2, and 3 components, component supports, and core supports, to verify that the component design is in accordance with the methodology and criteria described in the APR1400 FSAR and ASME BPV Code. The staff will also review the documentation of equipment qualification, classification, quality groups, and design process for plant components of safety significance.

The reviewers will focus the audit on the areas shown in the list below:

- Confirm that the design of ASME components reflects the APR1400 FSAR.
- Confirm that the design documents have been adequately prepared in accordance with the ASME BPV Code, Section III, NCA-3250, for design specifications and other codes and standards needed to satisfy General Design Criterion (GDC) 1 and GDC 2 in 10 CFR Part 50, Appendix A. This includes classification documents that establish the design basis for seismic and quality group classifications pertaining to risk-significant systems, and important to safety and safety-related components.
- Confirm that the component design meets the design criteria and that the analytical methods and functional provisions are in accordance with the commitments made in the application.

The staff selected the audit samples that listed in Table 1 for this audit. Table 1 shows the list of design specifications; specific reviewers for each section are designated as follow:

Table 1: List of Components¹

Safety-Related PO Specification List (for Reference Plant)			
Doc. No.	TITLE	SAFETY CLASS	Reviewer*
9-184-J232B	SPECIFICATION FOR CONTROL VALVES FOR SAFETY RELATED AND SEVERE SERVICES	2, 3 & NNS	TS, JS, YW
9-184-J233	BUTTERFLY VALVES FOR NUCLEAR SERVICES	2&3	TS, JS, YW
9-184-J237A	SPECIFICATION FOR MAIN STEAM SAFETY VALVES	2	TS, JS, YW, TL
9-184-J237B	SAFETY/RELIEF VALVES	2, 3, NNS	TS, JS, YW
9-184-J239	SOLENOID VALVES	1,2,3	TS, JS, YW
9-521-M243	MAIN STEAM ISOLATION VALVES AND MAIN FEEDWATER ISOLATION VALVES	2	TS, JS, TL
9-132-M214	DIESEL FUEL OIL & LUBE OIL TRANSFER PUMPS	3 & NNS	TS, JS
9-135-M231	SAFETY RELATED STRAINERS	3	TL
9-159-M273	FLOW RESTRICTION ELEMENTS AND VENTURIES	1, 2, 3 & NNS	CJ
9-132-N201	ESSENTIAL SERVICE WATER PUMPS AND SCREEN WASH PUMPS	3	TS, JS
9-132-N202	SAFETY RELATED CENTRIFUGAL PUMPS	3	TS, JS, YW
9-133-N204	SAFETY RELATED HEAT EXCHANGERS	2, 3	CJ, TL
9-447-N206	IRWST SUMP STRAINERS	3	TL
9-451-N222	POSITIVE DISPLACEMENT PUMP SUCTION STABILIZER AND PULSATION DAMPENERS	3,NNS	YW
9-144-P202A	SAFETY RELATED SHOP FABRICATED PIPING	1,2 & 3	CJ
9-145-P204	SR MANUAL STEEL GATE, GLOBE & CHECK VALVES, 2- 1/2" & LARGER	2&3	TS, JS, YW
9-145-P206A	SAFETY RELATED STEEL GATE AND GLOBE VALVES WITH ACTURATOR	2 & 3	TS, JS, YW
9-145-P206C	SAFETY RELATED CONTROLLED CLOSURE CHECK VALVES	2	TS, JS, YW
9-145-P206D	SAFETY & NON SAFETY RELATED TILTING DISC CHECK VALVES	3	TS, JS, YW
9-145-P207	SAFETY & NON-SAFETY RELATED MANUAL STEEL GATE, GLOBE & CHECK VALVES, 2" AND SMALLER	1,2 & NNS	TS, JS, CJ
9-147-C215C	SNUBBERS	1,2,3,NNS ((TL)	TS, JS, TL, YW
9-147-C215A	SAFETY RELATED SHOP FABRICATED PIPE SUPPORTS	1,2 & 3	CJ
List of Piping System Design Specifications (for APR1400 DC)			
Document	Title	Safety Class	Reviewer*
1-521-M407-	MSS PIPING DESIGN SPEC.	2	CJ
1-037-N407-	GENERAL PIPING DESIGN SPEC.	1,2,3	CJ
1-431-N407-	RCS PIPING DESIGN SPEC.	1,2,3	CJ
1-441-N407-	SI/SC PIPING DESIGN SPEC	2	CJ

¹ From KHNP-supplied list of components for regulatory audit

1-451-N407-	CVCS PIPING DESIGN SPEC	1,2,3	CJ
List of Safety Related Design Specifications for NSSS System (for APR1400 DC)			
Document No.	Title	Reviewer*	
9-441-Z-S-404-32	DESIGN SPECIFICATION FOR SHUTDOWN COOLING PUMP MINIFLOW HEAT EXCHANGER	TL	
9-451-Z-S-404-31	DESIGN SPECIFICATION FOR CENTRIFUGAL CHARGING PUMP	TS, JS, YW	
9-451-Z-S-404-34	DESIGN SPECIFICATION FOR AUXILIARY CHARGING PUMP	TS, JS, YW	
9-451-Z-S-404-41	DESIGN SPECIFICATION FOR VOLUME CONTROL TANK	TL	
9-451-Z-S-404-32	DESIGN SPECIFICATION FOR BORIC ACID MAKEUP PUMP	TS, JS, YW	
9-441-Z-S-404-11	DESIGN SPECIFICATION FOR SAFETY INJECTION PUMP	TS, JS, YW	
9-441-Z-S-404-12	DESIGN SPECIFICATION FOR SHUTDOWN COOLING PUMP	TS, JS, TL	
9-431-Z-S-404-91	DESIGN SPECIFICATION FOR REACTOR COOLANT PUMPS	TS, JS, TL	
9-450-Z-S-404-11	DESIGN SPECIFICATION FOR PRESSURIZER PILOT OPERATED SAFETY RELIEF VALVES	TS, JS, TL	
9-451-Z-S-404-72	DESIGN SPECIFICATION FOR LETDOWN HEAT EXCHANGER	CJ	
9-451-Z-S-404-50	DESIGN SPECIFICATION FOR ORIFICES	CJ	
9-450-Z-S-404-00	DESIGN SPECIFICATION FOR CHECK VALVES GREATER THAN TWO INCHES	TS, JS, YW	
9-450-Z-S-404-18	DESIGN SPECIFICATION FOR SOLENOID OPERATED VALVES	TS, JS, YW	
9-450-Z-S-404-14	DESIGN SPECIFICATION FOR MOTOR OPERATED VALVES	TS, JS, YW	
9-450-Z-S-404-16	DESIGN SPECIFICATION FOR MANUAL VALVES	TS, JS, YW	
9-450-Z-S-404-13	DESIGN SPECIFICATION FOR PNEUMATIC OPERATED VALVES	TS, JS, YW	
9-431-Z-S-404-30	DESIGN SPECIFICATION FOR RTD THERMOWELLS	TL	
9-450-Z-S-404-19	DESIGN SPECIFICATION FOR MISCELLANEOUS SAFETY AND RELIEF VALVES	TS, JS, YW	
9-431-Z-S-404-50	DESIGN SPECIFICATION FOR STEAM GENERATOR SINGLE NOZZLE DAMS	TS, JS, YW	
9-732-Z-S-404-40	DESIGN SPECIFICATION FOR THE IN-CORE INSTRUMENT ASSEMBLIES	YL	

9-431-Z-S-404-10	DESIGN SPECIFICATION FOR REACTOR VESSEL ASSEMBLY	TL, CJ
9-431-Z-S-404-20	DESIGN SPECIFICATION FOR PRESSURIZER ASSEMBLY	TL
9-431-Z-S-404-40	DESIGN SPECIFICATION FOR STEAM GENERATOR ASSEMBLY	TL
9-431-Z-S-404-80	DESIGN SPECIFICATION FOR REACTOR COOLANT PIPE AND FITTINGS	CJ
9-728-Z-S-404-22	DESIGN SPECIFICATION FOR HEATED JUNCTION THERMOCOUPLE PROBE ASSEMBLY	CJ
9-728-Z-S-404-40	DESIGN SPECIFICATION FOR HEATED JUNCTION THERMOCOUPLE INSTRUMENTATION FLANGE ASSEMBLIES	YL
9-431-Z-S-404-A1	DESIGN SPECIFICATION FOR REACTOR COOLANT PUMP SUPPORTS	TL, CJ
9-431-Z-S-404-A2	DESIGN SPECIFICATION FOR REACTOR COOLANT PUMP HYDRAULIC SNUBBERS	TS, JS, TL
9-431-Z-S-404-62	DESIGN SPECIFICATION FOR STEAM GENERATOR UPPER SUPPORT SNUBBER	TS, JS, TL
9-431-Z-S-404-61	DESIGN SPECIFICATION FOR STEAM GENERATOR SUPPORT COMPONENTS	TL
9-410-Z-S-404-11	DESIGN SPECIFICATION FOR CONTROL ELEMENT DRIVE MECHANISMS AND CEA EXTENSION SHAFT ASSEMBLIES	TL
9-412-Z-S-404-10	DESIGN SPECIFICATION FOR REACTOR VESSEL CORE SUPPORT AND INTERNAL STRUCTURES	TL
9-431-Z-S-404-C0	DESIGN SPECIFICATION FOR THE INTEGRATED HEAD ASSEMBLY	TL
9-431-Z-S-404-B0	DESIGN SPECIFICATION FOR SURGE LINE SUPPORT	TL
9-430-Z-S-404-40	DESIGN SPECIFICATION FOR REACTOR VESSEL SUPPORT ASSEMBLIES	TL

***Legend:**

TL = Tuan Le
TS = Thomas Scarbrough
JS = James Strnisha
CJ = Caylee Johanson
YW = Yuken Wong

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, District of Columbia Center, or in the electronic reading room:

1. If not included in the as highlighted in Table 1 above, provide the specifications (or information to be contained in specifications) for safety-related pumps, valves, and snubbers in the following systems:
 - Reactor Coolant System (RCS)
 - Reactor Coolant Gas Vent System (RCGVS)
 - Auxiliary Feedwater System (AF)
 - Safety Injection/Shutdown Cooling System (SIS/SCS)
 - Containment Spray System (CSS)
 - Incontainment Refueling Water Storage System (IRWS)
 - Chemical Volume Control System (CVCS)
 - Component Cooling Water System (CCWS)
 - Essential Service Water System (ESWS)
 - Spent Fuel Pool Cooling and Cleanup System (SFPPCS)
 - Essential Chilled Water System (ECWS)
2. Detailed P&IDs that include piping system, as well as designation of ASME BPV Code class and/or quality group, as applicable.
3. The specifications (or information to be contained in specifications) should include environmental qualification of the components as part of the component specification or in a separate environmental qualification specification.
4. The specifications (or information to be contained in specifications) should include seismic qualification of the equipment as part of the equipment specification or in a separate equipment qualification specification.

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

Audit Team:

Tuan Le, Mechanical Engineer, Audit Lead (NRC)
Thomas G. Scarbrough, Sr. Mechanical Engineer (NRC)
Yuken Wong, Sr. Mechanical Engineer (NRC)
James Strnisha, Mechanical Engineer (NRC)
Caylee Johanson, Mechanical Engineer (NRC)
Luis Betancourt, Project Manager (NRC)

Applicant Contacts:

Steven Mannon (AECOM)

Harry Chang (KHNP)

Special Requests:

The NRC staff requests that KHNP provide:

- Searchable electronic copies of the documents related to selected components listed in Table 1, including available references in each specification.
- All equipment classification documents and P&IDs related to the design specifications identified in Section IV, including engineering drawings.
- Other documents that the applicant deems necessary to support the NRC staff's audit, outlined under audit activities.
- In response to NRC staff's audit findings, KHNP will have subject matter experts knowledgeable in the NRC selected audit components available during the meetings between the NRC audit team and KHNP scheduled for Tuesday, Wednesday, and Thursday at 7:30 a.m. (August 24 – 26, 2015).

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 24, 2015, and August 27, 2015, from 7:30 a.m. to 3:30 p.m. The audit entrance meeting will start at 7:30 a.m. on August 24, 2015, and will conclude with an exit meeting at 7:30 a.m. on August 28, 2015.

The NRC staff will have internal meetings from 3:00 p.m. to 4:00 p.m. to summarize preliminary findings at the end of that day's audit. A summary of daily audit preliminary findings will be provided to KHNP by email. The staff will summarize the preliminary findings to be provided in teleconferences between the NRC audit team and KHNP that are scheduled for Tuesday, Wednesday, and Thursday at 7:30 a.m. (August 25 – 27, 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, Virginia, 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. NRO-REG-108, "Regulatory Audits," ADAMS Accession Number ML081910260, issued April 2, 2009.
3. APR 1400 Design Control Document, Revision 0, issued December 2014.
4. ASME *Boiler and Pressure Vessel Code*, Section III, Division 1, "Rules for Construction of Nuclear Facility Components"
5. SRP Section 3.9.3, "ASME Code Class 1, 2, and 3 Components and Component Supports, and Core Support Structures"
6. SRP Section 3.10, "Seismic and Dynamic Qualification of Mechanical and Electrical Equipment"
7. SRP Section 3.9.6, "Functional Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints"
8. SRP Section 3.11, "Environmental Qualification of Mechanical and Electrical Equipment"
9. SRP Section 3.2.1, "Seismic and Dynamic Qualification of Mechanical and Electrical Equipment"
10. SRP Section 3.2.2, "System Quality Group Classification"