July 10, 2017

Dr. Han Gon Kim, Project Manager
APR1400 Design Certification
Advanced Reactors Development Laboratory
Korea Hydro and Nuclear Power Co., Ltd.
70-1312-gil, Yuseong-daero,Yuseong-Gu
Daejeon 305-343 Korea (Republic of)

SUBJECT: NUCLEAR REGULATORY COMMISSION INSPECTION OF KOREA HYDRO & NUCLEAR POWER CO., LTD., REPORT NO. 05200046/2017-201

Dear Dr. Han Gon Kim:

On May 22 through May 26, 2017, the U.S. Nuclear Regulatory Commission (NRC) staff conducted an inspection of Korea Hydro & Nuclear Power Co (KHNP) at the Westinghouse Electric Company facility in Rockville, Maryland. The purpose of this limited scope inspection was to assess KHNP's implementation of applicable requirements of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," and 10 CFR Part 21, "Reporting of Defects and Noncompliance."

This inspection assessed aspects of KHNP's design and quality assurance (QA) activities used for the APR1400 Design Certification application, which included QA Organization, Design Control, Corrective Action, Audits, Oversight of Contracted Activities, Procurement Document Control, and 10 CFR Part 21. The inspection included a technical focus on the implementation of these programs, in the areas of structural analysis of safety-related building foundations, piping stress analysis, and design of the instrumentation and control system. The enclosed report presents the results of this inspection. This NRC inspection report does not constitute an NRC endorsement of KHNP's QA and 10 CFR Part 21 programs.

Based on the results of this inspection, the NRC staff determined that four Severity Level IV violations of NRC requirements occurred. These violations are cited in the enclosed Notice of Violation (Notice) and the circumstances surrounding them are described in detail in the subject inspection report. The violations are being cited in the Notice for KHNP's failure to implement their design control, corrective action, and internal audit programs in accordance with Appendix B to 10 CFR Part 50. Specifically, KHNP failed to: (1) implement measures for control of design interfaces and coordination among participating design organizations; (2) establish measures to assure objective evidence of quality furnished by the contractor or subcontractor, resulting in applicable regulatory requirements and design basis not being correctly translated into specifications, drawings, procedures and instructions; (3) identify conditions adverse to quality; and (4) ensure that audits are performed by personnel not having direct responsibilities in the areas being audited.

You are required to respond to this letter and should follow the instructions specified in the enclosed Notice when preparing your response. If you have additional information that you believe the NRC should consider, you may provide it in your response to the Notice. The NRC review of your response to the Notice will also determine whether further enforcement action is necessary to ensure compliance with regulatory requirements.

In accordance with 10 CFR 2.390, "Public Inspections, Exemptions, Requests for Withholding," of NRC's "Rules of Practice," a copy of this letter, its enclosures, and your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System, accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. To the extent possible, your response should not include any personal privacy, proprietary, or Safeguards Information so that it can be made available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request that such material be withheld from public disclosure, you must specifically identify the portions of your response that you seek to have withheld and provide, in detail, the bases for your claim (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390 (b) to support a request for withholding confidential commercial or financial information). If Safeguards Information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Sincerely,

/RA/

Kerri A. Kavanagh, Chief
Quality Assurance Vendor Inspection Branch-3
Division of Construction Inspection
and Operational Programs
Office of New Reactors

Docket No.: 05200046

Enclosures:
1. Notice of Violation
2. Inspection Report No. 05200046/2017-201
   and Attachment

SUBJECT: NUCLEAR REGULATORY COMMISSION INSPECTION OF KOREA HYDRO & NUCLEAR POWER CO., LTD., REPORT NO. 05200046/2016-201

Dated: July 10, 2017

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ADAMS Accession No.: ML17171A237 *via e-mail NRO-002

OFC	NRO/DCIP/QVIB-1	NRO/DEIA/MEB	NRO/DCIP/QVIB-3
NAME	AArmstrong*	ATsirigotis*	AFerguson
DATE	07/10/2017	06/29/2017	07/10/17
OFC	NRO/DEIA/ICE1	NRO/DEIA/SEB	NRO/DCIP/QVIB-3
NAME	DZhang*	AIstar*	AKeim
DATE	07/06/2017	07/10/2017	07/07/2017
OFC	NRO/DCIP/QVIB-3	NRC/DCIP/EC	
NAME	PPrescott	SSmith	
DATE	07/10/2017	07/06/2017	
OFC	NRO/DCIP/QVIB-3	NRO/DCIP/QVIB-3	
NAME	TKendzia	KKavanagh	
DATE	07/10/2017	07/10/2017	

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NOTICE OF VIOLATION

Korea Hydro and Nuclear Power Co., Ltd.
Central Research Institute
70-1312-gil, Yuseong-daero, Yuseong-gu,
Daejeon 305-343, Korea (Republic of)

Docket No. 0520046
Report No. 2017-201

During a U.S. Nuclear Regulatory Commission (NRC) inspection of Korea Hydro and Nuclear Power Co. Ltd., (KHNP) conducted at the Westinghouse offices located in Rockville, MD from May 22, 2017 through May 26, 2017, four violations of NRC requirements were identified. In accordance with the NRC Enforcement Policy, the violations are listed below:

A. Criterion III, "Design Control," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," states in part that, "Measures shall be established for the identification and control of design interfaces and for coordination among participating design organizations."
KHNP Quality Assurance Manual (QAM) for APR1400 Design Certification (DC) Project, Subsection 3.2.2 states, "Procedures are establish and implemented to describe how to manage and oversee the design inputs, the design outputs, the design analysis, the design review, verification, and approval, the design change control, design interface control, the software control, and the documentation of these activities."

Contrary to the above, as of May 26, 2017, KHNP failed to implement measures for control of design interfaces and for coordination among participating design organizations. Specifically, the NRC inspection team identified the following examples in which KHNP did not implement adequate control of APR1400 design requirements between its design organizations:

1) KHNP did not ensure that measures were established for control of the design interface and coordination for the safety-related "Full Penetration Nozzle Load Criteria" calculation among its participating design organizations Korea Electric Power Corporation (KEPCO) - Engineering and Construction (E&C) - System Development (SD) and Doosan.

2) KHNP did not ensure that measures were established for control of the design interface and coordination for the Core Protection Calculator System (CPCS) design requirements among its participating design organizations SD and KEPCO-Nuclear Fuels (KNF).

This issue has been identified as Violation 05200046/2017-201-01.

This is a Severity Level IV violation (Section 6.5.d of the NRC Enforcement Policy).

B. Criterion VII, "Control of Purchased Material, Equipment, and Services," of Appendix B, to 10 CFR Part 50, states in part that, "Measures shall include provisions, as appropriate, for source evaluation and selection, objective evidence of quality furnished by the contractor or subcontractor, inspection at the contractor or subcontractor source, and examination of products upon delivery."

Criterion III, "Design Control," of Appendix B, to 10 CFR Part 50, states in part that, "Measures shall be established to assure that applicable regulatory requirements and

design basis, as defined in § 50.2 and as specified in the license application, for those structures, systems, and components to which this appendix applies are correctly translated into specifications, drawings, procedures, and instructions."

KHNP QAM for APR1400 DC Project, Subsection 3.2.2 states, "Procedures are established and implemented to describe how to manage and oversee the design inputs, the design outputs, the design analysis, the design review, verification, and approval, the design change control, design interface control, the software control, and the documentation of these activities."

Contrary to the above, as of May 26, 2017, KHNP failed to establish measures to obtain objective evidence of quality furnished by contractors and for the examination of products upon delivery. Therefore, KHNP failed to assure applicable regulatory requirements and design basis are correctly translated into specifications, drawings, procedures, and instructions. Specifically, the NRC inspection team identified the following examples in which requirements from the APR1400 Design Control Document (DCD) were not adequately translated into the design specifications developed by design organizations SD and KEPCO- E&C Architect Engineering (AE):

1) KHNP failed to ensure that measures were established to ensure AE included the requirement for one-out-of-two coincidence logic for the Balance of Plant Engineered Safety Features Actuation System (ESFAS) function in the System Functional Description for ESFAS, as required by the APR1400 Tier 2 DCD and the AE Design Control Manual for ESFAS.

2) KHNP failed to ensure that measures were established to ensure SD included the requirement for the fail-safe loss-of-power functionally for Plant Protection System (PPS) channels in the Design Specification for PPS, as required by the APR1400 Tier 1 DCD and the SD System Design Requirements for PPS.

This issue has been identified as Violation 05200046/2017-201-02.

This is a Severity Level IV violation (Section 6.5.d of the NRC Enforcement Policy)

C. Criterion XVI, "Corrective Action," of Appendix B, to 10 CFR Part 50 states in part that, "Measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected."

KHNP QAM for APR1400 DC Project, Section 16, states in part, "KHNP procedures require personnel to identify known conditions adverse to quality."

APR1400 DC Project Internal Procedures, DC-DG-16-01, "Corrective Action," step 6.1.1, states in part, "If any individual working for the APR1400 DC project discovers an adverse condition, he or she is expected to issue a CR."

Contrary to the above, as of May 26, 2017, KHNP failed to identify conditions adverse to quality for NRC audit findings and requests for information related to the review of the APR1400 DC application. Specifically, the NRC inspection team identified the following examples in which conditions adverse to quality were not identified:

1) RAI 8285, Question 03.08.05-9 and Question 03.08.05-14 identified questions with the stability checks of the emergency diesel generator building and diesel fuel oil tank foundations. AE determined that the DCD was inadequate and needed revision.

2) KHNP is committed to NRC Bulletin 88-11 in the APR1400 DCD. RAI 8027, Question 03.12-3 identified questions with thermal stratification of the pressurizer surge line as required by NRC Bulletin 88-11. AE determined that thermal stratification had not been adequately addressed, the DCD needed to be revised, and a test in the initial test program added.

3) During a NRC piping audit on November 9, 2015, it was identified to AE that the detailed piping analysis for feedwater and main steam piping sections (11E47-1-325-P397-FW209, FW219, MS271, MS272) were missing. During the piping audit it was also identified that the evaluation for environmentally assisted fatigue of the reactor coolant loop piping had not been performed. AE determined that the analysis were required and had not been performed.

This issue has been identified as Violation 05200046-2017-201-03.

This is a Severity Level IV violation (Section 6.5.d of the NRC Enforcement Policy).

D. Criterion XVIII, "Audits," of Appendix B to 10 CFR Part 50 states in part that, "…audits shall be performed in accordance with written procedures or checklists by appropriately trained personnel not having direct responsibilities in the areas being audited." KHNP QAM for APR1400 DC Project, Subsection 18.2.1 states, "Audits are performed, independently, and periodically, in accordance with written procedures or checklists by qualified personnel who do not have direct responsibility for audited activities."

Contrary to the above, as of May 26, 2017, KHNP failed to ensure that audits were performed by personnel not having direct responsibilities in the areas being audited. Specifically, in 2015 and 2017, the Quality Assurance Team Leader and Quality Engineer performed internal audits in areas that they had direct responsibility, including design control and corrective action. The NRC inspection team identified deficiencies in both the design control and corrective action programs during this inspection.

This issue has been identified as Violation 05200046/2017-201-04.

This is a Severity Level IV violation (Section 6.9.d of the NRC Enforcement Policy).

Under the provisions of 10 CFR 2.201, "Notice of Violation," KHNP is hereby required to submit a written statement or explanation to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001, with a copy to the Chief, Quality Assurance Vendor Inspection Branch-3, Division of Construction Inspection and Operational Programs, Office of New Reactors, within 30 days of the date of the letter transmitting this notice of violation. This reply should be clearly marked as a "Reply to a Notice of Violation" and should include (1) the reason for the violation or, if contested, the basis for disputing the violation or severity level, (2) the corrective steps that have been taken and the results achieved, (3) the corrective steps that will be taken, and (4) the date when full compliance will be achieved. Your response may reference or include previous docketed correspondence if the

correspondence adequately addresses the required response. Where good cause is shown, the NRC will consider extending the response time.

If you contest this enforcement action, provide a copy of your response, with the basis for your denial, to the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

Because your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System, which is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html, to the extent possible it should not include any personal privacy, proprietary, or Safeguards Information (SGI) so that the agency can make it available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request that such material be withheld, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim of withholding (e.g., explain why the disclosure of information would create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If SGI is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements"

In accordance with 10 CFR 19.11, "Posting of Notices to Workers," you may be required to post this notice within 2 working days of receipt.

Dated this the 10th day of July 2017.

U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NEW REACTORS
DIVISION OF CONSTRUCTION INSPECTION AND
OPERATIONAL PROGRAMS

Docket No.:	05200046	
Report No.:	05200046/2017-201	
Applicant:	Korea Hydro & Nuclear Power Co., Ltd. (KHNP) 70-1312-GIL Yuseong-Daero, Yuseong-Gu Daejeon, 305-343, Korea	
Applicant Contact:	Dr. Han Gon Kim +82-42-870-5400 Kimhg1108@khnp.co.kr	
Nuclear Industry Activity:	KHNP submitted its Design Certification (DC) application for the APR1400 in December 2014.	
Inspection Dates:	May 22, 2017 to May 26, 2017	
Inspection Team:	Thomas Kendzia	NRO/DCIP/QVIB-3, Team Leader
	Alexander Tsirigotis	NRO/DEIA/MEB
	Ashley Ferguson	NRO/DCIP/QVIB-3
	Deanna Zhang	NRO/DEIA/ICE1
	Aaron Armstrong	NRO/DCIP/QVIB-1
	Vaughn Thomas	NRO/DEIA/SEB
	Andrea Keim	NRO/DCIP/QVIB-3
	Paul Prescott	NRO/DCIP/QVIB-3
Approved by:	Kerri A. Kavanagh, Chief Quality Assurance Vendor Inspection Branch-3 Division of Construction Inspection and Operational Programs Office of New Reactors	

EXECUTIVE SUMMARY

Korea Hydro & Nuclear Power Co., Ltd.
0520046/2017-201

The U.S. Nuclear Regulatory Commission (NRC) conducted this Design Certification (DC) inspection to verify that, Korea Hydro & Nuclear Power Co., Ltd. (hereafter referred to as KHNP), implemented an adequate quality assurance (QA) program in compliance with the applicable requirements of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," and 10 CFR Part 21, "Reporting of Defects and Noncompliance." The NRC inspection team conducted the inspection at the Westinghouse Electric Company (WEC) facility in Rockville, Maryland.

This inspection assessed aspects of KHNP's design and QA activities, which included the corrective action, oversight of contracted activities, and 10 CFR Part 21 programs associated with the control of: structural analysis of safety-related building foundations; analysis of the Safety Injection Tank fluidic device (downstream effects related to piping stress analysis); design of the instrumentation and control system; and safety-related piping stress analysis used for the APR1400 DC application.

The following regulations served as the bases for the NRC inspection:

- Appendix B to 10 CFR Part 50
- 10 CFR Part 21

During the planning and course of this inspection, the NRC inspection team followed Inspection Procedure (IP) 35017, "Quality Assurance Implementation Inspection," and IP 36100, "Inspection of 10 CFR Part 21 and Programs for Reporting Defects and Nonconformance."

The information below summarizes the results of this inspection.

10 CFR Part 21 Program

The NRC inspection team determined that for the sample evaluated, the implementation of KHNP's 10 CFR Part 21 program is consistent with the regulatory requirements of 10 CFR Part 21. No findings of significance were identified.

Design Control – Control of Design Interfaces and Coordination among Participating Design Organizations

The NRC inspection team issued Violation 05200046/2017-201-01, in association with KHNP's failure to implement the regulatory requirements of Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. Violation 05200046/2017-201-01 cites KHNP for failure to implement measures for control of design interfaces and for coordination among participating design organizations. Specifically, the NRC inspection team identified two examples in which KHNP did not implement adequate control of APR1400 design requirements between its contracted design organizations.

Design Control - Applicable Regulatory Requirements and Design Basis are Translated into Specifications, Drawings, Procedures, and Instructions

The NRC inspection team issued Violation 05200046/2017-201-02 in association with KHNP's failure to implement the regulatory requirements of Criterion VII, "Control of Purchased Material, Equipment, and Services," and Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. Violation 05200046/2017-201-02 cites KHNP for failure to establish measures to obtain objective evidence of quality furnished by contractors and for the examination of products upon delivery. Therefore, KHNP failed to assure applicable regulatory requirements and design basis are correctly translated into specifications, drawings, procedures, and instructions. Specifically, the NRC inspection team identified two examples in which requirements from the APR1400 design control document were not adequately translated into the design specifications developed by Korea Electric Power Corporation (KEPCO) - Engineering and Construction (E&C) - System Development (SD) and KEPCO-E&C Architect Engineer (AE).

Corrective Action

The NRC inspection team issued Violation 05200046/2017-201-03 in association with KHNP's failure to implement the regulatory requirements of Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50. Violation 05200046/2017-201-03 cites KHNP for failure to identify conditions adverse to quality related to NRC audit findings and requests for additional information. Specifically, the NRC inspection team identified three examples in which conditions adverse to quality were not identified by KHNP and condition reports were not initiated.

Audits

The NRC inspection team issued Violation 05200046/2017-201-04 in association with KHNP's failure to implement the regulatory requirements of Criterion XVIII, "Audits," of Appendix B to 10 CFR Part 50. Violation 05200046/2017-04 cites KHNP for failure to ensure that internal audits were performed by personnel not having direct responsibilities in the areas being audited. Specifically, the NRC inspection team identified that for internal audits conducted in 2015 and 2017 members of the audit team audited areas for which they had direct responsibility.

Organization and Quality Assurance Program

The NRC inspection team found that KHNPs organization conformed to the requirements in Criterion I, "Organization," of Appendix B to 10 CFR Part 50. KHNP was effectively implementing its QA policies and procedures within its scope of work related to the APR1400 standard DC. In addition, the NRC inspection team found that KHNP's QA program requirements conformed to the requirements of Criterion II, "Quality Assurance Program," of Appendix B to 10 CFR Part 50 and that for the sample of documents reviewed, KHNP was effectively implementing its policy and procedures for the QA program, with the exception of the four violations identified in this report. No additional findings of significance were identified during the NRC inspection team's review of Criterion I and Criterion II of Appendix B to 10 CFR Part 50.

REPORT DETAILS

1) 10 CFR Part 21 Program

a. Scope

The NRC inspection team reviewed Korea Hydro & Nuclear Power Co., Ltd. (hereafter referred to as KHNP), Korea Electric Power Corporation (KEPCO) - Engineering and Construction (E&C) - System Development (SD) and KEPCO-NF (KNF) quality assurance (QA) manuals, policies, and procedures that govern the evaluation program to determine compliance with 10 CFR Part 21. The inspection team verified that KHNP's nonconformance and corrective action processes provide adequate links to the Part 21 procedure. The NRC inspection team reviewed SD's and KNF's procedures and corrective action program to verify adequate identification of conditions that could require 10 CFR Part 21 evaluation, and to ensure the transfer of the responsibility for evaluation to KHNP. Additionally, the NRC inspection team chose a sample of four corrective action reports (CARs) to determine if KHNP properly addressed the documented issues for potential reporting under the requirements of 10 CFR Part 21.

The NRC inspection team discussed the Part 21 process with KHNP personnel to assess their understanding of Part 21, and how they would identify conditions that could require 10 CFR Part 21 evaluation.

The documents reviewed and personnel interviewed by the NRC inspection team are included in the attachment to this inspection report.

b. Finding and Observations

There were no Part 21 evaluations initiated or completed at the time of inspection. No findings of significance were identified.

c. Conclusion

The NRC inspection team determined that for the sample evaluated, the implementation of KHNP's 10 CFR Part 21 program is consistent with the regulatory requirements of 10 CFR Part 21, "Reporting of Defects and Noncompliance." No findings of significance were identified.

2) Design Control – Control of Design Interfaces and Coordination among Participating Design Organizations

a. Scope

The NRC inspection team reviewed KHNP's policies and implementing procedures that govern the implementation of its oversight of contracted activities to verify compliance with the requirements of Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. The NRC inspection team evaluated implementation of QA processes associated with oversight of contracted safety-related design activities.

The NRC inspection team focused its review on design control for the APR1400 and KHNP's control of suppliers, KEPCO–E&C Architect Engineer (AE), SD, KNF, and

Doosan that perform safety-related design activities for the APR1400 design certification (DC) application. The NRC inspection team evaluated KHNP's design interface control for design inputs, design outputs, design analysis, and design verification as well as interfaces between KHNP, AE, SD, KNF, and Doosan. Specifically, the NRC inspection team assessed: 1) how design information was shared amongst all design entities, and 2) the level of review and approval performed by KHNP for outputs at the end of each development phase.

The documents reviewed and personnel interviewed by the NRC inspection team are included in the attachment to this inspection report.

b. Finding and Observations

APR1400 Project Procedure Manual, DC-BG-12, "Document Review and Approval," Revision 0, dated February 2016, documents the level of review and approval by KHNP, required for SD, AE, KNF and Doosan's design documents which consists of the design requirements and design data. The NRC inspection team identified that DC-BG-12 did not instruct KHNP to perform the same level of review for equivalent type design documents generated by each supplier. KHNP issued condition report (CR) 01068897 to address this issue.

The NRC inspection team reviewed KHNP's design control for Doosan calculation MHS/RD-120006M, "Steam Outlet Nozzle Loading," supplied to SD and calculation document N11023-160CN-0900, "Full Penetration Nozzle Load." The NRC inspection team assessed the translation of design requirements into the APR1400 Design Control Document (DCD). The NRC inspection team reviewed how the design interface control for safety-related activities between KHNP's suppliers met regulatory requirements. The NRC inspection team and KHNP discussed the process of how Doosan's calculation MHS/RD-120006M was supplied and used by SD. KHNP does not review and approve the calculations from Doosan to the other suppliers because they performed audits on all the suppliers. KHNP performed audits of AE, SD, KNF, and Doosan, but the scope and area of KHNP's audits were not made available to its suppliers. The NRC inspection team and KHNP discussed that without KHNP's design interface control, the suppliers would not know the areas and scope of KHNP's audits; therefore not know the acceptability of design outputs being exchanged among the suppliers. KHNP issued CR 01068527 to address this issue. The NRC inspection team identified this issue as the first example of Violation 05200046/2017-201-01, for KHNP's failure to implement measures for control of design interfaces and for coordination among participating design organizations.

The NRC inspection team and KHNP discussed the established measures for the coordination among participating design entities. Specifically, for the design of the Core Protection Calculator System (CPCS), as developed by SD, and supplemented by KNF, the APR1400 Tier 2 DCD requires that the high local power density (LPD) and the low departure from nucleate boiling ratio (DNBR) trip signals will also be generated based on the CPCS auxiliary trips. SD's System Design Requirements (SDRs) for CPCS are derived from the DCD and requires that the CPCS channel shall provide simultaneous DNBR and LPD trip signals for the auxiliary trip conditions. KNF is responsible for the APR1400 core design, and provides information to SD regarding the detailed functional design requirements (FDRs) for the CPCS. However, SD did not directly incorporate the requirements from KNF's FDRs into the CPCS Design Specification, beyond listing the

FDRs in the reference section of the Design Specification. SD issued CR 11A60-CR-17-IC-003 to address this issue. The NRC inspection team identified this issue as the second example of Violation 05200046/2017-201-01, for KHNP's failure to implements measure for control of design interfaces and for coordination among participating design organizations.

c. Conclusion

The NRC inspection team issued Violation 05200046/2017-201-01, in association with KHNP's failure to implement the regulatory requirements of Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. Violation 05200046/2017-201-01 cites KHNP for failure to implement measures for control of design interfaces and for coordination among participating design organizations. Specifically, the NRC inspection team identified two examples in which KHNP did not implement adequate control of APR1400 design requirements between its contracted design organizations.

3) Design Control - Applicable Regulatory Requirements and Design Basis are Translated into Specifications, Drawings, Procedures, and Instructions

a. Scope

The NRC inspection team reviewed KHNP's implementation of its policies and procedures governing the design control process in order to verify compliance with the requirements of Criterion III, "Design Control," and Criterion VII, "Control of Purchased Material, Equipment, and Services," of Appendix B to 10 CFR Part 50.

The NRC inspection team focused its review on design activities for the APR1400 Instrumentation and Control (I&C) System. KHNP contracted with suppliers, AE, SD, and KNF, to perform safety-related design activities for the development of the I&C system for the APR1400 reactor design. Specifically, the NRC inspection team reviewed the design requirements and design specifications for the three I&C safety-related systems: Plant Protection System (PPS), Engineered Safety Features Actuation System (ESFAS)-Component Control System (CCS), and CPCS. The NRC inspection team assessed the translation of design requirements, as stated in the APR1400 DCD, into lower system requirements and specifications, which will later be used for the development of the I&C software and manufacture of the complete I&C system.

The NRC inspection team also assessed the implementation of independent verification performed by SD, AE, and KNF for their respective design documentation. The NRC inspection team reviewed the training records for the individuals who performed the independent verification and validation (V&V) review of the APR1400 I&C system.

The documents reviewed and personnel interviewed by the NRC inspection team are included in the attachment to this inspection report.

b. Finding and Observations

The NRC inspection team determined that KHNP failed to adequately evaluate the adequacy of the measures established by SD and AE for the correct translation of regulatory requirements and design basis into specifications, drawings, procedures, and instructions. During the review of the design documentation for the APR1400 I&C

system, the NRC inspection team identified the following examples in which requirements from the APR1400 DCD were not adequately translated into the design specifications developed by SD and AE and KHNP failed to identify during its review and approval or audit process:

1) For the ESFAS-CCS design, developed by AE, the APR1400 DCD, Tier 2, Section 7.3.1.3 states that, "The BOP [balance of plant] ESFAS consists of 1-out-of-2 logic taken twice except the FHEVAS [fuel handling area emergency ventilation actuation signal], which has one 1-out-of-2 logic." AE's Design Control Manual (DCM) (System Design Criteria) which contains requirements derived from the DCD, requires that the initiation logic of the BOP ESFAS shall use one-out-of-two actuation logic; however this requirement was not included in the ESFAS System Functional Description (SFD), which describes a summary of the design approach, design data, final system configuration, and requirements applied to the system design. The ESFAS-CCS performs both BOP and nuclear steam supply system (NSSS) ESFAS functions. The SFD states that the ESFAS except for the FHEVAS, containment purge isolation actuation signal (CPIAS) and control room emergency ventilation actuation signal (CREVAS), which are the BOP functions, utilize a full two-out-of-four-coincidence logic. The SFD did not explicitly state the requirement for one-out-of-two logic for the ESFAS BOP functions (FHEVAS, CPIAS and CREVAS). Additionally, the SFD contains bypass requirements for the ESFAS, which include that if a channel is bypassed, the ESFAS coincidence logics become two-out-of-three. It is unclear from the SFD as to whether the bypass requirements are applicable to the ESFAS BOP functions and what the required coincidence logic is for these functions. The NRC inspection team identified unclear design requirements in an implementing document as the first example of Violation 05200046/2017-201-02, for KHNP's failure to establish measures to assure applicable regulatory requirements and design basis are correctly translated into specifications, drawings, procedures, and instructions. AE issued CR 11E47-CR-17-J-002 to address this issue.

2) For the PPS design, developed by SD, the APR1400 DCD, Tier 1, Revision 1, Section 2.5.1.1, Item 13 states that, "The RT [reactor trip] logic of the PPS is designed to fail to a safe state such that a processor lock-up or loss of electrical power to a division of PPS results in a trip condition for that division but the ESFAS logic of the PPS is designed to fail to a safe state such that loss of electrical power to a division of PPS does not result in ESF initiation for that division." The SDR for the PPS, which implements the design requirements from the DCD, state that the PPS shall be designed so that a loss of power in one channel will cause that channel to assume a "tripped" condition and that a loss of power in more than one channel would result in all protective actuations. This requirement was not translated into the design specification for the PPS which is the lower tier documentation that describes in detail: the system design, fabrication, inspection, performance, and testing requirements for the PPS. Specifically, the design specification does not include a description of how the requirement for the loss of power to a single channel will result in a trip condition for that channel or that a loss of power to multiple channels will result in the initiation of all protective actions will be implemented. The design specification only provides a high level description for loss of power which states, that the PPS shall be designed for fail-safe operation upon component failure or loss of power. The NRC inspection team identified the inadequate design requirement in the

implementing document as the second example of Violation 05200046/2017-201-02, for KHNP's failure to evaluate the adequacy of the implementation of SD's design control program for translating design basis and requirements into design specifications. SD issued CR 11A60-CR-17-IC-004 to address this issue.

c. Conclusion

The NRC inspection team issued Violation 05200046/2017-201-02 in association with KHNP's failure to implement the regulatory requirements of Criterion VII, "Control of Purchased Material, Equipment, and Services," and Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. Violation 05200046/2017-201-02 cites KHNP for failure to establish measures to obtain objective evidence of quality furnished by contractors and for the examination of products upon delivery. KHNP failed to assure applicable regulatory requirements and design basis are correctly translated into specifications, drawings, procedures, and instructions. Specifically, the NRC inspection team identified two examples in which requirements from the APR1400 DCD were not adequately translated into the design specifications developed by SD and AE.

4) Corrective Action

a. Scope

The NRC inspection team reviewed the policies and procedures governing the implementation of the KHNP's corrective action processes to verify compliance with Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50. Specifically, the NRC inspection team reviewed KHNP's Quality Assurance Program Description (QAPD) and QAM which describes the overall requirements for the corrective action processes.

KHNP has two corrective action processes, the CAR process which is used for QA items (audits, quality surveillance and quality trend analysis), and the Corrective Action Program (CAP) process which is used for all other conditions adverse to quality. The NRC inspection team verified that KHNP had established and implemented procedures for promptly identifying and correcting conditions adverse to quality. With regard to significant conditions adverse to quality (SCAQ), the NRC inspection team confirmed that KHNP had established and implemented procedures to ensure (1) identification of the causes, (2) documentation of the corrective actions to prevent recurrence, and (3) reporting of the SCAQs and actions taken to the appropriate levels of management. In addition, the NRC inspection team confirmed that the corrective action processes provide a connection to evaluate for 10 CFR Part 21 requirements.

The NRC inspection team reviewed implementation of the corrective action processes. The NRC inspection team reviewed twenty-eight CARs, which included all the CARs associated with the 2014 NRC inspection of KHNP (inspection report 99901453/2014-201) that included four Notice of Violations. The NRC inspection team also reviewed twenty-one CRs, and discussed the CAR and CAP processes with KHNP personnel responsible for the implementation of the corrective action processes.

The NRC inspection team reviewed how the KHNP process for responding to NRC staff questions from NRC audits, and NRC requests for additional information (RAIs) interfaces with the corrective action processes. The NRC inspection team reviewed specific RAIs and audit questions that identified errors, mistakes or omissions in the

engineering documents to determine if they were considered by KHNP or their safety-related design suppliers to be conditions adverse to quality requiring CRs. The NRC inspection team also interviewed personnel from KHNP and the contracted safety-related design suppliers about the interface of the corrective action processes with NRC audits and RAIs.

The documents reviewed and personnel interviewed by the NRC inspection team are included in the attachment to this inspection report.

b. Finding and Observations

The NRC inspection team reviewed the corrective actions implemented by KHNP to address the four violations identified during the 2014 NRC inspection of KHNP (inspection report (IR) 99901453/2014-201). The NRC inspection team determined that the corrective actions were adequate to address the violations. Based on the NRC inspection team's review, the violations associated with IR 99901453/2014-201 are closed.

APR1400 Project Internal Procedure, DC-BG-16-01, "Corrective Action Program," Revision 2, dated February 2016, requires that any individual working for the APR1400 DC project initiate a CR when an adverse condition is discovered.

The NRC inspection team determined that KHNP issued CRs for RAIs and audit questions that KHNP was responding to, but for RAIs and audit questions that were assigned by KHNP to the contracted safety-related design suppliers, KHNP did not issue CRs or verify the design supplier issued CRs (or the design supplier's equivalent). The KHNP and suppliers' procedure for RAI response, APR1400 Project Procedure Manual, DC-BG-21, "RAI Processing," Revision 2, dated February 2016, does not require screening for adverse conditions and there is no specific KHNP procedure for addressing audit questions. Discussions with the design suppliers indicated that the design suppliers considered RAIs and audit questions from the engineering design perspective and not a corrective action perspective.

The NRC requested KHNP look at the extent of condition of not identifying conditions adverse to quality in the corrective action program from RAIs and audit questions. KHNP identified that for 85 RAIs and a number of audit questions addressed by KHNP which required no technical reports/design specifications/calculations to be revised, KHNP initiated 35 CRs for conditions adverse to quality. KHNP also identified that KHNP delegated 2,123 RAIs and a number of audit questions to the safety-related design suppliers which resulted in 686 technical reports/design specifications/calculations being revised and only six CRs were written. The NRC inspection team identified that KHNP did not issue CRs for these adverse conditions identified from audits and RAIs. KHNP issued CRs 01068523 and 01068907 to address this issue.

The NRC inspection team identified the following examples in which conditions adverse to quality were not identified by KHNP and no CRs were initiated:

1) RAI 8285, Question 03.08.05-9 and Question 03.08.05-14 identified questions with the stability checks of the emergency diesel generator building and diesel fuel oil tank foundations. AE determined that the DCD was inadequate and

needed revision. The NRC inspection team identified the DCD being inadequate for addressing foundation stability checks as the first example of Violation 05200046/2017-201-03, for KHNP's failure to identify conditions adverse to quality as required by Criterion XVI, "Corrective Action," of Appendix B to10 CFR 50.

2) KHNP is committed to NRC Bulletin 88-11 in the APR1400 DCD. RAI 8027, Question 03.12-3 identified questions with thermal stratification of the pressurizer surge line as required by NRC Bulletin 88-11. AE determined that thermal stratification had not been adequately addressed and the DCD needed to be revised, and a test in the initial test program added. The NRC inspection team identified thermal stratification not being adequately addressed as the second example of Violation 05200046/2017-201-03, for KHNP's failure to identify conditions adverse to quality as required by Criterion XVI, "Corrective Action," of Appendix B to 10 CFR 50.

3) During a NRC piping audit on November 9, 2015, it was identified to AE that the detailed piping analysis for feedwater and main steam piping sections (11E47-1-325-P397-FW209, FW219, MS271, MS272) were missing. During the piping audit it was also identified that the evaluation for environmentally assisted fatigue (EAF) of the reactor coolant loop piping had not been performed. AE determined that the analysis were required and had not been performed. The NRC inspection team identified safety-related piping analysis not being completed as the third example of Violation 05200046/2017-201-03 for KHNP's failure to identify conditions adverse to quality as required by Criterion XVI, "Corrective Action," of Appendix B to 10 CFR 50.

c. Conclusion

The NRC inspection team issued Violation 05200046/2017-201-03 in association with KHNP's failure to implement the regulatory requirements of Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50. Violation 05200046/2017-201-03 cites KHNP's failure to identify conditions adverse to quality related to NRC audit questions and RAIs. Specifically, the NRC inspection team identified three examples in which conditions adverse to quality were not identified by KHNP and CRs were not initiated.

5) Audits

a. Scope

The NRC inspection team reviewed the policies and procedures governing the implementation of the KHNP's audit program to verify compliance with Criterion XVIII, "Audits," of Appendix B to 10 CFR Part 50. In addition, the NRC inspection team reviewed the internal audit reports from 2015, 2016, and 2017 and external audit reports from 2017. The NRC inspection team verified that the audit reports contained objective evidence of the review of the relevant quality assurance criteria of Appendix B to 10 CFR Part 50.

The documents reviewed and personnel interviewed by the NRC inspection team are listed in the attachment to this inspection report.

b. Finding and Observations

The NRC inspection team reviewed KHNP's procedure for performing QA audits of suppliers and their standard checklist. The NRC inspection team assessed the implementation of KHNP's supplier audit program by reviewing a sample of audits. Specifically, the NRC inspection team reviewed KHNP's audits of KNF, SD, AE, and Doosan performed in 2017.

During the review of the internal audits, the NRC inspection team identified that for the internal audits conducted at KHNP in 2015 and 2017 the QA Manager and the Director of Quality led or participated as a team member. The NRC inspection team noted that several sections of the QA program audit, specifically, Corrective Action, Inspection, QA Program, Procurement Document Control, and Control of Purchased Items and Services, were performed by the QA Team Leader and Quality Engineer having direct responsibility of those areas. This issue is identified as Violation 05200046/2017-201-04. KHNP issued CR 01069684 to address this issue.

c. Conclusion

The NRC inspection team issued Violation 05200046/2017-201-04 in association with KHNP's failure to implement the regulatory requirements of Criterion XVIII of Appendix B to 10 CFR Part 50. Violation 05200046/2017-04 cites KHNP's failure to ensure that internal audits were performed by personnel not having direct responsibilities in the areas being audited. Specifically, the NRC inspection team identified that for internal audits conducted in 2015 and 2017 at KHNP the QA team leader and Quality Engineer participated as members of the audit team and audited areas for which they had direct responsibility.

6) Organization and Quality Assurance Program

a. Inspection Scope

The NRC inspection team reviewed KHNP's policies and procedures to verify that KHNP described and implemented its organization in a manner consistent with the regulatory requirements in Criterion I, "Organization," of Appendix B to 10 CFR Part 50. In addition, the NRC inspection team discussed the organization with KHNP management and staff. The NRC inspection team also reviewed the program controls and the personnel training and qualification process to verify conformance with the requirements in Criterion II, "Quality Assurance Program," of Appendix B to 10 CFR Part 50. In addition, the NRC inspection team discussed the QA program controls and the personnel training and qualification process with KHNP management and technical staff.

The documents reviewed and personnel interviewed by the NRC inspection team are included in the attachment to this inspection report.

b. Observations and Findings

The NRC inspection team reviewed the KHNP managerial functions in the QAPD organization description and verified that they have adequate QA controls for review and approval of QA procedures and records within their functional area of responsibility, proper delegation of work, review of nonconforming items, and interface controls between the management functions to meet the requirements in Appendix B to 10 CFR Part 50.

The NRC inspection verified that KHNP was implementing a QA program, including training activities, in a manner consistent with regulatory requirements and industry standards. The NRC inspection team reviewed qualification and training records for the KHNP QA team lead auditor currently responsible for auditing the four sub-suppliers involved in the APR1400 Design Certification - KNF, SD, AE and Doosan Heavy Industries. The NRC inspection team also verified that training records for recertification training were in compliance with KHNP's procedures.

c. Conclusions

The NRC inspection team concluded that KHNP's organization conformed to the requirements of Criterion I of Appendix B to 10 CFR Part 50 and that KHNP was effectively implementing the QA policies and procedures for the organization's scope of work. The NRC inspection team also found that KHNP's QA program requirements conformed to the requirements in Criterion II of Appendix B to 10 CFR Part 50 and that KHNP was effectively implementing the policy and procedures of its the QA program except for the four violations identified in this report. No additional findings of significance were identified.

7. Entrance and Exit Meetings

On May 22, 2017, the NRC inspection team discussed the scope of the inspection during an entrance meeting with Mr. Jaesoo Lim and other KHNP, WEC, SD, AE, KNF and Doosan personnel. On May 26, 2017, the NRC inspection team presented the inspection results during an exit meeting with Mr. Jaesoo Lim and other KHNP, WEC, KEPCO-SD, KEPCO-AE, KEPCO-NF, and Doosan personnel.

ATTACHMENT

1. ENTRANCE/EXIT MEETING ATTENDEES

Name	Title	Affiliation	Entrance	Exit	Interviewed
Jungho Kim	Senior Manager	KHNP	X	X	X
Jaesoo Lim	QA Engineer	KHNP	X	X	X
Taejin Kim	QA Engineer	KHNP	X	X	X
Gidong Park	QA Manager	KNF	X	X	X
Heonjeong Ha	Mechanical Engineer (Fuel)	KNF	X	X	X
Seongho Won	QA Engineer	KEPCO-AE	X	X	X
Younghoon Kim	Civil Engineer	KEPCO-AE	X	X	X
Youngki Kim	Assistant Project Manager	KEPCO-AE	X	X	X
Chongho Park	Project Manager	KEPCO-AE	X	X	X
Jinkui Kim	I&C Engineer	KEPCO-AE	X	X	X
Seokhwan Hur	SMEr	KEPCO-AE	X	X	X
Sangho Jeong	QA Manager	KEPCO-SD	X	X	X
Hyeong Soon Yim	I&C Engineer Mgr	KEPCO-SD	X	X	X
Seung Wook Lee	APR 1400 Project Team - EGS	KEPCO-SD	X	X	X
Gee Seok Kim	Mechanical Engineer EGSr	KEPCO-SD	X	X	X
Sangho Jeong	QA Manager	KEPCO-SD	X		X
A Reum Jang	QA Engineer	Doosan	X	X	X
Jun Soo Park	Engineer	Doosan	X	X	X
Edward Baker	Consultant	Talisman	X	X	X
Jill Monahan	Licensing Manager	Westinghouse	X	X	X
Rob Sisk	Director of Licensing	Westinghouse		X	X
Mark Lintz	Project Manager	NRC	X		
Thomas Kendzia	Inspection Team Leader	NRC	X	X	
Alexander Tsirigotis	Tech Reviewer	NRC	X	X	
Ashley Ferguson	Inspector	NRC	X	X	
Deanna Zhang	Tech Reviewer	NRC	X	X	
Andrea Keim	Inspector	NRC	X	X	
Aaron Armstrong	Inspector	NRC	X	X	
Ata Istar	Tech Reviewer	NRC	X	X	

Paul Prescott	Sr. Reactor Operations Engineer	NRC	X	X	
Alexander Tsirigotis	Tech Reviewer	NRC	X	X	
Kerri Kavanagh	Branch Chief	NRC	X	X	
Tim McGinty	Director NRO/DCIP	NRC		X	
Mike McCoppin	Branch Chief	NRC		X	
Andy Oh	KHNP Sr. Manager	KHNP		X	X
Tony Ahn	WDCC Director	KHNP		X	X
Dacheon Lim	WDCC SME	KEPCO-SD		X	X
James Ross	Project Manager	KHNP/AECOM		X	X
Joohan Kim	QA Engineer	KEPCO		X	X

2. ACRONYMS USED IN THIS REPORT

AE	KEPCO E&C Architect Engineering
CAP	Corrective Action Program
CAR	Corrective Action Report
CCS	Component Control System
CFR	Code of Federal Regulations
CPCS	Core Protection Calculator System
CPIAS	Containment Purge isolation Actuation Signal
CR	Condition Report
CREVAS	Control Room Emergency Ventilation Actuation Signal
DC	Design Certification
DCD	Design Control Document
DNBR	Departure from Nucleate Boiling Ratio
E&C	Engineering and Construction
EAF	Environmentally Assisted Fatigue
ESFAS	Engineered Safety Features Actuation System
FDRs	Functional Design Requirements
FHEVAS	Fuel Handling Area Emergency Ventilation Actuation Signal
I&C	Instrumentation and Control
IP	Inspection Procedure
IR	Inspection Report
KEPCO	Korean Electric Power Company
KNF	KEPCO-Nuclear Fuels
KHNP	Korea Hydro & Nuclear Co., Ltd.
LPD	Local Power Density
NRC	Nuclear Regulatory Commission
NSSS	Nuclear Steam Supply System
PPS	Plant Protection System
QA	Quality Assurance
QAM	Quality Assurance Manual
QAPD	Quality Assurance Program Description
V&V	Verification and Validation
WEC	Westinghouse Electric Company

RAI	Request for Additional Information
SD	KEPCO E&C System Development
SDR	System Design Requirements
SFD	System Functional Description

3. INSPECTION PROCEDURES USED

Inspection Procedure 35017, "Quality Assurance Implementation Inspection," dated July 29, 2008

Inspection Procedure 36100, "Inspection of 10 CFR Part 21 and Programs for Reporting Defects and Noncompliance," dated February 13, 2012

4. LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Item Number	Status	Type	Description	Applicable ITAAC
05200046/2017-201-01	Opened	NOV	Criterion III	N/A
05200046/2017-201-02	Opened	NOV	Criterion VII and III	N/A
05200046/2017-201-03	Opened	NOV	Criterion XVI	N/A
05200046/2017-201-04	Opened	NOV	Criterion XVIII	N/A
99901453/2014-201-01	Closed	NOV	Criterion III	N/A
99901453/2014-201-02	Closed	NOV	Criterion XI	N/A
99901453/2014-201-03	Closed	NOV	Criterion XI	N/A
99901453/2014-201-04	Closed	NOV	Criterion XVI	N/A

5. DOCUMENTS REVIEWED

Policies and Procedures

KHNP:

- AP1400 DC-QAM, "Quality Assurance Manual for the APR1400 DC," Revision 8, dated February 2017
- APR-1400-K-Q-TR-11005-NP, "KHNP Quality Assurance Program Description (QAPD) for the APR1400 Design Certification," Revision 5, dated September 2014
- QA-02-03-DC, "Indoctrination and Training of the QA Personnel," Revision 4, dated February 2017
- QA-02-04-DC, "Qualification for the QA Auditors," Revision 4, dated February 2017
- QA-15-01-DC, "Control of NCR," Revision 4, dated February 2017
- QA-15-02-DC, "Trend Analysis for NCR," Revision 4, dated February 2017
- QA-16-01-DC, "Control of CAR," Revision 4, dated February 2017
- QA-16-02-DC, "Trend Analysis of CAR," Revision 4, dated February 2017
- QA-16-03-DC, "Control of Significant Adversity to Quality (SAQ)," Revision 4, dated February 2017
- QA-16-04-DC, "Control of WSO," Revision 4, dated February 2017
- QA-18-01-DC, "QA Audit," Revision 4, dated February 2017
- DC-DG-02-01, "Indoctrination, Training and Qualification," Revision 1, dated February 2016
- DC-DG-03-04, "Review of Contracted Products," Revision 1, dated February 2016

- DC-DG-03-05, “Technical Audit at Supplier’s Facility,” Revision 1, dated February 2016
-
- DC-DG-16-02, “Control of 10 CFR 21 Reporting,” Revision 1, dated February 2016
- DC-DG-16-01, “Corrective Action Program,” Revision 2, dated February 2016
- DC-BG-14, “Quality Assurance Policy,” Revision 0, dated February 2016
- DC-BG-15, “QA Scope and Responsibilities,” Revision 0, dated February 2016
- DC-BG-21, “RAI Processing,” Revision 1, dated February 2016
- EP-5.13, “Computer Software,” Revision 15, dated January 15, 2016
- DC-DG-03-13, “Design Verification,” Revision 1, dated February 2016
- DC-DG-03-17, “Preparation and Review of the DCD,” , dated February 2016
- DC-DG-03-18, “Final Review of DCD Submittal to NRC,” Revision 2, dated February 2016
- DC-DG-03-01, “Design Change Control,” Revision 4, dated February 2016
- DC DG 0306, “DCD Change Control,” Revision 0, February 2016

KEPCO E&C-SD:
- TAP-16-06, “Corrective Action Program,” Revision 4, dated April 20, 2017
- EP 5.02, “Engineering Procedure-Design Input,” Revision 11, dated March 31, 2015
- EP-5.03, “Engineering Procedure-Deign Documents,” Revision 16, dated February 15, 2017
- EP-5.10, Engineering Procedure-Design Verification,” Revision 13, dated January 15, 2016
- PJQ-JE-01, “Personnel Job Qualification for I&C System Design,” Revision 0, dated August 31, 2015
- DDA-11A60-DWAW, “Design Document Review and Approval,” dated October 6, 2014

KEPCO E&C-AE:
- EP-6.02, “Design Criteria Manual and Classification Criteria,” Revision 3, dated December 30, 2014
- EP-6.06, “System Functional Description and Plant Manual,” Revision 3 dated December 12, 2014

<u>Design Documents</u>

KEPCO E&C-SD:
- APR1400-Z-J-NR-14003P, “Software Program Manual,” Revision 1, dated February 2017
- 9-710-Z-S-441-10, 11A60-1C-SR570, “System Design Requirements for Core Protection Calculator System,” Revision 2, dated December 15, 2014
- 9-710-Z-S-404-40, 11A60-1C-DS570, “Design Specification for Core Protection Calculator System,” Revision 2, dated January 1, 2015
- 9-711-Z-S-441-10, 11A60-1C-SR560, “System Design Requirements for Plant Protection System,” Revision 2, dated December 31, 2014
- 9-711-Z-S-404-10, 11A60-1C-DS560, “Design Specification for Plant Protection System,” Revision 3, dated January 2, 2015
- 9-712-Z-S-444-10, 11A60-1C-1R564, “Interface Requirements for Engineered Safety Features –Component Control System,“ dated March 3, 2015
- KEPCO Document No. 00000-AM-VV-028, “ANSYS Version 14.0 Software Verification and Validation Report,” Revision 00 dated July 31, 2012

- KEPCO Calculation Document No. 11A60-ME-1R222-00, “Interface Requirements for Reactor Coolant System Branch Line Piping Nozzles,” Revision 1, dated July 31, 2013
- KEPCO Calculation Document No. 11A60-ME-1R222-00, “Interface Requirements for Reactor Coolant System Branch Line Piping Nozzles,” Revision 2, dated July 31, 2013

KEPCO E&C-AE:
- Design Review Notice for Doc 1-762-J402-001 Revision 2, dated April 12, 2017
- 1-712-J402-001, “Design Criteria Manual (System Design Criteria) Engineered Safety Features Actuation (EF),” Revision 1, dated September 11, 2013
- 1-712-J403-001, “System Functional Description Engineered Safety Features Actuation system (EF),” Revision 1, dated September 11, 2013
- 1-745-J402-001, “Design Criteria Manual (System Design Criteria) Engineered Safety Features-Component Control system (PE),” Revision 2, dated September 11, 2013
- 1-745-J403-001, “System Functional Description Engineered Safety Features-Component Control System (PE),” Revision 2, dated September 11, 2013
- EP-6.17, “Design Interface Control,” Revision 4, dated December 30, 2014
- EP-6.14, “Design Report And Engineering Study Report,” Revision 3, dated December 30, 2014
- EP-6.15, “Design Calculations,” Revision 3, dated December 30, 2014
- EP-6.16, “Interdisciplinary Design Review,” Revision 3, dated December 30, 2014

KNF:
- APR1400-F-C-NCR-14003-P, “Functional Design Requirements for Core Protection Calculator system for APR1400,” Revision 0, dated August 2014

Doosan:
- Doosan Calculation Document MHS/RD-120006M, “Steam Outlet Nozzle Loading,” dated June 7, 2012
- Doosan Calculation Document N11023-160CN-0900, “Full Penetration Nozzle Load,” Revision 0, dated December 19, 2011

Audits

Internal Audit No. 2017-QA-1400-PM-102, dated March 2017
Internal Audit No. 2016-QA-1400-PM-102, dated January 2016
Internal Audit No. 2015-QA-1400-PM-102, dated March 2015

External Audit (EA) No. 2017-QA-4100-PM-201, “KHNP Audit of KEPCO E&C-AE,” dated March 2017
EA No. 2017-QA-4100-PM-203, “KHNP Audit of KEPCO E&C-SD,” dated February 2017
EA No. 2017-QA-4100-PM-206, “KHNP Audit of KEPCO-NF,” dated March 2017
EA No. 2017-QA-4100-PM-208, “KHNP Audit of Doosan,” dated March 2017

Condition Reports (CRs)

00720664, 00838407, 00866323, 00868457, 00866885, 00868900, 00869413, 00811864, 00910828, 00920654, 00920660, 00920667, 00920671, 00925923, 00934807, 00934808, 00933876, 00945612, 00960584, 00960596, 00960617

Corrective Action Reports (CARs)

00794049, 00794516, 00795620, 00795621, 00795622, 00795624, 00795625 ,00797404, 00791887, 00791901, 00791904, 00791906, 00792198, 00792199, 00792200, 00792201, 00792203, 00792204, 00792205, 00792206, 00792207, 00792208, 00792209, 00792211, 00792215, 00792218, 00792222, 00792225,

CRs Generated During the NRC Inspection

KHNP:
- 01068523, dated May 25, 2017
- 01068907, dated May 25, 2017
- 01068897, dated May 25, 2017
- 01068527, dated May 25, 2017
- 01069684, dated May 25, 2017

KEPCO E&C-AE:
- 11E47-CR-17-J-002 dated May 25, 2017

KEPCO E&C-SD:
- 11A60-CR-17-IC-002, dated May 25, 2017
- 11A60-CR-17-IC-003, dated May 25, 2017
- 11A60-CR-17-IC-004 dated May 25, 2017

Procurement Documents

KHNP Contract No. L145038000 with KEPCO AE and SD
KHNP Contract No. L145035000 with KNF
KHNP Contract No. L145007000 with Doosan

Training Records

- KHNP QA Lead Auditor and QA Inspector
  Haeng-Jin Kim
  Jae-Soo Lim
- KEPCO E&C-SD Personnel Job Qualification for :
  Jin Koo Kim
  Jong Soon Kwon
  Han Gyu Kim
  A Ram Kim
  Kil Young Jung
  Kim Ki Bum