KHNPDCDRAIsPEm Resource

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Sent: Monday, July 27, 2015 8:55 AM
To: apr1400rai@khnp.co.kr; KHNPDCDRAIsPEm Resource; Harry (Hyun Seung) Chang; Yunho Kim; Steven Mannon
Cc: Li, Chang; Dias, Antonio; Betancourt, Luis; Lee, Samuel
Subject: APR1400 Design Certification Application RAI 114-8041 (03.04.01 - Internal Flood Protection for Onsite Equipment Failures)
Attachments: APR1400 DC RAI 114 SPSB 8041.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. However, KHNP requests, and we grant, the following days to respond to the RAI's questions. We may adjust the schedule accordingly.

03.04.01-1: 60 days
03.04.01-2: 60 days
03.04.01-3: 30 days
03.04.01-4: 60 days
03.04.01-5: 60 days
03.04.01-6: 90 days
03.04.01-7: 60 days
03.04.01-8: 60 days
03.04.01-9: 60 days

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

Thank you,

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United States Nuclear Regulatory Commission
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REQUEST FOR ADDITIONAL INFORMATION 114-8041

Issue Date: 07/27/2015
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 03.04.01 - Internal Flood Protection for Onsite Equipment Failures
Application Section:

QUESTIONS

03.04.01-1

3.4.1-1 Identification of SSCs Subject to Flood Protection:

10 CFR 52.47(a)(2) requires that a standard design certification applicant provide a description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefor, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished.

SRP Section 3.4.1 states that safety-related SSCs should be protected against flooding. DCD Tier 2 Section 3.4.1.5 refers to Section 7.4 for scoping the systems subject to flood protection. Section 7.4 describes the systems required for safe shutdown, which is a subset of the safety-related systems.

The staff noted that DCD Table 3.2-1 lists all the safety-related SSCs, but Section 7.4 does not include the complete list of safety-related SSCs. This is an inconsistency in the application.

The applicant is requested to use Table 3.2-1 or justify the use of Section 7.4 to identify the SSCs subject to flood protection.

03.04.01-2

Identification of SSCs Subject to Flood Protection:

10 CFR 52.47(a)(2) requires that a standard design certification applicant provide a description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefor, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished.

DCD Tier 2, Section 3.4.1 states that “the reactor containment building systems to be protected from flooding are the reactor coolant system (RCS), safety injection system (SIS), reactor coolant gas vent system (RCGVS), and main steam system (MSS). The components to be protected from flooding are the valves and electric instrumentation of these systems.”

The applicant is requested to clarify in the DCD whether the instrumentation and valves in the in-containment refueling water storage tank (IRWST) are subject to flood protection or are above the flood level in the containment.

03.04.01-3

3.4.1-3 Determination of the Worst Case Internal Flooding:

10 CFR 52.47(a)(2) requires that a standard design certification applicant provide a description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefor, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished.

DCD Tier 2, Sections 3.4.1.3 and 3.4.1.5 identify the in-containment flooding sources as coming from a loss of coolant accident (LOCA) or from a break in the fire protection system. The applicant states that the worst-case flooding event is a double-ended discharge leg LOCA with the minimum safety injection because it results in the most limiting flooding source for the reactor containment building.

The applicant is requested to provide the following information relating to the determination of the worst case:

a) Provide a comprehensive explanation of the calculation method for using "maximum break", instead of "maximum flood water volume" to determine the worst case flooding event. In general, flood level is determined by the water volume. Provide design requirements (such as the drain capability) and the basis to support the method being used by APR1400.

b) Explain the basis for the determination of the worst case being LOCA with duration of 50 second. It should be noted that LOCA has higher peak flow but drops quickly lasting much longer than 50 second, while fire protection water could leak indefinitely without isolation resulting in larger volume of flood water. If isolation is used, provide the design basis and justifications.

c) Explain how other in-containment water sources (such as main feedwater line, main steam line, auxiliary feedwater system, shutdown cooling system, component cooling system, safety injection tank (SIT), and other water carrying piping) compare against the worst case LOCA?

03.04.01-4

3.4.1-4 Determination of the Flood Level:

10 CFR 52.47(a)(2) requires that a standard design certification applicant provide a description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefor, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished.

DCD Section 3.4.1.5 states that the fluid flow rate through a stairwell or a floor opening is calculated using equation 5.2-1, and the flow rate under a door is calculated using equation 5.2-3. Both these equations are to be found in Reference 5 (ANSI 56.11-1988). The staff found that Reference 5 has not been endorsed or reviewed by NRC and has been withdrawn by ANS.

The applicant is requested to provide sufficient information to demonstrate the acceptability and applicability of the above two equations.

03.04.01-5

3.4.1-5 Fire Water Flooding:

10 CFR 52.47(a)(2) requires that a standard design certification applicant provide a description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefor, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished.

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DCD Tier 2, Section 3.4.1.5 states that indoor hydrants that could reach the area or zone where a fire occurs are considered as internal flooding sources when a fire occurs. The discharge flow rate from these indoor hydrants is assumed to be 0.044 m3/s (700 gpm).

The applicant is requested to provide the following information:

a) Why is the assumption of 700 gpm adequate for flood protection? How long is it assumed for the fire water? The staff noted that in DCD Section 19.1.5.3.1.5, page 19.1-157, the fire protection system is assumed to have infinite volume of water.

b) What is the total discharge water volume from the indoor hydrants? Is this the limiting volume for the potential flood resulting from all the possible fire protection system failures?

c) Why is it bounded by the worst case LOCA as far as flooding is concerned? What is the flood height in containment resulting from the fire protection water, which may last for long time?

GDC 3 states, in part, that "fire detection and fighting systems of appropriate capacity and capability shall be provided and designed to minimize the adverse effects of fires on structures, systems, and components important to safety. Firefighting systems shall be designed to assure that their rupture or inadvertent operation does not significantly impair the safety capability of these structures, systems, and components."

Section 3.4 of the DCD, third paragraph, only mentions "operation of fire protection systems." It does not mention the inadvertent rupture of a fire protection system. In the Fire Hazard Analysis, Appendix 9.5A of the DCD, only the inadvertent operation of the automatic sprinkler systems is considered.

The applicant is requested to also address the possibility of rupture/cracks in the fire protection system piping including standpipe system piping.

03.04.01-6

3.4.1-6 Flood Level Determination:

10 CFR 52.47(a)(2) requires that a standard design certification applicant provide a description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefor, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished.

During the audit review of the calculations, the staff found in Containment Flooding Analysis (1-035-N385-001), Table 2 (Sheet 9 of 41) that the non-safety drainage system appears to be taking credit for the determination of flood levels.

The applicant is requested to address the following concerns relating to the use of non-safety drainage system in the internal flood protection:

a) Table 2 lists drain discharge (gpm) vs. depth of water (in.) up to 6 inch. What is the drain discharge flow for the flood level of 2 ft? Provide the basis for the determination.

b) How many drains are required to perform the function in each of the flood areas?

c) Specify and justify the required functional capability of the drainage system in the DCD.

d) A failure of the drainage system may prevent a safety-related system to perform its safety function. A failure modes and effects analysis should be provided in the DCD, in accordance with SRP Section 3.4.1, Subsection III.4.

e) The drainage system, as described in DCD Section 9.3.3, does not appear to recognize this safety function. Clarify this safety function and seismic classification in the DCD, including Section 9.3.3 and Table 3.2-1.

f) This functional capability should be tested and maintained throughout the life of the plant. The DCD should include information on initial testing, ITAAC, programmatic control for this system function.

g) The potential clogging of the drain path due to debris (resulting from dynamic forces or left behind in the building due to previous activities) is a plausible event and needs to be addressed in the DCD.

03.04.01-7

3.4.1-7 ITAAC:

10 CFR 52.47(a)(2) requires that a standard design certification applicant provide a description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefor, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished.

DCD Tier 1, Section 2.2.5.1.2, “Internal Flooding,” states that the inspection, tests, analyses, and associated acceptance criteria (ITAAC) for protection against hazards are specified in Item 2 of Table 2.2.5-1, “Protection against Hazards ITAAC.” It also states that the inspection of the as-built protective provisions against internal flooding hazard will be conducted. These provisions include divisional flood barriers, watertight doors, penetrations in the flood barrier, and safety-related electrical, instrumentation, and control (I&C) equipment in nuclear island are located above the internal design flood level.

The staff finds that the ITAAC includes only I&C equipment to be located above the flood level but not all the other safety-related SSCs (such as valves and pumps). The staff also finds that in the ITAAC “Acceptance Criteria” only the nuclear island and EDG structures are included but not ESWB or CCWHXB.

The applicant is requested to verify the scope of this ITAAC as well as its acceptance criteria. The DCD should be revised accordingly.

03.04.01-8

3.4.1-8 Inconsistency:

10 CFR 52.47(a)(2) requires that a standard design certification applicant provide a description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefor, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished.

On page 3.4-11 of DCD Tier 2, the applicant states that “however, a malfunction of the fire protection system is not considered in this area because it has a CO2 suppression system;” while on page 9.5-17 the applicant states that there are no CO_2 systems used in the APR1400.

The applicant is requested to clarify this inconsistency.

03.04.01-9

3.4.1-9 Emergency Overflow Lines:

10 CFR 52.47(a)(2) requires that a standard design certification applicant provide a description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefor, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished.

In the audit of the calculations to support DCD Section 3.4.1 the staff found that emergency overflow lines are used for flood protection in the Auxiliary Building quadrants A, B, C, and D at elevation 55’. It is not clear why this is not discussed in the DCD.

The applicant is requested to provide in the DCD the following information relating to emergency overflow lines:

a) Describe how the emergency overflow lines are used for flood protection.

b) Specify the functional requirements and seismic classification of these lines.


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