

KHNPDCDRAIsPEm Resource

From: Ciocco, Jeff
Sent: Tuesday, September 08, 2015 6:45 AM
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Cc: Thomas, Vaughn; Xu, Jim; Betancourt, Luis; Lee, Samuel
Subject: APR1400 Design Certification Application RAI 199-8223 (03.08.01 - Concrete Containment)
Attachments: APR1400 DC RAI 199 SEB1 8223.pdf; image001.jpg

KHNP,

The attachment contains the subject request for additional information (RAI). This RAI was sent to you in draft form. Your licensing review schedule assumes technically correct and complete responses within 30 days of receipt of RAIs.

Please submit your RAI response to the NRC Document Control Desk.

Thank you,

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Hearing Identifier: KHNP_APR1400_DCD_RAI_Public
Email Number: 249

Mail Envelope Properties (51ecbbbe500e4dfc8d4d0f9621745257)

Subject: APR1400 Design Certification Application RAI 199-8223 (03.08.01 - Concrete Containment)
Sent Date: 9/8/2015 6:45:03 AM
Received Date: 9/8/2015 6:45:13 AM
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Files	Size	Date & Time
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APR1400 DC RAI 199 SEB1 8223.pdf		117087
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REQUEST FOR ADDITIONAL INFORMATION 199-8223

Issue Date: 09/08/2015
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 03.08.01 - Concrete Containment
Application Section: 3.8.1

QUESTIONS

03.08.01-7

Appendix A to 10 CFR Part 50, General Design Criteria 1, 2, 4, 16 and 50, provide the regulatory requirements for the design of the concrete containment. Standard Review Plan (SRP) 3.8.1, Section II.1 discusses the general information related to the internal and external attachments to the concrete containment.

In DCD Tier 2, Section 3.8.1.1.3, “Containment Shell,” the applicant discussed the physical characteristics of the of the containment shell, including the attachment of the polar crane into the cylindrical wall. The staff reviewed Section 3.8.1.1.3 and noted that the additional information is needed in order to better understand how equipment such as the electrical conduit, cable tray, spray piping, etc., are attached to the inside and outside surface of the concrete containment. In accordance with GDCs 1, 2, 4, 16, and 50, and SRP 3.8.1, the applicant is requested to provide a description of how attachments to the inside and outside of the concrete containment are designed.

03.08.01-8

10 CFR Part 50.44(c)(5) provides the regulatory requirements for analyzing an accident release of hydrogen generated from 100 percent fuel clad-coolant reaction accompanied by hydrogen burning. Standard Review Plan (SRP) 3.8.1, Section II.4.K and Regulatory Guide (RG) 1.216, “Containment Structural Integrity Evaluation for Internal Pressure Loadings Above Design-Basis Pressure,” provide guidance for demonstrating the structural integrity of the containment in accordance with the requirements in 10 CFR 50.44.

The staff reviewed Section 3.8.1.3, “Loads and Load Combinations,” of the DCD and noted that hydrogen generation pressure load due to fuel-clad and water interaction is included. However, DCD Sections 3.8.1.4 and 3.8.1.5 do not describe the design and analysis procedures, and the acceptance criteria for this loading condition. Regulatory Guide 1.216, Position 2, “Combustible Gas Control Inside Containment,” states that containment should be evaluated for the pressure arising from the fuel cladding-water reaction, hydrogen burning, and post-accident inerting. In accordance with 10 CFR 50.44, SRP 3.8.1 and RG 1.216, the applicant is requested to provide a description of the design and analysis approach, and the acceptance criteria for the structural evaluation of this loading condition. If the approach is different from the criteria presented in SRP 3.8.1 and RG 1.216, then provide the technical basis for this difference.

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03.08.01-9

10 CFR Part 50.55a provides the regulatory examination requirements of the prestressed concrete containment. Standard Review Plan (SRP) 3.8.1, Section II.7, provides guidance for testing and examining the preservice, in-service, and repair/replacement requirements of the concrete containment. DCD Tier 2, Section 3.8.1.7, "Testing and Inservice Inspection Requirements," describes the testing and in-service requirements of the containment. The staff reviewed Section 3.8.1.7 and noted that additional information is needed in order to complete the safety review procedure of the testing and in-service inspection of the concrete containment. In accordance with 10 CFR Part 50.55a, and SRP 3.8.1, the applicant is requested to explain the following:

- a. DCD Tier 2, Section 3.8.1.7.1, "General Requirements," does not identify whether this containment is considered a prototype containment. DCD Tier 2, Section 3.8.1.7.1, "General Requirements," does not identify whether this containment is considered a prototype containment. It is believed that containment designed to ASME Subsection CC, incorporating new or unique design features not yet confirmed by tests are supposed to be designated as prototype containment. Thus, the applicant is requested to address whether this containment is designated as a prototype design and if not, explain why not. If it is a prototype containment, Section 3.8.1.7.1 of the DCD should be updated accordingly and explain that the additional provisions applicable to prototype containments in ASME Subsection CC, Article CC-6000 are implemented.
- b. DCD Tier 2, Section 3.8.1.7 does not identify and discuss the examination requirements of the containment, including the supplemental requirements of 10 CFR 50.55a. DCD Tier 2, Section 3.8.1.7 does not identify and discuss the examination requirements of the containment, including the supplemental requirements of 10 CFR 50.55a. Thus, the applicant is requested to include this information in the DCD.
- c. CD Tier 2, Section 3.8.1.7, does not identify and discuss the periodic leakage testing and examination of the containment in accordance with 10 CFR 50, Appendix J. CD Tier 2, Section 3.8.1.7, does not identify and discuss the periodic leakage testing and examination of the containment in accordance with 10 CFR 50, Appendix J. The applicant is requested to provide this information in the DCD.
- d. From the information provided in Section 3.8.1.7.2 of the DCD, it is not clear to the staff whether all applicable positions of Regulator Guides (RG) 1.35 and 1.35.1 are performed for the inservice inspection of the tendon systems or whether there are any exceptions. From the information provided in Section 3.8.1.7.2 of the DCD, it is not clear to the staff whether all applicable positions of Regulator Guides (RG) 1.35 and 1.35.1 are performed for the inservice inspection of the tendon systems or whether there are any exceptions. The applicant is requested to provide this information in the DCD.

03.08.01-10

According to 10 CFR 52.47(a)(23), applications for light-water reactor (LWR) designs shall include a description and analysis of design features for the prevention and mitigation of severe accidents. Standard Review Plan (SRP) 3.8.1, Section II.4.K and Regulatory Guide (RG) 1.216, "Containment Structural Integrity Evaluation for Internal Pressure Loadings Above Design-Basis Pressure," provide guidance for demonstrating the structural integrity of the containment in accordance with the requirements in 10 CFR 52.47(a)(23). In accordance with RG 1.206 and RG 1.216, the description of the evaluation for containment pressure integrity under the more likely severe accident challenges is normally described in Section 19 of the applicant's DCD. DCD Section

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19.2.3.1.2, "Containment Pressure Limits" states that the containment structural integrity evaluation is described in Subsection 3.8.1.4.12.

The staff reviewed Section 3.8.1.4.12, "Severe Accident Capability," of the DCD and noted that additional information is needed in order for the staff to complete its safety review of the containment. The staff noted that information such as a description of the severe accidents that are being evaluated, the loads that are selected, the mathematical models that are being used, analysis approach and results are not included in the application. Regulatory Guide 1.216, Position 3, "Commission's Severe Accident Performance Goal," describes the methods acceptable for demonstrating that the containment can maintain its role as a reliable, leak-tight barrier for approximately 24 hours following the onset of core damage. In accordance with 52.47(a)(23), SRP 3.8.1 and RG 1.216, the applicant is requested to provide a description of its severe accident analysis approach in Section 3.8.1.4.12 of the DCD, and explain how it compares to the approach described in Regulatory Guide 1.216, Position 3.

03.08.01-11

Appendix A to 10 CFR Part 50, General Design Criteria 1, 2, 4, 16 and 50, provide the regulatory requirements for the design of the concrete containment. Standard Review Plan (SRP) 3.8.1, Section II discusses the applicable codes, standards and specifications, regulatory requirements, and regulatory guides applicable to the design of the concrete containment.

The containment structure, including the basemat directly beneath the containment is integral with the auxiliary building (AB) basemat. The staff noted that Section 3.8.1 of the DCD Tier 2 does not describe the jurisdictional boundary for design of the containment in accordance with ASME Section III, Division 2, Subsection CC. In accordance with Appendix A to 10 CFR Part 50, General Design Criteria 1, 2, 4, 16 and 50, and SRP 3.8.1, the applicant is requested to identify the jurisdictional boundary of the containment for design in accordance with ASME Section III, Division 2 Code, and describe what aspects of the design incorporates additional design requirements beyond the portion of the containment foundation directly beneath containment shell. In addition, the applicant is requested to update Section 3.8.1 of the DCD Tier 2 accordingly.

03.08.01-12

Appendix A to 10 CFR Part 50, General Design Criteria 1, 2, 4, 16 and 50, provide the regulatory requirements for the design of the concrete containment. Standard Review Plan (SRP) 3.8.1, Section II.5.A discusses the allowable limits for stresses and strains for the design of concrete containments with emphasis on the extent of compliance with Article CC-3000 of Section III, Division 2, of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code.

In DCD Section 3.8.1.5, "Structural Acceptance Criteria," the applicant indicated that the allowable stresses, strains, forces, displacements and temperatures for the containment structure including the liner are defined based on the requirements given in Article CC-3000 of the ASME Code. The applicant's structural acceptance criteria approach does not seem to be in accordance with SRP Section 3.8.1 II which indicates that the specified allowable limits are acceptable if they are in accordance with Subsection CC-3000 of the ASME Code, with additional guidance provided by Regulatory Guides 1.136

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and 1.216 which are referenced in the SRP. Also, the staff noted that the specific acceptance criteria for service level load conditions and factored load conditions listed in Sections 3.8.1.5.1 and 3.8.1.5.2 of the DCD Tier 2 respectively are not complete.

In accordance with Appendix A to 10 CFR Part 50, General Design Criteria 1, 2, 4, 16 and 50 and SRP 3.8.1, the applicant is requested to describe in Sections 3.8.1.5.1 and 3.8.1.5.2 that the acceptance criteria identified in these two sections are supplemented by other provisions in Subsection CC-3000 of the ASME Code, with additional guidance provided by RGs 1.136 and 1.216.

03.08.01-13

Appendix A to 10 CFR Part 50, General Design Criteria (GDC) 1, 2, 4, 16 and 50, provide the regulatory requirements for the design of the concrete containment. Standard Review Plan (SRP) 3.8.1, Section II specifies the materials for construction of concrete containments with emphasis on the extent of compliance with Article CC-2000 of Section III, Division 2, of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, with additional guidance provided in Regulatory Guide 1.136.

DCD Section 3.8.1.5.1.2, "Prestressing System," identifies the material for the prestressing elements and in the case of the anchorage components, refers to the tendon manufacturer's respective material specifications. However, the staff was unable to find the manufacturer's specifications for the bearing plates, anchor head assemblies, and the wedges which are part of the anchorage system. Per Appendix A to 10 CFR Part 50, GDC 1, 2, 4, 16 and 50; and SRP 3.8.1, the applicant is requested to identify what manufacture tendon system is used for the design of APR1400, and if the information is not publicly available, provide the manufacturer's technical literature on this type of tendon system, including their anchorage system.

03.08.01-14

Appendix A to 10 CFR Part 50, General Design Criteria (GDC) 1, 2, 4, 16 and 50, provide the regulatory requirements for the design of the concrete containment. Standard Review Plan (SRP) 3.8.1, Section II specifies the procedures used for design and analysis of the concrete containment with emphasis on the extent of compliance with Article CC-3300 of Section III, Division 2, of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, with additional guidance provided in Regulatory Guide 1.136.

DCD Tier 2, Section 3.8.1.4.5.2, "Thermal Stress Analysis," discusses the thermal analysis of the containment and Section 3.8A.1.4.1.3.2 discusses the effects of temperature variations during normal operating and accident conditions. However, these sections do not provide the design temperatures used for normal and accident conditions. Per Appendix A to 10 CFR Part 50, GDC 1, 2, 4, 16 and 50; and SRP 3.8.1, the applicant is requested to include in the DCD the ambient temperatures inside and outside containment considered for design during normal and accident conditions. In addition, for variation of temperature through the containment thickness, provide the results of the thermal analysis showing the gradient for the various cases (normal loading and accident loading over time), and identify which ones have been used in the design of the containment.

