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.:	**173-8213**
SRP Section:	**15.00.03 - Design Basis Accidents Radiological Consequence Analyses for Advanced Light Water Reactors**
Application Section:	**Chapter 15 including 15A**
Date of RAI Issue:	**08/26/2015**

Question No. 15.00.03-29

10 CFR 52.47(a)(2)(iv) requires that an application for a design certification include a final safety analysis report that provides a description and safety assessment of the facility. The safety assessment analyses are done, in part, to show compliance with the radiological consequence evaluation factors in 52.47(a)(2)(iv)(A) and 52.47(a)(2)(iv)(B) for offsite doses, 10 CFR 50, Appendix A, GDC 19 for control room radiological habitability, and the requirements related to the technical support center in 10 CFR 52.47(b)(8) and (b)(11) and Paragraph IV.E.8 of Appendix E to 10 CFR Part 50. The radiological consequences of design basis accidents are evaluated against these regulatory requirements and the dose acceptance criteria given in SRP 15.0.3.

In DCD Section 15.6.5.5.1.2, the assumptions on the analysis of engineered safety feature (ESF) system leakage for the loss-of-coolant accident (LOCA) dose analysis are discussed. On DCD page 15.6-49, the last sentence of the first full paragraph states that the assumed design ESF leakage rate is doubled to 37.8 liters per hour (L/hr) [10 gal/hr] to calculate the dose consequences. However, DCD Table 15.6.5-13, on sheet 2 of 3 lists the ESF leakage rate as 8.08 L/hr (2.13 gal/hr). Please resolve this discrepancy.

Response

The value of 8.08 L/hr (= 2.13 gal/hr) in Table 15.6.5-13 (2 of 3) will be updated to be consistent with the description in DCD Subsection 15.6.5.5.1.2.

Impact on DCD

DCD Table 15.6.5-13 (2 of 3) will be updated as indicated in the 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.

Table 15.6.5-13 (2 of 3)

Parameter	Value
Activity Transport Parameters in Primary Containment	
Containment Net Free Volume	8.86×10^4 m^3 (3.13×10^6 ft^3)
Sprayed Volume	6.64×10^4 m^3 (2.35×10^6 ft^3)
Unsprayed Volume	2.21×10^4 m^3 (7.82×10^5 ft^3)
Primary Containment Leak Rate	0.1 v/o/day (0 ~ 24 hr) 0.05 v/o/day (24 ~ 270 hr)
Flow Rate Between Sprayed and Unsprayed Regions	736 m^3/min (26,000 cfm) (Mixing Flow) 2 turnovers of unsprayed volume/hr
Spray Initiation Time	110 sec (Delay time)
Spray Recirculation Phase Initiation Time	Spray water is circulated from IRWST for entire duration of accident (IRWST→CS→HVT→IRWST)
Containment Spray Removal Coefficients Elemental (λ_E) Particulate (λ_P)	20 hr^{-1} (0 ~ 2.25 hr until DF is 200) 6.25 hr^{-1} (0 ~ 2.40 hr until DF is 50) 0.625 hr^{-1} (2.40 ~ 4 hr)
ESF Leakage Parameters	
Minimum IRWST Water Volume	2.44×10^3 m^3 (8.61×10^4 ft^3)
ESF Leakage Rate	8.08 L/hr (2.13 gal/hr)
ESF Leakage Initiation Time	0.0 min
Long-term Minimum IRWST Water pH	> 7
ESF Leakage Flashing Factor	10 % (0 ~ 3 hr) 2 % (3 ~ 16.67 hr) 10 % (> 16.67 hr)
Post-LOCA Sump Water Temperature 3.0 hr 7.64 hr 16.67 hr	 107 °C (225 °F) 113 °C (235.5 °F) 107 °C (225 °F)

37.8 L/hr (10 gal/hr)

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Question No. 15.00.03-30

10 CFR 52.47(a)(2)(iv) requires that an application for a design certification include a final safety analysis report that provides a description and safety assessment of the facility. The safety assessment analyses are done, in part, to show compliance with the radiological consequence evaluation factors in 52.47(a)(2)(iv)(A) and 52.47(a)(2)(iv)(B) for offsite doses, 10 CFR 50, Appendix A, GDC 19 for control room radiological habitability, and the requirements related to the technical support center in 10 CFR 52.47(b)(8) and (b)(11) and Paragraph IV.E.8 of Appendix E to 10 CFR Part 50. The radiological consequences of design basis accidents are evaluated against these regulatory requirements and the dose acceptance criteria given in SRP 15.0.3.

DCD Section 15.6.5.5.1.2 describes the assumptions for the ESF leakage release for the LOCA dose analysis, and includes some description of the modeling of filtration of the releases from the auxiliary building. The staff requires the following information to complete its review of the LOCA ESF system leakage analysis.

a. What safety-related ventilation system provides the filtration for the ESF area, is it the Auxiliary Building Controlled Area Emergency Exhaust System (ABCAEES)?

b. What is the assumption used in the dose analysis for the time after onset of the LOCA when the filtration system reaches full operation and filtration is credited? What is the basis for this time?

Response

a. The AB controlled area emergency exhaust system (ABCAEES) provides the safety-related ventilation for the ESF area.

b. Due to the loss of offsite power (LOOP), which is assumed to occur coincidently with the initiation of the event, the time required to reach full operation of the ABCAEES,

which is actuated by the SIAS (Safety Injection Actuation Signal), is 6 seconds. This is the time from the start of ESF systems to the start of ABCAEES, during this time of ABCAEES unavailability, all the iodines (except for noble gases and other particulates) leaked from the ESF components would be released to the environment without filtration by the ABCAEES. This time of unfiltered release is calculated to be about 6 seconds (= 35 seconds – 29.3 seconds) based on the following:

- ESF System Actuation Time: The SI system, which is actuated by the low pressurizer pressure signal, will be operated earlier than the CS system, which is actuated by high-high containment pressure signal. The resultant time needed to operate the SI pumps is estimated to be 29.3 seconds, including the time for the startup of the Emergency Diesel Generator (EDG) of 20 seconds and the time for signal processing to start the SI pump of 9.3 seconds.

- ABCAEES Actuation Time: The time to start the filtration operation includes the time for the startup of the EDG of 20 seconds, the time for signal processing to start the ABCAEES ACU fan of 5 seconds, and the time for the fan to reach the rated voltage of the motor of 10 seconds. Therefore, the total time for the ABCAEES to start its filtration operation is estimated to be 35 seconds.

In the ESF leakage dose analysis for APR1400, the unfiltered release during the 6 seconds was not considered since the analysis was performed using the conservative assumption specified in RG 1.183, Appendix A, Section 5.1. Per this guidance, all the fission products (except for noble gases) released from the core to the containment are assumed to be instantaneously and homogeneously mixed in the IRWST water. This assumption is conservative since the radioactivity released from the core would exist in both the containment atmosphere and the IRWST water and some of them are being released to the environment through containment leakage.

In addition, the impact was estimated to be negligible compared to the total dose as indicated in Table 1 below. This is attributed to the time-dependent core release characteristics and the negligible amount of unfiltered release during the short duration of 6 seconds.

Therefore, the consideration of the unfiltered release during the delay time to start the ABCAEES filtration operation was not assumed in this dose analysis.

Table 1 Comparison of EAB Doses With and Without Delay Time of Filtration

Release Pathways		Dose at EAB (rem)	
		Case 1 Without Delay Time [1)]	**Case 2** With Delay Time [2)]
ESF Leakage	Unfiltered	0	5.52E-06
	Sum	0.12	0.12
Sum of Containment Leakage, Purge Release, and ESF Leakage		20.4	20.4

1) Filter efficiency of 95% is applied, which is given in DCD Table 15.6.5-13.
2) Filter efficiency of 0 % is applied only for 6 seconds after the ESF system actuation time.

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.