

Enclosure 2

Docket No. 52-046

Reply to NOV 05200046/2017-201

August 2017

Reply to a Notice of Violation (NOV):**NRC Inspection Report No.05200046/2017-201****NRC Identification No. 05200046/2017-201-01****1. Issue identified as violation**

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 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 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 Design (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).

2. Reason for the violation

A) Incompletely described design interface control activities in the procedures:

- Work was performed in accordance with the APR1400 procedures provided in the Project Procedure Manual (PPM). (Note - KHNP periodically audited the qualified suppliers to check they are meeting KHNP requirements.)

- All qualified suppliers for the APR1400 DCA are required to implement the PPM described in the contracts between KHNP and each supplier.
 - However, as a result of the NRC QA Inspection, KHNP found that the procedures DC-BG-12 “Design Document Review and Approval” and DC-DG-03-04 “Review of Contracted Products” incompletely described the KHNP’s activities of checking and approving the interfaced design documents among the participating design suppliers [Korea Electric Power Corporation (KEPCO) - Engineering and Construction (E&C) – Architect Engineering (AE), SD, KNF and Doosan].
- B) As a result, KHNP failed to check interface and coordination for the Core Protection Calculator System (CPCS) design requirements between its participating design suppliers, SD and KNF.

3. Corrective steps that have been taken and the results achieved;

A) Corrective steps that have been taken and the results achieved:

- 1) KHNP and SD issued 3(three) Condition Reports (CRs) with each Corrective Action Program:
 - KHNP: CR 01068527 “Improving reliability of design information exchange among organizations”
 - KHNP: CR 01068897 “Improving design interface control”
 - SD: 11A60-CR-17-IC-003 “CPCS System Design Requirement required to be included in CPCS Design”
- 2) Status of CRs:
 - KHNP initiated the corrective actions related to the CRs 01068527 and 01068897: such as revising the related 3(three) procedures described below in 3, identifying the interfaced design documents among the interfacing suppliers to determine the extent of condition, and assessing the interfaced design documents.
 - SD closed the CR 11A60-CR-17-IC-003 on August 03, 2017. SD revised SR570 “The System Design Requirements for the Core Protection Calculator System” and DS570 “The Design Specification for the Core Protection Calculator System” by incorporating Functional Design Requirements for CPCS.
 - SD initiated the activity to perform the extent of condition with this CR.

3) KHNP initiated revision of 3(three) procedures:

- DC-BG-12 “Design Document Review and Approval”
- DC-DG-03-04 “Review of Contracted Products”
- QA-18-01-DC “QA audit”

5(five) kinds of revision are being made to KHNP procedures as follows:

- Extending the scope of the safety-related design documents reviewed and approved by KHNP (See No.1 “List of documents to be approved by KHNP” of NRC Identification No. 05200046/2017-201-01 in Enclosure 2)
- Changing the document and design information flow process to require KHNP’s review and approval before the receiving design suppliers can use the documents (See No.2 “Document and design information flow process among design suppliers and KHNP” of NRC Identification No. 05200046/2017-201-01 in Enclosure 2)
- Adding the checklist to be used by the receiving design suppliers and KHNP (See No.3 “Design Interface Checklist to be used by the receiving design suppliers and KHNP” of NRC Identification No. 05200046/2017-201-01 in Enclosure 2)
- Adding the checklist to be used by KHNP when KHNP reviews and approves the design deliverables submitted by design suppliers [See No.4-1 “Checklist for deliverable acceptance review and approval used by KHNP (Document)” and 4-2 “Checklist for deliverable acceptance review and approval used by KHNP (Drawing)” of NRC Identification No. 05200046/2017-201-01 in Enclosure 2]
- Adding qualified QA auditors from the receiving design suppliers to the KHNP audit team when KHNP does external audits to enhance the skill set of the audit team and the depth of the audit

4) Extent of Condition (EOC):

- Identified the interfaced design documents: KHNP and all design suppliers identified all the safety-related design interfaces among the participating design suppliers, and developed a list of the interface documents to be reassessed in accordance with Criterion III, “Design Control,” of Appendix B and KHNP Quality Assurance Manual (QAM) for APR1400 Design Certification (DC) Project, Subsection 3.2.2.
- Conducted the preliminary assessment: KHNP and all design suppliers began to conduct the assessment on each and every safety-related interfaced design document to address the extent of condition review requested by the NRC.

B) Corrective steps that will be taken:

- 1) KHNP will implement the 3(three) revised procedures as soon as the revisions have been incorporated into the procedures and approved:
 - Training: KHNP will give training to all members of APR1400 Project on the revised procedures and the NOV No. 05200046/2017-201-01 so that everyone is informed and implements them correctly.
 - Reviewing previously issued, interfaced design documents: KHNP will review and approve all previously issued safety-related interfaced design documents according to the revised procedures.
 - Reviewing future design documents: KHNP will review, approve, and deliver all the safety-related design documents when there are design documents interfaced among the design suppliers before using them, according to the revised procedures.
- 2) When KHNP identifies a problem during the review on the previously issued, interfaced design documents, KHNP will issue a new CR and will take corrective actions for each CR. Trend analysis of CRs will be also performed.
- 3) KHNP will re-perform all the external audits with KHNP audit team composed of the qualified QA auditors from KHNP and receiving design suppliers.
- 4) KHNP will perform the assessment of effectiveness in terms of procedure change and its implementation with the Corrective Action Program.

4. Date when full compliance will be achieved

KHNP will revise 3(three) procedures, DC-BG-12 "Design Document Review and Approval," DC-DG-03-04 "Review of Contracted Products," and QA-18-01-DC "QA audit" by August 31, 2017. KHNP will complete above corrective actions by January 31, 2018.

NRC Identification No. 05200046/2017-201-02**1. Issue identified as violation**

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.

2. Reason for the violation

- A) Work was performed in accordance with the APR1400 procedures provided in the Project Procedure Manual (PPM). Control of DCD and Design Documents are guided by the APR1400 PPM.

KHNP understands that the regulatory requirements and the design basis in DCD and/or upper tier design documents should be well translated into lower tier design documents. However, as a result of the NRC QA Inspection, KHNP found that the procedures DC-BG-12 "Design Document Review and Approval" and DC-DG-03-04 "Review of Contracted Products" incompletely described the activities of KHNP's checking and approving of the design documents as follows:

- Translation of regulatory requirements and requirements in DCD and upper tier design documents to lower tier design documents
- Checking of translation status by KHNP

- B) As a result, KHNP failed to check the translation of design requirements from higher level design documents to lower tier design documents: such as ESFAS-CCS design (AE) and PPS design (SD).

3. Corrective steps that have been taken and the results achieved;

A) Corrective steps that have been taken and the results achieved:

- 1) AE and SD issued CRs respectively:

- AE: 11E47-CR-17-J-002 "Corrective Action of SFD of Assessment -APR1400 DC-SAS-P-J-17-002"
- AE: 11E47-CR-17-Q-001 "Corrective action for improvement of traceability between high-level requirements and lower level documents"
- SD: 11A60-CR-17-IC-002 "Discrepancy in the DCD Tier 2 Fig 7.2-7"
- SD: 11A60-CR-17-IC-004 "Improvement of Requirement Traceability between DS for PPS and SR for PPS"

- 2) Status of CRs:

- AE closed the CR 11E47-CR-17-J-002 on August 01, 2017 with the revision of the SFD (1-712-J403-001) dated July 26, 2017. AE improved the quality of the document "System Functional Description of Engineered Safety Features Actuation (EF)," and kept consistency with DCD Tier 2, Chapter 7.3.

- AE has issued CR 11E47-CR-17-Q-001 on July 27, 2017 and it will be closed by January 31, 2018
- SD closed the CR 11A60-CR-17-IC-002 on August 03, 2017. The scope of Figure 7.2-7 in DCD Tier2 is clearly defined in the title of the figure and the relation with CEAC is added to avoid confusion.
- SD closed the CR 11A60-CR-17-IC-004 on August 03, 2017. The requirement in the section 5.1.6 of the SDR for PPS is translated into DS560 “The Design Specification for the Plant Protection System” to improve the traceability of the requirements.

3) KHNP initiated revision of 2(two) procedures:

- DC-BG-12 “Design Document Review and Approval”
- DC-DG-03-04 “Review of Contracted Products”

2(two) kinds of revisions to obtain objective evidence of quality furnished by the design suppliers in the process of examination of products upon delivery are as follows:

- Added the category diagram so that applicable regulatory requirements and design basis are correctly translated into design specifications, drawings, procedures, and instructions (See No.1 “Category diagram to be used by design suppliers and KHNP” of NRC Identification No. 05200046/2017-201-02 in Enclosure 2)
- Developed evaluation sheet to check consistency among DCD and safety-related design basis documents for the extend of condition (EOC) evaluation (See No.2 “Evaluation sheet to be used by design suppliers and KHNP” of NRC Identification No. 05200046/2017-201-02 in Enclosure 2)

4) Extent of Condition (EOC):

- KHNP and all design suppliers initiated the activity to perform EOC for the other safety-related design basis documents. The purpose of CR is to take a corrective action for improvement of traceability between upper tier design documents and lower tier design documents with a schedule to be closed by January 31, 2018.

B) Corrective steps that will be taken:

- 1) KHNP will implement the 2(two) revised procedures, DC-BG-12 “Design Document Review and Approval” and DC-DG-03-04 “Review of Contracted Products” as soon as the revised procedures are approved:

- Training: KHNP will give training to all members of APR1400 Project on the revised procedures and the NOV No. 05200046/2017-201-02 so that everyone is informed and implements them correctly.
 - Reviewing previously approved design documents by KHNP: KHNP will review and approve all previously approved safety-related interfaced design documents according to the revised procedures.
 - Reviewing future design documents: KHNP will review and approve all the safety-related design documents according to the revised procedures.
- 2) When KHNP identifies a problem during the review on the previously approved design documents, KHNP will issue a new CR and will take corrective actions for each CR. Trend analysis of CRs will be also performed.
 - 3) KHNP will re-perform all the external audits with KHNP audit team composed of the qualified QA auditors from KHNP.
 - 4) KHNP will perform the assessment of effectiveness in terms of procedure change and its implementation with the Corrective Action Program.

4. Date when full compliance will be achieved

KHNP will revise 2 (two) procedures DC-BG-12 "Design Document Review and Approval" and DC-DG-03-04 "Review of Contracted Products" by August 31, 2017. KHNP will complete above corrective actions by January 31, 2018.

NRC Identification No. 05200046/2017-201-03**1. Issue identified as violation**

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. SD 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 feed-water 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. Doosan determined that the analysis were required and had not been performed.

2. Reason for the violation

- 1) KHNP and its design suppliers have addressed the NRC feedbacks from RAI, audit, and inspection directly and technically. And KHNP maintained the quality by

tracking all the RAIs and findings from audit and inspection. However, during the NRC QA Inspection, KHNP and its design suppliers agreed that if the Corrective Action Program is used properly and timely, traceability and conditions adverse to quality are controlled at the same time and trends and causes can be identified.

3. Corrective steps that have been taken and the results achieved;

A) Corrective steps that have been taken and the results achieved:

1) KHNP issued 2(two) Condition Reports (CRs) with the Corrective Action Program:

- KHNP: CR 01068523 “Identifying conditions adverse to quality”
- KHNP: CR 01068907 “Monitoring the CAP system implementation of Design Suppliers”

With the CR 01068527 and 01068897, KHNP initiated to revise the procedure, DC-DG-16-01 “Corrective Action Program” and DC-BG-21 “RAI Processing” so that KHNP will expand corrective action activities to resolve all kinds of NRC feedbacks from RAI, audit, and inspection. There will be 3 (three) kinds of actions to be taken:

- Revising the criteria to require issuing CRs for NRC feedbacks from RAI, audit, and inspection
- Issuing CRs by KHNP and design suppliers concurrently, related to all the previous NRC feedbacks retroactively in detail level
- Adding the evaluation sheet to be used by KHNP to check the applicable revision of design documents and document to close the CRs (See No.1 “Evaluation sheet to check the status of CRs with the NRC feedbacks from RAI, Audit, and Inspection” of NRC Identification No. 05200046/2017-201-03 in Enclosure 2)

2) AE and SD issued 3(three) CRs respectively:

- AE: 11E47-CR-17-C-004 “Incorporate the stability check for EDGB & DFOT related to response of RAI 255-8285, Question 03.08.05-14, Rev. 2”
- AE: 11E47-CR-17-Q-002 “Corrective action for identifying conditions adverse to quality”
- SD: 11A60-CR-17-ME-003 “Update of the design requirement of design specification”

3) Status of CRs:

- KHNP initiated the corrective actions related to the CRs 01068523 and 01068907: such as revising the related 2(three) procedures, identifying the NRC feedbacks based on RAI, audit, and inspection, and issuing new CRs related to each and every feedback.
- AE closed the CR 11E47-CR-17-C-004 on August 01, 2017 with the revision of the document (1-300-C462-006) pertaining to the RAI 255-8285 Question 03.08.05-14 to incorporate stability check for EDGB & DFOT
- SD closed the CR 11A60-CR-17-ME-003 on August 04, 2017 with revision of DS275 "The Design Specification for Reactor Coolant Pipe and Fittings" to add more clear and defined design requirement.

4) Extent of Condition (EOC):

- With the CR, 11E47-CR-17-Q-002, AE initiated the activity to perform EOC to identify the issues pertaining to RAIs, audit, and inspection. All issues will be reviewed and CRs will be issued for those which can cause DCD and/or design document changes. The CR is scheduled to be closed by January 31, 2018.
- KHNP and all other design suppliers also initiated the activity to perform EOC scheduled to be closed by January 31, 2018.

B) Corrective steps that will be taken:

1) KHNP will initiate to implement the 2(two) revised procedures:

- Training: KHNP will give training to all members of APR1400 Project on the revised procedures and the NOV No. 05200046/2017-201-03 so that everyone is informed and implements them correctly.
- Reviewing and issuing CRs for RAI findings from audit and inspection: KHNP and design suppliers will review all the previous feedbacks from RAI, audit and inspection, and determine whether any of the changes necessary to address NRC feedback constitute conditions adverse to quality
- Taking corrective actions based on the review according to the revised procedures, DC-DG-16-01 and DC-BG-21: KHNP will have all the design suppliers review and revise their own corrective action program and design control procedures to address the commitments in this response to NOV 05200046/2017-201-03.

2) When KHNP and design suppliers identify a problem during the review on the previously issued RAI, audit, inspection, KHNP will issue a new CR and will take corrective actions for each CR. Trend analysis of CRs will be also performed.

- 3) KHNP will re-perform all the external audits with KHNP audit team composed of the qualified QA auditors from KHNP.
- 4) KHNP will perform the assessment of effectiveness in terms of procedure change and its implementation with the Corrective Action Program.

4. Date when full compliance will be achieved

KHNP will revise 2(two) procedures DC-BG-21 "RAI Processing" and DC-DG-16-01 "Corrective Action Program" by August 31, 2017. KHNP will complete above corrective actions by January 31, 2018.

NRC Identification No. 05200046/2017-201-04**1. Issue identified as violation**

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.

2. Reason for the violation

KHNP has tried to implement QA audits consistent with the independent responsibility concept, but did not implement it correctly during 2015 and 2017 internal audits. The procedures QA-18-01-DC "QA audit" was incompletely described for the independent internal audit.

3. Corrective steps that have been taken and the results achieved:**A) Corrective steps that have been taken and the results achieved:**

1) KHNP issued a Condition Reports (CR) with the Corrective Action Program:

- KHNP: CR 01069684 "Implementing independent internal audit"

2) Status of CR:

- KHNP initiated the corrective actions related to the CR 69684: such as revising the related procedure, identifying the potential independent internal auditors within KHNP, and training them to be qualified.

3) Initiated the revision of the procedure QA-18-01-DC "QA audit":

- With the CR 01069684, KHNP can organize the QA audit team with personnel not having direct responsibilities in the areas being audited when implementing internal audits. Especially in terms of internal audit, the Quality Assurance Team Leader and Quality Engineer, who are responsible for quality assurance of the APR1400 DC Project, will not join the internal audit team.

B) Corrective steps that will be taken:

1) KHNP will initiate to implement the revised procedures:

- Training: KHNP will give training to all members of QA team of KHNP on the revised procedures and the NOV No. 05200046/2017-201-04 so that everyone is informed and implements the independent internal audit correctly.
- Re-performing independent internal audit: After the completion of all the corrective actions related to NOV 05200046/2017-201 (from 01 to 03) by January 31, 2018, KHNP will re-perform all the internal and external audits according to the revised audit procedure, with an emphasis on completion of the corrective actions committed to in response to this NOV.

2) Extent of Condition (EOC):

- KHNP will also check the status of independent internal audit of design suppliers and if there is same problem, the same corrective actions will be taken.

3) KHNP will perform the assessment of effectiveness in terms of procedure change and its implementation with the Corrective Action Program.

4. Date when full compliance will be achieved

KHNP will revise the procedure, QA-18-01-DC "QA audit," by August 31, 2017. KHNP will complete the above corrective actions by March 31, 2018.