
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.: 390-8479
SRP Section: 12.02 – Radiation Sources
Application Section: 12.02
Date of RAI Issue: 02/01/2016

Question No. 12.02-27

This is a follow-up to RAI 8247, Question 12.02-18.

REQUIREMENT AND GUIDANCE

10 CFR 52.47(a)(5) requires that the FSAR contain the kinds and quantities of radioactive materials expected to be produced in the operation and the means for controlling and limiting radioactive effluents and radiation exposures within the limits set forth in 10 CFR 20.

SRP Section 12.2 indicates that the description of airborne sources should include a tabulation of the calculated concentrations of radioactive material, by nuclide, expected during normal operation, AOOs, and accident conditions for areas normally occupied by operating personnel and that the FSAR should provide the models and parameters used for the calculations.

INFORMATION NEEDED

In the response to RAI 8247, Question 12.02-18, the applicant indicated that editorial errors were found in FSAR Table 12.2-26 and they correct them in the proposed FSAR markup. Staff has the following questions as a result of the staff's review of these changes:

1. While the applicant indicates that the errors are editorial, many of the changes provide different inputs to the calculations for minimum required ventilation flow rates and airborne activity concentrations than what was used in calculation packages 11E47-I-035-N377-013 and 11E47-I-035-N377-014, which were reviewed in the source term audit (see ML15208A492 for audit plan). It would appear that the changes would require the calculations to be revised and could result in more minimum required ventilation flow rate changes than those shown and could result in many different calculated DAC fractions and airborne activity concentrations than what are provided in FSAR Table 12.2-23. However, the applicant didn't provide any information regarding changes to the calculations or make any changes to FSAR Table 12.2-23 in the

response. Please ensure that all calculations and FSAR values are updated and accurate and provide revised calculations 11E47-I-035-N377-013 and 11E47-I-035-N377-014 for staff review or provide a detailed explanation for why revisions are not necessary.

2. In performing confirmatory calculations to attempt to verify if the results provided in the FSAR were still adequate (with the changes), the staff noticed that the water volume assumed for the IRWST in 11E47-I-035-N377-013, used for calculating airborne activity from leaked IRWST fluids, was inconsistent with the normal water volume of the IRWST provided in FSAR Chapter 6, Table 6.8-1. In addition, the IRWST volume provided in the response to RAI 7856, Question 12.02-2 is also different. Please explain these discrepancies in IRWST water volume and ensure that the Chapter 12 source term information and estimated airborne activity concentrations associated with the IRWST are based on the normal operating water volume and concentrations, provided in FSAR Table 6.8-1 (with an estimated 0.25% fuel failure percentage), or are more conservative. Provide all revisions to the calculations and FSAR that are appropriate.

Response

1. Calculation 11E47-1-035-N377-013 was revised to rectify the editorial errors and to correct the discrepancy of the IRWST volume described in Item No.2 of this RAI. 11E47-1-035-N377-014 was also revised to correct the editorial errors. The two calculations are updated with the corrections of the editorial errors and with the IRWST volume. These updated results changes on the airborne radioactivity concentration and the Derived Air Concentration (DAC) fraction in Table 12.2-23, which will be included in Attachment 1 of this response. These changes are minor in nature and are within the margins provided with the actual ventilation flow in the original HVAC design.
2. The IRWST volume of 649,000 gal provided in DCD Table 6.8-1 represents the normal operating volume and is based on the useful volume of the tank between the lower water level and normal water level; the useful volume does not include the volume from the tank bottom to the lower water level and the sump volume.

The shielding calculation considers the IRWST geometry, from the bottom of the tank to the normal water level. Also, the IRWST volume used in 11E47-1-035-N377-013 considers the entire IRWST inventory, from the tank bottom to the Hi alarm point which is higher than normal water level.

However, the IRWST volumes used in the shielding calculation and the IRWST concentration calculation are inconsistent and not conservative values. Therefore, the IRWST shielding and the concentrations were recalculated with the volume of 649,000 provided in DCD Table 6.8-1. Calculation 11E47-1-035-N377-013 was updated and the changed airborne radioactivity concentration and the Derived Air Concentration (DAC) fraction in Table 12.2-23 is provided in Attachment 1. The sum of the DAC fractions is still within the acceptable range (i.e., less than 1); and the changes do not impact on the actual ventilation flows in the original HVAC design. The IRWST volume provided in Table 12.2-25 will also be changed in Attachment 2.

Impact on DCD

DCD Tier 2 Table 12.2-23 will be updated as indicated in Attachment 1.

DCD Tier 2 Table 12.2-25 will be updated as indicated in Attachment 2.

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 Environment Report.

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Table 12.2-23 (3 of 4)

RAI 321-8353 - Question 12.02-20

RAI 390-8479 - Question 12.02-27

Auxiliary Building Cubicles (Normal Operation)

Cubicle	Airborne Radioactivity Concentration (Bq/cm ³) ^{Note2}			Derived Air Concentration (DAC) Fraction			
	Kr, Xe	Br, I	H-3	Kr, Xe	Br, I	H-3	Total
CS Pump and Miniflow HX Rm (050-A01C,D)	7.37E-02	4.92E-07	9.82E-03	1.99E-02	5.18E-04	1.33E-02	3.37E-02
SI Pump Rm (050-A02C,D)	1.16E-01	7.81E-07	1.55E-02	3.13E-02	8.18E-04	2.09E-02	5.30E-02
Floor Drain Sump Pump Rm (055-A34A,B,C,D)	1.84E+00	5.34E-05	4.10E-02	7.99E-01	2.61E-02	5.54E-02	8.81E-01
Pipe Chase and Valve Rm (055-A14C)	9.44E-02	6.20E-07	1.27E-02	2.54E-02	6.64E-04	1.72E-02	4.32E-02
Shutdown Cooling HX Rm (055-A30A,B)	3.63E-02	2.39E-07	4.88E-03	9.77E-03	2.55E-04	6.59E-03	1.66E-02
Charging Pump Rm (055-A55B)	1.58E+00	2.68E-07	3.56E-02	6.44E-01	1.39E-04	4.81E-02	6.92E-01
Charging Pump Miniflow HX Rm (055-A43A)	4.49E-01	1.23E-05	1.01E-02	1.81E-01	6.37E-03	1.37E-02	2.01E-01
Equipment Drain Tank Rm (055-A51B)	8.48E-02	1.77E-06	3.59E-04	3.62E-02	1.03E-03	4.85E-04	3.77E-02
Reactor Drain Pump Rm (055-A52A, A53B)	2.70E+00	8.76E-06	2.11E-03	7.95E-01	5.20E-03	2.85E-03	8.04E-01
Gas Stripper Rm (068-A06A)	2.14E+00	6.11E-07	3.53E-07	9.02E-01	3.04E-04	4.76E-07	9.02E-01
Filter and Demin. Valve Area (068-A10A)	1.90E+00	4.85E-05	3.67E-02	7.92E-01	2.37E-02	4.96E-02	8.65E-01
SFP Cleanup Pump Rm (078-A38A)	4.16E-02	2.87E-07	5.17E-03	1.12E-02	3.00E-04	6.99E-03	1.85E-02
Reactor Makeup Water Pump Rm (078-A49B)	2.49E-07	1.36E-12	1.20E-02	6.57E-08	1.81E-09	1.63E-02	1.63E-02
Holdup Pump Rm (078-A50B)	5.29E-04	5.88E-08	1.19E-02	2.95E-04	6.30E-04	1.61E-02	1.65E-02
Volume Control Tank Rm (100-A25A)	1.06E+00	1.62E-07	2.41E-021	3.88E-01	9.22E-05	3.26E-02	4.20E-01
Valve Rm (120-A23A)	1.81E-01	5.27E-06	5.01E-03	7.89E-02	2.58E-03	6.78E-03	8.83E-02
Fuel Handling Area (Normal Operation)			2.40E-02			3.20E-02	3.20E-02
Fuel Handling Area (Refueling)			5.70E-02			7.70E-02	7.70E-02

Note 2 : The partition factor for other nuclides (primarily particulates) for airborne activity in the auxiliary building is 0.0.

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Table 12.2-23 (4 of 4)

RAI 321-8353 - Question 12.02-20

RAI 390-8479 - Question 12.02-27

Compound Building Cubicles (Normal Operation)

Cubicle	Airborne Radioactivity Concentration (Bq/cm ³)			Derived Air Concentration (DAC) Fraction			
	Kr, Xe	Br, I	H-3	Kr, Xe	Br, I	H-3	Total
Valve Rm (063-P07)	1.62E+00	1.03E-04	8.29E-02	6.66E-01	5.24E-02	1.12E-01	8.31E-01
Equipment Waste Pump Rm (063-P21,P22)	1.30E+00	3.72E-05	2.92E-02	5.52E-01	1.85E-02	3.94E-02	6.10E-01
Equipment Waste Tank Rm (063-P23,P24)	1.73E-01	4.87E-06	7.33E-04	7.20E-02	2.46E-03	9.91E-04	7.54E-02
Floor Drain Pump Rm (063-P25)	2.17E+00	5.93E-05	4.89E-02	8.71E-01	3.08E-02	6.61E-02	9.68E-01
Normal Sump Pump Rm (063-P26)	1.90E-01	5.52E-06	4.23E-03	8.26E-02	2.69E-03	5.72E-03	9.10E-02
Chemical Waste Pump Rm (063-P27)	5.50E-02	1.46E-06	1.13E-03	2.18E-02	7.16E-04	1.52E-03	2.40E-02
Floor Drain Tank Rm (063-P29)	4.74E-01	1.30E-05	1.07E-02	1.92E-01	6.73E-03	1.44E-02	2.13E-01
Chemical Waste Tank Rm (063-P30,P31)	1.07E-02	2.83E-07	2.42E-04	4.15E-03	1.51E-04	3.27E-04	4.62E-03
Detergent Waste Tank and Pump Rm (063-P32)	0.00E+00	5.85E-08	1.02E-05	0.00E+00	3.33E-05	1.38E-05	4.71E-05
Chemical Drain Sump Pump Rm (063-P36)	1.00E-01	2.92E-06	2.24E-03	4.37E-02	1.42E-03	3.02E-03	4.81E-02
Monitor Tank Rm (063-P37)	0.00E+00	1.08E-08	0.00E+00	0.00E+00	1.00E-05	0.00E+00	1.00E-05
Monitor Tank Pump Rm (063-P54)	0.00E+00	2.07E-07	0.00E+00	0.00E+00	1.84E-04	0.00E+00	1.84E-04
Valve Rm (085-P06)	0.00E+00	1.98E-05	1.62E-02	0.00E+00	1.02E-02	2.19E-02	3.20E-02
Valve Rm (085-P15)	0.00E+00	4.61E-05	3.64E-02	0.00E+00	2.31E-02	4.92E-02	7.23E-02
Valve Rm (085-P16)	2.06E-01	5.96E-06	4.59E-03	8.91E-02	2.92E-03	6.21E-03	9.82E-02

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RAI 13-7856 - Question 12.02-2_Rev.1

RAI 390-8479 - Question 12.02-27

Table 12.2-25 (3 of 3)

Building	Component	Source Dimension				Source Characteristic		Housing	
		Shape	Diameter (or Width) (cm)	Length (cm)	Height (cm)	Material	Partial Density (g/cm ³)	Material	Thickness (cm)
Auxiliary Building	Spent fuel pool	Rectangular parallelepiped	869.00	1,113.50	381.00	Water: 70% UO ₂ : 22% Zircaloy: 8%	0.70 1.98 0.56	Not considered	
	Cask loading pit	Rectangular parallelepiped	20.23	20.23	381.00	Water: 58% UO ₂ : 30% Zircaloy: 12%	0.58 2.76 0.79	Not considered	
	GRS header drain tank	Cylinder	45.72	-	172.48	Vapor: 100%	0.001293	Not considered	
Compound Building	Chemical waste tank	Cylinder	304.80	-	466.91	Water: 100%	1.00	Not considered	
	Floor drain tank	Cylinder	358.14	-	676.38	Water: 100%	1.00	Not considered	
	Equipment drain tank	Cylinder	358.14	-	676.38	Water: 100%	1.00	Not considered	
	Low-activity spent resin tank	Cylinder	274.32	-	383.33	Water: 100%	1.00	Not considered	
	Spent resin long-term storage tank	Cylinder	243.84	-	482.92	Water: 100%	1.00	Not considered	
	LRS IX	Cylinder	120.17	-	124.83	Water: 100%	1.00	Not considered	
	Waste drum storage	Rectangular parallelepiped	601.98	782.57	262.89	Carbon: 100%	2.62	Not considered	

IRWST	Annular Cylinder	O.D:4328 I.D:2987	-	4378.96	358.62	Water: 75%	1.00	Not considered	
				365.76	121.92	Vapor: 25%	0.001293		

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Rev. 0