REVISED 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.:	**13-7856**
SRP Section:	**12.02- Radiation Sources**
Application Section:	**12.2**
Date of RAI Issued:	**05/22/2015**

Question No. 12.02-3

REQUIREMENTS

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.

10 CFR 50, Appendix A, Criterion 61, requires that the fuel storage and handling, radioactive waste, and other systems which may contain radioactivity be designed to assure adequate safety under normal and postulated accident conditions, with suitable shielding for radiation protection, and with appropriate containment, confinement, and filtering systems.

10 CFR 20.1101(b) requires that the licensee use to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).

SRP Section 12.2 indicates that radiation sources should be determined and provided for all radiation sources that require (1) shielding, (2) special ventilation systems, (3) special storage locations and conditions, (4) traffic or access control, (5) special plans or procedures, or (6) monitoring equipment. The source descriptions should include all pertinent information required for (1) input to shielding codes used in the design process, (2) establishment of related facility design features, (3) development of plans and procedures, (4) assessment of occupational exposure and (5) determination of radiation dose to electrical equipment important to safety as described in 10 CFR 50.49.

SRP Section 12.2 also indicates that source descriptions should include the methods, models and assumptions used as the bases for all values provided in SAR Section 12.2. A listing of isotope, quantity, form, and use of all required radiation sources containing byproduct, source,

and special nuclear material exceeding 3.7 E+9 Bq (100 millicuries) that may warrant shielding design consideration, should be provided.

SRP Section 12.3-12.4, indicates that the plant structures, as well as the general plant yard should be subdivided into radiation zones, with maximum design dose rate zones and the criteria used in selecting maximum dose rates identified. SRP Section 12.3-12.4 also indicates that doses to workers and members of the public should be ALARA.

ISSUE

There is a lack of information in FSAR Section 12.2.1.6, "Stored Radioactivity," on

- holdup tanks,
- reactor makeup water tanks (RMWTs), and
- boric acid storage tanks (BASTs)

that are located outdoors, and these tanks are the most significant outdoor radiation sources. The staff has the following information needs regarding these tanks:

1. FSAR Section 12.2.1.6 reads as if there are multiple holdup tanks, RMWTs, and BASTs located outdoors, however in reviewing FSAR Figure 1.2-1, the staff can only identify one holdup tank, one RMWT, and one BAST located outdoors (they are all north of the Auxiliary Building on Figure 1.2-1). Please indicate if there is more than one holdup tank, RMWT, and BAST each and if so, please indicate where they are located. If not, please indicate that there is only one of each type of tank in FSAR Section 12.2.1.6.

2. FSAR Table 12.2-25 provides source dimensions and parameters used in the shielding analysis, for source terms provided within FSAR Section 12.2. While FSAR Section 12.2 provides a source term for each of these tanks, there is no information on these tanks in FSAR Table 12.2-25. This information is needed in the FSAR for staff to conduct a shielding review of these tanks.

3. FSAR Section 12.2.1.6 indicates that there will be administrative controls in place to prevent personnel from occupying the immediate vicinity of the outside tanks.

    a. Please describe these administrative controls or provide a COL item requesting that the COL applicant provide controls to provide the administrative controls ensuring that exposure to workers and members of the public from these tanks will be ALARA.

    b. Please indicate if there will be any shielding or barriers surrounding the tanks to limit doses to workers and members of the public and update the FSAR accordingly.

4. FSAR Section 12.2.1.6 indicates that the surface dose rate of these tanks will not exceed 2.5 micro Sieverts per hour. While staff cannot perform dose rate calculations without tank dimensions and parameters (as discussed in Question 2, above), the source terms for the holdup tank and BAST provided in FSAR Table 12.2-13, contain

fairly significant quantities of radioactive material. It seems unlikely to staff that the dose on the surface of these tanks would not exceed 2.5 micro Sieverts per hour using the 0.25% failed fuel percentage source term provided in Table 12.2-13. Please provide an analysis that shows the dose rate on the surface of these tanks will not exceed 2.5 micro Sieverts per hour on the surface of these tanks using the 0.25% failed fuel percentage source term provided in FSAR Table 12.2-13. If not, please modify FSAR Section 12.2.1.6 accordingly and provide the radiation zoning for these areas.

5. While the source term for the holdup tank is fairly significant, it appears to be significantly lower than the source term provided for a tank which appears to have a very similar function in another new reactor design. Please discuss all potential input paths of radioactive material to the holdup tank. If potential input paths that would result in a significantly higher source term than what is provided in FSAR Table 12.2-13 exist, please discuss why the current source term is adequate. Please provide the methods, models, and assumptions used in calculating the source term for the holdup tank in FSAR Table 12.2-13 in the response.

Response – (Rev. 2)

1. There is only one holdup tank, RMWT and BAST for APR1400. Therefore, the description in Subsection 12.2.1.6 will be updated to delete the “s” at the end of each tank’s name. Refer to Attachment 1 for DCD markups.

2. Table 12.2-25 will be revised to include the source dimensions and parameters used in the shielding analysis for the 3 yard tanks. Refer to Attachment 2 for DCD markup.

3.

   a. During normal operation, it is not anticipated to have any administrative controls in the vicinity of the outside tanks since the tanks are designed to maintain a dose rate outside the tanks less than 2.5 μSv/hr, which is the limit for Zone 1. If there is an event where the plant experiences a fuel failure higher than 0.25%, which is used as the design basis for shielding, then access to the area should be restricted due to design features that will prevent plant personnel from occupying the area. Figure 1 shows the design features such as how the holdup tank is surrounded by a 9 feet high dike with a key lock to the entrance. This dike design is also applied to other yard tanks such as the RMWT and the BAST. Therefore, it does not seem necessary to provide a COL item since the design prevents the inadvertent access to the vicinity of the tanks.

   b. As presented in Figure 1, the holdup tank itself is composed of a steel vessel with a minimum 14.75-inch thick concrete shield wall outside the vessel to ensure that the dose rate outside the tank is less than 2.5 μSv/hr. This design feature is also applicable to the BAST. The RWMT is not shielded with concrete since the design basis dose rate outside the vessel is low enough to maintain the dose rate below 2.5 μSv/hr without the concrete shield wall.

4. The Holdup Tank and the BAST are stainless steel tanks with a layer of concrete shield wall surrounding the tank, from bottom to top, with no gap between the tank surface and concrete wall. The thickness of the concrete layer is provided in Table 1 below for convenience. These and other parameters are added to Table 12.2-25 (Please refer to response to Issue #2 above). Please also note that other design features of the tanks are discussed in response to Issue #3 above. In Table 1, the contact dose rate of the BAST was revised only due to the source terms change.

   In the analysis, the concrete layer and steel wall (0.25-inch) are used to determine the contact doses for HUT, and the steel wall is not credited for shieling calculation for BAST. The analyses are available for NRC inspection if requested.

Table 1 Contact dose rates on the concrete wall

Tank (Required Concrete Thickness)	Contact Dose Rates (mSv/hr)
BAST (16”)	1.79E-03
HUT (14.75")	2.13E-03

5. The calculation method for HUT is similar to that of other CVCS tanks. It is assumed that the total waste volume for a cycle is 1.1E+07 gallons. The incoming flow from the Reactor Drain Tank (RDT) and the Equipment Drain Tank (EDT) are added to the total waste volume. APR-1400 DC plant uses the RCS activity with 0.25% fuel failure for shielding analysis, but US-APWR plant uses the RCS activity with 1% fuel failure for shielding analysis. The holdup tank activities are the sum of 1) normal power operation, 2) the shutdown boration operation, 3) the drain operation for reactor vessel removal, 4) the volume added during contraction cooldown.

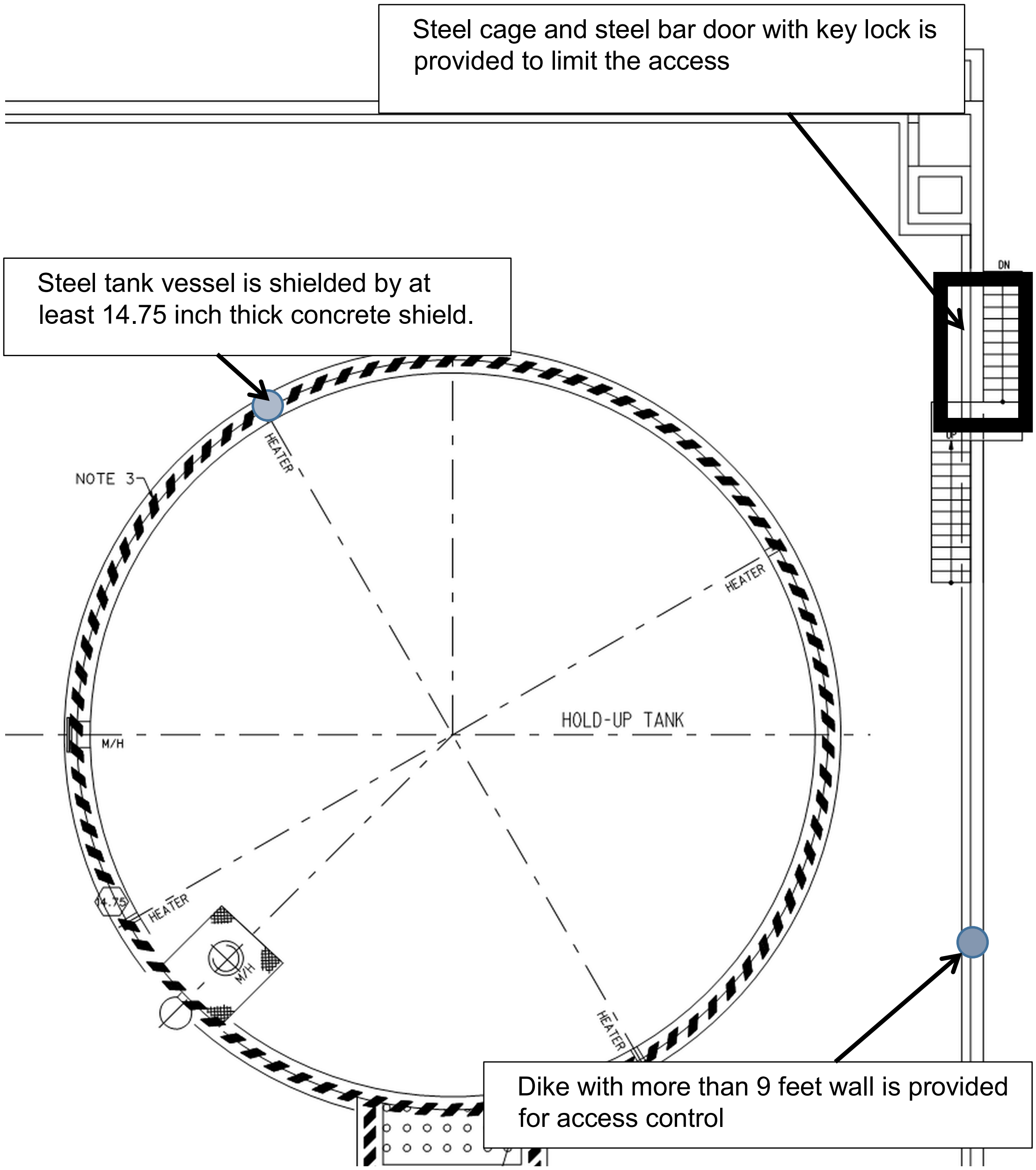

Figure 1. Shielding and Layout of Holdup Tank

Impact on DCD

DCD Subsection 12.2.1.6 will be revised as indicated in Attachment 1.
DCD Table 12.2-25 will be revised as indicated in Attachment 2.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

TS LCO 3.4.15 will be revised as indicated in Attachment 1.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

concentrations presented in Table 12.2-5 and the activity fractions in Table 11.2-2. Radionuclide concentrations in the LWMS are determined using the DIJESTER Code (Reference 2). The accumulation and decay of radionuclides in the LWMS can be modeled using this code.

The activities of LWMS demineralizers are calculated using an activity buildup and decay model. The calculation applies the process flow rates provided in Table 11.2-2, and the process fluid activity levels provided in Table 12.2-20. The demineralizer resin is assumed to have a service life of 1 year. Although the service life of filters and resins in the LWMS may vary according to operating conditions, for radiation protection purposes, they are replaced based on the source term strength to provide reasonable assurance that occupational exposures associated with radwaste system operations remain ALARA.

Solid waste management system (SWMS) source terms are provided in Table 12.2-22. Source terms for the spent resin long-term storage tank are calculated based on the activity of CVCS demineralizer resins presented in Table 12.2-11. Source terms for the low-activity spent resin storage tank are calculated based on the activity of LWMS demineralizer resins presented in Table 12.2-21.

Dimensions and parameters of the radiation sources in compound building used in the shielding analyses are listed in Table 12.2-25.

12.2.1.5 Sources Resulting from Design Basis Accidents

Design parameters and source terms for design basis accidents (DBAs) are addressed in Chapter 15.

12.2.1.6 Stored Radioactivity

The holdup tank, reactor makeup water tank (RMWT), and boric acid storage tank (BAST)

~~The holdup tanks, reactor makeup water tanks (RMWTs), and boric acid storage tanks (BASTs)~~ are the principal sources of activity outside the plant buildings. The surface dose rate of these tanks is designed so that it does not exceed 2.5 μSv/hr. Administrative controls are in place to prevent personnel from occupying the immediate vicinity of the outside tanks.

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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	

Add the "A" following end of this table

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A

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)
Yard	Boric Acid Storage Tank	Cylinder	1342.12	-	Liquid : 334.96 Vapor : 334.96	Water : 50% Vapor : 50%	1.00 0.001293	Concrete	40.64
	Holdup Tank	Cylinder	1706.88	-	Liquid : 86.85 Vapor : 607.96	Water : 12.5% Vapor : 87.5%	1.00 0.001293	Steel Concrete	0.635 37.465
	Reactor Makeup Water	Cylinder	1676.40	-	Liquid : 541.94 Vapor : 135.49	Water : 80% Vapor : 20%	1.00 0.001293	Not considered	