

Enclosure 1

Docket No. PROJ 0782

Reply to a Notice of Violation:  
NRC Inspection Report No. 99901453/2014-201

December 2014

**Reply to a Notice of Violation (NOV):  
NRC Inspection Report No.99901453/2014-201**

**NRC Identification No. 99901453/2014-201-01** (NOV-A)

**1. Issue identified as violation**

Criterion III, "Design Control," 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," states in part that, "the design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program. (...) Where a test program is used to verify the adequacy of a specific design feature in lieu of other verifying or checking processes, it shall include suitable qualifications testing of a prototype unit under the most adverse design conditions."

"Design changes, including field changes, shall be subject to design control measures commensurate with those applied to the original design and be approved by the organization that performed the original design unless the applicant designates another responsible organization."

Drawing #: K00-A1-001-SO1-M00, "Test Facility of In-vessel Test-Detailed Recirculation Flow Path RC-101," Revision 0, dated July 30, 2012 specifies the size of the flow channel around the fuel assembly.

KHNP APR1400-K-A-I(RA)-P, "Test Plan for IDE of the APR1400," Revision 3, dated July 2014, Section 2.3, "Test Column," states, in part, "the bottom region is shaped as a cone to avoid settling and loss of debris during the test."

Contrary to the above, as of September 26, 2014, KHNP failed to verify the adequacy of the design by the performance of a suitable testing program and to adequately control design changes. Specifically:

- a. KHNP did not verify that the test loop assembly met the design requirements for the size of the flow channel around the fuel assembly. The flow channel gap measurements taken by KHNP during the tests exceeded the design specifications stated in K00-A1-001-SO1-M00.
- b. KHNP did not verify that the lower plenum of the test loop assembly met the design requirements of a cone shape to prevent settling as required by KHNP APR1400-K-A-I(RA)-P. The lower plenum of the test loop assembly did have a slight inclination angle. However, the inclination angle was inadequate resulting in significant debris settling.
- c. KHNP failed to perform documented evaluations of design changes for changes to test loop assemblies to reduce impinging of bubbles in the system and debris settling.

## 2. Reason for the violation

- a. KHNP set the tolerance for the size of the flow channel around the fuel assembly based on the APR1400 plant data of the fuel assembly pitch (0.55 mm to 1.25 mm). However, the tolerance should be set based on the nominal value of the fuel assembly pitch and its tolerance (0.58 mm  $\pm$  0.15 mm).
- b. KHNP considered the debris settling at low flow rate to be a physical phenomenon, and to compensate for that, about 3.9 times the minimum required fiber loads were used in the tests. However, the inclination angle at the lower plenum of the test loop assembly should be designed to minimize debris settling.
- c. KHNP verified that documented evaluations of design changes for changes to test loop assemblies were not performed, and it was not specified in the scope of procedure DC-DG-03-01, "Design Change Control," to include design change of tests.

KHNP did not fully understand the requirements of Criterion III, "Design Control," of Appendix B to 10 CFR 50, and considered that they are only applicable to the APR1400 design and not to the test facility.

## 3. Corrective steps that have been taken and the results achieved; Corrective steps that will be taken to avoid further violations

- a. The finding concerning the flow channel gap was entered into KHNP's corrective action program (CAP) (CR 00792205).

The impact of flow channel gap on the validity of testing that has already been conducted will be described in APR1400-K-N-NR-14001, "In-vessel Downstream Effect Tests for the APR1400." (Dec. 31, 2014)

When the assessment of flow channel gap effects produces the adverse results in terms of the plant safety, further verification will be carried out. (July 31, 2015)

- b. The finding concerning the lower plenum of the test loop assembly was entered into KHNP's CAP (CR 00792200).

The impact of debris settling on the validity of testing that has already been conducted will be described in APR1400-K-N-NR-14001, "In-vessel Downstream Effect Tests for the APR1400." (Dec. 31, 2014)

When the assessment of debris settling effects produces the adverse results in terms of the plant safety, further verification will be carried out. (July 31, 2015)

- c. The finding concerning not documenting design changes was entered into KHNP's CAP (CR 00792206). KHNP held the 5th and 6th "Change Control Board" for the design changes: 1) replacing two perforated plexiglass plates with an octahedron at the lower plenum of the test loop, 2) filling the guide tube channels with silicone, 3) changing sections of the piping connected to the top of the flow channel to remove a flange, and 4) filling a flange with silicone (Oct. 21 and Nov. 12, 2014).

KHNP revised DC-DG-03-01, "Design Change Control," and added to the scope of

the procedure to clearly include design change of tests. (Completed Dec. 5, 2014)

Following the extent of condition review, KHNP performed a training session for related employees to notice the revision of "Design Change Control" procedure including the scope of requirements of Criterion III, "Design Control," of Appendix B to 10 CFR 50. (Dec. 5, 2014)

**4. Date when full compliance will be achieved**

KHNP will complete above confirmation 3.a and 3.b by the end of July, 2015.

**NRC Identification No. 99901453/2014-201-02(NOV-B)****1. Issue identified as violation**

Criterion XI, "Test Control" of Appendix B to 10 CFR Part 50 states, that, "A test program shall be established to assure that all testing required to demonstrate that structures, systems, and components will perform satisfactorily in service is identified and performed in accordance with written test procedures which incorporate the requirements and acceptance limits contained in applicable design documents. (...) Test procedures shall include provisions for assuring that all prerequisites for the given test have been met, that adequate test instrumentation is available and used, and that the test is performed under suitable environmental conditions."

DC-DG-11-02, "Test Procedure for the APR 1400 In-vessel Downstream Effects," describes the test parameters and steps to perform the in-vessel downstream effects tests.

Contrary to the above, as of September 26, 2014, KHNP failed to perform the test program in accordance with written test procedures and failed to assure that a prerequisite for the tests have been met. Specifically:

- a. KHNP failed to use an approved procedure to perform testing. KHNP used a preliminary revision of the test procedure during a test and the later approved revision 4 included test parameters that differed from the preliminary revision used at the beginning of the test.
- b. KHNP failed to follow the test procedure. KHNP failed to complete a quality control (QC) hold step and continued the test without stopping. KHNP also failed to appropriately document the measurements of the gap size as required by the test procedure.
- c. KHNP failed to assure that a prerequisite for QC hold points acceptance criteria was achievable for cold leg break tests. The cold leg break test's QC hold point acceptance criteria required verification that the differential pressure (dP) change after 30 minutes of the debris addition was less than or equal ( $\leq$ ) 2%. However, the uncertainty for the dP change in the cold leg break tests exceeded the 2% dP change stated as the acceptance criteria.

**2. Reason for the violation**

- a. Test parameters for low flow rate were frozen at the entrance meeting of the inspection. In addition, at Step 6.2 of the test procedure, stepwise decreasing or increasing flow rate, the period at each step was revised reflecting the recommendation from the entrance meeting.

To keep the test on schedule and to accommodate these sudden changes, the preliminary revision of the test procedure was used unexpectedly at the beginning of the test.

- b. After 30 minutes of the particulates addition, there were negligible pressure drops. So, the next step started with the verbal confirmation of the quality inspector (QI). However, the written approval by the QI should be confirmed prior to the next step.  
  
When measuring gap size, the orders were front, left, rear, and right. However, the recording orders in the test log were front, right, left, and rear. This caused inappropriate recording of the gap size.
- c. The definition of the QC hold points acceptance criteria was not clearly described in the test procedure.

**3. Corrective steps that have been taken and the results achieved; Corrective steps that will be taken to avoid further violations**

- a. The condition for using unapproved procedure was entered into KHNP's CAP (CR 00792203).  
  
KHNP finished the tests using an approved procedure in the inspection period.  
  
Following the extent of condition review, KHNP performed a training session for related employees to emphasize the importance of using only approved procedures. (Completed Dec. 5, 2014)
- b. The conditions for following test procedure and recording gap size were entered into KHNP's CAP (CRs 00792202, 00792204).  
  
KHNP performed a training session for related employees to emphasize the importance of properly implementing procedures. (Completed Dec. 5, 2014)  
  
KHNP revised DC-DG-11-02, "Test Procedure for the APR1400 In-vessel Downstream Effects," and modified the recording order of gap size (front, left, rear, and right) according to measuring orders. (Completed Dec. 5, 2014)
- c. The condition for QC hold points was entered into KHNP's CAP (CR 00792215).  
  
KHNP revised DC-DG-11-02, "Test Procedure for the APR1400 In-vessel Downstream Effects," and described the following hold point definition for clear understanding. (Completed Dec. 5, 2014)

**Note** : 1) A steady state pressure drop is defined as less than 2 % or 0.064 kPa change in pressure drop across the full test fuel assembly over the last 30 minute time interval.

The corrective and preventive actions listed above are expected to prevent a repeat of these conditions.

**4. Date when full compliance will be achieved**

KHNP has already achieved full compliance with the subject conditions, as indicated above.

**NRC Identification No. 99901453/2014-201-03(NOV-C)****1. Issue identified as violation**

Criterion XI, "Test Control" of Appendix B to 10 CFR Part 50 states, that, "Test procedures shall include provisions for assuring that all prerequisites for the given test have been met, that adequate test instrumentation is available and used, and that the test is performed under suitable environmental conditions."

Contrary to the above, as of September 26, 2014, KHNP failed to assure that adequate test instrumentation was available and used during the tests. Specifically, KHNP used an electromagnetic flow meter outside its calibration range to measure and control flow during eight cold leg break tests. The flow rate used for the cold leg break tests were between 9.2 lpm (liters/minute) and 16.6 lpm, which was below the flow meter calibrated range of 34.17 lpm to 251.67 lpm.

**2. Reason for the violation**

KHNP did not specify the calibration range of flow meter GF630 when the flow meter was recalibrated, and the calibration range of flow meter was not stated in DC-DG-12-01, "Control of Measuring and Test Equipment (M&TE)."

**3. Corrective steps that have been taken and the results achieved; Corrective steps that will be taken to avoid further violations**

The condition for calibration of flow meter was entered into KHNP's CAP (CR00791887).

KHNP conducted additional calibration of flow meter and confirmed that it met the required accuracy at measurement range (7.53 lpm to 250 lpm), which was provided by the GF630 manufacturer Toshiba (Document No. EJL-140). (Completed Oct. 31, 2014)

KHNP revised DC-DG-12-01, "Control of Measuring and Test Equipment (M&TE)," and added the following note for calibration range. (Completed Dec. 5, 2014)

**Note** : The calibration range of flow meter GF630(7.53 lpm~250 lpm) and pressure transmitter EJA110A (0 kPa~98.07 kPa) should be confirmed and documented.

Following the extent of condition review, KHNP performed a training session for related employees to emphasize the importance of properly implementing "Control of M&TE" procedure. (Completed Dec. 5, 2014)

The corrective and preventive actions listed above are expected to prevent a repeat of this condition.

**4. Date when full compliance will be achieved**

KHNP has already achieved full compliance in the calibration range of flow meter, as indicated above.

**NRC Identification No. 99901453/2014-201-04(NOV-D)****1. Issue identified as violation**

Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50 states 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.

The NRC conducted a regulatory audit on November 11-13, 2013 of Korea Hydro and Nuclear Power Co. Ltd. (KHNP), Advanced Power Reactor 1400 (APR1400) In-Vessel Downstream Effects (IDE) performance tests at KHNP Central Research Institute facility in Daejeon, South Korea. During the audit, NRC identified nine observations considered to be conditions adverse to quality.

Contrary to the above, as of September 26, 2014, KHNP failed to promptly identify and correct conditions adverse to quality identified during the NRC audit in November 2013 and the NRC inspection in September 2014. Specifically,

- a. KHNP failed to identify in their corrective action program four of the nine conditions adverse to quality identified during the NRC audit in November 2013 and failed to correct three of these conditions.
- b. KHNP entered into their corrective action program the other five conditions adverse to quality identified during the NRC audit in November 2013 and completed their corrective actions. However, two of these five conditions adverse to quality were not adequately corrected.
- c. During this inspection, KHNP failed to identify, evaluate and document test abnormalities during the testing as conditions adverse to quality.

**2. Reason for the violation**

- a. KHNP verified that four conditions adverse to quality identified during the NRC audit in November 2013 were not entered into KHNP's CAP.

KHNP did not fully understand the scope of Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50 and its applicability to "audit findings" versus NRC issued Notices of Nonconformance or Violations.

- b. KHNP verified two conditions adverse to quality, which were entered into KHNP's CAP, were not adequately corrected.

KHNP took a measure to remove air bubbles in the test loop assembly. However, several bubbles less than 5 mm diameter were observed in the bottom nozzle of the mock-up fuel assembly. KHNP thought that a few bubbles would have no effects on the test results.

The reason for inadequacy of procedure usage is described above in NOV-B 2. b.

- c. KHNP did not realize test abnormalities had occurred during the testing because KHNP believed that the effect of a few bubbles on pressure drop is negligible.

**3. Corrective steps that have been taken and the results achieved; Corrective steps that will be taken to avoid further violations**

- a. The conditions for CAP were entered into KHNP's CAP (CRs 00791901, 00791903, 00791904, and 00791906).

The spurious readings on the fifth pressure instrument (dP5) were resolved by replacing the pressure transmitting tubes.

The non-conservatism in the recirculation start time was modified in APR1400-E-N-NR-14001, "Design Features to Address GSI-191," Section 4.3.1.2.1.

The impact of debris settling on the cold leg test will be described above corrective action NOV-A 3.b.

KHNP promptly initiated CRs to address the previous NRC audit issues that had not been corrected. (Completed Sep. 29, 2014)

Following the extent of condition review, KHNP performed a training session for related employees to notice the scope of Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50. (Completed Dec. 5, 2014)

- b. The conditions for bubbles impinging on the bottom nozzle and adequacy of procedure usage were entered into KHNP's CAP (CRs 00792198, 00791906).

KHNP revised DC-DG-11-02, "Test Procedure for the APR1400 In-vessel Downstream Effects," and modified the procedure to remove air bubbles. (Completed Dec. 5, 2014)

The impact of bubbles impinging on the bottom nozzle of the fuel assembly will be described in APR1400-K-N-NR-14001, "In-vessel Downstream Effect Tests for the APR1400." (Dec. 31, 2014)

- c. The condition for test abnormalities was entered into KHNP's CAP (CR 00792201).

KHNP revised DC-DG-11-02, "Test Procedure for the APR1400 In-vessel Downstream Effects," and added a note as follows: (Completed Dec. 5, 2014)

**Note** : Test anomalies should be recorded.

The corrective and preventive actions listed above are expected to prevent a repeat of these conditions.

**4. Date when full compliance will be achieved**

KHNP will complete above confirmation 3.b by the end of December, 2014.