RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.: **168-8140**

SRP Section: **05.02.04 – Reactor Coolant Pressure Boundary Inservice Inspection and Testing**

Application Section: **5.2.4**

Date of RAI Issue: **8/25/2015**

Question No. 05.02.04-1

Title 10 of the Code of Federal Regulations (CFR) section 50.55a(g), "Inservice Inspection Requirements," states, "Systems and components of boiling and pressurized water-cooled nuclear power reactors must meet the requirements of the ASME BPV [Boiler and Pressure Vessel] Code as specified in this paragraph." Sub-paragraph 50.55a(g)(3) gives the requirements for plants to be licensed under Part 52. In order to make a safety determination regarding these requirements, NRC staff is requesting additional information regarding the inservice inspection of bottom mounted instrumentation (BMI) nozzles.

Based on operating experience where cracking and leakage was identified in bottom mounted instrumentation (BMI) nozzles on PWR lower reactor pressure vessel (RPV) lower heads, the NRC issued Bulletin 2003-02, “Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity (ML032320153),” to advise PWR licensees that current methods of inspecting the RPV lower heads may need to be supplemented with additional measures (e.g., bare metal visual inspections) to detect reactor coolant pressure boundary leakage. In APR1400 FSAR Sections 5.1 and 5.3.3, the applicant states that the lower head is welded to the RPV shell and contains 61 in-core instrumentation nozzle penetrations. In light of this fact, the staff determined that the issues identified in NRC Bulletin 2003-02 are applicable to the APR1400. However, the applicant has not provided any information in the DCD to address this issue. Therefore, the staff requests the following:

1. Revise FSAR Section 5.2.4 to describe how the ASME Code ISI program for the APR1400 will be augmented to ensure the structural and leakage integrity of the RPV lower head penetrations. The description should include the following:

   a. The extent of inspections which will be conducted with respect to the areas and penetrations to be inspected,
   b. The inspection methods to be used,
   c. The qualifications standards for the inspection methods,
   d. The process used to resolve the source of findings of boric acid deposits or corrosion,

e. The inspection documentation to be generated, and,
f. The basis for concluding that the plant will satisfy applicable regulatory requirements.

2. Operating PWRs have addressed this issue by performing bare metal visual inspections of the bottom head and nozzle penetrations. If this approach is taken for the APR1400, then the applicant needs to describe in the FSAR how any coatings applied to the RPV prior to shipping will be removed to ensure that the inspections can be performed properly. This issue may be most appropriately addressed in a revision of FSAR Section 5.3.3, but is being initially identified here as it directly related to effective visual examination of the RPV lower head penetrations.

3. 10 CFR 50.55a(g)(3) requires that all ASME Code Class 1 components be designed and provided with access to perform the required inspections. Therefore, in addition to describing the inspection methods used to address the issue, the applicant must also describe how the BMI nozzles are designed and provided with access to perform the required inspections.

Response

The response to Question No. 05.02.04-1 is the same as that of Issue #4 of Section 5.2.4 in Public Meeting (Action Item 3-52) and the response are as follows:

1. The leakage in reactor bottom head penetration has been experienced in Alloy 600 and Alloy 82/182 welding materials. As a result of this experience, ASME Code Case N-722-1 was developed to inspect Alloy 600/82/182 materials used in the components other than reactor vessel head penetrations. However, the material for the reactor bottom head penetrations and their welds of the APR1400 are Alloy 690 and Alloy 52/152, which are very resistant to stress corrosion cracking in a PWR environment and the Code Case does not identify the need for visual examination for these materials. Therefore, augmentation of the ISI program for the RPV bottom head penetrations is not necessary.

2. Since additional bare metal visual inspection of the reactor vessel bottom head penetration nozzles is not planned for the APR1400, specifications for adequate removal of coatings applied to the head prior to shipping is not necessary. However, the coating (e.g., strippable coating) will be removed before RPV installation at field.

3. Though examinations are not planned for the bare surface of reactor vessel bottom head and penetration nozzles, the design of the APR1400 does provide access to this area for the examination should examination be desired. The bottom panels that cover the reactor vessel bottom head area are removable and can be easily disassembled and assembled in the field. The accessed area is sufficient to accommodate the examination tools necessary to perform inspections during a plant outage.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical or Environmental Reports.

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Question No. 05.02.04-2

In a letter dated July 17, 2015 (ML15198A549), the applicant provided responses to the issues associated with APR1400 FSAR Section 5.2.4 (ML15198A564) that were discussed at the June 30, 2015 public meeting. The staff has reviewed the applicant's responses and determined that they are acceptable provided that the statements are made in the FSAR. In most cases, the applicant had already provided draft revisions to the FSAR along with the issue response. However, the applicant did not provide any proposed revisions to the FSAR for Issue #6 or Issue #8. Therefore, the staff requests that APR1400 FSAR Section 5.2.4 be revised, as appropriate, to include the responses to Issue #6(Action Item 5-5.6) and Issue #8 (Action Item 5.5-8).

Response

DCD Section 5.2.4.1.7 will be revised to incorporate the Code exemptions as follows:

“For the inservice inspection of APR1400, there are no ASME Code Class 1 components (or portions of components) that are to be exempted from ASME Code, Section XI, IWB-2500 examination requirements, except for the items allowed by ASME Code, Section XI, IWB-1220.”

DCD Section 5.2.4.1.9 will be revised and replaced with the changes below. Also COL item (COL 5.2(12)) will be deleted since it is covered by COL item (COL 5.2(2)):

“The ASME Code Cases that are expected to be used in preservice and inservice inspection programs of APR1400 are listed as follows. The COL 5.2(2) of FSAR 5.2.6 addresses the ASME Code Cases for the ISI program:

1. ASME Code Cases acceptable without limitations
   - N-460, N-494-4, N-508-3, N-526, N-609, N-613-1, N-624, N-663, N-665, N-706-1, N-731, and N-753

2. ASME Code Cases acceptable with additional limitations
   - N-416-4, N-504-4, N-593, N-597-2, N-639, and N-648-1

The above referenced ASME Code Cases are all approved for usage by Regulatory Guide (RG) 1.147 Rev. 17 and will be incorporated into the preservice and inservice inspection program of APR1400 at the construction stage.

ASME Code Case N-729-1 (Alternative Examination Requirements for PWR Reactor Vessel Upper Heads with Nozzles having Pressure-Retaining Partial-Penetration Welds Section XI, Division 1) is also applied with additional limitation by 10CFR50.55a to the preservice and inservice inspection programs of APR1400. However, ASME Code Case N-722-1 (Additional Examinations for PWR Pressure Retaining Welds in Class 1 Components Fabricated with Alloy 600/82/182 Materials, Section XI, Division 1) is not applied to APR1400 because there are no reactor coolant pressure boundary parts fabricated with Alloy 600/82/182 materials.”

Impact on DCD

DCD Sections 5.2.4.1.7, 5.2.4.1.9, 5.2.6 and Table 1.8-2 will be revised as indicated in Attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical or Environmental Reports.

The methods, procedures, and requirements for ultrasonic examination of RV welds are qualified by performance demonstration in accordance with the requirements of ASME Section XI, Appendix VIII.

5.2.4.1.4 Inspection Intervals

The examination program for the 10-year inspection interval is defined in the ISI plan. The inspection period may be reduced or extended by as much as 1 year to enable an inspection to coincide with a plant outage. The ISI plan for all Class 1 systems and components is in accordance with ASME Section XI, IWA 2400 and IWB 2400.

5.2.4.1.5 Evaluation of Examination Results

Evaluation of examination results for Class 1 components is conducted in accordance with IWA 3000 and IWB 3000 of ASME Section XI. Unacceptable indications are repaired in accordance with the requirements of IWA 4000 of ASME Section XI. Criteria for establishing need for repair or replacement are in accordance with IWB 3000 of ASME Section XI.

5.2.4.1.6 System Pressure Tests

The leakage and hydrostatic pressure tests of the RCPB Code Class 1 components are conducted in accordance with the requirements of IWA 5000 and IWB 5000 of ASME Section XI and the Technical Specification. The requirements in the Technical Specifications (Chapter 16) on operating limits during heatup, cooldown, and system hydrostatic pressure testing are used for these tests.

5.2.4.1.7 Code Exemptions

The COL applicant is to provide a list of ASME Section XI Code exemptions in the ISI program of the specific plants, if it exists (COL 5.2(10)).

"For the inservice inspection of APR1400, there are no ASME Code Class 1 components (or portions of components) that are to be exempted from ASME Code, Section XI, IWB-2500 examination requirements, except for the items allowed by ASME Code, Section XI, IWB-1220."

5.2.4.1.8 Relief from ASME Code Requirements

The COL applicant is to prepare and provide any requests for relief from the ASME Code requirements that are impracticable as a result of limitations of component design, geometry, or materials of construction for specific plants, if necessary. The request is to contain the information on applicable ASME Code requirements, alternative ISI methods, and justification (COL 5.2(11)).

5.2.4.1.9 Code Cases

~~The COL applicant may invoke ASME Code Cases listed in NRC RG 1.147 for the ISI program (COL 5.2(12)).~~

5.2.4.1.10 Other Inspection Program

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"The ASME Code Cases that are expected to be used in preservice and inservice inspection programs of APR1400 are listed as follows. The COL 5.2(2) of FSAR 5.2.6 addresses the ASME Code Cases for the ISI program:

1. ASME Code Cases acceptable without limitations
   - N-460, N-494-4, N-508-3, N-526, N-609, N-613-1, N-624, N-663, N-665, N-706-1, N-731, and N-753
2. ASME Code Cases acceptable with additional limitations
   - N-416-4, N-504-4, N-593, N-597-2, N-639, and N-648-1

The above referenced ASME Code Cases are all approved for usage by Regulatory Guide (RG) 1.147 Rev. 17 and will be incorporated into the preservice and inservice inspection program of APR1400 at the construction stage.

ASME Code Case N-729-1 (Alternative Examination Requirements for PWR Reactor Vessel Upper Heads with Nozzles having Pressure-Retaining Partial-Penetration Welds Section XI, Division 1) is also applied with additional limitation by 10CFR50.55a to the preservice and inservice inspection programs of APR1400. However, ASME Code Case N-722-1 (Additional Examinations for PWR Pressure Retaining Welds in Class 1 Components Fabricated with Alloy 600/82/182 Materials, Section XI, Division 1) is not applied to APR1400 because there are no reactor coolant pressure boundary parts fabricated with Alloy 600/82/182 materials."

~~COL 5.2(12) The COL applicant may invoke ASME Code Cases listed in NRC RG 1.147 for the ISI program.~~

Delete

COL 5.2(13) The COL applicant is to prepare and implement a boric acid corrosion (BAC) prevention program in conformance with Generic Letter 88-05.

COL 5.2(14) The COL applicant is to prepare the preservice inspection and testing program.

COL 5.2(15) The COL applicant is to address and develop the milestones for the preparation and implementation of the procedure for operator responses to prolonged low-level leakage.

5.2.7 References

1. ANSI/ANS 51.1-1983, "American Nation Standard Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants," American Nuclear Society, 1983.

2. ASME Boiler and Pressure Vessel Code, Section III, "Rules for Construction of Nuclear Facility Components," The American Society of Mechanical Engineers, the 2007 Edition with the 2008 Addenda.

3. 10 CFR 50.55a, "Codes and Standards," U.S. Nuclear Regulatory Commission.

4. Regulatory Guide 1.26, "Quality Group Classification and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," Rev. 4, U.S. Nuclear Regulatory Commission, March 2007.

5. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants," U.S. Nuclear Regulatory Commission.

6. ASME Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," The American Society of Mechanical Engineers, the 2007 Edition with the 2008 Addenda.

7. ASME Boiler and Pressure Vessel Code, OM Code, "Code for Operation and Maintenance of Nuclear Power Plants," The American Society of Mechanical Engineers, the 2004 Edition with the 2005 and the 2006 Addenda.

Table 1.8-2 (8 of 29)

Item No.	Description
COL 5.2(8)	The COL applicant is to provide and develop the implementation milestones for the inservice inspection and testing program for the RCPB, in accordance with ASME Code Section XI and 10 CFR 50.55a.
COL 5.2(9)	The COL applicant is to address the provisions to accessibility of Class 1 components for ISI if the design of the APR1400 Class 1 component is changed from the DCD design.
COL 5.2(10)	The COL applicant is to provide the list of Code exemptions in the ISI program of the specific plants, if it exists.
COL 5.2(11)	The COL applicant is to prepare and provide any requests for relief from the ASME Code requirements that are impracticable as a result of limitations of component design, geometry, or materials of construction for the specific plants, if necessary. The request will contain the information on applicable Code requirements, alternative ISI method, and justification.
~~COL 5.2(12)~~	~~The COL applicant may invoke ASME Code Cases listed in NRC RG 1.147 for the ISI program.~~ Delete
COL 5.2(13)	The COL applicant is to prepare and implement a boric acid corrosion (BAC) prevention program compliant with Generic Letter 88-05.
COL 5.2(14)	The COL applicant is to prepare the preservice inspection and testing program.
COL 5.2(15)	The COL applicant is to address and develop milestones for preparation and implementation of the procedure for operator responses to prolonged low level leakage.
COL 5.3(1)	The COL applicant is to provide a reactor vessel material surveillance program for a specific plant.
COL 5.3(2)	The COL applicant is to develop P-T limit curves based on plant-specific data.
COL 5.3(3)	The COL applicant is to verify the RT_{PTS} value and the USE at EOL based on plant-specific material property and neutron fluences.
COL 5.3(4)	The COL applicant is to provide and develop the inservice inspection and testing program for the RCPB, in accordance with ASME Section XI and 10 CFR 50.55a.
COL 5.4(1)	The COL applicant is to prepare operational procedures and maintenance programs as related to leak detection and contamination control of RCS.
COL 5.4(2)	The COL applicant is to maintain complete documentation of system design, construction, design modifications, field changes, and operations of RCS.
COL 5.4(3)	The COL applicant is to prepare operational procedures and maintenance programs as related to leak detection and contamination control of SCS.
COL 5.4(4)	The COL applicant is to maintain complete documentation of system design, construction, design modifications, field changes, and operations of SCS.
COL 5.4(5)	The COL applicant is to verify the as-built RV support material properties and 60-year neutron fluence.