KHNPDCDRAIsPEm Resource

From: Ward, William
Sent: Wednesday, August 05, 2015 7:26 PM
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Cc: Ciocco, Jeff; Lee, Samuel; Thomas, Vaughn; Umana, Jessica; Xu, Jim
Subject: APR1400 Design Certification Application RAI 129-8085 (3.8.1- Concrete Containment)
Attachments: image001.jpg; APR1400 DC RAI 129 SEB1 8085.pdf

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. However, KHNP requests, and we grant, the time shown below to respond to the RAI question. We may adjust the schedule accordingly.

Question	Time to respond
3.8.1-1	30 days
3.8.1-2	30 days
3.8.1-3	30 days
3.8.1-4	30 days
3.8.1-5	60 days
3.8.1-6	30 days

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

Thank you,

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Protecting People and the Environment

REQUEST FOR ADDITIONAL INFORMATION 129-8085

Issue Date: 08/05/2015
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: SRP 3.8.1

QUESTIONS

03.08.01-1

Appendix A to 10 CFR Part 50, General Design Criteria1, 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.3 discusses the loads and load combinations normally applicable to concrete containments with emphasis on the extent of compliance with Article CC-3230 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, "Design Limits, Loading Combinations, Materials, Construction, and Testing of Concrete Containments."

APR1400 DCD Tier 2, Section 3.8.1.3, "Loads and Load Combinations," states that the containment is designed to resist the loads given in the ASME Code and RG 1.136 with some exceptions. The staff reviewed the information pertaining to the applicable design loads and various combinations provided by the applicant and noticed that additional information is needed in order for the staff to complete its evaluation. In accordance with SRP 3.8.1, and Appendix A to 10 CFR Part 50, General Design Criteria 1, 2, 4, 16 and 50, the applicant is requested to address the following and include this information in the DCD:

a. Provide a description for other loads which are included in the load combinations presented in DCD Table 3.8-2, but are not defined in DCD Section 3.8.1.3.2, i.e., G, H, H_s, and P_s, as well as D_d, L_h, and C which are identified in the footnotes to the table.

b. In DCD Section 3.8.1.3.2, the seismic load (E_s) is defined as loads generated by the safe shutdown earthquake (SSE) in which only the actual dead loads and live loads are considered in evaluating seismic response forces. Since it is not clear whether full live load or a portion of the live load is considered when evaluating the seismic response forces in design, provide this information and the basis for that approach. This seismic inertial live load would be in addition to the separate live load used in the applicable load combinations.

c. DCD Section 3.8.1.3, item b, describes the load combination associated with the combustible hydrogen generation due to fuel clad metal-water reaction. Identify what is the pressure calculated for this loading condition and if it is greater than 45 psig, what pressure is used in the design.

d. In DCD Table 3.8-2, "Seismic Category I Structure Load Combination for the Reactor Containment Building," it is not clear why both load combinations (LCs) 13 and 14 were provided with the only difference being that in LC 13, W is included and in LC 14, W is omitted. KHNP is requested to explain whether they followed the approach that if any load reduces the effects of other loads, then that load is omitted. The use of LC 13 and 14 suggests that this approach may not have been followed.

e. Explain where in DCD Sections 3.8.1.3 and 3.8.3.3 the load descriptions and load combinations for consideration of safety/relief valve actuation loads on the containment and containment internal structures are described and whether or not the safety/relief valve actuation loads include potential direct loads on the structures and potential building dynamic response loads.

f. DCD Section 3.8.1.3 does not describe the safety/relief valve actuation load, if applicable, and the method used for combining dynamic loads that include SSE, LOCA and safety/relief valve actuation. Provide this information and indicate if it is in accordance with SRP 3.8.1 (including Appendix A) and Regulatory Guide (RG) 1.136, "Materials, Construction, and Testing of Concrete Containments," Revision 3.

03.08.01-2

10 CFR Part 50, Appendix A, 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.4.D discusses the approach for obtaining the concrete creep and concrete shrinkage values for the containment. DCD Tier 2, Section 3.8.1.4.6, "Creep and Shrinkage Analysis," states that the effects of concrete creep, concrete shrinkage, concrete elastic shortening, and tendon steel relaxation are included in the computations for prestress losses in the tendons. The applicant also provided values for these items. DCD Section 3.8.1.4.8 also indicates that the values are based on engineering experience. Based on the above information, it is not clear to the staff as to how the values provided were obtained. SRP 3.8.1, Section II.4.D states that creep and shrinkage values should be established by tests performed on the concrete to be used or from data obtained from completed containments with the same kind of concrete. In accordance with SRP 3.8.1, and Appendix A to 10 CFR Part 50, General Design Criteria 1, 2, 4, 16 and 50, the applicant is requested to address the following:

a. Describe in Section 3.8.1.4.6 of the DCD how the values provided were obtained.

b. DCD Section 3.8.1.4.6 describes the various parameters for prestress tendon losses but does not discuss (1) frictional loses due to curvature of the tendons and (2) slip at the anchorage. These are additional items that are identified in the ASME Code and should also be addressed in Section 3.8.1.4.6 of the DCD.

c. To understand how all of the parameters affect the prestress losses over the life of the plant and to ensure sufficient prestressing in the tendons, the applicant is requested to provide a table for each type of tendon (hoop and vertical), at the start of prestressing and at the end of life (60 years), the following: initial prestress; the actual losses in prestress (in terms of stress or percent) from all of the individual sources; total value of losses; and final prestress.

d. The staff reviewed DCD Section 3.8.1 and noted that the applicant did not provide a description of how concrete cracking is considered in the analysis and design of the concrete containment (containment shell and basemat). The applicant is requested to provide a description of the effects of concrete cracking in Section 3.8.1 of the DCD or provide a technical basis for not considering the effects of concrete cracking.

03.08.01-3

10 CFR Part 50, Appendix A, 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 I, provides the description of the general information for the concrete containment.

DCD Tier 2, Section 3.8.1.1.4.4, "Liner Plate Details and Anchorage," states that, "Radial and hoop stiffeners are provided for attaching the 6.0 mm (1/4 in) liner plate to the concrete dome." DCD Figure 3.8-5 shows the use of meridional and hoop stiffeners but not radial stiffeners. Without a figure or further description, it is not clear to the staff what the radial stiffeners are. SRP 3.8.1, Section I discusses the description of the general information related to the containment shell including the wall liner plate and its anchorage and stiffening system. In accordance with SRP 3.8.1, and Appendix A to 10 CFR Part 50, General Design Criteria 1, 2, 4, 16 and 50, the applicant is requested to provide a description and/or a figure that depicts all of the stiffeners used to attach the liner plate to the concrete dome.

03.08.01-4

Appendix A to 10 CFR Part 50, GDC 1 requires that the generally recognized codes and standards used shall be identified and evaluated to determine their applicability, adequacy, and sufficiency and shall be supplemented or modified as necessary to assure a quality product.

DCD Tier 2, Section 3.8.1.2, "Applicable Codes, Standards, and Specifications," presents DCD Table 3.8-1, "Codes, Standards, Specifications, and Regulations," which lists the codes, standards, specifications, and regulations used in the design of the concrete containment. However, the identification of the codes, standards, and specifications applicable to the individual DCD sections or applicable to the different types of structures, i.e., concrete containment, containment internal structures, other Category I structures such as the Auxiliary building, and the foundation, is not clear to the staff. Generally, the individual DCD sections reference DCD Table 3.8-1 without indication of what sections or structures they apply to. Standard Review Plan (SRP) 3.8.1, Section II.2, states that the design, materials, fabrication, erection, inspection, testing, and inservice surveillance of concrete containment are covered by codes, standards, specifications, and regulatory guides that are either in their entirety or in part. It then lists the various applicable codes that are acceptable. A similar statement is given in the other SRP Sections 3.8.2, 3.8.3, 3.8.4, and 3.8.5.

In accordance with SRP 3.8.1 through 3.8.5, and GDC 1, the applicant is requested to provide information in the applicable sections of the DCD, regarding the codes, standards, specifications, and regulations, which will enable the staff to determine whether the design of the APR 1400 is in accordance with SRP 3.8.1 through 3.8.5, or explain why not. In addition, the applicant is requested to address the following:

a. The version/edition of some of the codes provided in the DCD is not consistent (e.g., ASME III, Subsection CC 2001 Edition with 2003 Addenda and ASME III, Subsection NE 2007 Edition with 2008 Addenda). The staff also noted that DCD Table 3.8-1 does not

provide the editions; however, some of the editions are identified in the list of references. The applicant is requested to identify the version/edition of the various codes, standards, specifications, and regulations, and in the case of the ASME Code Section III, provide the consistent editions or justify why they are not consistent.

b. Some specifications and standards are listed in DCD Table 3.8-1 without the full title and edition (e.g., AISC ASD, AISC LRFD, ACI 301). In the case of AISC LRFD, it is not discussed in DCD Section 3, so it's not clear how this code was used. Since the LRFD code is not identified in SRP 3.8.1 and has not been endorsed by the NRC staff, its use would need to be reviewed on a case-by-case basis. The applicant is requested to provide complete titles and editions of the codes, standards, and specifications listed in DCD Table 3.8-1. Since this table is referenced by DCD Sections 3.8.2 through 3.8.5, the above requested information should be provided that is applicable to the other DCD sections. It should be clear from the text within each section of DCD Sections 3.8.1 through 3.8.5 or from DCD Table 3-1, which codes, standards, and specifications are applicable to the particular sections. Also, a description of how or where the AISC LRFD code is used in the design of the APR 1400 structures should be provided, and if utilized will have to be reviewed on a case-by-case basis.

c. Some of the codes and standards used in the individual DCD Sections 3.8.1 through 3.8.5, e.g., AISC N690 and Supplement No. 2, are not listed in DCD Section 3.8.7 "References." Therefore, the applicant is requested to include in DCD Section 3.8.7, all of the codes, standards, specifications, and regulations, as well as other references cited in DCD Section 3.8.

03.08.01-5

10 CFR Part 50, Appendix A, GDC 16, "Containment Design," requires concrete containment to act as a leak-tight membrane to prevent the uncontrolled release of radioactive effluents to the environment. DCD Section 3.8.1.4.11, "Ultimate Pressure Capacity," states that the ultimate pressure capacity (UPC) of the containment is evaluated based on the design results of the structure. The applicant further states that the analysis for the UPC is performed considering material nonlinear behaviors for the reinforced concrete containment.

In reviewing DCD Section 3.8.1.4.11 of the application, the staff noted that additional information is needed to better understand the applicant's approach for determining the UPC of the containment. Standard Review Plan (SRP) 3.8.1, Section II.4.K discusses the regulatory criteria for determining the internal pressure capacity of the containment. SRP 3.8.1 states that the design and analysis procedure for the UPC of the containment is acceptable if performed in accordance with Regulatory Guide (RG) 1.216, "Containment Structural Integrity Evaluation for Internal Pressure Loadings Above Design-Basis Pressure."

In accordance with SRP 3.8.1, and GDC 16, the applicant is requested to provide a detailed description of the approach used to calculate the UPC of the containment identified in Section 3.8.1.4.11 of the DCD and explain how this approach compares to that described in Regulatory Position 1 of the RG 1.216.

03.08.01-6

Appendix A to 10 CFR Part 50, General Design Criteria1, 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 3.8.1.5.1.2, "Prestressing System," the applicant stated that the tendon stresses during stressing and anchoring and the tendon stresses used for the design do not exceed the tendon minimum yield strength (f_{py}) of 0.96 and the tendon ultimate strength (f_{pu}) of 0.80. The applicant further stated "Immediately after anchoring, the tensile stress at the anchor point does not exceed 0.81 f_{py} or 0.73 f_{pu} and the average tensile stress at the anchorage point of the tendon group after anchoring does not exceed 0.70 f_{pu}."

The staff reviewed Subsection CC-3433, "Tendon System Stress," of the ASME Code (the 2001 Edition with 2003 Addenda) that is referenced in the DCD, and noticed the allowable minimum yield strength provided by the applicant during stressing of the tendons exceeds the allowable of 0.94 f_{py} in the 2001 Edition cited above. In addition, the values for the tension stress immediately after anchoring are not consistent with the values presented in the 2001Edition of the code. In accordance with GDCs 1, 2, 4, 16, and 50, and SRP 3.8.1, the applicant is requested to explain why the allowable limits for the tendon stresses are not in accordance with the ASME code edition, and if different, provide a technical justification for this difference.