
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.: 207-8247
SRP Section: 12.02 – Radiation Sources
Application Section: 12.2
Date of RAI Issue: 09/11/2015

Question No. 12.02-16

REGULATIONS AND GUIDANCE

10 CFR 52.47(a)(8) requires that the FSAR contain, the information necessary to demonstrate compliance with any technically relevant portions of the Three Mile Island requirements set forth in 10 CFR 50.34(f), except paragraphs (f)(1)(xii), (f)(2)(ix), and (f)(3)(v).

10 CFR 50.34(f)(2)(vii) requires that the applicant preform radiation and shielding design reviews of spaces around systems that may, as a result of an accident, contain accident source term, and design as necessary to permit adequate access to important areas and to protect safety equipment from the radiation environment.

10 CFR 50, GDC 19 requires that radiation exposure for the duration of an accident does not exceed 5 rem whole body, or its equivalent to any part of the body.

SRP 12.2 indicates that the applicant should provide a description of radiation sources during accident conditions in the plant which are used in shielding calculations and that the source terms should be based from NUREG_0737, Item II.B.2, or RG 1.183.

SRP 12.3-12.4 indicates that the staff will conduct shielding design review to ensure that the design permits adequate access to important areas and provides for protection of safety equipment from radiation, following an accident.

ISSUE

While the applicant provided assumptions for developing source post-accident source terms in FSAR Table 12.2-24, consistent with RG 1.183, the applicant does not provide source term information for major post-accident sources (while Table 12.2-24 provides post-accident gap release and early in-vessel release to containment sump water and atmosphere, which are used as an assumption in developing sources, it does not provide the source terms of major systems or components in radionuclide concentrations or gamma energies).

To develop post-accident source terms in recirculating fluids, the information in Table 12.2-24 is needed, however, source terms are based on the volume of recirculating fluids, size of components, time after the release, and other factors. Therefore, the post-accident source term information currently provided in the FSAR is insufficient to meet the SRP.

In addition to recirculating fluids, the applicant does not provide any source term information for post-accident control room ventilation filters. The assumptions and source terms for these filters are required to ensure that doses do not exceed 5 rem in accordance with GDC 19.

In addition, the applicant does not provide shielding information for the main control room or technical support center.

Therefore, the staff requests the following information:

INFORMATION NEEDED

1. Please update the FSAR to provide source term information for systems that recirculate post-accident fluids outside containment (such as the shutdown cooling system, safety-injection system or other systems containing radioactive fluid), with time intervals showing how the source term changes during the duration of the accident. Also in the FSAR, indicate which systems are included in the source terms provided and provide the total volume of recirculating fluid (or in the response, point to information elsewhere in the FSAR where this information can be found). In the response, provide the basis for the volume of recirculating fluid used in developing the source term.
2. Update the FSAR to provide maximum post-accident source term information for all control room and technical support center emergency ventilation filters using appropriate assumptions for post-accident filter loading (for example, using assumptions for radioactive material entering the control room ventilation system, equivalent to material assumed in the Chapter 15 control room dose analysis).
3. Update the FSAR to provide radioactive source dimensions and parameters for major post-accident source term components such as the shutdown cooling pumps and accident emergency control room ventilation filters and identify the locations of these components.
4. Indicate if there are any filters (either normal operation or accident) physically within the main control room or technical support center areas (those areas requiring continuous access). If so, discuss shielding of these filters and the dose from these components during design basis accidents.
5. Indicate radiation shielding thicknesses for the main control room and technical support center in the FSAR and indicate how the design ensures that there are not radiation streaming paths that could affect doses to these areas.
6. Ensure that in responding to the above questions, that information in FSAR Chapter 15 is still valid (for example, ensure that emergency ventilation filter shine dose rates provided in Chapter 15 are still accurate). If not, please update the FSAR, as appropriate.

Response – (Rev. 1)

1. To determine the source term in the systems containing post-accident radioactive fluids, it is assumed that all radionuclides except noble gases released to the containment atmosphere until the early in-vessel release phase of the AST (Alternative Source Term) are mixed instantaneously and homogeneously in the primary containment sump water at the start of the accident. The specific activity of circulating water as a function of time is then calculated using the volume of the circulating water considering radioactive decay and in-growth of daughters as shown in the equation below.

$$N = \frac{C}{V} \times R \times e^{-\lambda t}$$

Where,

N : specific activity of circulating water (Bq/cm³)

R : release fraction, Table 12.2-24 of DCD

C : core inventory (Bq)

V : total volume of circulating water (cm³), 2.44E+09 cm³, Table 15.6.5-13 of DCD

λ : decay constant (hr⁻¹)

t : decay time (hr)

The total source terms (i.e., total activity) in each component of the circulating systems are calculated by multiplying the above specific activity by the volume of each component. The radioactive concentrations of post-accident recirculating water (i.e., IRWST) will be added to DCD Table 12.2-24. The source term estimation method described above is applicable to the following components of the engineered safety systems which use water in the IRWST during post-accident conditions:

- Shutdown Cooling System : shutdown cooling pumps, shutdown cooling mini flow heat exchanger
- Safety Injection System: safety injection pump
- Containment Spray System : containment spray pump, containment spray heat exchanger, containment spray mini flow heat exchanger
- Piping : associated pipes of the above systems

The list of the above components will be added to DCD Table 12.2-24 and the volumes which are considered as a source region are provided in Table 1.

Table 1 Source dimensions for component containing post-accident radioactive

fluids

Component	Location		Source		Source Dimension			
	Elevation	Room No.	Shape	Qty	Diameter (cm)	Length (cm)	Height (cm)	Volume (cm ³)
Shutdown cooling pump	50 ft	050-A04A 050-A04B	Cylinder	1	38.1	-	609.6	6.95E+05
Shutdown cooling mini flow heat exchanger	50 ft	050-A04A 050-A04B	U-tube	80	1.41	-	173.4	4.33E+04
Safety injection pump	50 ft	050-A02C 050-A02D 050-A03A 050-A03B	Cylinder	1	25.5	-	609.6	3.11E+05
Containment spray pump	50 ft	050-A01C 050-A01D	Cylinder	1	38.1	-	609.6	6.95E+05
Containment spray heat exchanger	55 ft	055-A01C 055-A01D	U-tube	346	2.93	-	701.0	3.27E+06
Containment spray mini flow heat exchanger	50 ft	050-A01C 050-A01D	Cylinder	24	2.29	-	186.1	3.68E+04

- It is assumed that the source term within the control room emergency makeup ACU is the largest value in the case of a Post-LOCA. The RADTRAD code calculates the cumulative elemental and organic iodine atoms and the aerosol mass deposited on the MCR recirculation charcoal/HEPA filters.

The amount of total iodine and aerosol activities deposited on the charcoal and HEPA filters in the Main Control Room Emergency Ventilation System is presented in Table 2. The values will be added to DCD Table 12.2-24.

Table 2 Post-Accident Total Iodine and Aerosol Activity on MCR Charcoal/HEPA Filters

Isotope	Cumulative Activity (Bq)				
	1 hr	1 day	1 hr	1 week	1 hr
I-131	2.77E+09	1.75E+10	2.25E+10	4.84E+25	3.12E+10
I-132	3.70E+09	2.33E+10	2.99E+10	7.69E+23	4.16E+10
I-133	5.30E+09	3.34E+10	4.29E+10	9.99E+24	5.96E+10
I-134	5.19E+08	3.28E+09	4.22E+09	4.16E+22	5.87E+09
I-135	3.96E+09	2.49E+10	3.20E+10	2.37E+24	4.45E+10
Co-58	1.67E+05	9.05E+05	9.54E+05	1.63E-02	9.90E+05
Co-60	1.28E+05	6.93E+05	7.30E+05	3.52E-01	7.58E+05
Rb-86	5.68E+06	3.08E+07	3.24E+07	2.17E-01	3.37E+07
Sr-89	1.99E+08	1.08E+09	1.14E+09	2.13E+01	1.18E+09
Sr-90	1.79E+07	9.69E+07	1.02E+08	4.08E+02	1.06E+08
Sr-91	2.11E+08	1.14E+09	1.20E+09	1.81E-01	1.25E+09
Sr-92	1.17E+08	6.32E+08	6.67E+08	2.89E-02	6.92E+08
Y-90	2.46E+05	1.33E+06	1.40E+06	1.40E-03	1.46E+06
Y-91	2.46E+06	1.33E+07	1.40E+07	3.11E-01	1.46E+07
Y-92	9.73E+06	5.27E+07	5.56E+07	3.14E-03	5.77E+07
Y-93	1.56E+06	8.46E+06	8.91E+06	1.45E-03	9.25E+06
Zr-95	2.85E+06	1.54E+07	1.63E+07	4.12E-01	1.69E+07
Zr-97	2.37E+06	1.28E+07	1.35E+07	3.85E-03	1.40E+07
Nb-95	2.84E+06	1.54E+07	1.62E+07	2.26E-01	1.69E+07
Mo-99	3.59E+07	1.95E+08	2.05E+08	2.33E-01	2.13E+08
Tc-99m	3.26E+07	1.77E+08	1.86E+08	1.93E-02	1.93E+08
Ru-103	3.38E+07	1.83E+08	1.93E+08	3.25E+00	2.00E+08
Ru-105	1.54E+07	8.33E+07	8.78E+07	7.11E-03	9.11E+07
Ru-106	1.51E+07	8.21E+07	8.65E+07	1.41E+01	8.97E+07
Rh-105	2.28E+07	1.24E+08	1.30E+08	8.41E-02	1.35E+08
Sb-127	3.67E+07	1.99E+08	2.10E+08	4.27E-01	2.18E+08
Sb-129	7.61E+07	4.12E+08	4.34E+08	4.21E-02	4.51E+08
Te-127	3.72E+07	2.02E+08	2.13E+08	4.39E-02	2.21E+08
Te-127m	6.30E+06	3.41E+07	3.60E+07	2.07E+00	3.73E+07
Te-129	9.43E+07	5.11E+08	5.39E+08	1.40E-02	5.59E+08
Te-129m	2.52E+07	1.36E+08	1.44E+08	2.60E+00	1.49E+08
Te-131m	7.62E+07	4.13E+08	4.35E+08	2.97E-01	4.52E+08
Te-132	5.32E+08	2.88E+09	3.04E+09	5.45E+00	3.16E+09
Cs-134	6.11E+08	3.31E+09	3.49E+09	1.47E+03	3.62E+09
Cs-136	1.56E+08	8.45E+08	8.90E+08	6.61E+00	9.24E+08
Cs-137	3.39E+08	1.83E+09	1.93E+09	1.21E+04	2.01E+09
Ba-139	5.88E+07	3.19E+08	3.36E+08	1.12E-02	3.49E+08
Ba-140	3.00E+08	1.63E+09	1.72E+09	1.28E+01	1.78E+09
La-140	4.57E+06	2.47E+07	2.61E+07	2.55E-02	2.71E+07
La-141	1.56E+06	8.46E+06	8.92E+06	8.58E-04	9.25E+06
La-142	6.40E+05	3.47E+06	3.65E+06	1.39E-04	3.79E+06
Ce-141	6.82E+06	3.69E+07	3.89E+07	7.43E-01	4.04E+07
Ce-143	6.50E+06	3.52E+07	3.71E+07	3.04E-02	3.85E+07
Ce-144	4.94E+06	2.68E+07	2.82E+07	4.82E+00	2.93E+07
Pr-143	2.73E+06	1.48E+07	1.56E+07	1.26E-01	1.61E+07
Nd-147	1.08E+06	5.86E+06	6.18E+06	4.16E-02	6.41E+06
Np-239	8.63E+07	4.67E+08	4.93E+08	1.16E+00	5.11E+08
Pu-238	2.54E+04	1.38E+05	1.45E+05	4.62E+00	1.51E+05
Pu-239	1.22E+03	6.62E+03	6.98E+03	6.11E+01	7.24E+03
Pu-240	2.30E+03	1.24E+04	1.31E+04	3.13E+01	1.36E+04
Pu-241	6.45E+05	3.50E+06	3.69E+06	1.95E+01	3.82E+06
Am-241	2.78E+02	1.50E+03	1.59E+03	2.52E-01	1.65E+03
Cm-242	1.39E+05	7.53E+05	7.94E+05	1.30E-01	8.23E+05
Cm-244	1.98E+04	1.07E+05	1.13E+05	7.62E-01	1.18E+05

- Source dimensions for component containing post-accident radioactive fluids are presented in Table 1 and will be added to DCD Table 12.2-25.

Dimensions for the MCR filter is provided in DCD Table 15.6-13 (3 of 3). The geometric model for the MCR charcoal filter shine dose calculation is shown in Figure 1. This model is based on the location of the MCR ACU and surrounding concrete shielding. In the shielding analysis, the charcoal tray of height 1.65 m is conservatively used.

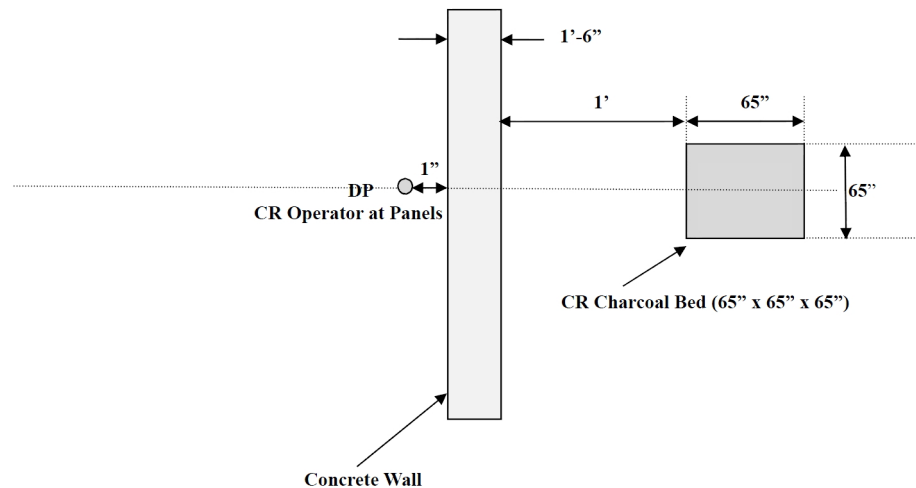


Figure 1 MCR Charcoal Filter Shine Geometric Shielding Model

- There are no additional filters to be considered in the shielding analysis within the CRE except for the emergency makeup ACU.
- The CRE is designed in accordance with the design requirements in 10 CFR Part 50, Appendix A, GDC 19, and is shielded so that, after a postulated DBA, radiation exposure in the CRE for the duration of the accident does not exceed 50 mSv TEDE.

The CRE will be maintained at a minimum 3.175 mm (0.125 in) of water gauge of positive pressure with respect to the surrounding areas to provide habitability and to prevent uncontrolled incoming air leakage during normal and emergency modes of operation.

Since the elevation of MCR and TSC is 156'-0" and the major penetrations of the containment building toward the MCR/TSC direction are located in other elevations, there is no radiation streaming path from containment to the MCR/TSC during the accident.

The shielding design and the thickness for the MCR/TSC are described in detail in Subsection 6.4.2.5 and Table 6.4-1 of the DCD.

6. As described in DCD Subsection 6.4.2.5, the MCR/TSC shielding design is performed in accordance with the guidance in RG 1.183, which is consistent with the approaches applied in Chapter 15. The assumptions, parameters and results provided in DCD Subsection 15.6.5.5 are still valid with this response.
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Impact on DCD

DCD Table 12.2-24 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

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

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

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Table 12.2-24

(1 of 14)

Source Terms for Post-Accident Shielding Analysis

Source Term ⁽¹⁾	Gap Release		Early In-Vessel Release Plus Gap Release	
	Nuclide Group ⁽²⁾	Percentage	Nuclide Group ⁽²⁾	Percentage
Liquid-containing systems ⁽³⁾	2 and 3	5 %	2	40 %
			3	30 %
			4	5 %
			5	2 %
			6	0.25 %
			7	0.02 %
			8	0.05 %
			Airborne	1, 2, and 3
2	40 %			
3	30 %			
4	5 %			
5	2 %			
6	0.25 %			
7	0.02 %			
8	0.05 %			

a. Initial Release Fraction from the Core

(1) The source terms represent the initial releases from the core into the reactor containment building sump water and atmosphere.

(2) Nuclide Group 1: Xe, Kr

Nuclide Group 2: I, Br

Nuclide Group 3: Cs, Rb

Nuclide Group 4: Te, Sb, Se

Nuclide Group 5: Sr, Ba

Nuclide Group 6: Co, Ru, Rh, Pd, Mo, Tc

Nuclide Group 7: Am, Cm, La, Zr, Nd, Eu, Nb, Pm, Pr, Sm, Y

Nuclide Group 8: Ce, Pu, Np

(3) The following components of the engineered safety systems use water in the IRWST during post-accident conditions:

- Shutdown Cooling System : shutdown cooling pumps, shutdown cooling mini flow heat exchanger

- Safety Injection System : safety injection pump

- Containment Spray System : containment spray pump, containment spray heat exchanger, containment spray mini flow heat exchanger

- Piping : associated pipes of the above systems

Add the "A" following end of this table

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"A" (Update Table 12.2-24) (1 of 13)

Table 12.2-24 (2 of 14)

b. Radioactive Concentration of Post-Accident Recirculating Water (Bq/cc) (1 of 5)

Nuclide	Elapsed Time after the onset of the Accident				
	0 hr	1 hr	1 day	1 week	1 month
Se-84	2.75E+07	9.25E+01	0.00E+00	0.00E+00	0.00E+00
Se-85	1.37E+07	2.24E-21	0.00E+00	0.00E+00	0.00E+00
Se-87	2.03E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	2.25E+08	6.08E+07	5.26E-06	8.54E-88	0.00E+00
Br-85	2.59E+08	1.30E+02	0.00E+00	0.00E+00	0.00E+00
Br-87	4.25E+08	1.61E-11	0.00E+00	0.00E+00	0.00E+00
Br-88	4.28E+08	1.40E-58	0.00E+00	0.00E+00	0.00E+00
Br-89	2.89E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85	0.00E+00	3.93E+00	2.73E+01	2.79E+01	2.78E+01
Kr-85m	0.00E+00	2.39E+06	6.80E+04	1.43E-05	1.16E-42
Rb-86	1.59E+06	1.59E+06	1.53E+06	1.23E+06	5.22E+05
Rb-88	5.74E+08	5.55E+07	2.55E-16	0.00E+00	0.00E+00
Rb-89	7.62E+08	5.15E+07	6.41E-20	0.00E+00	0.00E+00
Rb-90	7.19E+08	9.00E+01	0.00E+00	0.00E+00	0.00E+00
Rb-91	9.04E+08	2.17E-10	0.00E+00	0.00E+00	0.00E+00
Sr-89	4.68E+07	4.69E+07	4.63E+07	4.27E+07	3.11E+07
Sr-90	4.20E+06	4.20E+06	4.20E+06	4.20E+06	4.19E+06
Sr-91	6.30E+07	5.86E+07	1.09E+07	2.99E+02	9.65E-16
Sr-92	6.35E+07	4.92E+07	1.37E+05	1.38E-11	6.67E-73
Sr-95	5.93E+07	1.24E-34	0.00E+00	0.00E+00	0.00E+00
Y-90	4.43E+04	8.90E+04	9.94E+05	3.52E+06	4.19E+06
Y-91	5.74E+05	5.92E+05	9.13E+05	9.24E+05	7.03E+05
Y-91m	3.64E+05	1.98E+07	6.88E+06	1.88E+02	6.07E-16
Y-92	6.41E+05	1.04E+07	1.45E+06	1.08E-06	1.23E-53
Y-93	4.60E+05	4.29E+05	8.86E+04	4.52E+00	1.60E-16
Y-95	7.08E+05	1.35E+04	3.68E-36	0.00E+00	0.00E+00
Zr-93	0.00E+00	2.30E-05	2.80E-04	3.46E-04	3.46E-04
Zr-95	6.70E+05	6.70E+05	6.63E+05	6.21E+05	4.84E+05
Zr-97	6.37E+05	6.11E+05	2.38E+05	6.48E+02	9.53E-08
Nb-93m	0.00E+00	6.29E-11	2.30E-08	2.88E-07	1.32E-06
Nb-95	6.68E+05	6.68E+05	6.68E+05	6.65E+05	6.21E+05

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"A" (Update Table 12.2-24) (2 of 13)

Table 12.2-24 (3 of 14)

b. Radioactive Concentration of Post-Accident Recirculating Water (Bq/cc) (2 of 5)

Nuclide	Elapsed Time after the onset of the Accident				
	0 hr	1 hr	1 day	1 week	1 month
Nb-95m	0.00E+00	4.27E+01	9.32E+02	3.79E+03	4.09E+03
Nb-97	0.00E+00	2.69E+05	2.56E+05	6.98E+02	1.03E-07
Nb-97m	0.00E+00	5.80E+05	2.26E+05	6.14E+02	9.04E-08
Nb-99	4.14E+05	6.81E-71	0.00E+00	0.00E+00	0.00E+00
Mo-99	8.74E+06	8.65E+06	6.79E+06	1.50E+06	4.56E+03
Mo-103	7.79E+06	6.76E-12	0.00E+00	0.00E+00	0.00E+00
Tc-99	0.00E+00	3.22E-03	7.24E-02	2.76E-01	3.34E-01
Tc-99m	7.69E+06	7.69E+06	6.57E+06	1.46E+06	4.44E+03
Tc-103	7.89E+06	1.67E-15	0.00E+00	0.00E+00	0.00E+00
Tc-106	4.52E+06	2.32E-23	0.00E+00	0.00E+00	0.00E+00
Ru-103	7.94E+06	7.93E+06	7.80E+06	7.02E+06	4.68E+06
Ru-105	6.03E+06	5.16E+06	1.42E+05	2.45E-05	9.22E-43
Ru-106	3.57E+06	3.57E+06	3.56E+06	3.52E+06	3.37E+06
Rh-103m	0.00E+00	4.14E+06	7.79E+06	7.01E+06	4.67E+06
Rh-105	5.40E+06	5.40E+06	3.89E+06	2.33E+05	4.65E+00
Rh-105m	0.00E+00	1.27E+06	3.50E+04	6.03E-06	2.26E-43
Rh-106	0.00E+00	3.57E+06	3.56E+06	3.52E+06	3.37E+06
Sb-127	8.85E+06	8.78E+06	7.39E+06	2.51E+06	3.99E+04
Sb-129	3.03E+07	2.59E+07	6.91E+05	9.72E-05	1.67E-42
Sb-131	7.44E+07	1.22E+07	1.06E-11	0.00E+00	0.00E+00
Sb-132	4.32E+07	1.53E+01	0.00E+00	0.00E+00	0.00E+00
Sb-133	6.84E+07	2.04E+00	0.00E+00	0.00E+00	0.00E+00
Sb-134	1.32E+07	4.00E-92	0.00E+00	0.00E+00	0.00E+00
Te-127	8.77E+06	8.77E+06	8.14E+06	3.75E+06	1.29E+06
Te-127m	1.48E+06	1.48E+06	1.48E+06	1.45E+06	1.27E+06
Te-129	2.89E+07	2.80E+07	4.44E+06	3.23E+06	2.01E+06
Te-129m	5.90E+06	5.90E+06	5.81E+06	5.13E+06	3.19E+06
Te-131	7.56E+07	1.77E+07	2.50E+06	8.96E+04	2.59E-01
Te-131m	1.93E+07	1.89E+07	1.11E+07	3.98E+05	1.15E+00
Te-132	1.29E+08	1.28E+08	1.04E+08	2.91E+07	2.18E+05
Te-133	1.09E+08	1.05E+07	2.29E-01	2.58E-48	0.00E+00

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"A" (Update Table 12.2-24) (3 of 13)

Table 12.2-24 (4 of 14)

b. Radioactive Concentration of Post-Accident Recirculating Water (Bq/cc) (3 of 5)

Nuclide	Elapsed Time after the onset of the Accident				
	0 hr	1 hr	1 day	1 week	1 month
Te-133m	9.10E+07	4.30E+07	1.36E+00	1.54E-47	0.00E+00
Te-134	1.92E+08	7.10E+07	8.18E-03	4.90E-65	0.00E+00
Te-135	9.49E+07	3.42E-49	0.00E+00	0.00E+00	0.00E+00
I-129	3.70E+01	3.70E+01	3.70E+01	3.70E+01	3.70E+01
I-131	7.26E+08	7.24E+08	6.67E+08	3.99E+08	5.49E+07
I-132	1.05E+09	8.10E+08	1.08E+08	3.00E+07	2.25E+05
I-133	1.54E+09	1.49E+09	6.95E+08	5.72E+06	5.87E-02
I-134	1.75E+09	8.56E+08	1.43E+01	5.12E-49	0.00E+00
I-135	1.45E+09	1.31E+09	1.17E+08	3.24E+01	2.35E-24
I-137	7.48E+08	6.62E-36	0.00E+00	0.00E+00	0.00E+00
I-138	3.75E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-131m	0.00E+00	1.92E+04	4.30E+05	1.96E+06	1.63E+06
Xe-133	0.00E+00	8.09E+06	1.27E+08	1.20E+08	5.92E+06
Xe-133m	0.00E+00	5.72E+05	8.14E+06	3.07E+06	2.19E+03
Xe-135	0.00E+00	9.53E+07	3.09E+08	1.07E+04	6.22E-15
Xe-135m	0.00E+00	2.08E+08	2.01E+07	5.56E+00	4.04E-25
Cs-134	1.70E+08	1.70E+08	1.70E+08	1.69E+08	1.65E+08
Cs-135	3.65E+02	3.65E+02	3.65E+02	3.65E+02	3.65E+02
Cs-136	4.36E+07	4.35E+07	4.14E+07	3.02E+07	8.98E+06
Cs-137	9.41E+07	9.41E+07	9.41E+07	9.41E+07	9.39E+07
Cs-138	1.12E+09	3.08E+08	3.86E-05	6.51E-86	0.00E+00
Cs-140	9.69E+08	1.00E-08	0.00E+00	0.00E+00	0.00E+00
Ba-137m	5.98E+06	8.90E+07	8.90E+07	8.90E+07	8.89E+07
Ba-139	7.19E+07	4.36E+07	4.37E+02	2.20E-29	0.00E+00
Ba-140	7.11E+07	7.09E+07	6.73E+07	4.87E+07	1.40E+07
Ba-143	5.80E+07	1.20E-72	0.00E+00	0.00E+00	0.00E+00
Ba-144	4.84E+07	1.47E-91	0.00E+00	0.00E+00	0.00E+00
La-140	7.13E+05	1.91E+06	2.39E+07	5.15E+07	1.61E+07
La-141	6.56E+05	5.50E+05	9.62E+03	9.57E-08	6.40E-50
La-142	6.57E+05	4.25E+05	1.88E+01	1.02E-26	0.00E+00
La-143	6.51E+05	3.34E+04	7.09E-26	0.00E+00	0.00E+00

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"A" (Update Table 12.2-24) (4 of 13)

Table 12.2-24 (5 of 14)

b. Radioactive Concentration of Post-Accident Recirculating Water (Bq/cc) (4 of 5)

Nuclide	Elapsed Time after the onset of the Accident				
	0 hr	1 hr	1 day	1 week	1 month
La-144	5.93E+05	4.79E-22	0.00E+00	0.00E+00	0.00E+00
Ce-141	1.60E+06	1.60E+06	1.57E+06	1.38E+06	8.46E+05
Ce-143	1.64E+06	1.61E+06	9.91E+05	4.81E+04	4.44E-01
Ce-144	1.16E+06	1.16E+06	1.16E+06	1.14E+06	1.08E+06
Pr-143	6.39E+05	6.41E+05	6.71E+05	5.71E+05	1.78E+05
Pr-144	4.66E+05	1.10E+06	1.16E+06	1.14E+06	1.08E+06
Pr-144m	0.00E+00	1.65E+04	1.65E+04	1.63E+04	1.54E+04
Nd-147	2.57E+05	2.56E+05	2.41E+05	1.65E+05	3.87E+04
Pm-147	0.00E+00	7.74E+00	1.80E+02	1.05E+03	2.47E+03
Sm-147	0.00E+00	2.89E-15	1.63E-12	7.06E-11	8.65E-10
Tl-207	0.00E+00	1.24E-21	1.62E-21	5.24E-22	8.85E-22
Tl-208	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.29E-21
Tl-209	0.00E+00	0.00E+00	3.67E-20	3.19E-20	6.68E-21
Pb-209	0.00E+00	8.72E-21	7.73E-21	6.82E-19	4.81E-19
Pb-210	0.00E+00	0.00E+00	3.99E-16	4.62E-16	0.00E+00
Pb-211	0.00E+00	0.00E+00	1.41E-22	0.00E+00	1.61E-22
Pb-212	0.00E+00	3.13E-22	0.00E+00	0.00E+00	9.82E-21
Pb-214	0.00E+00	1.09E-15	1.09E-15	1.81E-15	4.64E-15
Bi-210	0.00E+00	7.82E-17	4.58E-16	6.84E-16	4.92E-16
Bi-211	0.00E+00	1.76E-21	1.70E-20	0.00E+00	1.26E-21
Bi-213	0.00E+00	2.75E-22	1.03E-18	4.55E-18	2.52E-18
Bi-214	0.00E+00	1.14E-15	1.21E-15	1.54E-15	4.67E-15
Po-210	0.00E+00	5.95E-16	9.23E-16	1.37E-15	1.04E-15
Po-211	0.00E+00	1.52E-24	2.40E-24	0.00E+00	1.61E-25
Po-213	0.00E+00	2.69E-22	1.01E-18	4.45E-18	2.46E-18
Po-214	0.00E+00	3.84E-16	4.37E-16	7.67E-16	3.89E-15
Po-215	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.25E-21
Po-216	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.26E-20
Po-218	0.00E+00	6.34E-16	9.98E-16	1.28E-15	4.64E-15
At-217	0.00E+00	2.15E-18	2.87E-18	4.35E-19	1.32E-19
Rn-220	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.27E-20

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"A" (Update Table 12.2-24) (5 of 13)

Table 12.2-24 (6 of 14)

b. Radioactive Concentration of Post-Accident Recirculating Water (Bq/cc) (5 of 5)

Nuclide	Elapsed Time after the onset of the Accident				
	0 hr	1 hr	1 day	1 week	1 month
Rn-222	0.00E+00	6.00E-16	2.53E-16	4.19E-16	4.00E-15
Fr-221	0.00E+00	0.00E+00	1.23E-17	4.08E-18	7.07E-19
Fr-223	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.54E-22
Ra-224	0.00E+00	4.69E-22	0.00E+00	5.97E-22	1.33E-21
Ra-225	0.00E+00	3.85E-18	2.41E-18	0.00E+00	2.46E-18
Ra-226	0.00E+00	3.49E-16	7.43E-16	1.35E-15	6.77E-15
Ra-228	0.00E+00	7.14E-22	0.00E+00	0.00E+00	6.90E-20
Ac-225	0.00E+00	1.84E-18	1.09E-20	3.42E-19	1.95E-18
Ac-227	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.79E-20
Ac-228	0.00E+00	3.55E-20	0.00E+00	2.21E-22	4.05E-20
Th-228	0.00E+00	1.03E-20	0.00E+00	4.76E-20	6.32E-20
Th-229	0.00E+00	2.40E-18	1.82E-18	6.53E-18	4.90E-18
Th-230	0.00E+00	9.12E-16	5.71E-13	2.79E-11	5.14E-10
Th-231	0.00E+00	4.34E-13	2.06E-10	4.29E-09	2.24E-08
Th-232	0.00E+00	1.12E-21	0.00E+00	1.41E-19	2.69E-18
Pa-231	0.00E+00	0.00E+00	0.00E+00	7.13E-16	1.85E-14
Pa-233	0.00E+00	1.29E-12	7.40E-10	3.55E-08	5.99E-07
U-233	0.00E+00	0.00E+00	6.15E-18	1.22E-15	7.34E-14
U-234	0.00E+00	1.93E-06	4.63E-05	3.24E-04	1.39E-03
U-235	0.00E+00	3.22E-11	7.76E-10	5.48E-09	2.36E-08
U-236	0.00E+00	1.82E-09	4.37E-08	3.06E-07	1.31E-06
U-237	0.00E+00	1.59E-02	3.63E-01	1.91E+00	3.54E+00
Np-237	0.00E+00	2.41E-09	5.83E-08	4.26E-07	2.07E-06
Np-239	2.11E+07	2.08E+07	1.57E+07	2.69E+06	3.09E+03
Pu-238	5.96E+03	5.96E+03	5.96E+03	5.96E+03	5.98E+03
Pu-239	2.87E+02	2.87E+02	2.88E+02	2.92E+02	2.93E+02
Pu-240	5.39E+02	5.39E+02	5.39E+02	5.39E+02	5.39E+02
Pu-241	1.52E+05	1.52E+05	1.52E+05	1.52E+05	1.51E+05
Am-241	6.52E+01	6.52E+01	6.59E+01	6.99E+01	8.52E+01
Cm-242	3.27E+04	3.27E+04	3.26E+04	3.17E+04	2.88E+04
Cm-244	4.66E+03	4.66E+03	4.66E+03	4.66E+03	4.65E+03

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"A" (Update Table 12.2-24) (6 of 13)

Table 12.2-24 (7 of 14)

c. Radioactive Concentration of Post-Accident Airborne in Containment (Bq/cc) (1 of 6)

Nuclide	Elapsed Time after the onset of the Accident				
	0 hr	1 hr	1 day	1 week	1 month
Se-84	7.56E+05	2.54E+00	0.00E+00	0.00E+00	0.00E+00
Se-85	3.77E+05	6.15E-23	0.00E+00	0.00E+00	0.00E+00
Se-87	5.60E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	5.92E-12	1.67E+06	1.45E-07	2.35E-89	0.00E+00
Br-85	6.55E-11	3.57E+00	0.00E+00	0.00E+00	0.00E+00
Br-87	2.03E-10	4.43E-13	0.00E+00	0.00E+00	0.00E+00
Br-88	6.82E-10	3.86E-60	0.00E+00	0.00E+00	0.00E+00
Br-89	2.56E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85	6.62E+05	6.62E+05	6.62E+05	6.61E+05	6.59E+05
Kr-85m	1.78E+07	1.53E+07	4.36E+05	9.20E-05	7.46E-42
Kr-87	3.65E+07	2.12E+07	7.60E+01	6.21E-33	0.00E+00
Kr-88	5.16E+07	4.04E+07	1.47E+05	8.04E-11	2.48E-69
Kr-89	6.63E+07	1.28E+02	0.00E+00	0.00E+00	0.00E+00
Kr-90	7.21E+07	2.13E-26	0.00E+00	0.00E+00	0.00E+00
Kr-91	4.97E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	1.89E+05	1.89E+05	1.82E+05	1.46E+05	6.20E+04
Rb-87	0.00E+00	4.70E-08	1.12E-07	1.12E-07	1.12E-07
Rb-88	1.58E+07	4.11E+07	1.65E+05	8.98E-11	2.77E-69
Rb-89	2.10E+07	2.57E+06	3.20E-21	0.00E+00	0.00E+00
Rb-90	1.98E+07	9.08E+00	1.12E-96	0.00E+00	0.00E+00
Rb-90m	0.00E+00	7.75E+01	1.90E-95	0.00E+00	0.00E+00
Rb-91	2.49E+07	5.97E-12	0.00E+00	0.00E+00	0.00E+00
Sr-89	1.29E+06	1.30E+06	1.28E+06	1.18E+06	8.60E+05
Sr-90	1.16E+05	1.16E+05	1.16E+05	1.16E+05	1.16E+05
Sr-91	1.73E+06	1.61E+06	3.00E+05	8.21E+00	2.65E-17
Sr-92	1.75E+06	1.36E+06	3.78E+03	3.81E-13	1.84E-74
Sr-95	1.63E+06	3.40E-36	0.00E+00	0.00E+00	0.00E+00
Y-90	1.22E+03	2.45E+03	2.75E+04	9.73E+04	1.16E+05
Y-91	1.58E+04	1.63E+04	2.51E+04	2.54E+04	1.93E+04
Y-91m	1.00E+04	5.44E+05	1.89E+05	5.17E+00	1.67E-17
Y-92	1.77E+04	2.88E+05	3.98E+04	2.97E-08	3.40E-55

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"A" (Update Table 12.2-24) (7 of 13)

Table 12.2-24 (8 of 14)

c. Radioactive Concentration of Post-Accident Airborne in Containment (Bq/cc) (2 of 6)

Nuclide	Elapsed Time after the onset of the Accident				
	0 hr	1 hr	1 day	1 week	1 month
Y-93	1.27E+04	1.19E+04	2.45E+03	1.25E-01	4.41E-18
Y-95	1.95E+04	3.71E+02	1.01E-37	0.00E+00	0.00E+00
Zr-93	0.00E+00	6.34E-07	7.72E-06	9.56E-06	9.56E-06
Zr-95	1.85E+04	1.85E+04	1.83E+04	1.71E+04	1.34E+04
Zr-97	1.75E+04	1.68E+04	6.54E+03	1.78E+01	2.62E-09
Nb-93m	0.00E+00	1.74E-12	6.34E-10	7.94E-09	3.65E-08
Nb-95	1.84E+04	1.84E+04	1.84E+04	1.83E+04	1.71E+04
Nb-95m	0.00E+00	1.18E+00	2.57E+01	1.05E+02	1.13E+02
Nb-97	0.00E+00	7.38E+03	7.05E+03	1.92E+01	2.82E-09
Nb-97m	0.00E+00	1.59E+04	6.20E+03	1.69E+01	2.48E-09
Nb-99	1.14E+04	1.88E-72	0.00E+00	0.00E+00	0.00E+00
Mo-99	2.41E+05	2.38E+05	1.87E+05	4.13E+04	1.26E+02
Mo-103	2.15E+05	1.86E-13	0.00E+00	0.00E+00	0.00E+00
Tc-99	0.00E+00	8.89E-05	2.00E-03	7.61E-03	9.20E-03
Tc-99m	2.12E+05	2.12E+05	1.81E+05	4.03E+04	1.22E+02
Tc-103	2.17E+05	4.60E-17	0.00E+00	0.00E+00	0.00E+00
Tc-106	1.24E+05	6.37E-25	0.00E+00	0.00E+00	0.00E+00
Ru-103	2.19E+05	2.19E+05	2.15E+05	1.94E+05	1.29E+05
Ru-105	1.66E+05	1.42E+05	3.92E+03	6.76E-07	2.54E-44
Ru-106	9.82E+04	9.82E+04	9.80E+04	9.69E+04	9.28E+04
Rh-103m	0.00E+00	1.14E+05	2.15E+05	1.93E+05	1.29E+05
Rh-105	1.49E+05	1.49E+05	1.07E+05	6.42E+03	1.28E-01
Rh-105m	0.00E+00	3.49E+04	9.62E+02	1.66E-07	6.23E-45
Rh-106	0.00E+00	9.82E+04	9.80E+04	9.69E+04	9.28E+04
Sb-127	2.44E+05	2.42E+05	2.04E+05	6.92E+04	1.10E+03
Sb-129	8.35E+05	7.13E+05	1.90E+04	2.68E-06	4.59E-44
Sb-131	2.05E+06	3.36E+05	2.92E-13	0.00E+00	0.00E+00
Sb-132	1.19E+06	4.22E-01	0.00E+00	0.00E+00	0.00E+00
Sb-133	1.89E+06	5.63E-02	0.00E+00	0.00E+00	0.00E+00
Sb-134	3.64E+05	1.10E-93	0.00E+00	0.00E+00	0.00E+00
Te-127	2.42E+05	2.42E+05	2.24E+05	1.03E+05	3.54E+04

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RAI 207-8247 - Question 12.02-16

"A" (Update Table 12.2-24) (8 of 13)

Table 12.2-24 (9 of 14)

c. Radioactive Concentration of Post-Accident Airborne in Containment (Bq/cc) (3 of 6)

Nuclide	Elapsed Time after the onset of the Accident				
	0 hr	1 hr	1 day	1 week	1 month
Te-127m	4.07E+04	4.07E+04	4.07E+04	3.99E+04	3.49E+04
Te-129	7.96E+05	7.72E+05	1.23E+05	8.93E+04	5.56E+04
Te-129m	1.63E+05	1.63E+05	1.60E+05	1.42E+05	8.82E+04
Te-131	2.08E+06	4.88E+05	6.88E+04	2.47E+03	7.14E-03
Te-131m	5.32E+05	5.20E+05	3.06E+05	1.10E+04	3.17E-02
Te-132	3.55E+06	3.52E+06	2.87E+06	8.01E+05	6.01E+03
Te-133	3.01E+06	2.90E+05	6.30E-03	7.11E-50	0.00E+00
Te-133m	2.51E+06	1.18E+06	3.76E-02	4.24E-49	0.00E+00
Te-134	5.30E+06	1.96E+06	2.26E-04	1.35E-66	0.00E+00
Te-135	2.61E+06	9.41E-51	0.00E+00	0.00E+00	0.00E+00
I-129	2.28E-23	1.02E+00	1.02E+00	1.02E+00	1.02E+00
I-131	1.62E-14	1.99E+07	1.84E+07	1.10E+07	1.51E+06
I-132	1.36E-12	2.24E+07	2.97E+06	8.25E+05	6.19E+03
I-133	1.50E-13	4.10E+07	1.91E+07	1.57E+05	1.61E-03
I-134	3.57E-12	2.36E+07	3.94E-01	1.41E-50	0.00E+00
I-135	4.74E-13	3.59E+07	3.22E+06	8.91E-01	6.47E-26
I-137	4.61E-10	1.82E-37	0.00E+00	0.00E+00	0.00E+00
I-138	1.73E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-131m	7.36E+05	7.35E+05	7.06E+05	5.42E+05	1.72E+05
Xe-133	1.05E+08	1.05E+08	9.58E+07	4.56E+07	2.20E+06
Xe-133m	3.23E+06	3.20E+06	2.58E+06	4.37E+05	3.03E+02
Xe-135	3.16E+07	3.25E+07	1.37E+07	3.86E+02	2.23E-16
Xe-135m	2.19E+07	7.17E+06	5.53E+05	1.53E-01	1.11E-26
Xe-137	9.66E+07	1.86E+03	0.00E+00	0.00E+00	0.00E+00
Xe-138	9.77E+07	5.15E+06	2.05E-23	0.00E+00	0.00E+00
Xe-140	5.76E+07	1.19E-72	0.00E+00	0.00E+00	0.00E+00
Cs-134	4.67E+06	4.67E+06	4.67E+06	4.64E+06	4.54E+06
Cs-135	1.01E+01	1.01E+01	1.01E+01	1.01E+01	1.01E+01
Cs-136	1.20E+06	1.20E+06	1.14E+06	8.30E+05	2.47E+05
Cs-137	2.59E+06	2.59E+06	2.59E+06	2.59E+06	2.59E+06
Cs-138	3.09E+07	2.55E+07	3.70E-06	6.24E-87	0.00E+00

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"A" (Update Table 12.2-24) (9 of 13)

Table 12.2-24 (10 of 14)

c. Radioactive Concentration of Post-Accident Airborne in Containment (Bq/cc) (4 of 6)

Nuclide	Elapsed Time after the onset of the Accident				
	0 hr	1 hr	1 day	1 week	1 month
Cs-140	2.67E+07	2.76E-10	0.00E+00	0.00E+00	0.00E+00
Ba-137m	1.65E+05	2.45E+06	2.45E+06	2.45E+06	2.45E+06
Ba-139	1.98E+06	1.20E+06	1.20E+01	6.05E-31	0.00E+00
Ba-140	1.96E+06	1.96E+06	1.86E+06	1.34E+06	3.86E+05
Ba-143	1.60E+06	3.31E-74	0.00E+00	0.00E+00	0.00E+00
Ba-144	1.33E+06	4.03E-93	0.00E+00	0.00E+00	0.00E+00
La-140	1.96E+04	5.27E+04	6.58E+05	1.42E+06	4.44E+05
La-141	1.81E+04	1.52E+04	2.65E+02	2.64E-09	1.77E-51
La-142	1.81E+04	1.17E+04	5.17E-01	2.82E-28	0.00E+00
La-143	1.79E+04	9.18E+02	1.95E-27	0.00E+00	0.00E+00
La-144	1.63E+04	1.32E-23	0.00E+00	0.00E+00	0.00E+00
Ce-141	4.41E+04	4.41E+04	4.33E+04	3.81E+04	2.33E+04
Ce-143	4.50E+04	4.41E+04	2.72E+04	1.32E+03	1.22E-02
Ce-144	3.20E+04	3.20E+04	3.19E+04	3.15E+04	2.97E+04
Pr-143	1.76E+04	1.77E+04	1.85E+04	1.57E+04	4.89E+03
Pr-144	1.28E+04	3.02E+04	3.19E+04	3.15E+04	2.97E+04
Pr-144m	0.00E+00	4.56E+02	4.56E+02	4.50E+02	4.25E+02
Nd-147	7.07E+03	7.05E+03	6.64E+03	4.54E+03	1.06E+03
Pm-147	0.00E+00	2.13E-01	4.95E+00	2.89E+01	6.79E+01
Sm-147	0.00E+00	7.94E-17	4.48E-14	1.94E-12	2.38E-11
Tl-207	0.00E+00	3.42E-23	4.46E-23	1.44E-23	2.44E-23
Tl-208	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.29E-23
Tl-209	0.00E+00	0.00E+00	1.01E-21	8.81E-22	1.85E-22
Pb-209	0.00E+00	2.40E-22	2.13E-22	1.88E-20	1.33E-20
Pb-210	0.00E+00	0.00E+00	1.10E-17	1.27E-17	0.00E+00
Pb-211	0.00E+00	0.00E+00	3.88E-24	0.00E+00	4.44E-24
Pb-212	0.00E+00	8.59E-24	0.00E+00	0.00E+00	2.70E-22
Pb-214	0.00E+00	2.99E-17	3.00E-17	4.98E-17	1.28E-16
Bi-210	0.00E+00	2.15E-18	1.26E-17	1.88E-17	1.35E-17
Bi-211	0.00E+00	4.85E-23	4.67E-22	0.00E+00	3.47E-23
Bi-213	0.00E+00	7.55E-24	2.85E-20	1.26E-19	6.95E-20

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"A" (Update Table 12.2-24) (10 of 13)

Table 12.2-24 (11 of 14)

c. Radioactive Concentration of Post-Accident Airborne in Containment (Bq/cc) (5 of 6)

Nuclide	Elapsed Time after the onset of the Accident				
	0 hr	1 hr	1 day	1 week	1 month
Bi-214	0.00E+00	3.15E-17	3.34E-17	4.25E-17	1.29E-16
Po-210	0.00E+00	1.64E-17	2.54E-17	3.76E-17	2.86E-17
Po-211	0.00E+00	4.18E-26	6.62E-26	0.00E+00	4.43E-27
Po-213	0.00E+00	7.39E-24	2.79E-20	1.23E-19	6.80E-20
Po-214	0.00E+00	1.06E-17	1.20E-17	2.11E-17	1.07E-16
Po-215	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.43E-23
Po-216	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.46E-22
Po-218	0.00E+00	1.74E-17	2.75E-17	3.53E-17	1.28E-16
At-217	0.00E+00	5.92E-20	7.92E-20	1.20E-20	3.64E-21
Rn-220	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.48E-22
Rn-222	0.00E+00	1.65E-17	6.97E-18	1.15E-17	1.10E-16
Fr-221	0.00E+00	0.00E+00	3.38E-19	1.13E-19	1.95E-20
Fr-223	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.75E-24
Ra-224	0.00E+00	1.29E-23	0.00E+00	1.64E-23	3.66E-23
Ra-225	0.00E+00	1.06E-19	6.65E-20	0.00E+00	6.79E-20
Ra-226	0.00E+00	9.61E-18	2.04E-17	3.72E-17	1.86E-16
Ra-228	0.00E+00	1.96E-23	0.00E+00	0.00E+00	1.89E-21
Ac-225	0.00E+00	5.06E-20	2.99E-22	9.45E-21	5.38E-20
Ac-227	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E-21
Ac-228	0.00E+00	9.75E-22	0.00E+00	6.08E-24	1.11E-21
Th-228	0.00E+00	2.82E-22	0.00E+00	1.31E-21	1.74E-21
Th-229	0.00E+00	6.64E-20	5.03E-20	1.80E-19	1.35E-19
Th-230	0.00E+00	2.51E-17	1.57E-14	7.69E-13	1.41E-11
Th-231	0.00E+00	1.19E-14	5.66E-12	1.18E-10	6.17E-10
Th-232	0.00E+00	3.08E-23	0.00E+00	3.88E-21	7.37E-20
Pa-231	0.00E+00	0.00E+00	0.00E+00	1.96E-17	5.09E-16
Pa-233	0.00E+00	3.56E-14	2.04E-11	9.80E-10	1.65E-08
U-233	0.00E+00	0.00E+00	1.70E-19	3.37E-17	2.03E-15
U-234	0.00E+00	5.30E-08	1.27E-06	8.91E-06	3.82E-05
U-235	0.00E+00	8.88E-13	2.14E-11	1.51E-10	6.50E-10
U-236	0.00E+00	5.00E-11	1.20E-09	8.40E-09	3.60E-08

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"A" (Update Table 12.2-24) (11 of 13)

Table 12.2-24 (12 of 14)

c. Radioactive Concentration of Post-Accident Airborne in Containment (Bq/cc) (6 of 6)

Nuclide	Elapsed Time after the onset of the Accident				
	0 hr	1 hr	1 day	1 week	1 month
U-237	0.00E+00	4.37E-04	9.99E-03	5.25E-02	9.74E-02
Np-237	0.00E+00	6.65E-11	1.61E-09	1.18E-08	5.71E-08
Np-239	5.81E+05	5.74E+05	4.33E+05	7.40E+04	8.50E+01
Pu-238	1.64E+02	1.64E+02	1.64E+02	1.64E+02	1.64E+02
Pu-239	7.90E+00	7.90E+00	7.94E+00	8.04E+00	8.06E+00
Pu-240	1.48E+01	1.48E+01	1.48E+01	1.48E+01	1.48E+01
Pu-241	4.18E+03	4.18E+03	4.18E+03	4.18E+03	4.16E+03
Am-241	1.80E+00	1.80E+00	1.82E+00	1.93E+00	2.35E+00
Cm-242	9.01E+02	9.01E+02	8.97E+02	8.75E+02	7.93E+02
Cm-244	1.28E+02	1.28E+02	1.28E+02	1.28E+02	1.28E+02

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RAI 207-8247 - Question 12.02-16

"A" (Update Table 12.2-24) (12 of 13)

RAI 207-8247 - Question 12.02-16_Rev.1

Table 12.2-24 (13 of 14)

d. MCR Emergency Makeup ACU Filter Inventories (Bq) (1 of 2)

Nuclide	Elapsed Time after the onset of the Accident				
	1 hr	1 hr	4 days	1 week	1 month
I-131	2.82E+08	7.49E+09	1.25E+10	1.53E+10	2.34E+10
I-132	3.76E+08	9.98E+09	1.66E+10	2.04E+10	3.11E+10
I-133	5.40E+08	1.43E+10	2.39E+10	2.93E+10	4.47E+10
I-134	5.34E+07	1.42E+09	2.36E+09	2.89E+09	4.42E+09
I-135	4.04E+08	1.07E+10	1.78E+10	2.19E+10	3.34E+10
Co-58	5.41E+05	4.61E+06	4.87E+06	4.97E+06	5.06E+06
Co-60	4.14E+05	3.53E+06	3.73E+06	3.81E+06	3.87E+06
Rb-86	1.84E+07	1.57E+08	1.65E+08	1.69E+08	1.72E+08
Sr-89	6.44E+08	5.49E+09	5.80E+09	5.93E+09	6.02E+09
Sr-90	5.79E+07	4.94E+08	5.21E+08	5.33E+08	5.42E+08
Sr-91	6.83E+08	5.82E+09	6.14E+09	6.28E+09	6.38E+09
Sr-92	3.79E+08	3.23E+09	3.41E+09	3.49E+09	3.54E+09
Y-90	8.04E+05	6.85E+06	7.23E+06	7.40E+06	7.52E+06
Y-91	7.95E+06	6.78E+07	7.16E+07	7.32E+07	7.44E+07
Y-92	3.25E+07	2.77E+08	2.93E+08	2.99E+08	3.04E+08
Y-93	5.06E+06	4.31E+07	4.55E+07	4.65E+07	4.73E+07
Zr-95	9.23E+06	7.86E+07	8.30E+07	8.49E+07	8.63E+07
Zr-97	7.68E+06	6.54E+07	6.91E+07	7.06E+07	7.18E+07
Nb-95	9.21E+06	7.85E+07	8.29E+07	8.47E+07	8.61E+07
Mo-99	1.16E+08	9.91E+08	1.05E+09	1.07E+09	1.09E+09
Tc-99m	1.06E+08	9.00E+08	9.50E+08	9.72E+08	9.88E+08
Ru-103	1.09E+08	9.31E+08	9.83E+08	1.01E+09	1.02E+09
Ru-105	4.99E+07	4.25E+08	4.49E+08	4.59E+08	4.66E+08
Ru-106	4.90E+07	4.18E+08	4.41E+08	4.51E+08	4.58E+08
Rh-105	7.39E+07	6.30E+08	6.65E+08	6.80E+08	6.91E+08
Sb-127	1.19E+08	1.01E+09	1.07E+09	1.09E+09	1.11E+09
Sb-129	2.47E+08	2.10E+09	2.22E+09	2.27E+09	2.31E+09
Te-127	1.21E+08	1.03E+09	1.09E+09	1.11E+09	1.13E+09
Te-127m	2.04E+07	1.74E+08	1.83E+08	1.88E+08	1.91E+08
Te-129	3.07E+08	2.61E+09	2.76E+09	2.82E+09	2.87E+09
Te-129m	8.15E+07	6.95E+08	7.34E+08	7.50E+08	7.62E+08

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RAI 207-8247 - Question 12.02-16

RAI 207-8247 - Question 12.02-16_Rev.1

"A" (Update Table 12.2-24) (13 of 13)

Table 12.2-24 (14 of 14)

d. MCR Emergency Makeup ACU Filter Inventories (Bq) (2 of 2)

Nuclide	Elapsed Time after the onset of the Accident				
	1 hr	1 hr	4 days	1 week	1 month
Te-131m	2.47E+08	2.10E+09	2.22E+09	2.27E+09	2.31E+09
Te-132	1.72E+09	1.47E+10	1.55E+10	1.59E+10	1.61E+10
Cs-134	1.98E+09	1.68E+10	1.78E+10	1.82E+10	1.85E+10
Cs-136	5.05E+08	4.30E+09	4.54E+09	4.64E+09	4.72E+09
Cs-137	1.10E+09	9.34E+09	9.86E+09	1.01E+10	1.02E+10
Ba-139	1.92E+08	1.63E+09	1.72E+09	1.76E+09	1.79E+09
Ba-140	9.73E+08	8.29E+09	8.75E+09	8.95E+09	9.10E+09
La-140	1.50E+07	1.28E+08	1.35E+08	1.38E+08	1.40E+08
La-141	5.07E+06	4.32E+07	4.56E+07	4.66E+07	4.74E+07
La-142	2.08E+06	1.77E+07	1.87E+07	1.92E+07	1.95E+07
Ce-141	2.21E+07	1.88E+08	1.99E+08	2.03E+08	2.06E+08
Ce-143	2.10E+07	1.79E+08	1.89E+08	1.94E+08	1.97E+08
Ce-144	1.60E+07	1.36E+08	1.44E+08	1.47E+08	1.50E+08
Pr-143	8.82E+06	7.52E+07	7.94E+07	8.12E+07	8.25E+07
Nd-147	3.50E+06	2.99E+07	3.15E+07	3.22E+07	3.27E+07
Np-239	2.79E+08	2.38E+09	2.51E+09	2.57E+09	2.61E+09
Pu-238	8.24E+04	7.02E+05	7.41E+05	7.58E+05	7.70E+05
Pu-239	3.96E+03	3.37E+04	3.56E+04	3.64E+04	3.70E+04
Pu-240	7.43E+03	6.33E+04	6.69E+04	6.84E+04	6.95E+04
Pu-241	2.09E+06	1.78E+07	1.88E+07	1.92E+07	1.95E+07
Am-241	8.99E+02	7.66E+03	8.09E+03	8.27E+03	8.41E+03
Cm-242	4.50E+05	3.83E+06	4.05E+06	4.14E+06	4.21E+06
Cm-244	6.42E+04	5.47E+05	5.78E+05	5.91E+05	6.00E+05

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"A" (Update Table 12.2-24) (12 of 13)

Table 12.2-24 (13 of 14)

d. MCR Emergency Makeup ACU Filter Inventories (Bq) (1 of 2)

Nuclide	Elapsed Time After the Onset of the Accident				
	1 hour	1 day	4 days	1 week	1 month
I-131	2.77E+09	1.75E+10	2.25E+10	4.84E+25	3.12E+10
I-132	3.70E+09	2.33E+10	2.99E+10	7.69E+23	4.16E+10
I-133	5.30E+09	3.34E+10	4.29E+10	9.99E+24	5.96E+10
I-134	5.19E+08	3.28E+09	4.22E+09	4.16E+22	5.87E+09
I-135	3.96E+09	2.49E+10	3.20E+10	2.37E+24	4.45E+10
Co-58	1.67E+05	9.05E+05	9.54E+05	1.63E-02	9.90E+05
Co-60	1.28E+05	6.93E+05	7.30E+05	3.52E-01	7.58E+05
Rb-86	5.68E+06	3.08E+07	3.24E+07	2.17E-01	3.37E+07
Sr-89	1.99E+08	1.08E+09	1.14E+09	2.13E+01	1.18E+09
Sr-90	1.79E+07	9.69E+07	1.02E+08	4.08E+02	1.06E+08
Sr-91	2.11E+08	1.14E+09	1.20E+09	1.81E-01	1.25E+09
Sr-92	1.17E+08	6.32E+08	6.67E+08	2.89E-02	6.92E+08
Y-90	2.46E+05	1.33E+06	1.40E+06	1.40E-03	1.46E+06
Y-91	2.46E+06	1.33E+07	1.40E+07	3.11E-01	1.46E+07
Y-92	9.73E+06	5.27E+07	5.56E+07	3.14E-03	5.77E+07
Y-93	1.56E+06	8.46E+06	8.91E+06	1.45E-03	9.25E+06
Zr-95	2.85E+06	1.54E+07	1.63E+07	4.12E-01	1.69E+07
Zr-97	2.37E+06	1.28E+07	1.35E+07	3.85E-03	1.40E+07
Nb-95	2.84E+06	1.54E+07	1.62E+07	2.26E-01	1.69E+07
Mo-99	3.59E+07	1.95E+08	2.05E+08	2.33E-01	2.13E+08
Tc-99m	3.26E+07	1.77E+08	1.86E+08	1.93E-02	1.93E+08
Ru-103	3.38E+07	1.83E+08	1.93E+08	3.25E+00	2.00E+08
Ru-105	1.54E+07	8.33E+07	8.78E+07	7.11E-03	9.11E+07
Ru-106	1.51E+07	8.21E+07	8.65E+07	1.41E+01	8.97E+07
Rh-105	2.28E+07	1.24E+08	1.30E+08	8.41E-02	1.35E+08
Sb-127	3.67E+07	1.99E+08	2.10E+08	4.27E-01	2.18E+08
Sb-129	7.61E+07	4.12E+08	4.34E+08	4.21E-02	4.51E+08
Te-127	3.72E+07	2.02E+08	2.13E+08	4.39E-02	2.21E+08
Te-127m	6.30E+06	3.41E+07	3.60E+07	2.07E+00	3.73E+07
Te-129	9.43E+07	5.11E+08	5.39E+08	1.40E-02	5.59E+08
Te-129m	2.52E+07	1.36E+08	1.44E+08	2.60E+00	1.49E+08

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"A" (Update Table 12.2-24) (13 of 13)

Table 12.2-24 (14 of 14)

d. MCR Emergency Makeup ACU Filter Inventories (Bq) (2 of 2)

Nuclide	Elapsed Time After the Onset of the Accident				
	1 hour	1 day	4 days	1 week	1 month
Te-131m	7.62E+07	4.13E+08	4.35E+08	2.97E-01	4.52E+08
Te-132	5.32E+08	2.88E+09	3.04E+09	5.45E+00	3.16E+09
Cs-134	6.11E+08	3.31E+09	3.49E+09	1.47E+03	3.62E+09
Cs-136	1.56E+08	8.45E+08	8.90E+08	6.61E+00	9.24E+08
Cs-137	3.39E+08	1.83E+09	1.93E+09	1.21E+04	2.01E+09
Ba-139	5.88E+07	3.19E+08	3.36E+08	1.12E-02	3.49E+08
Ba-140	3.00E+08	1.63E+09	1.72E+09	1.28E+01	1.78E+09
La-140	4.57E+06	2.47E+07	2.61E+07	2.55E-02	2.71E+07
La-141	1.56E+06	8.46E+06	8.92E+06	8.58E-04	9.25E+06
La-142	6.40E+05	3.47E+06	3.65E+06	1.39E-04	3.79E+06
Ce-141	6.82E+06	3.69E+07	3.89E+07	7.43E-01	4.04E+07
Ce-143	6.50E+06	3.52E+07	3.71E+07	3.04E-02	3.85E+07
Ce-144	4.94E+06	2.68E+07	2.82E+07	4.82E+00	2.93E+07
Pr-143	2.73E+06	1.48E+07	1.56E+07	1.26E-01	1.61E+07
Nd-147	1.08E+06	5.86E+06	6.18E+06	4.16E-02	6.41E+06
Np-239	8.63E+07	4.67E+08	4.93E+08	1.16E+00	5.11E+08
Pu-238	2.54E+04	1.38E+05	1.45E+05	4.62E+00	1.51E+05
Pu-239	1.22E+03	6.62E+03	6.98E+03	6.11E+01	7.24E+03
Pu-240	2.30E+03	1.24E+04	1.31E+04	3.13E+01	1.36E+04
Pu-241	6.45E+05	3.50E+06	3.69E+06	1.95E+01	3.82E+06
Am-241	2.78E+02	1.50E+03	1.59E+03	2.52E-01	1.65E+03
Cm-242	1.39E+05	7.53E+05	7.94E+05	1.30E-01	8.23E+05
Cm-244	1.98E+04	1.07E+05	1.13E+05	7.62E-01	1.18E+05

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Table 12.2-25 (1 of 3)

700.06	Water : 48%	0.59
747.71	Vapor : 52%	0.001293

Radioactive Source Dimensions and Parameters Used in Shielding Analysis

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)
Reactor Containment Building	Pressurizer	Cylinder	244.48	-	706.66	Water: 100 %	0.59	Steel	12.38
	Reactor coolant pump	Cylinder	185.00	-	126.74	Water: 100 %	0.75	Steel	14.00
	Reactor drain tank	Cylinder	Liquid: 162.90 Vapor: 99.70	-	528.57	Water: 27 % Vapor: 73 %	1.00 0.001293	Not considered	
	Regenerative HX	Cylinder	24.69	-	400.69	Water: 85 % Steel: 15 %	0.85 1.18	Steel	2.22
	Letdown HX	Cylinder	45.72	-	341.36	Water: 88 % Steel: 12 %	0.88 0.95	Steel	2.54
	Steam generator	Annular cylinder	OD: 497.80 ID: 415.80	-	969.57	Water: 100 %	0.70	Steel	12.86
Auxiliary Building	SC HX	Cylinder	68.58	-	803.15	Water: 94 % Steel: 6 %	0.94 0.54	Steel	1.27
	SC miniflow HX	Cylinder	33.66	-	173.43	Water: 93 % Steel: 7 %	0.93 0.59	Steel	0.95
	Charging pump miniflow HX	Cylinder	38.10	-	298.70	Water: 94 % Steel: 6 %	0.94 0.50	Steel	1.27
	CS HX	Cylinder	129.54	-	701.04	Water: 94 % Steel: 6 %	0.94 0.49	Steel	1.59

SC pump Cylinder 38.1 - 609.6 Water: 100% 1 Steel 1.27

(1)

12.2-56

Rev. 0

(1) For post-accident, the volume to estimate source term in the heat exchanger is limited to the volume of tube side. (SC mini flow HX : 4.33E+04 cm³, CS HX : 3.27E+06 cm³)

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CS pump	Cylinder	38.1	-	609.6	Water: 100%	1	Steel	1.27
SI pump	Cylinder	25.5	-	609.6	Water: 100%	1	Steel	0.93

Table 12.2-25 (2 of 3)

Liquid: 96.80
Vapor: 96.80

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	CS miniflow HX	Cylinder	31.75	-	186.06	Water: 94 % Steel: 6 %	0.94 0.45	Steel	0.95
	Equipment drain tank	Cylinder	193.59	-	610.87	Water: 50 % Vapor: 50 %	1.00 0.001293	Not considered	
	Boric acid concentrator	Cylinder	Liquid: 193.53 Vapor: 206.58	-	180.52	Water: 47 % Vapor: 53 %	1.00 0.001293	Not considered	
	SC HX	Cylinder	137.16	-	803.15	Water: 94 % Vapor: 6 %	0.942 0.453	Steel	1.27
	SFP cleanup demin.	Cylinder	145.70	-	144.17	Water: 100 %	1.00	Not considered	
	Boric acid condensate IX	Cylinder	74.60	-	206.17	Water: 100 %	1.00	Not considered	
	Deborating IX	Cylinder	105.08	-	104.49	Water: 100 %	1.00	Not considered	
	Pre-holdup IX	Cylinder	52.54	-	104.49	Water: 100 %	1.00	Not considered	
	Purification IX	Cylinder	52.54	-	104.49	Water: 100 %	1.00	Not considered	
	SFP cooling HX	Rectangular parallelepiped	31.19	134.16	198.28	Water: 67 % Steel: 33 %	0.67 2.63	Not considered	
	Volume control tank	Cylinder	120.72	-	218.09	Water: 40 % Vapor: 60 %	1.00 0.001293	Not considered	
	SGBD flash tank	Cylinder	152.40	-	455.96	Water: 100 %	1.00	Not considered	
SGBD HX	Cylinder	42.43	-	487.68	Water: 86 % Steel: 14 %	0.90 1.12	Steel	1.27	

Delete this line

Liquid: 223.23
Vapor: 330.72

(1)

1) For post-accident, the volume to estimate source term in the CS mini flow heat exchanger is limited to the volume of tube side, 3.68E+04 cm³