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.:	**103-7998**
SRP Section:	**12.02 – Radiation Sources**
Application Section:	**12.2**
Date of RAI Issue:	**07/22/2015**

Question No. 12.02-10

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.

ISSUE

FSAR Table 15A-1 provides the core fission product inventories for 60 essential isotopes. This list includes the isotopes Y-90, Rb-86, Sr-92, Y-92, Zr-97, Ru-105, Sb-127, Sb-129, Te-127, Te-127m, Ba-139, La-141, La-142, Rh-105, Pr-143, Nd-147, Pu-238, Pu-289, Pu-240, Pu-241, Am-241, Cm-242, Cm-244. In addition, source terms for the liquid waste management system (LWMS) and solid waste management system (SWMS) include some of these isotopes. However, the RCS design basis source terms provided in FSAR Tables 11.1-2 and 12.2-5 and other relevant source terms in Chapter 11 and Chapter 12 do not include these isotopes.

In addition, other isotopes such as Rh-103m and Rh-106 appear in the waste management system source terms but do not appear in the source term for other components.

Finally, APR1400 component source terms contain fewer isotopes than other new reactor applications and many of these isotopes are included in other new reactor application source terms.

INFORMATION NEEDED

It is unclear why the afore mentioned isotopes would not be included in the design basis RCS source terms and all other relevant source terms in Chapter 11 and 12, when they are essential

isotopes relevant to core inventory and some of them appear relevant and are included in the LWMS and SWMS source terms.

Please update the FSAR to include the calculated activities of these isotopes within the source terms or provide justification for why these isotopes are not needed in FSAR Tables 11.1-2 and 12.2-5, as well as in all other sources listed within Chapters 11 and 12.

Response

The principal radionuclides of the design basis RCS source terms conform to ANSI/ANS-18.1-1999, Table 6. This standard lists the RCS expected source terms for use in estimating the expected release of radioactivity from various effluent streams. It is reasonable to use the same nuclides between the expected source terms and the design basis source terms.

The source terms for LWMS and SWMS are calculated using the RCS source terms. However, since the DIJESTER code used to determine the LWMS source term is capable of considering daughter nuclides such as Y-90 and Pr-143, which are produced from Sr-90 and Ce-143, respectively, these nuclides are included in the LWMS source term. In addition, since the SWMS source term includes the resins and sludge generated from the LWMS, the SWMS source term also includes the above daughter nuclides.

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.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

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Docket No. 52-046

RAI No.:	**103-7998**
SRP Section:	**12.02 – Radiation Sources**
Application Section:	**12.2**
Date of RAI Issue:	**07/22/2015**

Question No. 12.02-11

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.

ISSUE

A review of the gaseous radwaste system (GRS) in Chapters 11 and 12 reveals apparent missing information and anomalies in the FSAR. Staff needs this information to conduct source term and shielding design reviews as well as to conduct the SRP Chapter 11 review. Therefore, the staff has the following questions.

INFORMATION NEEDED

1. A review of FSAR Chapters 11 and 12 reveals that for some noble gas isotopes, the 1% failed fuel source term is lower than both the expected and 0.25% failed fuel source term in both the RCS and the GRS. The 1% RCS source term assumes continuous gas stripping while the expected and 0.25% source term assumes no gas stripping. However, based on the system information provided in Chapter 11, it would appear that stripped gas would accumulate in the GRS. Therefore, it is unclear how gas stripping would result in both a decrease in RCS and GRS source terms.

    a. Please revise the source terms for the RCS and/or GRS, as appropriate, to ensure that noble gases are accounted for in the 1% source term, or explain how gas stripping is reducing the inventory in both the RCS and GRS.

b. Discuss how the response to this question, and any changes made to the FSAR as a result of this response, effect the information regarding BTP 11-5 and the BTP 11-5 analysis, and update the FSAR, as appropriate.

2. Please explain how the values for “At Inlet” in Tables 11.3-11 and 12.2-19 were determined and update the FSAR as appropriate with this information.

3. Please include the 0.25% header drain tank, guard bed, and waste gas dryer source terms in Chapter 12 or justify not including them.

4. Please include the dimensions and parameters for the delay beds, guard beds, waste gas dryer, and header drain tank in FSAR Table 12.2-25 or justify not including them in the table.

5. FSAR Table 11.3-4 indicates that there is a HEPA filter as part of the GRS package. Please include the 0.25% failed fuel source term for this filter in Chapter 12 and associated dimensions and parameters in Table 12.2-25 or justify not including it.

Response

1. a. The gas stripper removal efficiency for noble gases is 0.999. For noble gases, there are four nuclides which the concentrations of 1% source term are lower than those of 0.25% source term in the RCS. These nuclides are Kr-85, Xe-131m, Xe-133m, and Xe-133. The half-lives of these four nuclides are longer than the half-lives of other noble gases. For 1% source terms in RCS, these nuclides are removed by the gas stripper operation. For 0.25% source terms in RCS, the concentrations of these nuclides are increased until the end of cycle because there is no gas stripper operation. For noble gases with long half-lives, the concentrations of 1% source terms are lower than those of 0.25% source terms.

   b. Based on the explanation provided in the response to Item 1.a, no change to the DCD is needed.

   As for the BTP 11-5 analysis, the GRS source term for the 1% failed fuel was calculated using 0.25% RCS source terms with no gas stripping multiplied by a factor of 4 (0.25% → 1%) so that the gaseous releases due to the GRS failure are based on 1% fuel failure with no gas stripping. Since this approach maximizes the gaseous releases due to GRS failure, the current BTP 11-5 analysis is not affected by the above concerns.

2. The inlet source to the GRS header from CVCS components is determined using Eq. 1 shown below.

$$C_{input}=\frac{C_{GS}\times F_{GS}+C_{RDT}\times F_{RDT}+C_{VCT}\times F_{VCT}+C_{EDT}\times F_{EDT}}{F_{GS}+F_{RDT}+F_{VCT}+F_{EDT}} \quad \text{Eq. 1}$$

Where,

C : Concentration [Bq/cc]

F : Flow rate [cfm].

Subscripts used in Eq. 1 are as follows:

GS : Gas Stripper

RDT : Reactor Drain Tank

VCT : Volume Control Tank

EDT : Equipment Drain Tank.

DCD Subsection 11.3.1.5 will be updated to include this equation.

3. The 0.25% source terms for the header drain tank, the guard beds, and the waste gas dryer will be included in DCD Table 12.2-19.
4. DCD Table 12.2-25 will be revised to include the dimensions and parameters for the delay beds, guard beds, waste gas dryer, and header drain tank.
5. Since all iodines are captured in the guard bed and delay beds of GRS and the particulates are not transferred to GRS from CVCS, only noble gases are carried into the HEPA filter. Therefore, the HEPA filter shielding calculation assumes that noble gases with concentrations at the outlet of the delay beds are collected in the HEPA filter vessel. The source term calculated using this assumption will be added in DCD Table 12.2-19.

Impact on DCD

DCD Sections 11.3, Table 12.2-19, and Table 12.2-25 will be revised as indicated in Attachments 1 through 3.

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.

The GRS uses equipment that is commonly used in the nuclear power industry, whose performance is proven and documented. The equipment is sized to process waste gases using design basis source term and design conditions that bound normal operation including AOOs. The equipment is also housed in the compound building with sufficient shielding. Charcoal guard beds reduce the concentration of radioactive iodine in the effluent stream. Noble gases are delayed in the charcoal beds to facilitate decay prior to release.

GRS equipment is designed, located, and shielded to conform with the guidance of NRC RG 8.8 (Reference 11), thus maintaining occupational doses ALARA.

The GRS includes radiation monitoring to continuously measure the radioactivity in the effluent stream prior to release into the environment to conform with the requirements of GDC 60 (Reference 13) and 64 (Reference 15). Additional and redundant radiation monitors are provided in the building ventilation system to verify the radiation level. Upon detection of radiation levels above the setpoint, the monitor activates an alarm and sends signals to close the GRS discharge valves. Hence, the GRS design precludes the unmonitored and uncontrolled releases of radioactivity to the environment to meet the requirements of IE Bulletin 80-10 (Reference 19).

The GRS is designed with at least two isolation valves between the clean and contaminated systems to minimize the potential for contamination of clean systems. This feature meets the requirements of 10 CFR 20.1406 (Reference 23) and RG 4.21 (Reference 18).

11.3.1.5 Radioactive Source Terms in GRS

As shown in Figure 11.3-1, the input sources to the GRS are the vent gases from the reactor drain tank (RDT), volume control tank (VCT), equipment drain tank (EDT), and gas stripper. The radioactive sources for each component of the GRS are calculated using the radioactive concentrations of the inflows to the GRS from the CVCS components shown in Table 11.1-8, which are determined based on the reactor coolant radionuclide concentrations provided in Table 11.1-2.

The mixed specific activities of sources to the GRS are then calculated by weighting each source contribution corresponding to its partial flow fractions. Activity buildup on the

Insert “A” in next page at this location

A

The average input source (C_{input}) from the CVCS to GRS is determined by using the equation below;

$$C_{input} = \frac{C_{Gas} \times F_{Gas} + C_{RDT} \times F_{RDT} + C_{VCT} \times F_{VCT} + C_{EDT} \times F_{EDT}}{F_{Gas} + F_{RDT} + F_{VCT} + F_{EDT}}$$

Where, C : concentration [μCi/cc (Bq/cc)]
F : flow rate [cfm]
Gas : Gas Stripper
RDT : Reactor Drain Tank
VCT : Volume Control Tank
EDT : Equipment Drain Tank

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Table 12.2-19

Gaseous Radwaste System Source Terms (0.25 % Fuel Defect)

Nuclide	At Inlet (Bq/cm^3)	Buildup Activity on Charcoal Bed (Bq)				At Outlet (Bq/cm^3)
		1st Delay Bed	2nd Delay Bed	3rd Delay Bed	4th Delay Bed	
Kr-85m	3.22E+05	3.67E+12	1.43E+11	5.53E+09	2.15E+08	7.32E-01
Kr-85	1.38E+06	5.32E+13	5.32E+13	5.32E+13	5.32E+13	1.38E+06
Kr-87	2.48E+05	8.35E+11	8.93E+06	9.54E+01	1.02E-03	3.24E-15
Kr-88	6.99E+05	5.22E+12	3.10E+10	1.84E+08	1.09E+06	8.65E-04
Xe-131m	1.37E+06	4.99E+14	2.59E+14	1.35E+14	6.98E+13	9.98E+04
Xe-133m	8.24E+04	1.11E+13	3.16E+11	8.99E+09	2.55E+08	5.37E-02
Xe-133	8.88E+07	2.29E+16	5.18E+15	1.17E+15	2.65E+14	2.32E+05
Xe-135m	1.82E+05	1.23E+11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-135	1.83E+06	4.40E+13	5.02E+04	5.73E-05	6.54E-14	3.10E-30
Xe-137	4.19E+04	7.07E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-138	1.55E+05	9.69E+10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	7.37E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	9.16E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-132	2.44E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	1.32E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-134	1.54E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	7.44E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

B

Table 12.2-19 (1 of 2)

Gaseous Radwaste System Source Terms (0.25 % Fuel Defect)

Nuclide	At Inlet	Buildup Activity on Charcoal Bed					At Outlet
		Guard Bed	1st Delay Bed	2nd Delay Bed	3rd Delay Bed	4th Delay Bed	
	Bq/cm^3	Bq	Bq	Bq	Bq	Bq	Bq/cm^3
Kr-85m	3.22E+05	8.28E+09	3.67E+12	1.43E+11	5.53E+09	2.15E+08	7.32E-01
Kr-85	1.38E+06	3.55E+10	5.32E+13	5.32E+13	5.32E+13	5.32E+13	1.38E+06
Kr-87	2.48E+05	6.38E+09	8.35E+11	8.93E+06	9.54E+01	1.02E-03	3.24E-15
Kr-88	6.99E+05	1.80E+10	5.22E+12	3.10E+10	1.84E+08	1.09E+06	8.65E-04
Xe-131m	1.37E+06	3.53E+10	4.99E+14	2.59E+14	1.35E+14	6.98E+13	9.98E+04
Xe-133m	8.24E+04	2.12E+09	1.11E+13	3.16E+11	8.99E+09	2.55E+08	5.37E-02
Xe-133	8.88E+07	2.28E+12	2.29E+16	5.18E+15	1.17E+15	2.65E+14	2.32E+05
Xe-135m	1.82E+05	4.69E+09	1.23E+11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-135	1.83E+06	4.70E+10	4.40E+13	5.02E+04	5.73E-05	6.54E-14	3.10E-30
Xe-137	4.19E+04	1.08E+09	7.07E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-138	1.55E+05	3.99E+09	9.69E+10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	7.37E-02	1.03E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	9.16E+00	4.68E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-132	2.44E+00	1.48E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	1.32E+01	7.27E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-134	1.54E+00	3.58E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	7.44E+00	1.30E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

B

Table 12.2-19 (2 of 2)

Nuclide	Header Drain Tank	Waste Gas Dryer	Vessel for HEPA Filter
	Bq	Bq	Bq
Kr-85m	1.82E+11	6.20E+09	5.86E+03
Kr-85	7.82E+11	2.66E+10	1.10E+10
Kr-87	1.41E+11	4.78E+09	2.59E-11
Kr-88	3.96E+11	1.35E+10	6.93E+00
Xe-131m	7.77E+11	2.64E+10	7.99E+08
Xe-133m	4.67E+10	1.59E+09	4.30E+02
Xe-133	5.03E+13	1.71E+12	1.86E+09
Xe-135m	1.03E+11	3.51E+09	0.00E+00
Xe-135	1.04E+12	3.53E+10	2.48E-26
Xe-137	2.37E+10	8.07E+08	0.00E+00
Xe-138	8.78E+10	2.99E+09	0.00E+00
Br-84	4.17E+04	1.42E+03	0.00E+00
I-131	5.19E+06	1.76E+05	0.00E+00
I-132	1.38E+06	4.70E+04	0.00E+00
I-133	7.48E+06	2.54E+05	0.00E+00
I-134	8.73E+05	2.97E+04	0.00E+00
I-135	4.21E+06	1.43E+05	0.00E+00

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	

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C

<table>
<tr><th rowspan="2">Building</th><th rowspan="2">Component</th><th colspan="4">Source Dimension</th><th colspan="2">Source Characteristic</th><th colspan="2">Housing</th></tr>
<tr><th>Shape</th><th>Diameter (or Width) (cm)</th><th>Length (cm)</th><th>Height (cm)</th><th>Material</th><th>Partial Density (g/cm^3)</th><th>Material</th><th>Thickness (cm)</th></tr>
<tr><td rowspan="6">Compound Building</td><td>Header Drain Tank</td><td>Cylinder</td><td>45.72</td><td>-</td><td>172.48</td><td>Vapor : 100%</td><td>0.001293</td><td colspan="2">Not considered</td></tr>
<tr><td rowspan="2">Waste Gas Dryer</td><td rowspan="2">Cylinder</td><td rowspan="2">0.629</td><td rowspan="2">-</td><td rowspan="2">91.72</td><td>Vapor : 96%</td><td>0.00117</td><td rowspan="2">Steel</td><td rowspan="2">1.03</td></tr>
<tr><td>Steel : 4%</td><td>0.339</td></tr>
<tr><td>Guard Bed</td><td>Cylinder</td><td>50.80</td><td>-</td><td>139.71</td><td>Carbon : 100%</td><td>0.41</td><td colspan="2">Not considered</td></tr>
<tr><td>Delay Bed</td><td>Cylinder</td><td>180.08</td><td>-</td><td>456.05</td><td>Carbon : 100%</td><td>0.41</td><td colspan="2">Not considered</td></tr>
<tr><td>HEPA filter</td><td>Cylinder</td><td>45.72</td><td>-</td><td>50.80</td><td>Vapor : 100%</td><td>0.001293</td><td colspan="2">Not considered</td></tr>
</table>

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.:	**103-7998**
SRP Section:	**12.02 – Radiation Sources**
Application Section:	**12.2**
Date of RAI Issue:	**07/22/2015**

Question No. 12.02-12

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.

ISSUE

In addition to the information requested in previous requests for additional information, staff identified various other missing pieces of information in the Chapter 12 source term information. This question is not intended to include information requested in previous requests for additional information.

INFORMATION NEEDED

1. Staff identified several components source dimensions and parameters in FSAR Table 12.2-25 for which no source term is included in FSAR Chapter 12. These sources are as follows:

    a. Spent fuel pool cleanup demineralizer

    b. Steam generator blowdown flash tank

    c. Waste storage drum area

    Please include the source terms for these sources in the FSAR or justify an alternative.

2. The staff identified various source terms in Chapter 12 which do not have source dimensions and parameters provided in FSAR Table 12.2-25. These sources are as follows:

   a. Seal injection filter (Table 12.2-12)

   b. Reactor drain filter (Table 12.2-12)

   c. Boric acid filter (Table 12.2-12)

   d. Purification filter (Table 12.2-12)

   e. Reactor makeup water filter (Table 12.2-12)

   f. Concentrate heater (Table 12.2-14)

   g. Concentrate cooler (Table 12.2-14)

   h. Flash tank (Table 12.2-14)

   i. Vapor separator (Table 12.2-14)

   j. Concentrate pump (Table 12.2-14)

   k. Concentrate transfer pump (Table 12.2-14)

   l. Steam generator blowdown mixed-bed (Table 12.2-18)

   m. Blowdown pre-filter (Table 12.2-18)

   n. Blowdown post-filter (Table 12.2-18)

   o. CPS cation bed (Table 12.2-18)

   p. CPS mixed bed (Table 12.2-18)

   q. Equipment waste tank (Table 12.2-20)

   r. Monitor tank (Table 12.2-20)

   s. Reverse osmosis (Table 12.2-21)

   Please include the dimensions and parameters for these sources in FSAR Table 12.2-25 or justify an alternative.

3. Table 12.2-25 lists the liquid radwaste system (LRS) ion exchanger (IX). It is unclear which ion exchanger in Table 12.2-21 this represents (cation bed, mixed bed 1, mixed

bed 2). Please update FSAR Table 12.2-25 to clearly identify which component LRS IX represents and include the information for the missing IXs.

Response

1. a. The source term of the spent fuel pool cleanup demineralizer was provided as a response to Item No. 1.d of RAI 13-7856 (Q : 12.02-2). Please refer to this response.

   b. DCD Table 12.2-18 will be revised to include the source term for the steam generator blowdown flash tank.

   c. Section 12.2 will be revised to include the source term for the waste drum storage area. This source term is determined based on the case that the R/O concentrate source term and DAW source term are mixed, put into a drum and the maximum number of the drums (13×10×3) are stored in the area.

2. Source dimensions and parameters for the components in question except for Items (f) through (k) will be provided in a revised DCD Table 12.2-25.

   Since the components for Items (f) through (k), which constitute the Boric Acid Concentrator (BAC) package, are located in a single compartment (078-A04B), all sources of the BAC components given in DCD Table 12.2-14 are conservatively assumed to be contained in the Flash Tank of the BAC package for the shielding design. Therefore, the dimensions and parameters for the BAC given in DCD Table 12.2-25 are the values for the Flash Tank, which represents the whole BAC components.

3. The three LRS ion exchangers (Cation, Mixed Bed 1, and Mixed Bed 2) have the same size. For clarity, DCD Table 12.2-25 will be updated.

Impact on DCD

DCD Sections 12.2, Table 12.2-25 will be revised as indicated in Attachments 1, 3, and 4. Table 12.2-22a 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 Reports.

Table 12.2-18 (1 of 3)

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Steam Generator Blowdown and Condensate Polishing System Source Terms (0.25 % Fuel Defect)

Isotope	SG Water (Bq/g)	SG Steam (Bq/g)	Blowdown Mixed Bed (Bq)	Blowdown Pre-Filter (Bq)	Blowdown Post-Filter (Bq)	Condensate (Bq/g)	CPS Cation Bed (Bq)	CPS Mixed Bed (Bq)
Kr-85m	0.00E+00	1.29E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85	0.00E+00	5.49E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-87	0.00E+00	1.01E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-88	0.00E+00	2.80E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-131m	0.00E+00	5.49E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-133m	0.00E+00	3.34E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-133	0.00E+00	3.58E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-135m	0.00E+00	7.32E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-135	0.00E+00	7.32E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-137	0.00E+00	1.70E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-138	0.00E+00	6.41E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	7.65E-02	7.65E-04	4.71E+06	0.00E+00	0.00E+00	2.43E-04	0.00E+00	1.28E+05
I-131	2.99E+01	2.99E-01	6.73E+11	0.00E+00	0.00E+00	9.50E-02	0.00E+00	1.71E+10
I-132	5.44E+00	5.44E-02	1.46E+09	0.00E+00	0.00E+00	1.73E-02	0.00E+00	3.97E+07
I-133	4.05E+01	4.05E-01	9.90E+10	0.00E+00	0.00E+00	1.29E-01	0.00E+00	2.70E+09
I-134	2.16E+00	2.16E-02	2.18E+08	0.00E+00	0.00E+00	6.87E-03	0.00E+00	5.94E+06
I-135	2.08E+01	2.08E-01	1.63E+10	0.00E+00	0.00E+00	6.61E-02	0.00E+00	4.44E+08
Rb-88	5.96E+00	2.98E-02	2.06E+08	0.00E+00	0.00E+00	1.36E-02	4.00E+06	4.00E+05

Add “A” after this last column

Table 12.2-18 (2 of 3)

Isotope	SG Water (Bq/g)	SG Steam (Bq/g)	Blowdown Mixed Bed (Bq)	Blowdown Pre-Filter (Bq)	Blowdown Post-Filter (Bq)	Condensate (Bq/g)	CPS Cation Bed (Bq)	CPS Mixed Bed (Bq)
Cs-134	4.77E+00	2.39E-02	1.55E+12	0.00E+00	0.00E+00	1.08E-02	5.27E+08	5.63E+08
Cs-136	6.50E-01	3.25E-03	2.36E+10	0.00E+00	0.00E+00	1.48E-03	6.65E+07	3.75E+07
Cs-137	5.52E+00	2.76E-02	1.94E+12	0.00E+00	0.00E+00	1.25E-02	6.10E+08	6.61E+08
Cr-51	6.78E-01	3.39E-03	5.20E+10	4.73E+10	4.73E+08	1.54E-03	7.23E+07	5.60E+07
Mn-54	7.85E-02	3.93E-04	2.28E+10	2.07E+10	2.07E+08	7.14E-05	3.46E+06	3.63E+06
Fe-55	5.88E-02	2.94E-04	1.95E+10	1.77E+10	1.77E+08	5.35E-05	2.60E+06	2.79E+06
Fe-59	1.47E-02	7.36E-05	1.73E+09	1.57E+09	1.57E+07	1.34E-05	6.37E+05	5.57E+05
Co-58	2.25E-01	1.13E-03	3.71E+10	3.37E+10	3.37E+08	2.05E-04	9.82E+06	9.28E+06
Co-60	2.60E-02	1.30E-04	8.90E+09	8.09E+09	8.09E+07	2.36E-05	1.15E+06	1.24E+06
Zr-95	1.91E-02	9.53E-05	2.96E+09	2.69E+09	2.69E+07	2.70E-05	1.29E+06	1.21E+06
Zn-65	2.50E-02	1.25E-04	6.90E+09	6.27E+09	6.27E+07	2.27E-05	1.10E+06	1.15E+06
N-16	7.38E-01	3.69E-03	7.09E+03	0.00E+00	0.00E+00	6.71E-04	5.52E+01	5.52E+00
Na-24	2.08E+00	1.04E-02	3.64E+09	0.00E+00	0.00E+00	1.89E-03	2.72E+07	2.83E+06
Sr-89	4.03E-02	2.02E-04	5.35E+09	0.00E+00	0.00E+00	1.46E-04	6.98E+06	6.28E+06
Sr-90	2.70E-03	1.35E-05	9.48E+08	0.00E+00	0.00E+00	1.00E-05	4.87E+05	5.27E+05
Sr-91	5.33E-02	2.67E-04	6.01E+07	0.00E+00	0.00E+00	1.93E-04	1.85E+06	1.87E+05
Y-91m	1.47E-02	7.36E-05	1.43E+06	0.00E+00	0.00E+00	5.28E-05	4.39E+04	4.39E+03
Y-91	5.95E-03	2.98E-05	8.64E+08	0.00E+00	0.00E+00	2.13E-05	1.02E+06	9.35E+05
Y-93	1.28E-03	6.41E-06	1.52E+06	0.00E+00	0.00E+00	4.50E-06	4.54E+04	4.58E+03
Nb-95	6.41E-03	3.20E-05	6.11E+08	0.00E+00	0.00E+00	2.29E-05	1.08E+06	8.98E+05

Add "A" after this last column

Table 12.2-18 (3 of 3)

Isotope	SG Water (Bq/g)	SG Steam (Bq/g)	Blowdown Mixed Bed (Bq)	Blowdown Pre-Filter (Bq)	Blowdown Post-Filter (Bq)	Condensate (Bq/g)	CPS Cation Bed (Bq)	CPS Mixed Bed (Bq)
Mo-99	3.42E+00	1.71E-02	2.68E+10	0.00E+00	0.00E+00	1.23E-02	4.25E+08	8.24E+07
Tc-99m	1.70E+00	8.48E-03	1.18E+09	0.00E+00	0.00E+00	6.30E-03	3.75E+07	3.75E+06
Ru-103	2.15E-03	1.08E-05	2.28E+08	0.00E+00	0.00E+00	7.91E-06	3.75E+05	3.19E+05
Ru-106	9.16E-04	4.58E-06	2.74E+08	0.00E+00	0.00E+00	3.38E-06	1.64E+05	1.73E+05
Ag-110m	6.38E-02	3.19E-04	1.77E+10	0.00E+00	0.00E+00	5.80E-05	2.81E+06	2.93E+06
Te-129m	7.32E-02	3.66E-04	6.78E+09	0.00E+00	0.00E+00	2.66E-04	1.26E+07	1.03E+07
Te-129	3.91E-02	1.96E-04	5.24E+06	0.00E+00	0.00E+00	1.43E-04	1.63E+05	1.63E+04
Te-131m	3.35E-01	1.68E-03	1.17E+09	0.00E+00	0.00E+00	1.20E-03	2.89E+07	3.60E+06
Te-131	3.69E-02	1.85E-04	1.79E+06	0.00E+00	0.00E+00	1.34E-04	5.59E+04	5.59E+03
Te-132	2.39E+00	1.20E-02	2.18E+10	0.00E+00	0.00E+00	8.62E-03	3.12E+08	6.71E+07
Ba-137m	1.65E-01	8.25E-04	8.17E+05	0.00E+00	0.00E+00	6.29E-04	2.66E+04	2.66E+03
Ba-140	5.02E-02	2.51E-04	1.79E+09	0.00E+00	0.00E+00	1.78E-04	8.02E+06	4.48E+06
La-140	1.65E-02	8.25E-05	7.74E+07	0.00E+00	0.00E+00	6.08E-05	1.71E+06	2.44E+05
Ce-141	1.88E-03	9.40E-06	1.70E+08	0.00E+00	0.00E+00	6.66E-06	3.14E+05	2.56E+05
Ce-143	4.87E-03	2.44E-05	1.87E+07	0.00E+00	0.00E+00	1.82E-05	4.62E+05	5.98E+04
Ce-144	5.50E-03	2.75E-05	1.57E+09	0.00E+00	0.00E+00	1.91E-05	9.28E+05	9.71E+05
W-187	1.15E-01	5.73E-04	3.19E+08	0.00E+00	0.00E+00	1.04E-04	2.16E+06	2.48E+05
Np-239	1.05E-01	5.23E-04	6.86E+08	0.00E+00	0.00E+00	9.51E-05	3.10E+06	5.34E+05

A

Isotope	Flash Tank (Bq)
Kr-85m	0.00E+00
Kr-85	0.00E+00
Kr-87	0.00E+00
Kr-88	0.00E+00
Xe-131m	0.00E+00
Xe-133m	0.00E+00
Xe-133	0.00E+00
Xe-135m	0.00E+00
Xe-135	0.00E+00
Xe-137	0.00E+00
Xe-138	0.00E+00
Br-84	7.48E+05
I-131	2.92E+08
I-132	5.32E+07
I-133	3.96E+08
I-134	2.11E+07
I-135	2.03E+08
Rb-88	5.83E+07

Isotope	Flash Tank (Bq)
Cs-134	4.67E+07
Cs-136	6.35E+06
Cs-137	5.40E+07
Cr-51	9.87E+08
Mn-54	5.94E+10
Fe-55	6.80E+09
Fe-59	6.89E+10
Co-58	8.52E+09
Co-60	1.07E+09
Zr-95	8.03E+08
Zn-65	1.91E+08
N-16	7.22E+06
Na-24	2.04E+07
Sr-89	3.94E+05
Sr-90	2.64E+04
Sr-91	5.21E+05
Y-91m	1.44E+05
Y-91	5.82E+04
Y-93	1.25E+04
Nb-95	6.27E+04

Isotope	Flash Tank (Bq)
Mo-99	3.35E+07
Tc-99m	1.66E+07
Ru-103	2.10E+04
Ru-106	8.96E+03
Ag-110m	6.24E+05
Te-129m	7.16E+05
Te-129	3.83E+05
Te-131m	3.28E+06
Te-131	3.61E+05
Te-132	2.34E+07
Ba-137m	1.61E+06
Ba-140	4.91E+05
La-140	1.61E+05
Ce-141	1.84E+04
Ce-143	4.77E+04
Ce-144	5.38E+04
W-187	1.12E+06
Np-239	1.02E+06

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.

Additionaly, the source term in the waste drum storage area is presented in Table 12.2-22a.

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 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.

Table 12.2-22

Solid Radwaste System Tank Source Terms (Bq)

Nuclide	Spent Resin Long-Term Storage Tank	Low-Activity Spent Resin Tank
Na-24	7.01E+11	7.16E+10
Cr-51	9.49E+12	1.86E+11
Mn-54	1.45E+13	2.37E+10
Fe-55	3.40E+13	1.79E+10
Co-58	8.28E+12	6.60E+10
Fe-59	3.34E+11	4.20E+09
Co-60	2.38E+13	7.90E+09
Zn-65	3.57E+12	7.53E+09
Br-84	2.73E+09	3.46E+08
Rb-88	1.15E+11	2.27E+10
Sr-89	1.01E+12	1.16E+10
Y-89m	0.00E+00	1.16E+06
Sr-90	3.96E+12	8.23E+08
Y-90	0.00E+00	4.97E+08
Sr-91	1.20E+10	1.23E+09
Y-91m	9.40E+07	7.83E+08
Y-91	1.63E+07	1.84E+09
Y-93	3.80E+06	3.10E+07
Zr-93	0.00E+00	3.13E-01
Zr-95	6.34E+11	5.56E+09
Nb-95m	0.00E+00	5.63E+07
Nb-95	1.10E+11	2.25E+09
Mo-99	4.81E+12	4.37E+11
Tc-99m	2.50E+11	4.03E+11
Tc-99	0.00E+00	2.33E+04
Ru-103	4.32E+10	6.10E+08
Rh-103m	0.00E+00	6.07E+08
Ru-106	2.01E+11	2.77E+09

Nuclide	Spent Resin Long-Term Storage Tank	Low-Activity Spent Resin Tank
Rh-106	0.00E+00	2.77E+09
Ag-110m	9.29E+12	1.92E+10
Ag-110	0.00E+00	2.50E+08
Te-129m	1.31E+12	2.05E+10
Te-129	1.92E+09	1.32E+10
I-129	0.00E+00	1.03E+01
Te-131m	2.12E+11	2.20E+10
Te-131	1.21E+09	4.10E+09
I-131	4.04E+11	6.61E+12
Te-132	4.04E+12	3.37E+11
I-132	4.04E+11	3.78E+11
I-133	1.92E+13	1.95E+12
I-134	9.30E+10	1.08E+10
Cs-134	1.20E+15	1.32E+12
I-135	3.54E+12	3.58E+11
Cs-136	2.34E+12	1.45E+11
Cs-137	4.60E+15	1.53E+12
Ba-137m	4.60E+15	1.43E+12
Ba-140	3.21E+11	1.23E+10
La-140	1.40E+10	1.07E+10
Ce-141	3.11E+10	5.23E+08
Ce-143	3.51E+09	3.50E+08
Pr-143	0.00E+00	1.01E+08
Ce-144	9.18E+11	1.66E+09
Pr-144	0.00E+00	1.65E+09
W-187	6.01E+10	6.07E+09
Np-239	1.30E+11	1.18E+10

Insert table "B" in next page

B

Table 12.2-22a

Waste Drum Storage Area Source Terms (Bq)

Nuclide	Activity
I-131	2.96E+12
I-132	6.15E-82
I-133	2.12E+03
I-134	3.77E-235
I-135	5.15E-20
Cs-134	5.47E+12
Cs-136	1.57E+11
Cs-137	6.56E+12
Cr-51	4.11E+11
Mn-54	9.70E+10
Fe-55	7.38E+10
Fe-59	1.19E+10
Co-58	2.55E+11
Co-60	2.31E+11
Zr-95	2.05E+10
Zn-65	2.95E+10
Na-24	1.02E-02
Sr-89	3.43E+10
Sr-90	3.45E+09
Sr-91	1.17E-12
Y-91m	1.10E-251

Nuclide	Activity
Y-91	5.35E+09
Y-93	6.34E-13
Nb-95	1.42E+10
Mo-99	2.33E+09
Tc-99m	2.57E-24
Ru-103	1.63E+09
Ru-106	1.08E+10
Ag-110m	7.64E+10
Sb-125	5.30E+10
Te-129m	1.42E-176
Te-129	2.66E+04
Te-131m	0.00E+00
Te-132	5.26E+09
Ba-137m	5.86E+12
Ba-140	1.27E+10
La-140	8.88E+04
Ce-141	1.27E+09
Ce-143	1.75E+03
Ce-144	6.55E+09
W-187	1.24E+02
Np-239	2.00E+07

This table will be re-arranged including "C" after this table

Table 12.2-25 (1 of 3)

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/cm3)	Material	Thickness (cm)
Reactor Containment Building	Pressurizer	Cylinder	244.48	-	700.66	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
		Semisphere	472.60						
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

This table will be re-arranged including "C" after this table

Table 12.2-25 (2 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	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

This table will be re-arranged including "C" after this table

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	

C

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	Seal injection filter	Cylinder	10.80	-	54.00	Water : 100%	1.00	Not considered	
	Reactor drain filter	Cylinder	19.35	-	50.50	Water : 100%	1.00	Not considered	
	Boric acid filter	Cylinder	19.35	-	50.50	Water : 100%	1.00	Not considered	
	Purification filter	Cylinder	19.35	-	50.50	Water : 100%	1.00	Not considered	
	Reactor makeup water filter	Cylinder	19.35	-	50.50	Water : 100%	1.00	Not considered	
	Steam generator blowdown mixed-bed	Cylinder	228.60	-	152.40	Water : 100%	1.00	Not considered	

C

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)
	Blowdown pre-filter	Cylinder	25.93	-	51.12	Water : 100%	1.00	Not considered	
	Blowdown post-filter	Cylinder	25.93	-	51.12	Water : 100%	1.00	Not considered	
Compound Building	Equipment waste tank	Cylinder	358.14	-	676.38	Water : 100%	1.00	Not considered	
	Monitor tank	Cylinder	487.68	-	547.16	Water : 100%	1.00	Not considered	
	Reverse osmosis	Cylinder	66.33	-	101.60	Water : 100%	1.00	Not considered	
Turbine Building	CPS cation bed	Sphere	314.96	-	-	Water : 100%	1.00	Steel	3.40

C

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)
	CPS mixed bed	Sphere	314.96	-	-	Water : 100%	1.00	Steel	3.40

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	

Insert "D" in next page

D

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)
Compound Building	LRS IX (Cation Bed)	Cylinder	120.17	-	124.83	Water : 100%	1.00	Not considered	
	LRS IX (Mixed1 Bed)	Cylinder	120.17	-	124.83	Water : 100%	1.00	Not considered	
	LRS IX (Mixed2 Bed)	Cylinder	120.17	-	124.83	Water : 100%	1.00	Not considered	