Exelon.
Generation

NP-11-0003
January 13, 2011

10 CFR 52, Subpart A

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: Exelon Nuclear Texas Holdings, LLC
Victoria County Station Early Site Permit Application
Additional Information – Accident Analysis Clarifications
NRC Docket No. 52-042

References:
(1) Exelon Nuclear Texas Holdings, LLC letter to USNRC, Application for Early Site Permit for Victoria County Station, dated March 25, 2010

(2) Exelon Nuclear Texas Holdings, LLC letter to USNRC, Additional Information – Accident Analysis Clarifications in Support of Early Site Permit Application, dated May 6, 2010

(3) Exelon Nuclear Texas Holdings, LLC letter to USNRC, Early Site Permit Application Update Schedule and Commitment Revisions, dated November 9, 2010

Exelon Nuclear Texas Holdings, LLC (Exelon) submitted an application for an early site permit (ESP) in Reference 1 for the Victoria County Station (VCS) site. That submittal consisted of six parts as described in the referenced letter.

In Reference 2, Exelon committed to revise the VCS ESP Application (ESPA) Site Safety Analysis Report (SSAR) and Environmental Report (ER) to address the following items discussed with NRC staff during the VCS ESP application acceptance review: (1) revisions to VCS ESPA SSAR Section 15.1 and ER 7.1.1 to remove the existing statements that the core source terms for the B&W mPower reactor design will be bounded by those for the other technologies proposed in the Plant Parameter Envelope (PPE), (2) revisions to VCS ESPA SSAR Section 15.1 and ER Section 7.1 to clarify that both the GE and Toshiba Advanced Boiling Water Reactor (ABWR) designs are being considered for the site; however, the existing PPE is based on the current ABWR certified design as described in 10 CFR 52 Appendix A, (3) revisions to VCS ESPA SSAR Section 15.2 and ER Section 7.1.2 to correct the referenced site acceptance criteria from 10 CFR 50.34 and 10 CFR 100 to 10 CFR 52.17(a)(1), and (4) revisions to VCS ESPA SSAR Chapter15 and ER Chapter 7 design-specific source term tables and design-specific accident dose consequence tables to include a reference to the

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appropriate reactor Design Control Document (DCD) revision number that these values are based on.

Since the VCS ESPA update is planned to be submitted to the NRC in the 1st Quarter of 2012, as previously described in Reference 3, Exelon is providing the VCS ESPA SSAR Chapter 15 and ER Chapter 7 page markups incorporating the changes described above in Enclosure 1 for NRC staff use during the ongoing application review. Additionally, the enclosed page markups incorporate updates to the design basis source term release data and design basis accident site dose values associated with the AP1000 design to be consistent with the current Westinghouse AP1000 DCD, Revision 17.

These SSAR and ER revisions will be included in the next ESPA update submittal planned for no later than March 31, 2012.

Regulatory commitments established in this submittal are identified in Enclosure 2. If any additional information is needed, please contact David J. Distel at (610) 765-5517.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 13th day of January, 2011.

Respectfully,

Marilyn C. Kray
Vice President, Nuclear Project Development

Enclosures: (1) Markup Pages of Victoria County Station ESPA
(2) Summary of Regulatory Commitments

cc: USNRC, Director, Office of New Reactors/NRLPO (w/enclosures)
USNRC, Project Manager, VCS, Division of New Reactor Licensing (w/enclosures)
USNRC, Environmental Project Manager, VCS, Division of New Reactor Licensing (w/enclosures)
USNRC Region IV, Regional Administrator (w/enclosures)

ENCLOSURE 1

MARKUP PAGES OF VICTORIA COUNTY STATION ESPA

(Exelon Letter to USNRC No. NP-11-0003, dated January 13, 2011)

The attached markup represents Exelon's good faith effort to show how the ESPA will be revised in a future ESPA submittal in response to the additional information described above. However, the same ESPA content may be impacted by revisions to the ESPA, responses to ESPA RAIs, other ESPA changes, editorial or typographical corrections, etc. As a result, the final ESPA content that appears in a future submittal may be somewhat different than as presented herein.

SSAR Chapter 15 Pages

15-1	15-12	15-22	15-33	15-45	15-55
15-2	15-13	15-23	15-34	15-46	15-56
15-3	15-14	15-24	15-35	15-47	15-57
15-5	15-15	15-25	15-36	15-48	15-58
15-6	15-16	15-27	15-38	15-49	15-60
15-7	15-17	15-28	15-39	15-50	15-61
15-8	15-18	15-29	15-40	15-51	15-62
15-9	15-19	15-30	15-41	15-52	
15-10	15-20	15-31	15-42	15-53	
15-11	15-21	15-32	15-43	15-54	

ER Chapter 7 Pages

7.1-1	7.1-12	7.1-23	7.1-34	7.1-45	7.1-56
7.1-2	7.1-13	7.1-24	7.1-35	7.1-46	7.1-57
7.1-3	7.1-14	7.1-25	7.1-36	7.1-47	7.1-58
7.1-5	7.1-15	7.1-26	7.1-37	7.1-48	
7.1-6	7.1-16	7.1-27	7.1-38	7.1-49	
7.1-7	7.1-17	7.1-28	7.1-39	7.1-50	
7.1-8	7.1-18	7.1-29	7.1-41	7.1-51	
7.1-9	7.1-19	7.1-30	7.1-42	7.1-52	
7.1-10	7.1-20	7.1-31	7.1-43	7.1-53	
7.1-11	7.1-21	7.1-32	7.1-44	7.1-54	

SSAR Chapter 15, Draft Revision 1

Pages Updated 01/13/2011

Chapter 15 Accident Analysis

15.1 Selection of Accidents

The radiological consequences of accidents are assessed to demonstrate that new units could be constructed and operated at the VCS site without undue risk to the health and safety of the public. To analyze the suitability of the VCS site, site-specific accident meteorology is used to evaluate the radiological consequences of design basis accidents (DBAs) associated with selected reactor designs. The assessment uses a robust and conservative set of surrogate DBAs that is representative of the range of reactor designs being considered for the VCS site. The DBAs include a spectrum of events, including those of relatively greater probability of occurrence as well as those that are less probable but have greater severity.

The set of accidents selected focuses on four light water reactor (LWR) designs: AP1000, APWR, ABWR, and ESBWR. Two versions of the ABWR (GE and Toshiba) are being considered for the VCS site, but the evaluation in this section is based upon the source term associated with the ABWR certified design~~applies to both versions~~. These four designs are standard designs that have recognized bases for postulated accident analyses. The accidents for the mPower are not as well defined as these other LWRs~~; however,~~. A~~a~~s the design is standard LWR technology and ~~the core source term is bounded by the other technologies~~, given its relatively small core thermal output, the accident consequences associated with the mPower reactor are considered to be bounded by those for the other four reactor types. If the mPower (or another reactor technology not previously evaluated) is selected for the VCS site, the COL application would verify that the accident doses are bounded by those provided in the ESP application or would provide a complete evaluation of accident radiological consequences compared with regulatory limits.

The following LWR accidents are identified in the SRP, NUREG-0800:

- SRP Section 15.1.5.A, Radiological Consequences of Main Steam Line Failures Outside Containment of a PWR
- SRP Section 15.2.8, Feedwater System Pipe Breaks Inside and Outside Containment (PWR)
- SRP Section 15.3.3, Reactor Coolant Pump Rotor Seizure (Locked Rotor Accident)
- SRP Section 15.3.4, Reactor Coolant Pump Shaft Break
- SRP Section 15.4.9, Spectrum of Rod Drop Accidents (BWR)
- SRP Section 15.6.2, Radiological Consequences of the Failure of Small Lines Carrying Primary Coolant Outside Containment
- SRP Section 15.6.3, Radiological Consequences of the Steam Generator Tube Failure

- SRP Section 15.6.5, Loss-of-Coolant Accident Resulting from Spectrum of Postulated Piping Breaks Within the Reactor Coolant Pressure Boundary
- SRP Section 15.7.4, Radiological Consequences of Fuel Handling Accidents

RG 1.183 (Reference 15.5-1) includes the following additional accidents:

- PWR Rod Ejection Accident (corresponding to SRP Section 15.4.8)
- BWR Main Steam Line Break (corresponding to SRP Section 15.6.4)

In addition, a cleanup water line break is evaluated for the ABWR and the ESBWR.

This set of accidents provides a reasonable basis for evaluating the suitability of the VCS site, and the associated radiological consequences from the above DBAs are analyzed as follows.

15.2 Evaluation Methodology

Doses for the representative DBAs are evaluated at the EAB and the LPZ. These doses must meet the site acceptance criteria in ~~10 CFR 50.34 and 10 CFR 100~~10 CFR 52.17(a)(1). Although the emergency safety features are expected to prevent core damage and mitigate releases of radioactivity, the loss-of-coolant accidents (LOCAs) analyzed presume substantial core melt with the release of significant amounts of fission products. The postulated LOCAs are expected to more closely approach 10 CFR ~~50.34~~52.17 limits than the other DBAs of greater probability of occurrence but lesser magnitude of activity releases. The calculated accident doses are compared to the acceptance criteria in RG 1.183 and NUREG-0800, to demonstrate that the consequences of the postulated accidents are acceptable.

The evaluations use short-term accident atmospheric dispersion factors (X/Qs). The X/Qs are calculated using the methodology of RG 1.145 (Reference 15.5-2) and site-specific meteorological data. As indicated in Section 2.3.4, the RG 1.145 methodology is implemented in the NRC-sponsored PAVAN computer program. This program computes X/Qs at the EAB and LPZ for each combination of wind speed and atmospheric stability for each of the 16 downwind direction sectors. Releases are assumed to be at ground level, and the shortest distances between the power block area and the offsite locations are selected to conservatively maximize the X/Q values. The following site-specific values from Section 2.3.4 are used in these evaluations, reflecting the larger of the overall site 5th percentile and sector-dependent 0.5th percentile, in accordance with RG 1.145:

- EAB, 0 to 2 hours: 2.66×10^{-4} sec/m^3

- LPZ, 0 to 8 hours: 1.55×10^{-5} sec/m^3

  8 to 24 hours: 1.01×10^{-5} sec/m^3

  24 to 96 hours: 4.20×10^{-6} sec/m^3

  96 to 720 hours: 1.19×10^{-6} sec/m^3

The accident dose calculations are performed using the activity releases for the following time intervals:

- EAB: 2-hour period yielding the maximum dose
- LPZ: 0 to 8 hours, 8 to 24 hours, 24 to 96 hours, and 96 to 720 hours

The accident doses are expressed as TEDE~~,~~ consistent with 10 CFR ~~50.34~~52.17. The TEDE consists of the sum of the committed effective dose equivalent (CEDE) from inhalation and either the deep dose equivalent (DDE) or the effective dose equivalent (EDE) from external exposure. The CEDE is determined using the dose conversion factors in Federal Guidance Report 11 (Reference 15.5-3), while the DDE and the EDE are based on dose conversion factors in Federal Guidance Report 12 (Reference 15.5-4).

15.3 Source Terms

Doses are calculated based on the time-dependent activities released to the environment during each DBA. The activities are based on the analyses used to support the reactor standard safety analysis reports. Different reactor technologies use different source terms and approaches in defining the activity releases. The ABWR source terms, methodologies, and assumptions are based on the guidance in the NUREG-0800 and Regulatory Guides 1.3 (Reference 15.5-5) and 1.25 (Reference 15.5-6). The AP1000, APWR, and ESBWR source terms, methodologies, and assumptions are based on the alternative source term guidance outlined in RG 1.183.

15.4 Radiological Consequences

For the accidents identified in Section 15.1, site-specific doses are calculated by multiplying the design certification doses by the ratio of site X/Qs to design certification X/Qs. Using the EAB and LPZ site-specific X/Qs provided in Section 15.2, with the X/Qs from the vendor design control documents (References 15.5-7 through 15.5-10), the ratios, presented in Tables 15.1-1 through 15.1-4, are obtained.

15.5-5 Regulatory Guide 1.3, *Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors*, Revision 2, NRC, June 1974.

15.5-6 Regulatory Guide 1.25 (Safety Guide 25), *Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors*, NRC, March 1972.

15.5-7 AP1000 Document No. APP-GW-GL-700, *AP1000 Design Control Document*, Tier 2 Material, Westinghouse, Revision 17, 20028.

15.5-8 Document MUAP-DC001, *APWR Design Control Document for the US-APWR*, Tier 2, Mitsubishi Heavy Industries, Ltd., Revision 2, 2009.

15.5-9 *ABWR Standard Safety Analysis Report Design Control Document,* Tier 2, GE Nuclear Energy, Revision 4, 1997.

15.5-10 Document 26A6642, *ESBWR Design Control Document*, Tier 2 Material, GE-Hitachi Nuclear Energy, Revision 6, 2009.

Table 15.1-1
Design Certification X/Q Values and Ratios to Site X/Q Values for AP1000

Accident	Location	Release Time (hr)	X/Q (sec/m^3)		X/Q Ratio (Site/DCD)
			DCD	Site	
LOCA	EAB	0–2	5.1×10^{-4}	2.66×10^{-4}	5.22×10^{-1}
	LPZ	0–8	2.2×10^{-4}	1.55×10^{-5}	7.05×10^{-2}
		8–24	1.6×10^{-4}	1.01×10^{-5}	6.31×10^{-2}
		24–96	1.0×10^{-4}	4.20×10^{-6}	4.20×10^{-2}
		96–720	8.0×10^{-5}	1.19×10^{-6}	1.49×10^{-2}
Other	EAB	0–2	1.0×10^{-3}	2.66×10^{-4}	2.66×10^{-1}
	LPZ	0–8	5.0×10^{-4}	1.55×10^{-5}	3.10×10^{-2}
		8–24	3.0×10^{-4}	1.01×10^{-5}	3.37×10^{-2}
		24–96	1.5×10^{-4}	4.20×10^{-6}	2.80×10^{-2}
		96–720	8.0×10^{-5}	1.19×10^{-6}	1.49×10^{-2}

Reference: AP1000 DCD Rev. 17 (15.5-7)

Table 15.1-2
Design Certification X/Q Values and Ratios to Site X/Q Values for APWR

Location	Release Time (hr)	X/Q (sec/m^3)		X/Q Ratio (Site/DCD)
		DCD	Site	
EAB	0–2	5.0×10^{-4}	2.66×10^{-4}	5.32×10^{-1}
LPZ	0–8	2.1×10^{-4}	1.55×10^{-5}	7.38×10^{-2}
	8–24	1.3×10^{-4}	1.01×10^{-5}	7.77×10^{-2}
	24–96	6.9×10^{-5}	4.20×10^{-6}	6.09×10^{-2}
	96–720	2.8×10^{-5}	1.19×10^{-6}	4.25×10^{-2}

Reference: APWR DCD Rev. 2 (15.5-8)

Table 15.1-3
Design Certification X/Q Values and Ratios to Site X/Q Values for ABWR

Accident	Location	Release Time (hr)	X/Q (sec/m^3) DCD	X/Q (sec/m^3) Site	X/Q Ratio (Site/DCD)
Cleanup Water Line Break	EAB	0–2	2.29×10^{-2}	2.66×10^{-4}	1.16×10^{-2}
	LPZ	0–8	2.29×10^{-2}	1.55×10^{-5}	6.77×10^{-4}
LOCA	EAB	0–2	1.37×10^{-3}	2.66×10^{-4}	1.94×10^{-1}
	LPZ	0–8	1.56×10^{-4}	1.55×10^{-5}	9.94×10^{-2}
		8–24	9.61×10^{-5}	1.01×10^{-5}	1.05×10^{-1}
		24–96	3.36×10^{-5}	4.20×10^{-6}	1.25×10^{-1}
		96–720	7.42×10^{-6}	1.19×10^{-6}	1.60×10^{-1}
Other	EAB	0–2	1.37×10^{-3}	2.66×10^{-4}	1.94×10^{-1}
	LPZ	0–8	1.37×10^{-3}	1.55×10^{-5}	1.13×10^{-2}

Reference: ABWR DCD Rev. 4 (15.5-9)

Table 15.1-4
Design Certification X/Q Values and Ratios to Site X/Q Values for ESBWR

Accident	Location	Release Time (hr)	X/Q (sec/m^3)		X/Q Ratio (Site/DCD)
			DCD	Site	
LOCA	EAB	0–2	2.00×10^{-3}	2.66×10^{-4}	1.33×10^{-1}
	LPZ	0–8	1.90×10^{-4}	1.55×10^{-5}	8.16×10^{-2}
		8–24	1.40×10^{-4}	1.01×10^{-5}	7.21×10^{-2}
		24–96	7.50×10^{-5}	4.20×10^{-6}	5.60×10^{-2}
		96–720	3.00×10^{-5}	1.19×10^{-6}	3.97×10^{-2}
Small Break Outside Containment	EAB	0–2	2.00×10^{-3}	2.66×10^{-4}	1.33×10^{-1}
	LPZ	0–8	1.90×10^{-4}	1.55×10^{-5}	8.16×10^{-2}
		8–24	1.40×10^{-4}	1.01×10^{-5}	7.21×10^{-2}
		24–96	7.50×10^{-5}	4.20×10^{-6}	5.60×10^{-2}
		96–720	3.00×10^{-5}	1.19×10^{-6}	3.97×10^{-2}
Other	EAB	0–2	2.00×10^{-3}	2.66×10^{-4}	1.33×10^{-1}
	LPZ	0–8	1.90×10^{-4}	1.55×10^{-5}	8.16×10^{-2}

Reference: ESBWR DCD Rev. 6 (15.5-10)

Table 15.1-5 (Sheet 1 of 2)
Summary of Design Basis Accident Site Doses

SRP Section	Accident		Design	DCD Section	Site Dose (rem TEDE)		
					EAB	LPZ	Limit
15.1.5A	Steam System Piping Failure	Pre-Incident Iodine Spike	AP1000	15.1.5	2.7×10^{-1}	2.3×10^{-2}	25
			APWR	15.1.5	1.0×10^{-1}	8.0×10^{-3}	
		Accident-Initiated Iodine Spike	AP1000	15.1.5	2.9×10^{-1}	5.9×10^{-2}	2.5
			APWR	15.1.5	1.7×10^{-1}	2.1×10^{-2}	
15.3.3	Locked Rotor Accident	No Feedwater	AP1000	15.3.3	2.1×10^{-1}	1.2×10^{-2}	2.5
		Feedwater Available	AP1000	15.3.3	1.6×10^{-1}	~~2.5~~2.3 $\times 10^{-2}$	
	Locked Rotor Accident		APWR	15.3.3	2.6×10^{-1}	5.2×10^{-2}	
15.4.8	Rod Ejection Accident		AP1000	15.4.8	9.6×10^{-1}	~~1.7~~1.6 $\times 10^{-1}$	6.3
			APWR	15.4.8	2.7	3.2×10^{-1}	
15.6.2	Small Break Outside Containment		AP1000	15.6.2	5.6×10^{-1}	3.2×10^{-2}	2.5
			APWR	15.6.2	8.0×10^{-1}	4.4×10^{-2}	
			ABWR	15.6.2	4.6×10^{-2}	2.7×10^{-3}	
	Small Break Outside Ctmt	Pre-Incident Iodine Spike	ESBWR	15.4.8	4.5×10^{-2}	8.2×10^{-3}	25
		Equilibrium Iodine Activity	ESBWR	15.4.8	1.3×10^{-2}	8.2×10^{-3}	2.5
15.6.3	Steam Generator Tube Rupture	Pre-Incident Iodine Spike	AP1000	15.6.3	5.9×10^{-1}	3.8×10^{-2}	25
			APWR	15.6.3	1.9	1.1×10^{-1}	
		Accident-Initiated Iodine Spike	AP1000	15.6.3	2.9×10^{-1}	2.5×10^{-2}	2.5
			APWR	15.6.3	5.1×10^{-1}	3.1×10^{-2}	
15.6.4	Main Steam Line Break	Pre-Incident Iodine Spike	ABWR	15.6.4	5.5×10^{-1}	3.2×10^{-2}	25
			ESBWR	15.4.5	3.5×10^{-1}	1.6×10^{-2}	
		Equilibrium Iodine Activity	ABWR	15.6.4	2.7×10^{-2}	1.6×10^{-3}	2.5
			ESBWR	15.4.5	2.7×10^{-2}	8.2×10^{-3}	
15.6.5	Loss-of-Coolant Accident		AP1000	15.6.5	1.3×10^{1}	1.6	25
			APWR	15.6.5	6.9	9.0×10^{-1}	
			ABWR	15.6.5	1.9	1.4	
			ESBWR	15.4.4	3.0	1.3	
15.7.4	Fuel Handling Accident		AP1000	15.7.4	1.4	8.0×10^{-2}	6.3
			APWR	15.7.4	1.8	1.0×10^{-1}	
			ABWR	15.7.4	6.7×10^{-1}	3.9×10^{-2}	
			ESBWR	15.4.1	5.5×10^{-1}	3.3×10^{-2}	

Table 15.1-5 (Sheet 2 of 2)
Summary of Design Basis Accident Site Doses

SRP Section	Accident		Design	DCD Section	Site Dose (rem TEDE)		
					EAB	LPZ	Limit
None	Feedwater Line Break	Pre-Incident Iodine Spike	ESBWR	15.4.7	2.4	1.4×10^{-1}	25
		Equilibrium Iodine Activity	ESBWR	15.4.7	1.5×10^{-1}	8.2×10^{-3}	2.5
None	Cleanup Water Line Break		ABWR	15.6.6	1.4×10^{-2}	8.0×10^{-4}	25
	Cleanup Water Line Break	Pre-Incident Iodine Spike	ESBWR	15.4.9	9.2×10^{-1}	5.7×10^{-2}	25
		Equilibrium Iodine Activity	ESBWR	15.4.9	5.3×10^{-2}	8.2×10^{-3}	2.5

Note: This table summarizes the doses from the tables that follow. For the ABWR, the whole body and thyroid doses within Tables 15.1-44 to 15.1-53 are converted into TEDE values using weighting factors as indicated in Section 15.4. For the designs being considered, there are no radiological consequences for the accidents described in SRP Sections 15.2.8, 15.3.4, and 15.4.9.

References: AP1000 DCD Rev. 17 (Reference 15.5-7)
APWR DCD Rev. 2 (Reference 15.5-8)
ABWR DCD Rev. 4 (Reference 15.5-9)
ESBWR DCD Rev. 6 (Reference 15.5-10)

Table 15.1-6
Activity Releases for AP1000 Main Steam System Piping Failure with Pre-Incident Iodine Spike

Isotope	Activity Release (Ci)				
	0–2 hr	2–8 hr	8–24 hr	24–72 hr	Total
Kr-85m	6.86×10^{-2}	1.14×10^{-1}	6.80×10^{-2}	6.20×10^{-3}	2.57×10^{-1}
Kr-85	2.82×10^{-1}	8.47×10^{-1}	2.25	6.68	1.01×10^{1}
Kr-87	2.76×10^{-2}	1.34×10^{-2}	5.20×10^{-4}	0.00	4.15×10^{-2}
Kr-88	1.12×10^{-1}	1.37×10^{-1}	4.04×10^{-2}	8.00×10^{-4}	2.90×10^{-1}
Xe-131m	1.28×10^{-1}	3.79×10^{-1}	9.81×10^{-1}	2.70	4.19
Xe-133m	1.59×10^{-1}	4.51×10^{-1}	1.04	2.05	3.70
Xe-133	1.18×10^{1}	3.45×10^{1}	8.65×10^{1}	2.16×10^{2}	3.49×10^{2}
Xe-135m	3.04×10^{-3}	1.30×10^{-5}	0.00	0.00	3.05×10^{-3}
Xe-135	3.10×10^{-1}	6.90×10^{-1}	8.35×10^{-1}	3.39×10^{-1}	2.17
Xe-138	3.99×10^{-3}	1.10×10^{-5}	0.00	0.00	4.00×10^{-3}
I-130	3.59×10^{-1}	1.42×10^{-1}	2.09×10^{-1}	1.33×10^{-1}	8.43×10^{-1}
I-131	2.40×10^{1}	1.21×10^{1}	3.10×10^{1}	8.21×10^{1}	1.49×10^{2}
I-132	3.05×10^{1}	4.14	8.07×10^{-1}	6.00×10^{-3}	3.55×10^{1}
I-133	4.34×10^{1}	1.90×10^{1}	3.53×10^{1}	3.98×10^{1}	1.38×10^{2}
I-134	6.74	1.63×10^{-1}	1.40×10^{-3}	0.00	6.90
I-135	2.60×10^{1}	8.16	7.54	1.71	4.34×10^{1}
Cs-134	1.90×10^{1}	1.95×10^{-1}	5.19×10^{-1}	1.54	2.13×10^{1}
Cs-136	2.82×10^{1}	2.86×10^{-1}	7.42×10^{-1}	2.06	3.13×10^{1}
Cs-137	1.37×10^{1}	1.41×10^{-1}	3.74×10^{-1}	1.11	1.53×10^{1}
Cs-138	1.01×10^{1}	1.02×10^{-3}	0.00	0.00	1.01×10^{1}
Total	**2.15×10^{2}**	**8.15×10^{1}**	**1.68×10^{2}**	**3.56×10^{2}**	**8.21×10^{2}**

Note: Source terms are for the radiation dose values recorded in DCD Rev. 17 (Reference 15.5-7).

Table 15.1-7
Doses for AP1000 Main Steam System Piping Failure with Pre-Existing Iodine Spike

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	1.00	—	2.66×10^{-1}	2.66×10^{-1}	—
0–8	—	5.81×10^{-1}	3.10×10^{-2}	—	1.80×10^{-2}
8–24	—	7.18×10^{-2}	3.37×10^{-2}	—	2.42×10^{-3}
24–96	—	1.08×10^{-1}	2.80×10^{-2}	—	3.02×10^{-3}
Total	1.00	7.61×10^{-1}	—	2.66×10^{-2}	2.35×10^{-2}
Limit	—	—	—	25	25

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Reference 15.5-7).

Table 15.1-8
Activity Releases for AP1000 Main Steam System Piping Failure Accident-Initiated Iodine Spike

	Activity Release (Ci)				
Isotope	**0–2 hr**	**2–8 hr**	**8–24 hr**	**24–72 hr**	**Total**
Kr-85m	6.86×10^{-2}	1.14×10^{-1}	6.80×10^{-2}	6.20×10^{-3}	2.57×10^{-1}
Kr-85	2.82×10^{-1}	8.47×10^{-1}	2.25	6.68	1.01×10^{1}
Kr-87	2.76×10^{-2}	1.34×10^{-2}	5.20×10^{-4}	0.00	4.15×10^{-2}
Kr-88	1.12×10^{-1}	1.37×10^{-1}	4.04×10^{-2}	8.00×10^{-4}	2.90×10^{-1}
Xe-131m	1.28×10^{-1}	3.79×10^{-1}	9.81×10^{-1}	2.70	4.19
Xe-133m	1.59×10^{-1}	4.51×10^{-1}	1.04	2.05	3.70
Xe-133	1.18×10^{1}	3.45×10^{1}	8.65×10^{1}	2.16×10^{2}	3.49×10^{2}
Xe-135m	3.04×10^{-3}	1.30×10^{-5}	0.00	0.00	3.05×10^{-3}
Xe-135	3.10×10^{-1}	6.90×10^{-1}	8.35×10^{-1}	3.39×10^{-1}	2.17
Xe-138	3.99×10^{-3}	1.10×10^{-5}	0.00	0.00	4.00×10^{-3}
I-130	4.15×10^{-1}	9.95×10^{-1}	1.58	1.01	4.00
I-131	2.57×10^{1}	5.73×10^{1}	1.56×10^{2}	4.13×10^{2}	6.52×10^{2}
I-132	4.57×10^{1}	9.74×10^{1}	2.23×10^{1}	2.00×10^{-1}	1.66×10^{2}
I-133	4.85×10^{1}	1.14×10^{2}	2.27×10^{2}	2.55×10^{2}	6.45×10^{2}
I-134	1.33×10^{1}	1.86×10^{1}	2.60×10^{-1}	0.00	3.22×10^{1}
I-135	3.20×10^{1}	7.74×10^{1}	7.83×10^{1}	1.77×10^{1}	2.05×10^{2}
Cs-134	1.90×10^{1}	1.95×10^{-1}	5.19×10^{-1}	1.54	2.13×10^{1}
Cs-136	2.82×10^{1}	2.86×10^{-1}	7.42×10^{-1}	2.06	3.13×10^{1}
Cs-137	1.37×10^{1}	1.41×10^{-1}	3.74×10^{-1}	1.11	1.53×10^{1}
Cs-138	1.01×10^{1}	1.02×10^{-3}	0.00	0.00	1.01×10^{1}
Total	**2.50×10^{2}**	**4.03×10^{2}**	**5.79×10^{2}**	**9.19×10^{2}**	**2.15×10^{3}**

Note: Source terms are for the radiation dose values recorded in DCD Rev. 17 (Reference 15.5-7).

Table 15.1-9
Doses for AP1000 Steam System Piping Failure with Accident-Initiated Iodine Spike

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	1.10	—	2.66×10^{-1}	2.93×10^{-1}	—
0–8	—	1.02	3.10×10^{-2}	—	3.16×10^{-2}
8–24	—	3.77×10^{-1}	3.37×10^{-2}	—	1.27×10^{-2}
24–96	—	5.36×10^{-1}	2.80×10^{-2}	—	1.50×10^{-2}
Total	1.10	1.93	—	2.93×10^{-1}	5.93×10^{-2}
Limit	—	—	—	2.5	2.5

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Reference 15.5-7).

Table 15.1-10
Activity Releases for AP1000 Locked Rotor Accident

Isotope	Activity Release (Ci)			
	No Feedwater	With Feedwater		
	0–2 hr	0–6 hr	6–8 hr	Total
Kr-85m	8.16×10^{1}	2.38×10^{2}	4.12×10^{1}	2.79×10^{2}
Kr-85	7.58	3.03×10^{1}	1.01×10^{1}	4.04×10^{1}
Kr-87	1.20×10^{2}	2.07×10^{2}	5.40	2.12×10^{2}
Kr-88	2.08×10^{2}	5.21×10^{2}	6.04×10^{1}	5.81×10^{2}
Xe-131m	3.77	1.50×10^{1}	4.94	1.99×10^{1}
Xe-133m	2.02×10^{1}	7.85×10^{1}	2.48×10^{1}	1.03×10^{2}
Xe-133	6.66×10^{2}	2.63×10^{3}	8.57×10^{2}	3.49×10^{3}
Xe-135m	3.24×10^{1}	3.30×10^{1}	0.00	3.30×10^{1}
Xe-135	1.59×10^{2}	5.40×10^{2}	1.32×10^{2}	6.72×10^{2}
Xe-138	1.29×10^{2}	1.30×10^{2}	0.00	1.30×10^{2}
I-130	8.45×10^{-1}	8.81×10^{-1}	5.65×10^{-1}	1.45
I-131	3.77×10^{1}	4.60×10^{1}	3.46×10^{1}	8.06×10^{1}
I-132	2.79×10^{1}	1.43×10^{1}	3.95	1.83×10^{1}
I-133	4.86×10^{1}	5.33×10^{1}	3.64×10^{1}	8.97×10^{1}
I-134	2.88×10^{1}	5.53	2.09×10^{-1}	5.74
I-135	4.19×10^{1}	3.74×10^{1}	2.05×10^{1}	5.79×10^{1}
Cs-134	1.29	1.48	1.11	2.59
Cs-136	5.63×10^{-1}	5.17×10^{-1}	3.47×10^{-1}	8.64×10^{-1}
Cs-137	7.74×10^{-1}	8.71×10^{-1}	6.50×10^{-1}	1.52
Cs-138	6.08	2.95	1.13	4.08
Rb-86	1.33×10^{-2}	1.64×10^{-2}	1.27×10^{-2}	2.91×10^{-2}
Total	**1.62×10^{3}**	**4.59×10^{3}**	**1.24×10^{3}**	**5.82×10^{3}**

Note: Source terms are for the radiation dose values recorded in DCD Rev. 17 (Reference 15.5-7).

Table 15.1-11
Doses for AP1000 Locked Rotor Accident with No Feedwater

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	8.00×10^{-1}	—	2.66×10^{-1}	2.13×10^{-1}	—
0–8	—	3.89×10^{-1}	3.10×10^{-2}	—	1.21×10^{-2}
Total	8.00×10^{-1}	3.89×10^{-1}	—	2.13×10^{-1}	1.21×10^{-2}
Limit	—	—	—	2.5	2.5

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Reference 15.5-7).

Table 15.1-12
Doses for AP1000 Locked Rotor Accident with Feedwater Available

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
~~0–2~~6–8[a]	6.00×10^{-1}	—	2.66×10^{-1}	1.60×10^{-1}	—
0–8	—	~~7.94~~7.52 $\times 10^{-1}$	3.10×10^{-2}	—	~~2.46~~2.33 $\times 10^{-2}$
Total	6.00×10^{-1}	~~7.94~~7.52 $\times 10^{-1}$	—	1.60×10^{-1}	~~2.46~~2.33 $\times 10^{-2}$
Limit	—	—	—	2.5	2.5

(a) Worst case 2-hour period is 6–8 hours.

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Reference 15.5-7).

Table 15.1-13
Activity Releases for AP1000 Rod Ejection Accident

Isotope	Activity Release (Ci)					
	0–2 hr	2–8 hr	8–24 hr	24–96 hr	96–720 hr	Total
Kr-85m	1.12×10^{2}	6.48×10^{1}	3.87×10^{1}	1.80	0.00	2.17×10^{2}
Kr-85	5.01	5.60	1.49×10^{1}	3.35×10^{1}	2.88×10^{2}	3.47×10^{2}
Kr-87	1.82×10^{2}	2.60×10^{1}	1.03	0.00	0.00	2.09×10^{2}
Kr-88	2.91×10^{2}	1.18×10^{2}	3.49×10^{1}	3.00×10^{-1}	0.00	4.44×10^{2}
Xe-131m	4.94	5.46	1.42×10^{1}	2.86×10^{1}	1.16×10^{2}	1.69×10^{2}
Xe-133m	2.67×10^{1}	2.81×10^{1}	6.49 x 101	8.45×10^{1}	5.31×10^{1}	2.57×10^{2}
Xe-133	8.79×10^{2}	9.59×10^{2}	2.40×10^{3}	4.27×10^{3}	8.44×10^{3}	1.69×10^{4}
Xe-135m	7.34×10^{1}	5.00×10^{-2}	0.00	0.00	0.00	7.35×10^{1}
Xe-135	2.15×10^{2}	1.72×10^{2}	2.09×10^{2}	4.34×10^{1}	2.00×10^{-1}	6.40×10^{2}
Xe-138	2.99×10^{2}	1.40×10^{-1}	0.00	0.00	0.00	2.99×10^{2}
I-130	4.90	7.28	4.32	2.00×10^{-1}	0.00	1.67×10^{1}
I-131	1.36×10^{2}	2.45×10^{2}	2.31×10^{2}	3.10×10^{1}	1.68×10^{1}	6.60×10^{2}
I-132	1.53×10^{2}	9.94×10^{1}	9.80	0.00	0.00	2.62×10^{2}
I-133	2.72×10^{2}	4.40×10^{2}	3.18×10^{2}	2.30×10^{1}	0.00	1.05×10^{3}
I-134	1.66×10^{2}	2.85×10^{1}	1.00×10^{-1}	0.00	0.00	1.95×10^{2}
I-135	2.39×10^{2}	2.97×10^{2}	1.19×10^{2}	2.40	0.00	6.57×10^{2}
Cs-134	3.08×10^{1}	6.22×10^{1}	6.03×10^{1}	7.70	5.20	1.66×10^{2}
Cs-136	8.79	1.75×10^{1}	1.67×10^{1}	2.05	6.50×10^{-1}	4.57×10^{1}
Cs-137	1.79×10^{1}	3.62×10^{1}	3.51×10^{1}	4.52	3.05	9.68×10^{1}
Cs-138	1.09×10^{2}	7.00	0.00	0.00	0.00	1.16×10^{2}
Rb-86	3.62×10^{-1}	7.27×10^{-1}	6.96×10^{-1}	8.40×10^{-2}	3.70×10^{-2}	1.91
Total	**3.23×10^{3}**	**2.62×10^{3}**	**3.57×10^{3}**	**4.53×10^{3}**	**8.92×10^{3}**	**2.29×10^{4}**

Note: Source terms are for the radiation dose values recorded in DCD Rev. 17 (Reference 15.5-7).

Table 15.1-14
Doses for AP1000 Rod Ejection Accident

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	3.60	—	2.66×10^{-1}	9.58×10^{-1}	—
0–8	—	~~4.58~~4.38	3.10×10^{-2}	—	~~1.42~~1.36 $\times 10^{-1}$
8–24	—	~~7.84~~7.85 $\times 10^{-1}$	3.37×10^{-2}	—	2.64×10^{-2}
24–96	—	~~6.32~~6.34 $\times 10^{-2}$	2.80×10^{-2}	—	~~1.77~~1.78 $\times 10^{-3}$
96–720	—	~~2.06~~2.02 $\times 10^{-2}$	1.49×10^{-2}	—	~~3.06~~3.00 $\times 10^{-4}$
Total	3.60	~~5.45~~5.25	—	9.58×10^{-1}	~~1.70~~1.64 $\times 10^{-1}$
Limit	—	—	—	6.3	6.3

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Reference 15.5-7).

Table 15.1-15
Activity Releases for AP1000 Small Break Outside Containment

Isotope	Activity Release (Ci) 0–0.5 hr
Kr-85m	1.24×10^{1}
Kr-85	4.40×10^{1}
Kr-87	7.05
Kr-88	2.21×10^{1}
Xe-131m	1.99×10^{1}
Xe-133m	2.50×10^{1}
Xe-133	1.84×10^{3}
Xe-135m	2.59
Xe-135	5.20×10^{1}
Xe-138	3.65
I-130	1.89
I-131	9.26×10^{1}
I-132	3.49×10^{2}
I-133	2.01×10^{2}
I-134	1.58×10^{2}
I-135	1.68×10^{2}
Cs-134	4.16
Cs-136	6.16
Cs-137	3.00
Cs-138	2.21
Rb-86	0.00
Total	**3.01×10^{3}**

Note: Source terms are for the radiation dose values recorded in DCD Rev. 17 (Reference 15.5-7).

Table 15.1-16
Doses for AP1000 Small Break Outside Containment

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	2.10	—	2.66×10^{-1}	5.59×10^{-1}	—
0–8	—	~~1.02~~1.03	3.10×10^{-2}	—	~~3.16~~3.19 $\times 10^{-2}$
Total	2.10	~~1.02~~1.03	—	5.59×10^{-1}	~~3.16~~3.19 $\times 10^{-2}$
Limit	—	—	—	2.5	2.5

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Reference 15.5-7).

Table 15.1-17
Activity Releases for AP1000 Steam Generator Tube Rupture with Pre-Incident Iodine Spike

Isotope	Activity Release (Ci)			
	0–2 hr	2–8 hr	8–14 hr	Total
Kr-85m	5.53×10^{1}	1.93×10^{1}	0.00	7.46×10^{1}
Kr-85	2.20×10^{2}	1.08×10^{2}	2.00×10^{-1}	3.28×10^{2}
Kr-87	2.39×10^{1}	3.61	0.00	2.75×10^{1}
Kr-88	9.22×10^{1}	2.65×10^{1}	0.00	1.19×10^{2}
Xe-131m	9.96×10^{1}	4.88×10^{1}	0.00	1.48×10^{2}
Xe-133m	1.24×10^{2}	5.91×10^{1}	1.00×10^{-1}	1.83×10^{2}
Xe-133	9.19×10^{3}	4.47×10^{3}	1.00×10^{1}	1.37×10^{4}
Xe-135m	3.44	6.00×10^{-3}	0.00	3.45
Xe-135	2.46×10^{2}	1.02×10^{2}	1.00×10^{-1}	3.48×10^{2}
Xe-138	4.56	5.00×10^{-3}	0.00	4.57
I-130	1.79	5.39×10^{-2}	2.67×10^{-1}	2.11
I-131	1.21×10^{2}	5.27	3.05×10^{1}	1.57×10^{2}
I-132	1.42×10^{2}	7.86×10^{-1}	1.91	1.45×10^{2}
I-133	2.16×10^{2}	7.63	4.06×10^{1}	2.64×10^{2}
I-134	2.74×10^{1}	1.06×10^{-2}	2.00×10^{-4}	2.74×10^{1}
I-135	1.27×10^{2}	2.70	1.17×10^{1}	1.41×10^{2}
Cs-134	1.63	6.10×10^{-2}	2.16×10^{-1}	1.91
Cs-136	2.42	8.80×10^{-2}	3.15×10^{-1}	2.82
Cs-137	1.17	4.40×10^{-2}	1.56×10^{-1}	1.37
Cs-138	5.64×10^{-1}	0.00	0.00	5.64×10^{-1}
Total	**1.07×10^{4}**	**4.85×10^{3}**	**9.61×10^{1}**	**1.57×10^{4}**

Note: Source terms are for the radiation dose values recorded in DCD Rev. 17 (Reference 15.5-7).

Table 15.1-18
Doses for AP1000 Steam Generator Tube Rupture with Pre-Incident Iodine Spike

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	2.20	—	2.66×10^{-1}	5.85×10^{-1}	—
0–8	—	1.16	3.10×10^{-2}	—	3.60×10^{-2}
8–24	—	~~7.24~~7.20 $\times 10^{-2}$	3.37×10^{-2}	—	~~2.44~~2.42 $\times 10^{-3}$
Total	2.20	1.23	—	5.85×10^{-1}	3.84×10^{-2}
Limit	—	—	—	25	25

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Reference 15.5-7).

Table 15.1-19
Activity Releases for AP1000 Steam Generator Tube Rupture with Accident Initiated Iodine Spike

Isotope	Activity Release (Ci)			
	0–2 hr	2–8 hr	8–14 hr	Total
Kr-85m	5.53×10^{1}	1.93×10^{1}	0.00	7.46×10^{1}
Kr-85	2.20×10^{2}	1.08×10^{2}	2.00×10^{-1}	3.28×10^{2}
Kr-87	2.39×10^{1}	3.61	0.00	2.75×10^{1}
Kr-88	9.22×10^{1}	2.65×10^{1}	0.00	1.19×10^{2}
Xe-131m	9.96×10^{1}	4.88×10^{1}	0.00	1.48×10^{2}
Xe-133m	1.24×10^{2}	5.91×10^{1}	1.00×10^{-1}	1.83×10^{2}
Xe-133	9.19×10^{3}	4.47×10^{3}	1.00×10^{1}	1.37×10^{4}
Xe-135m	3.44	6.00×10^{-3}	0.00	3.45
Xe-135	2.46×10^{2}	1.02×10^{2}	1.00×10^{-1}	3.48×10^{2}
Xe-138	4.56	5.00×10^{-3}	0.00	4.57
I-130	8.87×10^{-1}	1.62×10^{-1}	8.23×10^{-1}	1.87
I-131	4.36×10^{1}	1.14×10^{1}	6.76×10^{1}	1.23×10^{2}
I-132	1.47×10^{2}	4.89	1.29×10^{1}	1.65×10^{2}
I-133	9.33×10^{1}	1.99×10^{1}	1.08×10^{2}	2.21×10^{2}
I-134	5.59×10^{1}	6.06×10^{-2}	6.02×10^{-2}	5.60×10^{1}
I-135	7.61×10^{1}	9.89	4.38×10^{1}	1.30×10^{2}
Cs-134	1.63	6.10×10^{-2}	2.16×10^{-1}	1.91
Cs-136	2.42	8.80×10^{-2}	3.15×10^{-1}	2.82
Cs-137	1.17	4.40×10^{-2}	1.56×10^{-1}	1.37
Cs-138	5.64×10^{-1}	0.00	0.00	5.64×10^{-1}
Total	**1.05×10^{4}**	**4.88×10^{3}**	**2.44×10^{2}**	**1.56×10^{4}**

Note: Source terms are for the radiation dose values recorded in DCD Rev. 17 (Reference 15.5-7).

Table 15.1-20
Doses for AP1000 Steam Generator Tube Rupture with Accident-Initiated Iodine Spike

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	1.10	—	2.66×10^{-1}	2.93×10^{-1}	—
0–8	—	~~6.27~~6.10 $\times 10^{-1}$	3.10×10^{-2}	—	~~1.94~~1.89 $\times 10^{-2}$
8–24	—	~~1.69~~1.68 $\times 10^{-1}$	3.37×10^{-2}	—	~~5.69~~5.66 $\times 10^{-3}$
Total	1.10	~~7.96~~7.78 $\times 10^{-1}$	—	2.93×10^{-1}	~~2.51~~2.46 $\times 10^{-2}$
Limit	—	—	—	2.5	2.5

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Reference 15.5-7).

Table 15.1-21 (Sheet 2 of 2)
Activity Releases for AP1000 Loss-of-Coolant Accident

Isotope	Activity Release (Ci)							
	1.4–3.4 hr	0–2 hr	2–8 hr	8–24 hr	24–72 hr	72–96 hr	96–720 hr	Total
Ba-140	1.63×10^{2}	7.61×10^{1}	2.49×10^{2}	1.51×10^{1}	0	0	4.00×10^{-1}	3.41×10^{2}
Mo-99	2.15×10^{1}	1.01×10^{1}	3.24×10^{1}	1.86	1.00×10^{-2}	0	0	4.44×10^{1}
Tc-99m	1.47×10^{1}	7.54	1.91×10^{1}	5.90×10^{-1}	0	0	0	2.72×10^{1}
Ru-103	1.73×10^{1}	8.08	2.65×10^{1}	1.62	0	1.00×10^{-2}	6.00×10^{-2}	3.63×10^{1}
Ru-105	8.18	4.33	1.00×10^{1}	2.40×10^{-1}	0	0	0	1.46×10^{1}
Ru-106	5.70	2.66	8.75	5.40×10^{-1}	0	0	3.00×10^{-2}	1.20×10^{1}
Rh-105	1.03×10^{1}	4.88	1.53×10^{1}	8.30×10^{-1}	0	0	0	2.10×10^{1}
Ce-141	3.89	1.82	5.96	3.64×10^{-1}	1.00×10^{-3}	1.00×10^{-3}	1.20×10^{-2}	8.16
Ce-143	3.46	1.64	5.14	2.78×10^{-1}	1.00×10^{-3}	0	0	7.06
Ce-144	2.94	1.37	4.51	2.76×10^{-1}	1.00×10^{-3}	1.00×10^{-3}	1.30×10^{-2}	6.17
Pu-238	9.16×10^{-3}	4.28×10^{-3}	1.41×10^{-2}	8.60×10^{-4}	0	0	4.00×10^{-5}	1.93×10^{-2}
Pu-239	8.06×10^{-4}	3.76×10^{-4}	1.24×10^{-3}	7.60×10^{-5}	0	1.00×10^{-6}	3.00×10^{-6}	1.70×10^{-3}
Pu-240	1.18×10^{-3}	5.52×10^{-4}	1.81×10^{-3}	1.11×10^{-4}	1.00×10^{-6}	0	5.00×10^{-6}	2.48×10^{-3}
Pu-241	2.65×10^{-1}	1.24×10^{-1}	4.08×10^{-1}	2.50×10^{-2}	1.00×10^{-4}	0	1.20×10^{-3}	5.58×10^{-1}
Np-239	4.48×10^{1}	2.12×10^{1}	6.75×10^{1}	3.84	1.00×10^{-2}	1.00×10^{-2}	1.00×10^{-2}	9.26×10^{1}
Y-90	8.08×10^{-2}	3.81×10^{-2}	1.22×10^{-1}	7.00×10^{-3}	0	0	0	1.67×10^{-1}
Y-91	1.19	5.54×10^{-1}	1.82	1.11×10^{-1}	1.00×10^{-3}	0	4.00×10^{-3}	2.49
Y-92	7.89×10^{-1}	4.32×10^{-1}	9.19×10^{-1}	1.80×10^{-2}	0	0	0	1.37
Y-93	1.21	6.00×10^{-1}	1.68	6.80×10^{-2}	0	0	0	2.35
Nb-95	1.59	7.46×10^{-1}	2.44	1.49×10^{-1}	1.00×10^{-3}	0	5.00×10^{-3}	3.34
Zr-95	1.59	7.41×10^{-1}	2.43	1.49×10^{-1}	0	0	6.00×10^{-3}	3.33
Zr-97	1.43	6.89×10^{-1}	2.05	9.80×10^{-2}	0	0	0	2.84
La-140	1.67	7.92×10^{-1}	2.50	1.39×10^{-1}	0	0	0	3.43
La-141	1.03	5.54×10^{-1}	1.23	2.70×10^{-2}	0	0	0	1.81
La-142	5.38×10^{-1}	3.57×10^{-1}	4.74×10^{-1}	2.00×10^{-3}	0	0	0	8.33×10^{-1}
Nd-147	6.16×10^{-1}	2.89×10^{-1}	9.42×10^{-1}	5.70×10^{-2}	0	0	1.00×10^{-3}	1.29
Pr-143	1.39	6.50×10^{-1}	2.13	1.28×10^{-1}	1.00×10^{-3}	0	3.00×10^{-3}	2.91
Am-241	1.20×10^{-4}	5.59×10^{-5}	1.84×10^{-4}	1.13×10^{-5}	0	0	6.00×10^{-7}	2.52×10^{-4}
Cm-242	2.82×10^{-2}	1.32×10^{-2}	4.33×10^{-2}	2.65×10^{-3}	1.00×10^{-5}	1.00×10^{-5}	1.20×10^{-4}	5.93×10^{-2}
Cm-244	3.46×10^{-3}	1.62×10^{-3}	5.32×10^{-3}	3.26×10^{-4}	1.00×10^{-6}	0	1.60×10^{-5}	7.28×10^{-3}
Total	**3.53×10^{4}**	**1.72×10^{4}**	**8.14×10^{4}**	**1.35×10^{5}**	**1.54×10^{5}**	**6.17×10^{4}**	**4.29×10^{5}**	**8.78×10^{5}**

Note: Source terms are for the radiation dose values recorded in DCD Rev. 17 (Reference 15.5-7).

Table 15.1-22
Doses for AP1000 Loss-of-Coolant Accident

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
1.4–3.4[a] ~~0–2~~	2.46×10^{1}	—	5.22×10^{-1}	1.28×10^{1}	—
0–8	—	2.17×10^{1}	7.05×10^{-2}	—	1.53
8–24	—	7.50×10^{-1}	6.31×10^{-2}	—	4.73×10^{-2}
24–96	—	2.93×10^{-1}	4.20×10^{-2}	—	1.23×10^{-2}
96–720	—	5.49×10^{-1}	1.49×10^{-2}	—	8.17×10^{-3}
Total	2.46×10^{1}	2.33×10^{1}	—	1.28×10^{1}	1.60
Limit	—	—	—	25	25

(a) Worst case 2-hour period is 1.4–3.4 hours.

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Reference 15.5-7).

Table 15.1-23
Activity Releases for AP1000 Fuel Handling Accident

Isotope	Activity Release (Ci), 0–2 hr
Kr-85m	8.40
Kr-85	1.10×10^{3}
Kr-88	3.00×10^{-1}
Xe-131m	5.52×10^{2}
Xe-133m	2.30×10^{3}
Xe-133	8.88×10^{4}
Xe-135m	1.02×10^{2}
Xe-135	5.68×10^{3}
I-130	7.00×10^{-1}
I-131	3.47×10^{2}
I-132	2.44×10^{2}
I-133	1.08×10^{2}
I-135	3.20
Total	**9.92×10^{4}**

Note: Source terms are for the radiation dose values recorded in DCD Rev. 17 (Reference 15.5-7).

Table 15.1-24
Doses for AP1000 Fuel Handling Accident

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	5.20	—	2.66×10^{-1}	1.38	—
0–8	—	2.59	3.10×10^{-2}	—	8.03×10^{-2}
Total	5.20	2.59	—	1.38	8.03×10^{-2}
Limit	—	—	—	6.3	6.3

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Reference 15.5-7).

Table 15.1-25
Activity Releases for APWR Steam System Piping Failure with Pre-Incident Iodine Spike

Isotope	Activity Release (Ci)		
	0–8 hr	8–24 hr	Total
Kr-85	3.21×10^{1}	2.40×10^{1}	5.61×10^{1}
Kr-85m	3.56×10^{-1}	8.77×10^{-2}	4.43×10^{-1}
Kr-87	9.12×10^{-2}	1.13×10^{-3}	9.23×10^{-2}
Kr-88	5.10×10^{-1}	6.46×10^{-2}	5.74×10^{-1}
Xe-133	1.07×10^{2}	7.75×10^{1}	1.85×10^{2}
Xe-135	4.38	3.39	7.78
I-131	1.72×10^{1}	7.25	2.44×10^{1}
I-132	6.18	1.66×10^{-1}	6.35
I-133	2.79×10^{1}	9.03	3.69×10^{1}
I-134	3.49	1.01×10^{-3}	3.49
I-135	1.62×10^{1}	2.73	1.89×10^{1}
Rb-86	8.64×10^{-2}	1.62×10^{-3}	8.80×10^{-2}
Cs-134	8.80	1.68×10^{-1}	8.97
Cs-136	2.32	4.33×10^{-2}	2.37
Cs-137	5.01	9.56×10^{-2}	5.11
Total	2.32×10^{2}	1.25×10^{2}	3.56×10^{2}

Reference: APWR DCD Rev. 2 (15.5-8)

Table 15.1-26
Doses for APWR Steam System Piping Failure with Pre-Incident Iodine Spike

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	1.9×10^{-1}	—	5.32×10^{-1}	1.0×10^{-1}	—
0–8	—	1.0×10^{-1}	7.38×10^{-2}	—	7.4×10^{-3}
8–24	—	7.6×10^{-3}	7.77×10^{-2}	—	5.9×10^{-4}
Total	1.9×10^{-1}	1.1×10^{-1}	—	1.0×10^{-1}	8.0×10^{-3}
Limit	—	—	—	25	25

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 2 (Reference 15.5-8).

Table 15.1-27
Activity Releases for APWR Steam System Piping Failure Accident-Initiated Iodine Spike

Isotope	Activity Release (Ci)		
	0–8 hr	8–24 hr	Total
Kr-85	3.21×10^{1}	2.40×10^{1}	5.61×10^{1}
Kr-85m	3.56×10^{-1}	8.77×10^{-2}	4.43×10^{-1}
Kr-87	9.12×10^{-2}	1.13×10^{-3}	9.23×10^{-2}
Kr-88	5.10×10^{-1}	6.46×10^{-2}	5.74×10^{-1}
Xe-133	1.08×10^{2}	8.03×10^{1}	1.88×10^{2}
Xe-135	7.61	1.33×10^{1}	2.09×10^{1}
I-131	5.05×10^{1}	6.50×10^{1}	1.16×10^{2}
I-132	9.89	1.49	1.14×10^{1}
I-133	7.65×10^{1}	8.09×10^{1}	1.57×10^{2}
I-134	3.77	9.11×10^{-3}	3.78
I-135	3.77×10^{1}	2.45×10^{1}	6.21×10^{1}
Rb-86	8.64×10^{-2}	1.62×10^{-3}	8.80×10^{-2}
Cs-134	8.80	1.68×10^{-1}	8.97
Cs-136	2.32	4.33×10^{-2}	2.37
Cs-137	5.01	9.56×10^{-2}	5.11
Total	3.43×10^{2}	2.90×10^{2}	6.33×10^{2}

Reference: APWR DCD Rev. 2 (15.5-8)

Table 15.1-28
Doses for APWR Steam System Piping Failure with Accident-Initiated Iodine Spike

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	3.2×10^{-1}	—	5.32×10^{-1}	1.7×10^{-1}	—
0–8	—	2.1×10^{-1}	7.38×10^{-2}	—	1.6×10^{-2}
8–24	—	6.5×10^{-2}	7.77×10^{-2}	—	5.1×10^{-3}
Total	3.2×10^{-1}	2.8×10^{-1}	—	1.7×10^{-1}	2.1×10^{-2}
Limit	—	—	—	2.5	2.5

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 2 (Reference 15.5-8).

Table 15.1-29
Activity Releases for APWR Locked Rotor Accident

Isotope	Activity Release (Ci)		
	0–8 hr	8–24 hr	Total
Kr-85	1.12×10^{2}	8.40×10^{1}	1.96×10^{2}
Kr-85m	6.40×10^{2}	1.58×10^{2}	7.98×10^{2}
Kr-87	5.02×10^{2}	6.21	5.08×10^{2}
Kr-88	1.37×10^{3}	1.74×10^{2}	1.55×10^{3}
Xe-133	6.87×10^{3}	4.96×10^{3}	1.18×10^{4}
Xe-135	1.61×10^{3}	7.67×10^{2}	2.37×10^{3}
I-131	8.81×10^{1}	2.32×10^{2}	3.20×10^{2}
I-132	1.94×10^{1}	8.35	2.77×10^{1}
I-133	9.85×10^{1}	2.17×10^{2}	3.15×10^{2}
I-134	6.46	1.10×10^{-1}	6.57
I-135	6.38×10^{1}	9.16×10^{1}	1.55×10^{2}
Rb-86	3.23×10^{-2}	8.66×10^{-2}	1.19×10^{-1}
Cs-134	3.24	8.78	1.20×10^{1}
Cs-136	8.72×10^{-1}	2.33	3.21
Cs-137	1.84	5.00	6.84
Total	1.14×10^{4}	6.71×10^{3}	1.81×10^{4}

Reference: APWR DCD Rev. 2 (15.5-8)

Table 15.1-30
Doses for APWR Locked Rotor Accident

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
~~0–2~~10–12[a]	4.9×10^{-1}	—	5.32×10^{-1}	2.6×10^{-1}	—
0–8	—	4.4×10^{-1}	7.38×10^{-2}	—	3.2×10^{-2}
8–24	—	2.5×10^{-1}	7.77×10^{-2}	—	1.9×10^{-2}
Total	4.9×10^{-1}	6.9×10^{-1}	—	2.6×10^{-1}	5.2×10^{-2}
Limit	—	—	—	2.5	2.5

(a) Worst case 2-hour period is 10–12 hours.

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 2 (Reference 15.5-8).

Table 15.1-31
Activity Releases for APWR Rod Ejection Accident

Isotope	Activity Release (Ci)				
	0–8 hr	8–24 hr	24–96 hr	96–720 hr	Total
Kr-85	2.63×10^{2}	2.50×10^{2}	1.90×10^{2}	1.63×10^{3}	2.33×10^{3}
Kr-85m	3.59×10^{3}	9.58×10^{2}	9.86	0	4.56×10^{3}
Kr-87	2.81×10^{3}	3.50×10^{1}	0	0	2.85×10^{3}
Kr-88	7.70×10^{3}	1.02×10^{3}	2.05	0	8.72×10^{3}
Xe-133	3.81×10^{4}	3.46×10^{4}	2.11×10^{4}	4.22×10^{4}	1.36×10^{5}
Xe-135	9.31×10^{3}	5.32×10^{3}	5.40×10^{2}	2.81	1.52×10^{4}
I-131	5.82×10^{2}	7.17×10^{2}	2.58×10^{2}	7.79×10^{2}	2.34×10^{3}
I-132	4.62×10^{2}	3.93×10^{1}	1.40×10^{-2}	0	5.01×10^{2}
I-133	1.12×10^{3}	1.06×10^{3}	1.13×10^{2}	1.13×10^{1}	2.30×10^{3}
I-134	4.95×10^{2}	5.15×10^{-1}	0	0	4.95×10^{2}
I-135	8.75×10^{2}	4.39×10^{2}	6.60	4.00×10^{-3}	1.32×10^{3}
Rb-86	4.16×10^{-1}	9.65×10^{-2}	0	0	5.13×10^{-1}
Cs-134	4.15×10^{1}	9.79	1.01×10^{-3}	0	5.13×10^{1}
Cs-136	1.13×10^{1}	2.60	1.00×10^{-6}	0	1.39×10^{1}
Cs-137	2.36×10^{1}	5.57	0	0	2.92×10^{1}
Total	6.53×10^{4}	4.45×10^{4}	2.22×10^{4}	4.46×10^{4}	1.77×10^{5}

Reference: APWR DCD Rev. 2 (15.5-8)

Table 15.1-32
Doses for APWR Rod Ejection Accident

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	5.1	—	5.32×10^{-1}	2.7	—
0–8	—	3.2	7.38×10^{-2}	—	2.4×10^{-1}
8–24	—	8.8×10^{-1}	7.77×10^{-2}	—	6.8×10^{-2}
24–96	—	1.6×10^{-1}	6.09×10^{-2}	—	9.7×10^{-3}
96–720	—	1.7×10^{-1}	4.25×10^{-2}	—	7.2×10^{-3}
Total	5.1	4.4	—	2.7	3.2×10^{-1}
Limit	—	—	—	6.3	6.3

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 2 (Reference 15.5-8).

Table 15.1-33
Activity Releases for APWR Small Break Outside Containment

Isotope	Activity Release (Ci) 0–8 hr
Kr-85	6.84×10^{2}
Kr-85m	1.25×10^{1}
Kr-87	7.05
Kr-88	2.26×10^{1}
Xe-133	2.32×10^{3}
Xe-135	7.70×10^{1}
I-131	1.72×10^{2}
I-132	7.98×10^{1}
I-133	2.93×10^{2}
I-134	4.33×10^{1}
I-135	1.85×10^{2}
Total	3.90×10^{3}

Reference: APWR DCD Rev. 2 (15.5-8)

Table 15.1-34
Doses for APWR Small Break Outside Containment

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	1.5	—	5.32×10^{-1}	8.0×10^{-1}	—
0–8	—	6.0×10^{-1}	7.38×10^{-2}	—	4.4×10^{-2}
Total	1.5	6.0×10^{-1}	—	8.0×10^{-1}	4.4×10^{-2}
Limit	—	—	—	2.5	2.5

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 2 (Reference 15.5-8).

Table 15.1-35
Activity Releases for APWR Steam Generator Tube Rupture with Pre-Incident Iodine Spike

Isotope	Activity Release (Ci)				
	0–8 hr	8–24 hr	24–96 hr	96–720 hr	Total
Kr-85	3.43×10^{3}	4.64×10^{1}	2.06×10^{2}	1.59×10^{3}	5.27×10^{3}
Kr-85m	6.17×10^{1}	9.70×10^{-2}	8.00×10^{-3}	0	6.18×10^{1}
Kr-87	3.40×10^{1}	0	0	0	3.40×10^{1}
Kr-88	1.11×10^{2}	6.00×10^{-2}	1.00×10^{-2}	0	1.11×10^{2}
Xe-133	1.16×10^{4}	1.44×10^{2}	5.06×10^{2}	9.44×10^{2}	1.32×10^{4}
Xe-135	3.75×10^{2}	2.18	6.70×10^{-1}	0	3.78×10^{2}
I-131	4.18×10^{2}	1.81	0	0	4.20×10^{2}
I-132	2.09×10^{2}	3.92×10^{-2}	0	0	2.09×10^{2}
I-133	7.16×10^{2}	2.24	0	0	7.18×10^{2}
I-134	1.28×10^{2}	6.00×10^{-5}	0	0	1.28×10^{2}
I-135	4.61×10^{2}	6.70×10^{-1}	0	0	4.62×10^{2}
Rb-86	4.54×10^{-3}	5.44×10^{-4}	0	0	5.09×10^{-3}
Cs-134	4.63×10^{-1}	5.63×10^{-2}	0	0	5.19×10^{-1}
Cs-136	1.22×10^{-1}	1.45×10^{-2}	0	0	1.37×10^{-1}
Cs-137	2.64×10^{-1}	3.21×10^{-2}	0	0	2.96×10^{-1}
Total	1.76×10^{4}	1.98×10^{2}	7.12×10^{2}	2.53×10^{3}	2.10×10^{4}

Reference: APWR DCD Rev. 2 (15.5-8)

Table 15.1-36
Doses for APWR Steam Generator Tube Rupture with Pre-Incident Iodine Spike

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	3.6	—	5.32×10^{-1}	1.9	—
0–8	—	1.5	7.38×10^{-2}	—	1.1×10^{-1}
8–24	—	2.0×10^{-3}	7.77×10^{-2}	—	1.6×10^{-4}
24–96	—	2.1×10^{-4}	6.09×10^{-2}	—	1.3×10^{-5}
96–720	—	1.7×10^{-4}	4.25×10^{-2}	—	7.2×10^{-6}
Total	3.6	1.5	—	1.9	1.1×10^{-1}
Limit	—	—	—	25	25

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 2 (Reference 15.5-8).

Table 15.1-37
Activity Releases for APWR Steam Generator Tube Rupture with Accident-Initiated Iodine Spike

Isotope	Activity Release (Ci)				
	0–8 hr	8–24 hr	24–96 hr	96–720 hr	Total
Kr-85	3.43×10^{3}	4.64×10^{1}	2.06×10^{2}	1.59×10^{3}	5.27×10^{3}
Kr-85m	6.17×10^{1}	9.70×10^{-2}	8.00×10^{-3}	0	6.18×10^{1}
Kr-87	3.40×10^{1}	0	0	0	3.40×10^{1}
Kr-88	1.11×10^{2}	6.00×10^{-2}	1.00×10^{-2}	0	1.11×10^{2}
Xe-133	1.16×10^{4}	1.45×10^{2}	5.06×10^{2}	9.44×10^{2}	1.32×10^{4}
Xe-135	3.70×10^{2}	3.82	6.70×10^{-1}	0	3.74×10^{2}
I-131	1.10×10^{2}	1.03×10^{1}	0	0	1.20×10^{2}
I-132	5.24×10^{1}	2.12×10^{-1}	0	0	5.26×10^{1}
I-133	1.87×10^{2}	1.27×10^{1}	0	0	2.00×10^{2}
I-134	3.05×10^{1}	1.06×10^{-3}	0	0	3.05×10^{1}
I-135	1.19×10^{2}	3.74	0	0	1.23×10^{2}
Rb-86	4.54×10^{-3}	5.44×10^{-4}	0	0	5.09×10^{-3}
Cs-134	4.63×10^{-1}	5.63×10^{-2}	0	0	5.19×10^{-1}
Cs-136	1.22×10^{-1}	1.45×10^{-2}	0	0	1.37×10^{-1}
Cs-137	2.64×10^{-1}	3.21×10^{-2}	0	0	2.96×10^{-1}
Total	1.61×10^{4}	2.22×10^{2}	7.12×10^{2}	2.53×10^{3}	1.96×10^{4}

Reference: APWR DCD Rev. 2 (15.5-8)

Table 15.1-38
Doses for APWR Steam Generator Tube Rupture with Accident-Initiated Iodine Spike

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	9.6×10^{-1}	—	5.32×10^{-1}	5.1×10^{-1}	—
0–8	—	4.1×10^{-1}	7.38×10^{-2}	—	3.0×10^{-2}
8–24	—	1.0×10^{-2}	7.77×10^{-2}	—	7.8×10^{-4}
24–96	—	2.1×10^{-4}	6.09×10^{-2}	—	1.3×10^{-5}
96–720	—	1.7×10^{-4}	4.25×10^{-2}	—	7.2×10^{-6}
Total	9.6×10^{-1}	4.2×10^{-1}	—	5.1×10^{-1}	3.1×10^{-2}
Limit	—	—	—	2.5	2.5

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 2 (Reference 15.5-8).

Table 15.1-39 (Sheet 2 of 2)
Activity Release for APWR Loss-of-Coolant Accident

Isotope	Activity Release (Ci)				
	0–8 hr	8–24 hr	24–96 hr	96–720 hr	Total
Ru-105	3.14	1.12×10^{-2}	0	0	3.15
Ru-106	2.67	3.46×10^{-2}	0	0	2.70
Rh-105	4.61	5.41×10^{-2}	0	0	4.67
Y-90	7.44×10^{-2}	5.12×10^{-3}	6.06×10^{-6}	0	7.96×10^{-2}
Y-91	6.00×10^{-1}	8.54×10^{-3}	0	0	6.09×10^{-1}
Y-92	4.13	1.04×10^{-1}	0	0	4.24
Y-93	5.90×10^{-1}	4.32×10^{-3}	0	0	5.94×10^{-1}
Zr-95	7.55×10^{-1}	9.76×10^{-3}	0	0	7.65×10^{-1}
Zr-97	6.65×10^{-1}	6.12×10^{-3}	0	0	6.71×10^{-1}
Nb-95	7.60×10^{-1}	9.85×10^{-3}	1.01×10^{-5}	0	7.69×10^{-1}
La-140	1.76	1.43×10^{-1}	2.02×10^{-4}	0	1.90
La-141	4.25×10^{-1}	1.29×10^{-3}	0	0	4.27×10^{-1}
La-142	2.01×10^{-1}	7.07×10^{-5}	0	0	2.01×10^{-1}
Pr-143	6.74×10^{-1}	8.91×10^{-3}	1.00×10^{-5}	0	6.83×10^{-1}
Nd-147	2.80×10^{-1}	3.55×10^{-3}	0	0	2.83×10^{-1}
Am-241	7.51×10^{-5}	9.77×10^{-7}	0	0	7.60×10^{-5}
Cm-242	1.86×10^{-2}	2.41×10^{-4}	0	0	1.88×10^{-2}
Cm-244	2.26×10^{-3}	2.93×10^{-5}	0	0	2.29×10^{-3}
Ce-141	1.78	2.29×10^{-2}	0	0	1.80
Ce-143	1.63	1.78×10^{-2}	0	0	1.65
Ce-144	1.35	1.75×10^{-2}	0	0	1.36
Np-239	1.85×10^{1}	2.16×10^{-1}	1.00×10^{-5}	0	1.87×10^{1}
Pu-238	5.30×10^{-3}	6.88×10^{-5}	0	0	5.37×10^{-3}
Pu-239	4.00×10^{-4}	5.19×10^{-6}	0	0	4.05×10^{-4}
Pu-240	6.28×10^{-4}	8.14×10^{-6}	1.01×10^{-8}	0	6.36×10^{-4}
Pu-241	1.39×10^{-1}	1.81×10^{-3}	0	0	1.41×10^{-1}
Total	2.03×10^{5}	3.28×10^{5}	5.09×10^{5}	1.02×10^{6}	2.06×10^{6}

Reference: APWR DCD Rev. 2 (15.5-8)

Table 15.1-40
Doses for APWR Loss-of-Coolant Accident

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0.5–2.5[(a)]	1.3×10^{1}	—	5.32×10^{-1}	6.9	—
0–8	—	9.0	7.38×10^{-2}	—	6.6×10^{-1}
8–24	—	1.2	7.77×10^{-2}	—	9.3×10^{-2}
24–96	—	1.3	6.09×10^{-2}	—	7.9×10^{-2}
96–720	—	1.4	4.25×10^{-2}	—	6.0×10^{-2}
Total	1.3×10^{1}	1.3×10^{1}	—	6.9	9.0×10^{-1}
Limit	—	—	—	25	25

(a) Worst case 2-hour period is 0.5–2.5 hours.

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 2 (Reference 15.5-8).

Table 15.1-41
Activity Release for APWR Fuel Handling Accident

Isotope	Activity Release (Ci) 0–8 hr
Kr-85	1.20×10^{3}
Kr-85m	3.90×10^{2}
Kr-87	5.98×10^{-2}
Kr-88	1.25×10^{2}
Xe-133	9.90×10^{4}
Xe-135	2.21×10^{4}
I-131	3.67×10^{2}
I-132	2.75×10^{2}
I-133	2.31×10^{2}
I-134	2.71×10^{-6}
I-135	3.80×10^{1}
Total	1.24×10^{5}

Reference: APWR DCD Rev. 2 (15.5-8)

Table 15.1-42
Doses for APWR Fuel Handling Accident

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	3.3	—	5.32×10^{-1}	1.8	—
0–8	—	1.4	7.38×10^{-2}	—	1.0×10^{-1}
Total	3.3	1.4	—	1.8	1.0×10^{-1}
Limit	—	—	—	6.3	6.3

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 2 (Reference 15.5-8).

Table 15.1-43
Activity Releases for ABWR Main Steam Line Break

Isotope	Activity Release (MBq)	
	Equilibrium Activity	Pre-Incident Spike
I-131	7.29×10^4	1.46×10^6
I-132	7.10×10^5	1.42×10^7
I-133	5.00×10^5	9.99×10^6
I-134	1.40×10^6	2.79×10^7
I-135	7.29×10^5	1.46×10^7
Kr-83m	4.07×10^2	2.44×10^3
Kr-85m	7.18×10^2	4.29×10^3
Kr-85	2.26	1.36×10^1
Kr-87	2.44×10^3	1.47×10^4
Kr-88	2.46×10^3	1.48×10^4
Kr-89	9.88×10^3	5.92×10^4
Kr-90	2.55×10^3	1.55×10^4
Xe-131m	1.76	1.06×10^1
Xe-133m	3.39×10^1	2.04×10^2
Xe-133	9.47×10^2	5.70×10^3
Xe-135m	2.89×10^3	1.74×10^4
Xe-135	2.70×10^3	1.62×10^4
Xe-137	1.23×10^4	7.40×10^4
Xe-138	9.44×10^3	5.66×10^4
Xe-139	4.33×10^3	2.59×10^4

Reference: ABWR DCD Rev. 4 (15.5-9)

Table 15.1-44
Doses for ABWR Main Steam Line Break with Pre-Incident Iodine Spike

Location	Time (hr)	DCD Dose (Sv)		X/Q Ratio	Site Dose (rem TEDE)	
		W. Body	Thyroid	Site to DCD	W. Body	Thyroid
EAB	0–2	1.3×10^{-2}	5.1×10^{-1}	1.94×10^{-1}	2.5×10^{-1}	9.9
LPZ	0–8	—	—	1.13×10^{-2}	1.5×10^{-2}	5.8×10^{-1}
Limit	—	—	—	—	25	300

Reference: ABWR DCD Rev. 4 (15.5-9)

Table 15.1-45
Doses for ABWR Main Steam Line Break with Equilibrium Iodine Activity

Location	Time (hr)	DCD Dose (Sv)		X/Q Ratio	Site Dose (rem TEDE)	
		W. Body	Thyroid	Site to DCD	W. Body	Thyroid
EAB	0–2	6.2×10^{-4}	2.6×10^{-2}	1.94×10^{-1}	1.2×10^{-2}	5.0×10^{-1}
LPZ	0–8	—	—	1.13×10^{-2}	7.0×10^{-4}	2.9×10^{-2}
Limit	—	—	—	—	2.5	30

Reference: ABWR DCD Rev. 4 (15.5-9)

Table 15.1-46
Activity Releases for ABWR Small Break Outside Containment

Isotope	Activity Release (MBq)					
	1 min	10 min	1 hr	2 hr	4 hr	8 hr
I-131	6.36×10^{-1}	5.77×10^{1}	2.77×10^{4}	6.81×10^{4}	1.27×10^{5}	1.41×10^{5}
I-132	6.18	5.51×10^{2}	2.52×10^{5}	5.96×10^{5}	1.09×10^{6}	1.19×10^{6}
I-133	4.37	3.96×10^{2}	1.87×10^{5}	4.59×10^{5}	8.51×10^{5}	9.44×10^{5}
I-134	1.21×10^{1}	1.06×10^{3}	4.44×10^{5}	9.92×10^{5}	1.76×10^{6}	1.90×10^{6}
I-135	6.36	5.74×10^{2}	2.71×10^{5}	6.59×10^{5}	1.21×10^{6}	1.34×10^{6}

Reference: ABWR DCD Rev. 4 (15.5-9)

Table 15.1-47
Doses for ABWR Small Break Outside Containment

Location	Time (hr)	DCD Dose (Sv)		X/Q Ratio	Site Dose (rem TEDE)	
		W. Body	Thyroid	Site to DCD	W. Body	Thyroid
EAB	0–2	9.4×10^{-4}	4.8×10^{-2}	1.94×10^{-1}	1.8×10^{-2}	9.3×10^{-1}
LPZ	0–8	—	—	1.13×10^{-2}	1.1×10^{-2}	5.4×10^{-2}
Limit	—	—	—	—	2.5	30

Reference: ABWR DCD Rev. 4 (15.5-9)

Table 15.1-48 (Sheet 2 of 2)
Activity Releases for ABWR Loss-of-Coolant Accident

Isotope	Activity Release from Condenser (MBq)									
	1 min	10 min	1 hr	2 hr	4 hr	8 hr	12 hr	24 hr	96 hr	720 hr
I-131	0	0	7.0×10^{2}	1.2×10^{4}	1.2×10^{5}	8.5×10^{5}	2.4×10^{6}	1.2×10^{7}	1.8×10^{8}	2.0×10^{9}
I-132	0	0	8.1×10^{2}	1.1×10^{4}	7.0×10^{4}	2.4×10^{5}	3.5×10^{5}	4.4×10^{5}	4.4×10^{5}	4.4×10^{5}
I-133	0	0	1.5×10^{3}	2.4×10^{4}	2.3×10^{5}	1.5×10^{6}	3.7×10^{6}	1.5×10^{7}	7.4×10^{7}	8.9×10^{7}
I-134	0	0	8.5×10^{2}	8.5×10^{3}	3.0×10^{4}	4.8×10^{4}	4.8×10^{4}	4.8×10^{4}	4.8×10^{4}	4.8×10^{4}
I-135	0	0	1.3×10^{3}	2.1×10^{4}	1.7×10^{5}	9.3×10^{5}	2.0×10^{6}	5.2×10^{6}	7.4×10^{6}	7.4×10^{6}
Kr-83m	0	0	5.9×10^{3}	7.8×10^{4}	4.4×10^{5}	1.3×10^{6}	1.7×10^{6}	1.9×10^{6}	1.9×10^{6}	1.9×10^{6}
Kr-85	0	0	7.4×10^{2}	1.3×10^{4}	1.3×10^{5}	9.3×10^{5}	2.6×10^{6}	1.3×10^{7}	2.3×10^{8}	5.9×10^{9}
Kr-85m	0	0	1.5×10^{4}	2.3×10^{5}	1.8×10^{6}	8.5×10^{6}	1.6×10^{7}	3.0×10^{7}	3.6×10^{7}	3.6×10^{7}
Kr-87	0	0	2.0×10^{4}	2.4×10^{5}	1.1×10^{6}	2.4×10^{6}	2.7×10^{6}	2.8×10^{6}	2.8×10^{6}	2.8×10^{6}
Kr-88	0	0	3.7×10^{4}	5.6×10^{5}	3.7×10^{6}	1.4×10^{7}	2.3×10^{7}	3.1×10^{7}	3.2×10^{7}	3.2×10^{7}
Kr-89	0	0	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Xe-131m	0	0	4.1×10^{2}	6.7×10^{3}	6.7×10^{4}	4.8×10^{5}	1.3×10^{6}	6.7×10^{6}	1.0×10^{8}	1.3×10^{9}
Xe-133	0	0	1.4×10^{5}	2.4×10^{6}	2.3×10^{7}	1.6×10^{8}	4.4×10^{8}	2.2×10^{9}	3.0×10^{10}	1.8×10^{11}
Xe-133m	0	0	5.6×10^{3}	1.0×10^{5}	9.3×10^{5}	6.7×10^{6}	1.8×10^{7}	8.1×10^{7}	8.1×10^{8}	2.0×10^{9}
Xe-135	0	0	1.7×10^{4}	2.7×10^{5}	2.4×10^{6}	1.4×10^{7}	3.3×10^{7}	9.6×10^{7}	2.0×10^{8}	2.0×10^{8}
Xe-135m	0	0	2.9×10^{3}	1.0×10^{4}	1.3×10^{4}	1.3×10^{4}	1.3×10^{4}	1.3×10^{4}	1.3×10^{4}	1.3×10^{4}
Xe-137	0	0	3.4×10^{1}	3.5×10^{1}	3.5×10^{1}	3.5×10^{1}	3.5×10^{1}	3.5×10^{1}	3.5×10^{1}	3.5×10^{1}
Xe-138	0	0	1.0×10^{4}	3.2×10^{4}	3.7×10^{4}	3.7×10^{4}	3.7×10^{4}	3.7×10^{4}	3.7×10^{4}	3.7×10^{4}

Reference: ABWR DCD Rev. 4 (15.5-9)

Table 15.1-49
Doses for ABWR Loss-of-Coolant Accident

Location	Time (hr)	DCD Dose (Sv)		X/Q Ratio	Site Dose (rem TEDE)	
		W. Body	Thyroid	Site to DCD	W. Body	Thyroid
EAB	0–2	4.1×10^{-2}	1.9	1.94×10^{-1}	8.0×10^{-1}	3.7×10^{1}
LPZ	0–8	1.0×10^{-2}	3.1×10^{-1}	9.94×10^{-2}	9.9×10^{-2}	3.1
	8–24	8.0×10^{-3}	2.0×10^{-1}	1.05×10^{-1}	8.4×10^{-2}	2.1
	24–96	1.1×10^{-2}	7.9×10^{-1}	1.25×10^{-1}	1.4×10^{-1}	9.9
	96-720	9.0×10^{-3}	1.1	1.60×10^{-1}	1.4×10^{-1}	1.8×10^{1}
	Total	3.8×10^{-2}	2.4	—	4.7×10^{-1}	3.3×10^{1}
Limit	—	—	—	—	25	300

Reference: ABWR DCD Rev. 4 (15.5-9)

Table 15.1-50
Activity Releases for ABWR Cleanup Water Line Break

Isotope	Activity Release (MBq)
I-131	8.1×10^4
I-132	1.9×10^5
I-133	2.3×10^5
I-134	3.2×10^5
I-135	2.5×10^5

Reference: ABWR DCD Rev. 4 (15.5-9)

Table 15.1-51
Doses for ABWR Cleanup Water Line Break

Location	Time (hr)	DCD Dose (Sv)		X/Q Ratio	Site Dose (rem TEDE)	
		W. Body	Thyroid	Site to DCD	W. Body	Thyroid
EAB	0–2	2.8×10^{-3}	3.0×10^{-1}	1.16×10^{-2}	3.3×10^{-3}	3.5×10^{-1}
LPZ	0–8	—	—	6.77×10^{-4}	1.9×10^{-4}	2.0×10^{-2}
Limit	—	—	—	—	25	300

Reference: ABWR DCD Rev. 4 (15.5-9)

Table 15.1-52
Activity Releases for ABWR Fuel Handling Accident

Isotope	Activity Release (MBq)			
	1 min	10 min	1 hr	2 hr
I-131	2.85×10^{5}	2.56×10^{6}	4.55×10^{6}	4.55×10^{6}
I-132	3.67×10^{5}	3.22×10^{6}	5.62×10^{6}	5.62×10^{6}
I-133	2.95×10^{5}	2.64×10^{6}	4.70×10^{6}	4.70×10^{6}
I-134	1.60×10^{-2}	1.36×10^{-1}	2.28×10^{-1}	2.28×10^{-1}
I-135	4.85×10^{4}	4.29×10^{5}	7.62×10^{5}	7.62×10^{5}
Total	9.96×10^{5}	8.85×10^{6}	1.56×10^{7}	1.56×10^{7}
Kr-83m	1.52×10^{4}	1.32×10^{5}	2.33×10^{5}	2.38×10^{5}
Kr-85m	1.94×10^{5}	1.72×10^{6}	3.08×10^{6}	3.16×10^{6}
Kr-85	1.05×10^{6}	9.47×10^{6}	1.72×10^{7}	1.77×10^{7}
Kr-87	3.00×10^{1}	2.59×10^{2}	4.51×10^{2}	4.55×10^{2}
Kr-88	5.62×10^{4}	4.92×10^{5}	8.81×10^{5}	8.99×10^{5}
Kr-89	6.55×10^{-7}	2.77×10^{-6}	3.01×10^{-6}	3.01×10^{-6}
Xe-131m	1.84×10^{5}	1.65×10^{6}	3.00×10^{6}	3.09×10^{6}
Xe-133m	2.44×10^{6}	2.18×10^{7}	3.96×10^{7}	4.07×10^{7}
Xe-133	6.22×10^{7}	5.59×10^{8}	1.01×10^{9}	1.04×10^{9}
Xe-135m	7.25×10^{5}	5.44×10^{6}	8.18×10^{6}	8.18×10^{6}
Xe-135	1.42×10^{7}	1.27×10^{8}	2.29×10^{8}	2.36×10^{8}
Xe-137	1.45×10^{-6}	6.77×10^{-6}	7.66×10^{-6}	7.66×10^{-6}
Xe-138	1.46×10^{-6}	1.07×10^{-5}	1.59×10^{-5}	1.59×10^{-5}

Reference: ABWR DCD Rev. 4 (15.5-9)

Table 15.1-53
Doses for ABWR Fuel Handling Accident

Location	Time (hr)	DCD Dose (Sv)		X/Q Ratio	Site Dose (rem TEDE)	
		W. Body	Thyroid	Site to DCD	W. Body	Thyroid
EAB	0–2	1.2×10^{-2}	7.5×10^{-1}	1.94×10^{-1}	2.3×10^{-1}	1.5×10^{1}
LPZ	0–8	—	—	1.13×10^{-2}	1.4×10^{-2}	8.5×10^{-1}
Limit	—	—	—	—	6	75

Reference: ABWR DCD Rev. 4 (15.5-9)

Table 15.1-54
Activity Releases for ESBWR Main Steam Line Break

Isotope	Activity Release (Ci)	
	Equilibrium Iodine	Pre-Incident Iodine
Co-58	8.95×10^{-3}	8.95×10^{-3}
Co-60	1.79×10^{-2}	1.79×10^{-2}
Kr-85	9.48×10^{-4}	9.48×10^{-4}
Kr-85m	2.42×10^{-1}	2.42×10^{-1}
Kr-87	7.84×10^{-1}	7.84×10^{-1}
Kr-88	7.84×10^{-1}	7.84×10^{-1}
Sr-89	4.11×10^{-2}	4.11×10^{-2}
Sr-90	2.85×10^{-3}	2.85×10^{-3}
Sr-91	1.59	1.59
Sr-92	3.60	3.60
Y-90	2.85×10^{-3}	2.85×10^{-3}
Y-91	1.68×10^{-2}	1.68×10^{-2}
Y-92	2.18	2.18
Y-93	1.59	1.59
Zr-95	3.27×10^{-3}	3.27×10^{-3}
Nb-95	3.27×10^{-3}	3.27×10^{-3}
Mo-99	8.13×10^{-1}	8.13×10^{-1}
Tc-99m	8.13×10^{-1}	8.13×10^{-1}
Ru-103	8.21×10^{-3}	8.21×10^{-3}
Ru-106	1.26×10^{-3}	1.26×10^{-3}
Te-129m	1.68×10^{-2}	1.68×10^{-2}
Te-131m	4.02×10^{-2}	4.02×10^{-2}
Te-132	4.11×10^{-3}	4.11×10^{-3}
I-131	1.55	3.10×10^{1}
I-132	1.08×10^{1}	2.15×10^{2}
I-133	1.01×10^{1}	2.02×10^{2}
I-134	1.68×10^{1}	3.36×10^{2}
I-135	1.35×10^{1}	2.69×10^{2}
Xe-133	3.29×10^{-1}	3.29×10^{-1}
Xe-135	9.10×10^{-1}	9.10×10^{-1}
Cs-134	1.09×10^{-2}	1.09×10^{-2}
Cs-136	7.37×10^{-3}	7.37×10^{-3}
Cs-137	2.93×10^{-2}	2.93×10^{-2}
Ba-140	1.68×10^{-1}	1.68×10^{-1}
La-140	1.68×10^{-1}	1.68×10^{-1}
Ce-141	1.26×10^{-2}	1.26×10^{-2}
Ce-144	1.26×10^{-3}	1.26×10^{-3}
Np-239	3.27	3.27

Reference: ESBWR DCD Rev. 6 (15.5-10)

Table 15.1-55
Doses for ESBWR Main Steam Line Break with Pre-Incident Iodine Spike

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	0–2	2.6	1.33×10^{-1}	3.5×10^{-1}
LPZ	0–8	2.0×10^{-1}	8.16×10^{-2}	1.6×10^{-2}
Limit	—	—	—	25

Reference: ESBWR DCD Rev. 6 (15.5-10)

Table 15.1-56
Doses for ESBWR Main Steam Line Break with Equilibrium Iodine Activity

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	0–2	2.0×10^{-1}	1.33×10^{-1}	2.7×10^{-2}
LPZ	0–8	1.0×10^{-1}	8.16×10^{-2}	8.2×10^{-3}
Limit	—	—	—	2.5

Reference: ESBWR DCD Rev. 6 (15.5-10)

Table 15.1-57
Activity Releases from ESBWR Feedwater Line Break

Isotope	Activity Release (Ci)	
	Equilibrium Iodine	Pre-Incident Spike
I-131	1.08×10^{1}	2.16×10^{2}
I-132	7.50×10^{1}	1.50×10^{3}
I-133	7.03×10^{1}	1.41×10^{3}
I-134	1.17×10^{2}	2.34×10^{3}
I-135	9.37×10^{1}	1.87×10^{3}
Cs-134	7.75×10^{-2}	7.75×10^{-2}
Cs-136	5.25×10^{-2}	5.25×10^{-2}
Cs-137	2.09×10^{-1}	2.09×10^{-1}
Co-58	6.37×10^{-2}	6.37×10^{-2}
Co-60	1.27×10^{-1}	1.27×10^{-1}
Sr-89	2.92×10^{-1}	2.92×10^{-1}
Sr-90	2.03×10^{-2}	2.03×10^{-2}
Y-90	2.03×10^{-2}	2.03×10^{-2}
Sr-91	1.13×10^{1}	1.13×10^{1}
Sr-92	2.56×10^{1}	2.56×10^{1}
Y-91	1.19×10^{-1}	1.19×10^{-1}
Y-92	1.55×10^{1}	1.55×10^{1}
Y-93	1.13×10^{1}	1.13×10^{1}
Zr-95	2.33×10^{-2}	2.33×10^{-2}
Nb-95	2.33×10^{-2}	2.33×10^{-2}
Mo-99	5.78	5.78
Tc-99m	5.78	5.78
Ru-103	5.84×10^{-2}	5.84×10^{-2}
Ru-106	8.94×10^{-3}	8.94×10^{-3}
Te-129m	1.19×10^{-1}	1.19×10^{-1}
Te-131m	2.86×10^{-1}	2.86×10^{-1}
Te-132	2.92×10^{-2}	2.92×10^{-2}
Ba-140	1.19	1.19
La-140	1.19	1.19
Ce141	8.94×10^{-2}	8.94×10^{-2}
Ce-144	8.94×10^{-3}	8.94×10^{-3}
Np-239	2.33×10^{1}	2.33×10^{1}

Reference: ESBWR DCD Rev. 6 (15.5-10)

Table 15.1-58
Doses for ESBWR Feedwater Line Break Line Break with Pre-Incident Iodine Spike

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	0–2	1.8×10^{1}	1.33×10^{-1}	2.4
LPZ	0–8	1.7	8.16×10^{-2}	1.4×10^{-1}
Limit	—	—	—	25

Reference: ESBWR DCD Rev. 6 (15.5-10)

Table 15.1-59
Doses for ESBWR Feedwater Line Break with Equilibrium Iodine Activity

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	0–2	1.1	1.33×10^{-1}	1.5×10^{-1}
LPZ	0–8	1.0×10^{-1}	8.16×10^{-2}	8.2×10^{-3}
Limit	—	—	—	2.5

Reference: ESBWR DCD Rev. 6 (15.5-10)

Table 15.1-60
Activity Releases for ESBWR Small Break Outside Containment with Pre-Incident Iodine Spike

Isotope	Activity Release (Ci)				
	0.5 hr	1 hr	2 hr	4 hr	6 hr
Co-58	4.32×10^{-4}	6.91×10^{-4}	1.21×10^{-3}	1.90×10^{-3}	1.96×10^{-3}
Co-60	8.64×10^{-4}	1.38×10^{-3}	2.42×10^{-3}	3.81×10^{-3}	3.93×10^{-3}
Sr-89	1.98×10^{-3}	3.17×10^{-3}	5.55×10^{-3}	8.74×10^{-3}	9.02×10^{-3}
Sr-90	1.38×10^{-4}	2.20×10^{-4}	3.85×10^{-4}	6.06×10^{-4}	6.26×10^{-4}
Sr-91	7.69×10^{-2}	1.23×10^{-1}	2.15×10^{-1}	3.39×10^{-1}	3.50×10^{-1}
Sr-92	1.74×10^{-1}	2.78×10^{-1}	4.87×10^{-1}	7.67×10^{-1}	7.91×10^{-1}
Y-90	1.38×10^{-4}	2.20×10^{-4}	3.85×10^{-4}	6.06×10^{-4}	6.26×10^{-4}
Y-91	8.09×10^{-4}	1.29×10^{-3}	2.26×10^{-3}	3.57×10^{-3}	3.68×10^{-3}
Y-92	1.05×10^{-1}	1.68×10^{-1}	2.94×10^{-1}	4.64×10^{-1}	4.78×10^{-1}
Y-93	7.69×10^{-2}	1.23×10^{-1}	2.15×10^{-1}	3.39×10^{-1}	3.50×10^{-1}
Zr-95	1.58×10^{-4}	2.52×10^{-4}	4.42×10^{-4}	6.95×10^{-4}	7.18×10^{-4}
Nb-95	1.58×10^{-4}	2.52×10^{-4}	4.42×10^{-4}	6.95×10^{-4}	7.18×10^{-4}
Mo-99	3.93×10^{-2}	6.28×10^{-2}	1.10×10^{-1}	1.73×10^{-1}	1.78×10^{-1}
Tc-99m	3.93×10^{-2}	6.28×10^{-2}	1.10×10^{-1}	1.73×10^{-1}	1.78×10^{-1}
Ru-103	3.97×10^{-4}	6.34×10^{-4}	1.11×10^{-3}	1.75×10^{-3}	1.80×10^{-3}
Ru-106	6.07×10^{-5}	9.71×10^{-5}	1.70×10^{-4}	2.67×10^{-4}	2.76×10^{-4}
Te-129m	8.09×10^{-4}	1.29×10^{-3}	2.26×10^{-3}	3.57×10^{-3}	3.68×10^{-3}
Te-131m	1.94×10^{-3}	3.11×10^{-3}	5.44×10^{-3}	8.56×10^{-3}	8.83×10^{-3}
Te-132	1.98×10^{-4}	3.17×10^{-4}	5.55×10^{-4}	8.74×10^{-4}	9.02×10^{-4}
I-131	1.46	2.34	4.09	6.44	6.65
I-132	1.02×10^{1}	1.63×10^{1}	2.85×10^{1}	4.48×10^{1}	4.63×10^{1}
I-133	9.54	1.53×10^{1}	2.67×10^{1}	4.20×10^{1}	4.34×10^{1}
I-134	1.59×10^{1}	2.54×10^{1}	4.45×10^{1}	7.01×10^{1}	7.23×10^{1}
I-135	1.27×10^{1}	2.03×10^{1}	3.56×10^{1}	5.60×10^{1}	5.78×10^{1}
Cs-134	5.26×10^{-4}	8.41×10^{-4}	1.47×10^{-3}	2.32×10^{-3}	2.39×10^{-3}
Cs-136	3.56×10^{-4}	5.70×10^{-4}	9.96×10^{-4}	1.57×10^{-3}	1.62×10^{-3}
Cs-137	1.42×10^{-3}	2.27×10^{-3}	3.96×10^{-3}	6.24×10^{-3}	6.44×10^{-3}
Ba-140	8.09×10^{-3}	1.29×10^{-2}	2.26×10^{-2}	3.57×10^{-2}	3.68×10^{-2}
La-140	8.09×10^{-3}	1.29×10^{-2}	2.26×10^{-2}	3.57×10^{-2}	3.68×10^{-2}
Ce-141	6.07×10^{-4}	9.71×10^{-4}	1.70×10^{-3}	2.67×10^{-3}	2.76×10^{-3}
Ce-144	6.07×10^{-5}	9.71×10^{-5}	1.70×10^{-4}	2.67×10^{-4}	2.76×10^{-4}
Np-239	1.58×10^{-1}	2.52×10^{-1}	4.42×10^{-1}	6.95×10^{-1}	7.18×10^{-1}

Reference: ESBWR DCD Rev. 6 (15.5-10)

Table 15.1-61
Doses for ESBWR Small Break Outside Containment with Pre-Incident Iodine Spike

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	0–2	3.4×10^{-1}	1.33×10^{-1}	4.5×10^{-2}
LPZ	0–720	1.0×10^{-1}	8.16×10^{-2}	8.2×10^{-3}
Limit	—	—	—	25

Reference: ESBWR DCD Rev. 6 (15.5-10)

Note: Although the DCD indicates that the LPZ dose extends to 720 hr, it does not provide the dose as a function of time. The site LPZ dose is estimated by multiplying the total DCD dose by the maximum X/Q ratio from Table 15.1-4.

Table 15.1-62
Activity Releases for ESBWR Small Break Outside Containment with Pre-Incident Iodine Spike

Isotope	Activity Release (Ci)				
	0.5 hr	1 hr	2 hr	4 hr	6 hr
Co-58	4.32×10^{-4}	6.91×10^{-4}	1.21×10^{-3}	1.90×10^{-3}	1.96×10^{-3}
Co-60	8.64×10^{-4}	1.38×10^{-3}	2.42×10^{-3}	3.81×10^{-3}	3.93×10^{-3}
Sr-89	1.98×10^{-3}	3.17×10^{-3}	5.55×10^{-3}	8.74×10^{-3}	9.02×10^{-3}
Sr-90	1.38×10^{-4}	2.20×10^{-4}	3.85×10^{-4}	6.06×10^{-4}	6.26×10^{-4}
Sr-91	7.69×10^{-2}	1.23×10^{-1}	2.15×10^{-1}	3.39×10^{-1}	3.50×10^{-1}
Sr-92	1.74×10^{-1}	2.78×10^{-1}	4.87×10^{-1}	7.67×10^{-1}	7.91×10^{-1}
Y-90	1.38×10^{-4}	2.20×10^{-4}	3.85×10^{-4}	6.06×10^{-4}	6.26×10^{-4}
Y-91	8.09×10^{-4}	1.29×10^{-3}	2.26×10^{-3}	3.57×10^{-3}	3.68×10^{-3}
Y-92	1.05×10^{-1}	1.68×10^{-1}	2.94×10^{-1}	4.64×10^{-1}	4.78×10^{-1}
Y-93	7.69×10^{-2}	1.23×10^{-1}	2.15×10^{-1}	3.39×10^{-1}	3.50×10^{-1}
Zr-95	1.58×10^{-4}	2.52×10^{-4}	4.42×10^{-4}	6.95×10^{-4}	7.18×10^{-4}
Nb-95	1.58×10^{-4}	2.52×10^{-4}	4.42×10^{-4}	6.95×10^{-4}	7.18×10^{-4}
Mo-99	3.93×10^{-2}	6.28×10^{-2}	1.10×10^{-1}	1.73×10^{-1}	1.78×10^{-1}
Tc-99m	3.93×10^{-2}	6.28×10^{-2}	1.10×10^{-1}	1.73×10^{-1}	1.78×10^{-1}
Ru-103	3.97×10^{-4}	6.34×10^{-4}	1.11×10^{-3}	1.75×10^{-3}	1.80×10^{-3}
Ru-106	6.07×10^{-5}	9.71×10^{-5}	1.70×10^{-4}	2.67×10^{-4}	2.76×10^{-4}
Te-129m	8.09×10^{-4}	1.29×10^{-3}	2.26×10^{-3}	3.57×10^{-3}	3.68×10^{-3}
Te-131m	1.94×10^{-3}	3.11×10^{-3}	5.44×10^{-3}	8.56×10^{-3}	8.83×10^{-3}
Te-132	1.98×10^{-4}	3.17×10^{-4}	5.55×10^{-4}	8.74×10^{-4}	9.02×10^{-4}
I-131	7.31×10^{-2}	1.17×10^{-1}	2.05×10^{-1}	3.22×10^{-1}	3.33×10^{-1}
I-132	5.09×10^{-1}	8.14×10^{-1}	1.42	2.24	2.31
I-133	4.77×10^{-1}	7.63×10^{-1}	1.33	2.10	2.17
I-134	7.95×10^{-1}	1.27	2.22	3.50	3.61
I-135	6.36×10^{-1}	1.02	1.78	2.80	2.89
Cs-134	5.26×10^{-4}	8.41×10^{-4}	1.47×10^{-3}	2.32×10^{-3}	2.39×10^{-3}
Cs-136	3.56×10^{-4}	5.70×10^{-4}	9.96×10^{-4}	1.57×10^{-3}	1.62×10^{-3}
Cs-137	1.42×10^{-3}	2.27×10^{-3}	3.96×10^{-3}	6.24×10^{-3}	6.44×10^{-3}
Ba-140	8.09×10^{-3}	1.29×10^{-2}	2.26×10^{-2}	3.57×10^{-2}	3.68×10^{-2}
La-140	8.09×10^{-3}	1.29×10^{-2}	2.26×10^{-2}	3.57×10^{-2}	3.68×10^{-2}
Ce-141	6.07×10^{-4}	9.71×10^{-4}	1.70×10^{-3}	2.67×10^{-3}	2.76×10^{-3}
Ce-144	6.07×10^{-5}	9.71×10^{-5}	1.70×10^{-4}	2.67×10^{-4}	2.76×10^{-4}
Np-239	1.58×10^{-1}	2.52×10^{-1}	4.42×10^{-1}	6.95×10^{-1}	7.18×10^{-1}

Reference: ESBWR DCD Rev. 6 (15.5-10)

Table 15.1-63
Doses for ESBWR Small Break Outside Containment with Equilibrium Iodine Activity

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	0–2	1.0×10^{-1}	1.33×10^{-1}	1.3×10^{-2}
LPZ	0–720	1.0×10^{-1}	8.16×10^{-2}	8.2×10^{-3}
Limit	—	—	—	2.5

Reference: ESBWR DCD Rev. 6 (15.5-10)

Note: Although the DCD indicates that the LPZ dose extends to 720 hr, it does not provide the dose as a function of time. The site LPZ dose is estimated by multiplying the total DCD dose by the maximum X/Q ratio from Table 15.1-4.

Table 15.1-64
Activity Releases for ESBWR Cleanup Water Line Break

Isotope	Activity Release (Ci)	
	Equilibrium Iodine	Pre-Incident Spike
I-131	4.10	8.21×10^{1}
I-132	2.85×10^{1}	5.71×10^{2}
I-133	2.68×10^{1}	5.35×10^{2}
I-134	4.46×10^{1}	8.92×10^{2}
I-135	3.57×10^{1}	7.14×10^{2}
Cs-134	2.95×10^{-2}	2.95×10^{-2}
Cs-136	2.00×10^{-2}	2.00×10^{-2}
Cs-137	7.95×10^{-2}	7.95×10^{-2}
Co-58	2.42×10^{-2}	2.42×10^{-2}
Co-60	4.85×10^{-2}	4.85×10^{-2}
Sr-89	1.11×10^{-1}	1.11×10^{-1}
Sr-90	7.72×10^{-3}	7.72×10^{-3}
Y-90	7.72×10^{-3}	7.72×10^{-3}
Sr-91	4.31	4.31
Sr-92	9.76	9.76
Y-91	4.54×10^{-2}	4.54×10^{-2}
Y-92	5.90	5.90
Y-93	4.31	4.31
Zr-95	8.86×10^{-3}	8.86×10^{-3}
Nb-95	8.86×10^{-3}	8.86×10^{-3}
Mo-99	2.20	2.20
Tc-99m	2.20	2.20
Ru-103	2.23×10^{-2}	2.23×10^{-2}
Ru-106	3.41×10^{-3}	3.41×10^{-3}
Te-129m	4.54×10^{-2}	4.54×10^{-2}
Te-131m	1.09×10^{-1}	1.09×10^{-1}
Te-132	1.11×10^{-2}	1.11×10^{-2}
Ba-140	4.54×10^{-1}	4.54×10^{-1}
La-140	4.54×10^{-1}	4.54×10^{-1}
Ce141	3.41×10^{-2}	3.41×10^{-2}
Ce-144	3.41×10^{-3}	3.41×10^{-3}
Np-239	8.86	8.86

Reference: ESBWR DCD Rev. 6 (15.5-10)

Table 15.1-65
Doses for ESBWR Cleanup Water Line Break with Pre-Incident Iodine Spike

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	0–2	6.9	1.33×10^{-1}	9.2×10^{-1}
LPZ	0–8	7.0×10^{-1}	8.16×10^{-2}	5.7×10^{-2}
Limit	—	—	—	25

Reference: ESBWR DCD Rev. 6 (15.5-10)

Table 15.1-66
Doses for ESBWR Cleanup Water Line Break with Equilibrium Iodine Activity

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	0–2	4.0×10^{-1}	1.33×10^{-1}	5.3×10^{-2}
LPZ	0–8	1.0×10^{-1}	8.16×10^{-2}	8.2×10^{-3}
Limit	—	—	—	2.5

Reference: ESBWR DCD Rev. 6 (15.5-10)

Table 15.1-67 (Sheet 2 of 2)
Integrated Activity Releases for ESBWR Loss-of-Coolant Accident

Isotope	Activity Release (Ci)								
	0.5 hr	2 hr	8 hr	12 hr	24 hr	72 hr	96 hr	168 hr	720 hr
I-133	1.2×10^{1}	2.8×10^{2}	1.9×10^{3}	2.7×10^{3}	4.2×10^{3}	5.5×10^{3}	5.6×10^{3}	5.7×10^{3}	5.7×10^{3}
I-134	9.9	1.1×10^{2}	2.0×10^{2}	2.1×10^{2}	2.1×10^{2}	2.1×10^{2}	2.1×10^{2}	2.1×10^{2}	2.1×10^{2}
I-135	1.1×10^{1}	2.4×10^{2}	1.3×10^{3}	1.7×10^{3}	2.1×10^{3}	2.2×10^{3}	2.2×10^{3}	2.2×10^{3}	2.2×10^{3}
Xe-133	2.6×10^{1}	2.2×10^{3}	5.2×10^{4}	1.2×10^{5}	4.0×10^{5}	2.1×10^{6}	2.9×10^{6}	5.2×10^{6}	1.1×10^{7}
Xe-135	9.4	8.2×10^{2}	1.6×10^{4}	3.0×10^{4}	6.5×10^{4}	1.0×10^{5}	1.0×10^{5}	1.0×10^{5}	1.0×10^{5}
Cs-134	1.2	2.7×10^{1}	2.0×10^{2}	2.9×10^{2}	5.1×10^{2}	8.7×10^{2}	9.6×10^{2}	1.1×10^{3}	2.3×10^{3}
Cs-136	4.1×10^{-1}	8.7	6.3×10^{1}	9.4×10^{1}	1.6×10^{2}	2.7×10^{2}	2.9×10^{2}	3.4×10^{2}	5.0×10^{2}
Cs-137	7.9×10^{-1}	1.7×10^{1}	1.2×10^{2}	1.9×10^{2}	3.3×10^{2}	5.6×10^{2}	6.1×10^{2}	7.3×10^{2}	1.5×10^{3}
Ba-139	0	8.2	2.3×10^{1}	2.3×10^{1}	2.3×10^{1}	2.3×10^{1}	2.3×10^{1}	2.3×10^{1}	2.3×10^{1}
Ba-140	0	1.6×10^{1}	1.4×10^{2}	2.1×10^{2}	3.6×10^{2}	6.0×10^{2}	6.5×10^{2}	7.6×10^{2}	1.1×10^{3}
La-140	0	3.2×10^{-1}	8.8	1.9×10^{1}	5.9×10^{1}	1.9×10^{2}	2.3×10^{2}	3.3×10^{2}	7.4×10^{2}
La-141	0	1.2×10^{-1}	6.2×10^{-1}	7.4×10^{-1}	8.1×10^{-1}	8.2×10^{-1}	8.2×10^{-1}	8.2×10^{-1}	8.2×10^{-1}
La-142	0	7.8×10^{-2}	2.3×10^{-1}	2.4×10^{-1}	2.4×10^{-1}	2.4×10^{-1}	2.4×10^{-1}	2.4×10^{-1}	2.4×10^{-1}
Ce-141	0	3.9×10^{-1}	3.3	4.9	8.6	1.5×10^{1}	1.6×10^{1}	1.9×10^{1}	3.4×10^{1}
Ce-143	0	3.5×10^{-1}	2.8	4.0	6.4	8.9	9.1	9.3	9.4
Ce-144	0	3.2×10^{-1}	2.7	4.0	7.2	1.2×10^{1}	1.4×10^{1}	1.6×10^{1}	3.3×10^{1}
Pr-143	0	1.4×10^{-1}	1.2	1.8	3.2	5.6	6.1	7.3	1.1×10^{1}
Nd-147	0	6.3×10^{-2}	5.2×10^{-1}	7.8×10^{-1}	1.4	2.3	2.4	2.8	4.0
Np-239	0	4.6	3.7×10^{1}	5.4×10^{1}	9.1×10^{1}	1.4×10^{2}	1.4×10^{2}	1.5×10^{2}	1.6×10^{2}
Pu-238	0	9.6×10^{-4}	8.0×10^{-3}	1.2×10^{-2}	2.1×10^{-2}	3.7×10^{-2}	4.0×10^{-2}	4.9×10^{-2}	1.0×10^{-1}
Pu-239	0	1.1×10^{-4}	8.9×10^{-4}	1.3×10^{-3}	2.4×10^{-3}	4.1×10^{-3}	4.5×10^{-3}	5.4×10^{-3}	1.1×10^{-2}
Pu-240	0	1.4×10^{-4}	1.2×10^{-3}	1.7×10^{-3}	3.1×10^{-3}	5.3×10^{-3}	5.8×10^{-3}	7.0×10^{-3}	1.5×10^{-2}
Pu-241	0	4.4×10^{-2}	3.7×10^{-1}	5.6×10^{-1}	9.8×10^{-1}	1.7	1.9	2.2	4.6
Am-241	0	2.1×10^{-5}	1.8×10^{-4}	2.7×10^{-4}	4.7×10^{-4}	8.2×10^{-4}	9.1×10^{-4}	1.1×10^{-3}	2.4×10^{-3}
Cm-242	0	5.0×10^{-3}	4.2×10^{-2}	6.3×10^{-2}	1.1×10^{-1}	1.9×10^{-1}	2.1×10^{-1}	2.5×10^{-1}	5.1×10^{-1}
Cm-244	0	2.6×10^{-4}	2.2×10^{-3}	3.3×10^{-3}	5.8×10^{-3}	1.0×10^{-2}	1.1×10^{-2}	1.3×10^{-2}	2.8×10^{-2}

Reference: ESBWR DCD Rev. 6 (15.5-10)

Table 15.1-68
Doses for ESBWR Loss-of-Coolant Accident

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	2.3–4.3[(a)]	2.24×10^{1}	1.33×10^{-1}	2.98
LPZ	0–8	6.93	8.16×10^{-2}	5.65×10^{-1}
	8–24	4.54	7.21×10^{-2}	3.28×10^{-1}
	24-96	4.72	5.60×10^{-2}	2.64×10^{-1}
	96–720	4.56	3.97×10^{-2}	1.81×10^{-1}
	Total	2.08×10^{1}	—	1.34
Limit	—	—	—	25

(a) Worst case 2-hour period is 2.3–4.3 hours.

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 6 (Reference 15.5-10).

Table 15.1-69
Activity Releases for ESBWR Fuel Handling Accident

Isotope	Activity Release (Ci), 0–2 hr
I-131	1.37×10^{2}
I-132	7.01×10^{-2}
I-133	8.21×10^{1}
I-134	5.24×10^{-7}
I-135	1.28×10^{1}
Kr-85m	9.96×10^{1}
Kr-85	4.98×10^{2}
Kr-87	1.07×10^{-2}
Kr-88	2.85×10^{1}
Xe-133	3.23×10^{4}
Xe-135	2.01×10^{3}

Reference: ESBWR DCD Rev. 6 (15.5-10)

Table 15.1-70
Doses for ESBWR Fuel Handling Accident

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	0–2	4.1	1.33×10^{-1}	5.5×10^{-1}
LPZ	0–8	4.0×10^{-1}	8.16×10^{-2}	3.3×10^{-2}
Limit	—	—	—	6.3

Reference: ESBWR DCD Rev. 6 (15.5-10)

ER Chapter 7, Draft Revision 1

Pages Updated 01/13/2011

Chapter 7 Environmental Impacts of Postulated Accidents Involving Radioactive Materials

The purpose of this section is to assess the environmental impacts of postulated accidents involving radioactive materials. Section 7.1 evaluates DBAs, Section 7.2 considers the impact of severe accidents, Section 7.3 addresses severe accident mitigation alternatives (SAMA), and Section 7.4 pertains to transportation accidents.

7.1 Design Basis Accidents

7.1.1 Selection of Accidents

The radiological consequences of accidents are assessed to demonstrate that new units could be constructed and operated at the ESP site without undue risk to the health and safety of the public. To analyze the suitability of the ESP site, site-specific accident meteorology is used to evaluate the radiological consequences of DBAs associated with selected reactor designs. The DBAs include a spectrum of events, including those of relatively greater probability of occurrence as well as those that are less probable but have greater severity.

The set of accidents selected focuses on four light water reactor (LWR) designs: AP1000, APWR, ABWR, and ESBWR. Two versions of the ABWR (GE and Toshiba) are being considered for the VCS site, but the evaluation of this section ~~applies to both versions~~ is based upon the source term associated with the ABWR certified design. These four designs have been chosen because these are standard designs that have recognized bases for postulated accident analyses. The mPower technology is still in the early stages of design, thus the accidents are not as well defined as those for the other LWRs. The mPower design is standard LWR technology, ~~and its core will have a relatively small thermal output. Thus, the core source term will be bounded by those for the other technologies. Based on this, the accident consequences associated with the mPower reactor are considered to be bounded by those for the other four reactor types~~and given its relatively small thermal output, the accident consequences associated with the mPower reactor are considered to be bounded by those for the other four reactor types. If the mPower (or another reactor technology not previously evaluated) is selected for the ESP site, the COL application would verify that the accident doses are bounded by those provided in the ESP or would provide a complete evaluation of accident radiological consequences compared with regulatory limits.

The following LWR accidents are identified in NUREG-1555 (U.S. NRC Oct 1999), Section 7.1, Appendix A, as those that should be considered for radiological consequences, based on the SRP, NUREG-0800 (U.S. NRC Mar 2007):

- SRP Section 15.1.5A, Radiological Consequences of Main Steam Line Failure Outside Containment of a PWR

- SRP Section 15.2.8, Feedwater System Pipe Break
- SRP Section 15.3.3, Reactor Coolant Pump Rotor Seizure (Locked Rotor Accident)
- SRP Section 15.3.4, Reactor Coolant Pump Shaft Break
- SRP Section 15.4.9, Spectrum of Rod Drop Accidents
- SRP Section 15.6.2, Radiological Consequences of the Failure of Small Lines Carrying Primary Coolant Outside Containment
- SRP Section 15.6.3, Radiological Consequences of Steam Generator Tube Failure
- SRP Section 15.6.5, Loss of Coolant Accidents Resulting from Spectrum of Postulated Piping Breaks within the Reactor Coolant Pressure Boundary
- SRP Section 15.7.4, Radiological Consequences of Fuel Handling Accidents

RG 1.183 (U.S. NRC Jul 2000) includes the following additional accidents:

- PWR Rod Ejection Accident (corresponding to SRP Section 15.4.8)
- BWR Main Steam Line Break (corresponding to SRP Section 15.6.4)

In addition, a cleanup water line break is evaluated for the ABWR and the ESBWR.

This set of accidents provides a reasonable basis for evaluating the suitability of the ESP site, and the associated radiological consequences from the above DBAs are analyzed as follows.

7.1.2 Evaluation Methodology

Doses for the representative DBAs are evaluated at the EAB and the LPZ. These doses must meet the site acceptance criteria in ~~10 CFR 50.34 and 10 CFR 100~~10 CFR 52.17 (a)(1). Although the emergency safety features are expected to prevent core damage and mitigate releases of radioactivity, the loss-of-coolant accidents (LOCAs) analyzed presume substantial core melt with the release of significant amounts of fission products. The postulated LOCAs are expected to more closely approach 10 CFR 52.17~~50.34~~ limits than the other DBAs of greater probability of occurrence but lesser magnitude of activity releases. The calculated accident doses are compared to the acceptance criteria in RG 1.183 and NUREG-0800 to demonstrate that the consequences of the postulated accidents are acceptable.

The evaluations use short-term accident atmospheric dispersion factors (X/Qs). The X/Qs are calculated using the methodology of RG 1.145 (U.S. NRC Nov 1982) and site-specific meteorological

data. As indicated in Subsection 2.7.5, the RG 1.145 methodology is implemented in the NRC-sponsored PAVAN computer program. This program computes X/Qs at the EAB and the LPZ for each combination of wind speed and atmospheric stability for each of the 16 downwind direction sectors. Releases are assumed to be at ground level, and the shortest distances between the power block area and the offsite locations are selected to conservatively maximize the X/Q values. The following site-specific 50th percentile X/Q values from Subsection 2.7.5 are used in these evaluations, in accordance with NUREG-1555:

- EAB, 0 to 2 hours: 8.85×10^{-5} sec/m^3
- LPZ, 0 to 8 hours: 5.30×10^{-6} sec/m^3
  8 to 24 hours: 3.92×10^{-6} sec/m^3
  24 to 96 hours: 2.05×10^{-6} sec/m^3
  96 to 720 hours: 8.05×10^{-7} sec/m^3

The accident dose calculations are performed using the activity releases for the following time intervals:

- EAB: 2–hour period yielding the maximum dose
- LPZ: 0 to 8 hours, 8 to 24 hours, 24 to 96 hours, and 96 to 720 hours

The accident doses are expressed as total effective dose equivalent (TEDE), consistent with 10 CFR ~~50.34~~52.17. The TEDE consists of the sum of the committed effective dose equivalent (CEDE) from inhalation and either the deep dose equivalent (DDE) or the effective dose equivalent (EDE) from external exposure. The CEDE is determined using the dose conversion factors in Federal Guidance Report 11 (U.S. EPA 1988), while the DDE and the EDE are based on dose conversion factors in Federal Guidance Report 12 (U.S. EPA 1993).

7.1.3 Source Terms

Doses are calculated based on the time-dependent activities released to the environment during each DBA. The activities are based on the analyses used to support the reactor standard safety analysis reports. Different reactor technologies use different source terms and approaches in defining the activity releases. The ABWR source terms, methodologies, and assumptions are based on the guidance in NUREG-0800 and Regulatory Guides 1.3 (U.S. NRC Jun 1974) and 1.25 (U.S. NRC Mar 1972). The AP1000, APWR, and ESBWR source terms, methodologies, and assumptions are based on the alternative source term guidance in RG 1.183.

MHI ~~Aug 2008~~Oct 2009. Document MUAP-DC001, *APWR Design Control Document for the US-APWR,* Tier 2, Mitsubishi Heavy Industries, Ltd., Revision 2, ~~August 2008~~October 2009.

U.S. EPA 1988. Federal Guidance Report 11, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion*, U. S. Environmental Protection Agency, EPA-520/1-88-020, 1988.

U.S. EPA 1993. Federal Guidance Report 12, *External Exposure to Radionuclides in Air, Water, and Soil*, U. S. Environmental Protection Agency, EPA-402-R-93-081, 1993.

U.S. NRC Mar 1972. Regulatory Guide 1.25 (Safety Guide 25), *Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors*, NRC, March 1972.

U.S. NRC Jun 1974. Regulatory Guide 1.3, *Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors*, Revision 2, NRC, June 1974.

U.S. NRC Nov 1982. Regulatory Guide 1.145, *Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants*, Revision 1, NRC, November 1982.

U.S. NRC Oct 1999. NUREG-1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants*, Section 7.1, Design Basis Accidents, U.S. NRC, October 1999,

U.S. NRC Jul 2000. Regulatory Guide 1.183, *Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors*, NRC, July 2000.

U.S. NRC Mar 2007. NUREG-0800, *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants*, U.S. NRC, March 2007.

Westinghouse Sep 2008. AP1000 Document No. APP-GW-GL-700, *AP1000 Design Control Document*, Tier 2, Westinghouse, Revision 17, September 2008.

Table 7.1-1
Design Certification X/Q Values and Ratios to Site X/Q Value for AP1000

Accident	Location	Release Time (hr)	X/Q (sec/m^3)		X/Q Ratio (Site/DCD)
			DCD	Site	
LOCA	EAB	0–2	5.1×10^{-4}	8.85×10^{-5}	1.74×10^{-1}
	LPZ	0–8	2.2×10^{-4}	5.30×10^{-6}	2.41×10^{-2}
		8–24	1.6×10^{-4}	3.92×10^{-6}	2.45×10^{-2}
		24–96	1.0×10^{-4}	2.05×10^{-6}	2.05×10^{-2}
		96–720	8.0×10^{-5}	8.05×10^{-7}	1.01×10^{-2}
Other	EAB	0–2	1.0×10^{-3}	8.85×10^{-5}	8.85×10^{-2}
	LPZ	0–8	5.0×10^{-4}	5.30×10^{-6}	1.06×10^{-2}
		8–24	3.0×10^{-4}	3.92×10^{-6}	1.31×10^{-2}
		24–96	1.5×10^{-4}	2.05×10^{-6}	1.37×10^{-2}
		96–720	8.0×10^{-5}	8.05×10^{-7}	1.01×10^{-2}

Reference: AP1000 DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-2
Design Certification X/Q Values and Ratios to Site X/Q Values for APWR

Location	Release Time (hr)	X/Q (sec/m^3)		X/Q Ratio (Site/DCD)
		DCD	Site	
EAB	0–2	5.0×10^{-4}	8.85×10^{-5}	1.77×10^{-1}
LPZ	0–8	2.1×10^{-4}	5.30×10^{-6}	2.52×10^{-2}
	8–24	1.3×10^{-4}	3.92×10^{-6}	3.02×10^{-2}
	24–96	6.9×10^{-5}	2.05×10^{-6}	2.97×10^{-2}
	96–720	2.8×10^{-5}	8.05×10^{-7}	2.88×10^{-2}

Reference: APWR DCD Rev. 2 (MHI Oct 2009)

Table 7.1-3
Design Certification X/Q Values and Ratios to Site X/Q Values for ABWR

Accident	Location	Release Time (hr)	X/Q (sec/m^3)		X/Q Ratio (Site/DCD)
			DCD	Site	
Cleanup Water Line Break	EAB	0–2	2.29×10^{-2}	8.85×10^{-5}	3.86×10^{-3}
	LPZ	0–8	2.29×10^{-2}	5.30×10^{-6}	2.31×10^{-4}
LOCA	EAB	0–2	1.37×10^{-3}	8.85×10^{-5}	6.46×10^{-2}
	LPZ	0–8	1.56×10^{-4}	5.30×10^{-6}	3.40×10^{-2}
		8–24	9.61×10^{-5}	3.92×10^{-6}	4.08×10^{-2}
		24–96	3.36×10^{-5}	2.05×10^{-6}	6.10×10^{-2}
		96–720	7.42×10^{-6}	8.05×10^{-7}	1.08×10^{-1}
Other	EAB	0–2	1.37×10^{-3}	8.85×10^{-5}	6.46×10^{-2}
	LPZ	0–8	1.37×10^{-3}	5.30×10^{-6}	3.87×10^{-3}

Reference: ABWR DCD Rev. 4 (GENE Mar 1997)

Table 7.1-4
Design Certification X/Q Values and Ratios to Site X/Q Values for ESBWR

Accident	Location	Release Time (hr)	X/Q (sec/m^3)		X/Q Ratio (Site/DCD)
			DCD	Site	
LOCA	EAB	0–2	2.00×10^{-3}	8.85×10^{-5}	4.43×10^{-2}
	LPZ	0–8	1.90×10^{-4}	5.30×10^{-6}	2.79×10^{-2}
		8–24	1.40×10^{-4}	3.92×10^{-6}	2.80×10^{-2}
		24–96	7.50×10^{-5}	2.05×10^{-6}	2.73×10^{-2}
		96–720	3.00×10^{-5}	8.05×10^{-7}	2.68×10^{-2}
Small Break Outside Containment	EAB	0–2	2.00×10^{-3}	8.85×10^{-5}	4.43×10^{-2}
	LPZ	0–8	1.90×10^{-4}	5.30×10^{-6}	2.79×10^{-2}
		8–24	1.40×10^{-4}	3.92×10^{-6}	2.80×10^{-2}
		24–96	7.50×10^{-5}	2.05×10^{-6}	2.73×10^{-2}
		96–720	3.00×10^{-5}	8.05×10^{-7}	2.68×10^{-2}
Other	EAB	0–2	2.00×10^{-3}	8.85×10^{-5}	4.43×10^{-2}
	LPZ	0–8	1.90×10^{-4}	5.30×10^{-6}	2.79×10^{-2}

Reference: ESBWR DCD Rev. 6 (GEH Aug 2009)

Table 7.1-5 (Sheet 1 of 2)
Summary of Design Basis Accident Site Doses

SRP Section	Accident		Design	DCD Section	Site Dose (rem TEDE) EAB	LPZ	Limit
15.1.5A	Steam System Piping Failure	Pre-Incident Iodine Spike	AP1000	15.1.5	8.9×10^{-2}	8.6×10^{-3}	25
			APWR	15.1.5	3.4×10^{-2}	2.8×10^{-3}	
		Accident-Initiated Iodine Spike	AP1000	15.1.5	9.7×10^{-2}	2.3×10^{-2}	2.5
			APWR	15.1.5	5.7×10^{-2}	7.3×10^{-3}	
15.3.3	Locked Rotor Accident	No Feedwater	AP1000	15.3.3	7.1×10^{-2}	4.1×10^{-3}	2.5
		Feedwater Available	AP1000	15.3.3	5.3×10^{-2}	~~8.4~~8.0 $\times 10^{-3}$	
	Locked Rotor Accident		APWR	15.3.3	8.7×10^{-2}	1.9×10^{-2}	
15.4.8	Rod Ejection Accident		AP1000	15.4.8	3.2×10^{-1}	~~6.0~~5.8 $\times 10^{-2}$	6.3
			APWR	15.4.8	9.0×10^{-1}	1.2×10^{-1}	
15.6.2	Small Break Outside Containment		AP1000	15.6.2	1.9×10^{-1}	1.1×10^{-2}	2.5
			APWR	15.6.2	2.7×10^{-1}	1.5×10^{-2}	
			ABWR	15.6.2	1.5×10^{-2}	9.2×10^{-4}	
	Small Break Outside Ctmt	Pre-Incident Iodine Spike	ESBWR	15.4.8	1.5×10^{-2}	2.8×10^{-3}	25
		Equilibrium Iodine Activity	ESBWR	15.4.8	4.4×10^{-3}	2.8×10^{-3}	2.5
15.6.3	Steam Generator Tube Rupture	Pre-Incident Iodine Spike	AP1000	15.6.3	~~2.0~~1.9 $\times 10^{-1}$	1.3×10^{-2}	25
			APWR	15.6.3	6.4×10^{-1}	3.8×10^{-2}	
		Accident-Initiated Iodine Spike	AP1000	15.6.3	9.7×10^{-2}	~~8.9~~8.7 $\times 10^{-3}$	2.5
			APWR	15.6.3	1.7×10^{-1}	1.1×10^{-2}	
15.6.4	Main Steam Line Break	Pre-Incident Iodine Spike	ABWR	15.6.4	1.8×10^{-1}	1.1×10^{-2}	25
			ESBWR	15.4.5	1.2×10^{-1}	5.6×10^{-3}	
		Equilibrium Iodine Activity	ABWR	15.6.4	9.0×10^{-3}	5.4×10^{-4}	2.5
			ESBWR	15.4.5	8.9×10^{-3}	2.8×10^{-3}	
15.6.5	Loss-of-Coolant Accident		AP1000	15.6.5	4.3	5.5×10^{-1}	25
			APWR	15.6.5	2.3	3.4×10^{-1}	
			ABWR	15.6.5	6.3×10^{-1}	7.9×10^{-1}	
			ESBWR	15.4.4	9.9×10^{-1}	5.7×10^{-1}	
15.7.4	Fuel Handling Accident		AP1000	15.7.4	4.6×10^{-1}	~~2.8~~2.7 $\times 10^{-2}$	6.3
			APWR	15.7.4	5.8×10^{-1}	3.5×10^{-2}	
			ABWR	15.7.4	2.2×10^{-1}	1.3×10^{-2}	
			ESBWR	15.4.1	1.8×10^{-1}	1.1×10^{-2}	

Table 7.1-5 (Sheet 2 of 2)
Summary of Design Basis Accident Site Doses

SRP Section	Accident		Design	DCD Section	Site Dose (rem TEDE)		
					EAB	LPZ	Limit
None	Feedwater Line Break	Pre-Incident Iodine Spike	ESBWR	15.4.7	8.0×10^{-1}	4.7×10^{-2}	25
		Equilibrium Iodine Activity	ESBWR	15.4.7	4.9×10^{-2}	2.8×10^{-3}	2.5
None	Cleanup Water Line Break		ABWR	15.6.6	4.6×10^{-3}	2.7×10^{-4}	25
	Cleanup Water Line Break	Pre-Incident Iodine Spike	ESBWR	15.4.9	3.1×10^{-1}	2.0×10^{-2}	25
		Equilibrium Iodine Activity	ESBWR	15.4.9	1.8×10^{-2}	2.8×10^{-3}	2.5

Note: This table summarizes the doses from the tables that follow. For the ABWR, the whole body and thyroid doses within Tables 7.1-44 to 7.1-53 are converted into TEDE values using weighting factors as indicated in Subsection 7.1.4. For the designs being considered, there are no radiological consequences for the accidents described in SRP Sections 15.2.8, 15.3.4, and 15.4.9.

References: AP1000 DCD Rev. 17 (Westinghouse Sep 2008)
APWR DCD Rev. 2 (MHI Oct 2009)
ABWR DCD Rev. 4 (GENE Mar 1997)
ESBWR DCD Rev. 6 (GEH Aug 2009)

Table 7.1-6
Activity Releases for AP1000 Main Steam System Piping Failure with Pre-Incident Iodine Spike

Isotope	Activity Release (Ci)				
	0–2 hr	2–8 hr	8–24 hr	24–72 hr	Total
Kr-85m	6.86×10^{-2}	1.14×10^{-1}	6.80×10^{-2}	6.20×10^{-3}	2.57×10^{-1}
Kr-85	2.82×10^{-1}	8.47×10^{-1}	2.25	6.68	1.01×10^{1}
Kr-87	2.76×10^{-2}	1.34×10^{-2}	5.20×10^{-4}	0.00	4.15×10^{-2}
Kr-88	1.12×10^{-1}	1.37×10^{-1}	4.04×10^{-2}	8.00×10^{-4}	2.90×10^{-1}
Xe-131m	1.28×10^{-1}	3.79×10^{-1}	9.81×10^{-1}	2.70	4.19
Xe-133m	1.59×10^{-1}	4.51×10^{-1}	1.04	2.05	3.70
Xe-133	1.18×10^{1}	3.45×10^{1}	8.65×10^{1}	2.16×10^{2}	3.49×10^{2}
Xe-135m	3.04×10^{-3}	1.30×10^{-5}	0.00	0.00	3.05×10^{-3}
Xe-135	3.10×10^{-1}	6.90×10^{-1}	8.35×10^{-1}	3.39×10^{-1}	2.17
Xe-138	3.99×10^{-3}	1.10×10^{-5}	0.00	0.00	4.00×10^{-3}
I-130	3.59×10^{-1}	1.42×10^{-1}	2.09×10^{-1}	1.33×10^{-1}	8.43×10^{-1}
I-131	2.40×10^{1}	1.21×10^{1}	3.10×10^{1}	8.21×10^{1}	1.49×10^{2}
I-132	3.05×10^{1}	4.14	8.07×10^{-1}	6.00×10^{-3}	3.55×10^{1}
I-133	4.34×10^{1}	1.90×10^{1}	3.53×10^{1}	3.98×10^{1}	1.38×10^{2}
I-134	6.74	1.63×10^{-1}	1.40×10^{-3}	0.00	6.90
I-135	2.60×10^{1}	8.16	7.54	1.71	4.34×10^{1}
Cs-134	1.90×10^{1}	1.95×10^{-1}	5.19×10^{-1}	1.54	2.13×10^{1}
Cs-136	2.82×10^{1}	2.86×10^{-1}	7.42×10^{-1}	2.06	3.13×10^{1}
Cs-137	1.37×10^{1}	1.41×10^{-1}	3.74×10^{-1}	1.11	1.53×10^{1}
Cs-138	1.01×10^{1}	1.02×10^{-3}	0.00	0.00	1.01×10^{1}
Total	**2.15×10^{2}**	**8.15×10^{1}**	**1.68×10^{2}**	**3.56×10^{2}**	**8.21×10^{2}**

Note: Source terms are for the radiation dose values recorded in DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-7
Doses for AP1000 Steam System Piping Failure with Pre-Incident Iodine Spike

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	1.00	—	8.85×10^{-2}	8.85×10^{-2}	—
0–8	—	5.81×10^{-1}	1.06×10^{-2}	—	6.16×10^{-3}
8–24	—	7.18×10^{-2}	1.31×10^{-2}	—	9.38×10^{-4}
24–96	—	1.08×10^{-1}	1.37×10^{-2}	—	1.48×10^{-3}
Total	1.00	7.61×10^{-1}	—	8.85×10^{-2}	8.57×10^{-3}
Limit	—	—	—	25	25

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-8
Activity Releases for AP1000 Main Steam System Piping Failure with Accident-Initiated Iodine Spike

Isotope	Activity Release (Ci)				
	0–2 hr	2–8 hr	8–24 hr	24–72 hr	Total
Kr-85m	6.86×10^{-2}	1.14×10^{-1}	6.80×10^{-2}	6.20×10^{-3}	2.57×10^{-1}
Kr-85	2.82×10^{-1}	8.47×10^{-1}	2.25	6.68	1.01×10^{1}
Kr-87	2.76×10^{-2}	1.34×10^{-2}	5.20×10^{-4}	0.00	4.15×10^{-2}
Kr-88	1.12×10^{-1}	1.37×10^{-1}	4.04×10^{-2}	8.00×10^{-4}	2.90×10^{-1}
Xe-131m	1.28×10^{-1}	3.79×10^{-1}	9.81×10^{-1}	2.70	4.19
Xe-133m	1.59×10^{-1}	4.51×10^{-1}	1.04	2.05	3.70
Xe-133	1.18×10^{1}	3.45×10^{1}	8.65×10^{1}	2.16×10^{2}	3.49×10^{2}
Xe-135m	3.04×10^{-3}	1.30×10^{-5}	0.00	0.00	3.05×10^{-3}
Xe-135	3.10×10^{-1}	6.90×10^{-1}	8.35×10^{-1}	3.39×10^{-1}	2.17
Xe-138	3.99×10^{-3}	1.10×10^{-5}	0.00	0.00	4.00×10^{-3}
I-130	4.15×10^{-1}	9.95×10^{-1}	1.58	1.01	4.00
I-131	2.57×10^{1}	5.73×10^{1}	1.56×10^{2}	4.13×10^{2}	6.52×10^{2}
I-132	4.57×10^{1}	9.74×10^{1}	2.23×10^{1}	2.00×10^{-1}	1.66×10^{2}
I-133	4.85×10^{1}	1.14×10^{2}	2.27×10^{2}	2.55×10^{2}	6.45×10^{2}
I-134	1.33×10^{1}	1.86×10^{1}	2.60×10^{-1}	0.00	3.22×10^{1}
I-135	3.20×10^{1}	7.74×10^{1}	7.83×10^{1}	1.77×10^{1}	2.05×10^{2}
Cs-134	1.90×10^{1}	1.95×10^{-1}	5.19×10^{-1}	1.54	2.13×10^{1}
Cs-136	2.82×10^{1}	2.86×10^{-1}	7.42×10^{-1}	2.06	3.13×10^{1}
Cs-137	1.37×10^{1}	1.41×10^{-1}	3.74×10^{-1}	1.11	1.53×10^{1}
Cs-138	1.01×10^{1}	1.02×10^{-3}	0.00	0.00	1.01×10^{1}
Total	**2.50×10^{2}**	**4.03×10^{2}**	**5.79×10^{2}**	**9.19×10^{2}**	**2.15×10^{3}**

Note: Source terms are for the radiation dose values recorded in DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-9
Doses for AP1000 Steam System Piping Failure with Accident-Initiated Iodine Spike

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	1.10	—	8.85×10^{-2}	9.74×10^{-2}	—
0–8	—	1.02	1.06×10^{-2}	—	1.08×10^{-2}
8–24	—	3.77×10^{-1}	1.31×10^{-2}	—	4.93×10^{-3}
24–96	—	5.36×10^{-1}	1.37×10^{-2}	—	7.33×10^{-3}
Total	1.10	1.93	—	9.74×10^{-2}	2.31×10^{-2}
Limit	—	—	—	2.5	2.5

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-10
Activity Releases for AP1000 Locked Rotor Accident

	Activity Release (Ci)			
	No Feedwater	With Feedwater		
Isotope	0–2 hr	0–6 hr	6–8 hr	Total
Kr-85m	8.16×10^{1}	2.38×10^{2}	4.12×10^{1}	2.79×10^{2}
Kr-85	7.58	3.03×10^{1}	1.01×10^{1}	4.04×10^{1}
Kr-87	1.20×10^{2}	2.07×10^{2}	5.40	2.12×10^{2}
Kr-88	2.08×10^{2}	5.21×10^{2}	6.04×10^{1}	5.81×10^{2}
Xe-131m	3.77	1.50×10^{1}	4.94	1.99×10^{1}
Xe-133m	2.02×10^{1}	7.85×10^{1}	2.48×10^{1}	1.03×10^{2}
Xe-133	6.66×10^{2}	2.63×10^{3}	8.57×10^{2}	3.49×10^{3}
Xe-135m	3.24×10^{1}	3.30×10^{1}	0.00	3.30×10^{1}
Xe-135	1.59×10^{2}	5.40×10^{2}	1.32×10^{2}	6.72×10^{2}
Xe-138	1.29×10^{2}	1.30×10^{2}	0.00	1.30×10^{2}
I-130	8.45×10^{-1}	8.81×10^{-1}	5.65×10^{-1}	1.45
I-131	3.77×10^{1}	4.60×10^{1}	3.46×10^{1}	8.06×10^{1}
I-132	2.79×10^{1}	1.43×10^{1}	3.95	1.83×10^{1}
I-133	4.86×10^{1}	5.33×10^{1}	3.64×10^{1}	8.97×10^{1}
I-134	2.88×10^{1}	5.53	2.09×10^{-1}	5.74
I-135	4.19×10^{1}	3.74×10^{1}	2.05×10^{1}	5.79×10^{1}
Cs-134	1.29	1.48	1.11	2.59
Cs-136	5.63×10^{-1}	5.17×10^{-1}	3.47×10^{-1}	8.64×10^{-1}
Cs-137	7.74×10^{-1}	8.71×10^{-1}	6.50×10^{-1}	1.52
Cs-138	6.08	2.95	1.13	4.08
Rb-86	1.33×10^{-2}	1.64×10^{-2}	1.27×10^{-2}	2.91×10^{-2}
Total	**1.62×10^{3}**	**4.59×10^{3}**	**1.24×10^{3}**	**5.82×10^{3}**

Note: Source terms are for the radiation dose values recorded in DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-11
Doses for AP1000 Locked Rotor Accident with No Feedwater

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	8.00×10^{-1}	—	8.85×10^{-2}	7.08×10^{-2}	—
0–8	—	3.89×10^{-1}	1.06×10^{-2}	—	4.12×10^{-3}
Total	8.00×10^{-1}	3.89×10^{-1}	—	7.08×10^{-2}	4.12×10^{-3}
Limit	—	—	—	2.5	2.5

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-12
Doses for AP1000 Locked Rotor Accident with Feedwater Available

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
~~0–2~~6–8[a]	6.00×10^{-1}	—	8.85×10^{-2}	5.31×10^{-2}	—
0–8	—	~~7.94~~7.52 $\times 10^{-1}$	1.06×10^{-2}	—	~~8.42~~7.97 $\times 10^{-3}$
Total	6.00×10^{-1}	~~7.94~~7.52 $\times 10^{-1}$	—	5.31×10^{-2}	~~8.42~~7.97 $\times 10^{-3}$
Limit	—	—	—	2.5	2.5

(a) Worst case 2-hour period is 6–8 hours.

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-13
Activity Release for AP1000 Rod Ejection Accident

Isotope	Activity Release (Ci)					
	0–2 hr	2–8 hr	8–24 hr	24–96 hr	96–720 hr	Total
Kr-85m	1.12×10^{2}	6.48×10^{1}	3.87×10^{1}	1.80	0.00	2.17×10^{2}
Kr-85	5.01	5.60	1.49×10^{1}	3.35×10^{1}	2.88×10^{2}	3.47×10^{2}
Kr-87	1.82×10^{2}	2.60×10^{1}	1.03	0.00	0.00	2.09×10^{2}
Kr-88	2.91×10^{2}	1.18×10^{2}	3.49×10^{1}	3.00×10^{-1}	0.00	4.44×10^{2}
Xe-131m	4.94	5.46	1.42×10^{1}	2.86×10^{1}	1.16×10^{2}	1.69×10^{2}
Xe-133m	2.67×10^{1}	2.81×10^{1}	6.49×10^{1}	8.45×10^{1}	5.31×10^{1}	2.57×10^{2}
Xe-133	8.79×10^{2}	9.59×10^{2}	2.40×10^{3}	4.27×10^{3}	8.44×10^{3}	1.69×10^{4}
Xe-135m	7.34×10^{1}	5.00×10^{-2}	0.00	0.00	0.00	7.35×10^{1}
Xe-135	2.15×10^{2}	1.72×10^{2}	2.09×10^{2}	4.34×10^{1}	2.00×10^{-1}	6.40×10^{2}
Xe-138	2.99×10^{2}	1.40×10^{-1}	0.00	0.00	0.00	2.99×10^{2}
I-130	4.90	7.28	4.32	2.00×10^{-1}	0.00	1.67×10^{1}
I-131	1.36×10^{2}	2.45×10^{2}	2.31×10^{2}	3.10×10^{1}	1.68×10^{1}	6.60×10^{2}
I-132	1.53×10^{2}	9.94×10^{1}	9.80	0.00	0.00	2.62×10^{2}
I-133	2.72×10^{2}	4.40×10^{2}	3.18×10^{2}	2.30×10^{1}	0.00	1.05×10^{3}
I-134	1.66×10^{2}	2.85×10^{1}	1.00×10^{-1}	0.00	0.00	1.95×10^{2}
I-135	2.39×10^{2}	2.97×10^{2}	1.19×10^{2}	2.40	0.00	6.57×10^{2}
Cs-134	3.08×10^{1}	6.22×10^{1}	6.03×10^{1}	7.70	5.20	1.66×10^{2}
Cs-136	8.79	1.75×10^{1}	1.67×10^{1}	2.05	6.50×10^{-1}	4.57×10^{1}
Cs-137	1.79×10^{1}	3.62×10^{1}	3.51×10^{1}	4.52	3.05	9.68×10^{1}
Cs-138	1.09×10^{2}	7.00	0.00	0.00	0.00	1.16×10^{2}
Rb-86	3.62×10^{-1}	7.27×10^{-1}	6.96×10^{-1}	8.40×10^{-2}	3.70×10^{-2}	1.91
Total	**3.23×10^{3}**	**2.62×10^{3}**	**3.57×10^{3}**	**4.53×10^{3}**	**8.92×10^{3}**	**2.29×10^{4}**

Note: Source terms are for the radiation dose values recorded in DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-14
Doses for AP1000 Rod Ejection Accident

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	3.60	—	8.85×10^{-2}	3.19×10^{-1}	—
0–8	—	~~4.58~~4.38	1.06×10^{-2}	—	~~4.85~~4.64 $\times 10^{-2}$
8–24	—	7.85×10^{-1}	1.31×10^{-2}	—	1.03×10^{-2}
24–96	—	6.34×10^{-2}	1.37×10^{-2}	—	8.66×10^{-4}
96–720	—	2.02×10^{-2}	1.01×10^{-2}	—	2.03×10^{-4}
Total	3.60	~~5.45~~5.25	—	3.19×10^{-1}	~~5.99~~5.78 $\times 10^{-2}$
Limit	—	—	—	6.3	6.3

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-15
Activity Releases for AP1000 Small Break Outside Containment

Isotope	Activity Release (Ci) 0–0.5 hr
Kr-85m	1.24×10^{1}
Kr-85	4.40×10^{1}
Kr-87	7.05
Kr-88	2.21×10^{1}
Xe-131m	1.99×10^{1}
Xe-133m	2.50×10^{1}
Xe-133	1.84×10^{3}
Xe-135m	2.59
Xe-135	5.20×10^{1}
Xe-138	3.65
I-130	1.89
I-131	9.26×10^{1}
I-132	3.49×10^{2}
I-133	2.01×10^{2}
I-134	1.58×10^{2}
I-135	1.68×10^{2}
Cs-134	4.16
Cs-136	6.16
Cs-137	3.00
Cs-138	2.21
Rb-86	0.00
Total	**3.01×10^{3}**

Note: Source terms are for the radiation dose values recorded in DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-16
Doses for AP1000 Small Break Outside Containment

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	2.10	—	8.85×10^{-2}	1.86×10^{-1}	—
0–8	—	~~1.02~~1.03	1.06×10^{-2}	—	~~1.08~~1.09 $\times 10^{-2}$
Total	2.10	~~1.02~~1.03	—	1.86×10^{-1}	~~1.08~~1.09 $\times 10^{-2}$
Limit	—	—	—	2.5	2.5

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-17
Activity Releases for AP1000 Steam Generator Tube Rupture with Pre-Incident Iodine Spike

Isotope	Activity Release (Ci)			
	0–2 hr	2–8 hr	8–14 hr	Total
Kr-85m	5.53×10^{1}	1.93×10^{1}	0.00	7.46×10^{1}
Kr-85	2.20×10^{2}	1.08×10^{2}	2.00×10^{-1}	3.28×10^{2}
Kr-87	2.39×10^{1}	3.61	0.00	2.75×10^{1}
Kr-88	9.22×10^{1}	2.65×10^{1}	0.00	1.19×10^{2}
Xe-131m	9.96×10^{1}	4.88×10^{1}	0.00	1.48×10^{2}
Xe-133m	1.24×10^{2}	5.91×10^{1}	1.00×10^{-1}	1.83×10^{2}
Xe-133	9.19×10^{3}	4.47×10^{3}	1.00×10^{1}	1.37×10^{4}
Xe-135m	3.44	6.00×10^{-3}	0.00	3.45
Xe-135	2.46×10^{2}	1.02×10^{2}	1.00×10^{-1}	3.48×10^{2}
Xe-138	4.56	5.00×10^{-3}	0.00	4.57
I-130	1.79	5.39×10^{-2}	2.67×10^{-1}	2.11
I-131	1.21×10^{2}	5.27	3.05×10^{1}	1.57×10^{2}
I-132	1.42×10^{2}	7.86×10^{-1}	1.91	1.45×10^{2}
I-133	2.16×10^{2}	7.63	4.06×10^{1}	2.64×10^{2}
I-134	2.74×10^{1}	1.06×10^{-2}	2.00×10^{-4}	2.74×10^{1}
I-135	1.27×10^{2}	2.70	1.17×10^{1}	1.41×10^{2}
Cs-134	1.63	6.10×10^{-2}	2.16×10^{-1}	1.91
Cs-136	2.42	8.80×10^{-2}	3.15×10^{-1}	2.82
Cs-137	1.17	4.40×10^{-2}	1.56×10^{-1}	1.37
Cs-138	5.64×10^{-1}	0.00	0.00	5.64×10^{-1}
Total	**1.07×10^{4}**	**4.85×10^{3}**	**9.61×10^{1}**	**1.57×10^{4}**

Note: Source terms are for the radiation dose values recorded in DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-18
Doses for AP1000 Steam Generator Tube Rupture with Pre-Incident Iodine Spike

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	2.20	—	8.85×10^{-2}	1.95×10^{-1}	—
0–8	—	1.16	1.06×10^{-2}	—	1.23×10^{-2}
8–24	—	~~7.24~~7.20 $\times 10^{-2}$	1.31×10^{-2}	—	~~9.46~~9.41 $\times 10^{-4}$
Total	2.20	1.23	—	1.95×10^{-1}	1.32×10^{-2}
Limit	—	—	—	25	25

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-19
Activity Releases for AP1000 Steam Generator Tube Rupture with Accident Initiated Iodine Spike

Isotope	Activity Release (Ci)			
	0–2 hr	2–8 hr	8–14 hr	Total
Kr-85m	5.53×10^{1}	1.93×10^{1}	0.00	7.46×10^{1}
Kr-85	2.20×10^{2}	1.08×10^{2}	2.00×10^{-1}	3.28×10^{2}
Kr-87	2.39×10^{1}	3.61	0.00	2.75×10^{1}
Kr-88	9.22×10^{1}	2.65×10^{1}	0.00	1.19×10^{2}
Xe-131m	9.96×10^{1}	4.88×10^{1}	0.00	1.48×10^{2}
Xe-133m	1.24×10^{2}	5.91×10^{1}	1.00×10^{-1}	1.83×10^{2}
Xe-133	9.19×10^{3}	4.47×10^{3}	1.00×10^{1}	1.37×10^{4}
Xe-135m	3.44	6.00×10^{-3}	0.00	3.45
Xe-135	2.46×10^{2}	1.02×10^{2}	1.00×10^{-1}	3.48×10^{2}
Xe-138	4.56	5.00×10^{-3}	0.00	4.57
I-130	8.87×10^{-1}	1.62×10^{-1}	8.23×10^{-1}	1.87
I-131	4.36×10^{1}	1.14×10^{1}	6.76×10^{1}	1.23×10^{2}
I-132	1.47×10^{2}	4.89	1.29×10^{1}	1.65×10^{2}
I-133	9.33×10^{1}	1.99×10^{1}	1.08×10^{2}	2.21×10^{2}
I-134	5.59×10^{1}	6.06×10^{-2}	6.02×10^{-2}	5.60×10^{1}
I-135	7.61×10^{1}	9.89	4.38×10^{1}	1.30×10^{2}
Cs-134	1.63	6.10×10^{-2}	2.16×10^{-1}	1.91
Cs-136	2.42	8.80×10^{-2}	3.15×10^{-1}	2.82
Cs-137	1.17	4.40×10^{-2}	1.56×10^{-1}	1.37
Cs-138	5.64×10^{-1}	0.00	0.00	5.64×10^{-1}
Total	**1.05×10^{4}**	**4.88×10^{3}**	**2.44×10^{2}**	**1.56×10^{4}**

Note: Source terms are for the radiation dose values recorded in DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-20
Doses for AP1000 Steam Generator Tube Rupture with Accident-Initiated Iodine Spike

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	1.10	—	8.85×10^{-2}	9.74×10^{-2}	—
0–8	—	~~6.27~~6.10 $\times 10^{-1}$	1.06×10^{-2}	—	~~6.65~~6.47 $\times 10^{-3}$
8–24	—	~~1.69~~1.68 $\times 10^{-1}$	1.31×10^{-2}	—	~~2.21~~2.20 $\times 10^{-3}$
Total	1.10	~~7.96~~7.78 $\times 10^{-1}$	—	9.74×10^{-2}	~~8.85~~8.66 $\times 10^{-3}$
Limit	—	—	—	2.5	2.5

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-21 (Sheet 2 of 2)
Activity Releases for AP1000 Loss-of-Coolant Accident

	Activity Release (Ci)							
Isotope	**1.4–3.4 hr**	**0–2 hr**	**2–8 hr**	**8–24 hr**	**24–72 hr**	**72–96 hr**	**96–720 hr**	**Total**
Ba-139	5.44×10^{1}	3.74×10^{1}	4.56×10^{1}	1.50×10^{-1}	0	0	0	8.32×10^{1}
Ba-140	1.63×10^{2}	7.61×10^{1}	2.49×10^{2}	1.51×10^{1}	0	0	4.00×10^{-1}	3.41×10^{2}
Mo-99	2.15×10^{1}	1.01×10^{1}	3.24×10^{1}	1.86	1.00×10^{-2}	0	0	4.44×10^{1}
Tc-99m	1.47×10^{1}	7.54	1.91×10^{1}	5.90×10^{-1}	0	0	0	2.72×10^{1}
Ru-103	1.73×10^{1}	8.08	2.65×10^{1}	1.62	0	1.00×10^{-2}	6.00×10^{-2}	3.63×10^{1}
Ru-105	8.18	4.33	1.00×10^{1}	2.40×10^{-1}	0	0	0	1.46×10^{1}
Ru-106	5.70	2.66	8.75	5.40×10^{-1}	0	0	3.00×10^{-2}	1.20×10^{1}
Rh-105	1.03×10^{1}	4.88	1.53×10^{1}	8.30×10^{-1}	0	0	0	2.10×10^{1}
Ce-141	3.89	1.82	5.96	3.64×10^{-1}	1.00×10^{-3}	1.00×10^{-3}	1.20×10^{-2}	8.16
Ce-143	3.46	1.64	5.14	2.78×10^{-1}	1.00×10^{-3}	0	0	7.06
Ce-144	2.94	1.37	4.51	2.76×10^{-1}	1.00×10^{-3}	1.00×10^{-3}	1.30×10^{-2}	6.17
Pu-238	9.16×10^{-3}	4.28×10^{-3}	1.41×10^{-2}	8.60×10^{-4}	0	0	4.00×10^{-5}	1.93×10^{-2}
Pu-239	8.06×10^{-4}	3.76×10^{-4}	1.24×10^{-3}	7.60×10^{-5}	0	1.00×10^{-6}	3.00×10^{-6}	1.70×10^{-3}
Pu-240	1.18×10^{-3}	5.52×10^{-4}	1.81×10^{-3}	1.11×10^{-4}	1.00×10^{-6}	0	5.00×10^{-6}	2.48×10^{-3}
Pu-241	2.65×10^{-1}	1.24×10^{-1}	4.08×10^{-1}	2.50×10^{-2}	1.00×10^{-4}	0	1.20×10^{-3}	5.58×10^{-1}
Np-239	4.48×10^{1}	2.12×10^{1}	6.75×10^{1}	3.84	1.00×10^{-2}	1.00×10^{-2}	1.00×10^{-2}	9.26×10^{1}
Y-90	8.08×10^{-2}	3.81×10^{-2}	1.22×10^{-1}	7.00×10^{-3}	0	0	0	1.67×10^{-1}
Y-91	1.19	5.54×10^{-1}	1.82	1.11×10^{-1}	1.00×10^{-3}	0	4.00×10^{-3}	2.49
Y-92	7.89×10^{-1}	4.32×10^{-1}	9.19×10^{-1}	1.80×10^{-2}	0	0	0	1.37
Y-93	1.21	6.00×10^{-1}	1.68	6.80×10^{-2}	0	0	0	2.35
Nb-95	1.59	7.46×10^{-1}	2.44	1.49×10^{-1}	1.00×10^{-3}	0	5.00×10^{-3}	3.34
Zr-95	1.59	7.41×10^{-1}	2.43	1.49×10^{-1}	0	0	6.00×10^{-3}	3.33
Zr-97	1.43	6.89×10^{-1}	2.05	9.80×10^{-2}	0	0	0	2.84
La-140	1.67	7.92×10^{-1}	2.50	1.39×10^{-1}	0	0	0	3.43
La-141	1.03	5.54×10^{-1}	1.23	2.70×10^{-2}	0	0	0	1.81
La-142	5.38×10^{-1}	3.57×10^{-1}	4.74×10^{-1}	2.00×10^{-3}	0	0	0	8.33×10^{-1}
Nd-147	6.16×10^{-1}	2.89×10^{-1}	9.42×10^{-1}	5.70×10^{-2}	0	0	1.00×10^{-3}	1.29
Pr-143	1.39	6.50×10^{-1}	2.13	1.28×10^{-1}	1.00×10^{-3}	0	3.00×10^{-3}	2.91
Am-241	1.20×10^{-4}	5.59×10^{-5}	1.84×10^{-4}	1.13×10^{-5}	0	0	6.00×10^{-7}	2.52×10^{-4}
Cm-242	2.82×10^{-2}	1.32×10^{-2}	4.33×10^{-2}	2.65×10^{-3}	1.00×10^{-5}	1.00×10^{-5}	1.20×10^{-4}	5.93×10^{-2}
Cm-244	3.46×10^{-3}	1.62×10^{-3}	5.32×10^{-3}	3.26×10^{-4}	1.00×10^{-6}	0	1.60×10^{-5}	7.28×10^{-3}
Total	**3.53×10^{4}**	**1.72×10^{4}**	**8.14×10^{4}**	**1.35×10^{5}**	**1.54×10^{5}**	**6.17×10^{4}**	**4.29×10^{5}**	**8.78×10^{5}**

Note: Source terms are for the radiation dose values recorded in DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-22
Doses for AP1000 Loss-of-Coolant Accident

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
1.4–3.4[(a)]	2.46×10^{1}	—	1.74×10^{-1}	4.27	—
0–8	—	2.17×10^{1}	2.41×10^{-2}	—	5.23×10^{-1}
8–24	—	7.50×10^{-1}	2.45×10^{-2}	—	1.84×10^{-2}
24–96	—	2.93×10^{-1}	2.05×10^{-2}	—	6.01×10^{-3}
96–720	—	5.49×10^{-1}	1.01×10^{-2}	—	5.52×10^{-3}
Total	2.46×10^{1}	2.33×10^{1}	—	4.27	5.53×10^{-1}
Limit	—	—	—	25	25

(a) Worst case 2-hour period is 1.4–3.4 hours.

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-23
Activity Releases for AP1000 Fuel Handling Accident

Isotope	Activity Release (Ci) 0–2 hr
Kr-85m	8.40
Kr-85	1.10×10^{3}
Kr-88	3.00×10^{-1}
Xe-131m	5.52×10^{2}
Xe-133m	2.30×10^{3}
Xe-133	8.88×10^{4}
Xe-135m	1.02×10^{2}
Xe-135	5.68×10^{3}
I-130	7.00×10^{-1}
I-131	3.47×10^{2}
I-132	2.44×10^{2}
I-133	1.08×10^{2}
I-135	3.20
Total	**9.92×10^{4}**

Note: Source terms are for the radiation dose values recorded in DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-24
Doses for AP1000 Fuel Handling Accident

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	5.20	—	8.85×10^{-2}	4.60×10^{-1}	—
0–8	—	2.59	1.06×10^{-2}	—	2.75×10^{-2}
Total	5.20	2.59	—	4.60×10^{-1}	2.75×10^{-2}
Limit	—	—	—	6.3	6.3

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 17 (Westinghouse Sep 2008)

Table 7.1-25
Activity Releases for APWR Steam System Piping Failure with Pre-Incident Iodine Spike

Isotope	Activity Release (Ci)		
	0–8 hr	8–24 hr	Total
Kr-85	3.21×10^{1}	2.40×10^{1}	5.61×10^{1}
Kr-85m	3.56×10^{-1}	8.77×10^{-2}	4.43×10^{-1}
Kr-87	9.12×10^{-2}	1.13×10^{-3}	9.23×10^{-2}
Kr-88	5.10×10^{-1}	6.46×10^{-2}	5.74×10^{-1}
Xe-133	1.07×10^{2}	7.75×10^{1}	1.85×10^{2}
Xe-135	4.38	3.39	7.78
I-131	1.72×10^{1}	7.25	2.44×10^{1}
I-132	6.18	1.66×10^{-1}	6.35
I-133	2.79×10^{1}	9.03	3.69×10^{1}
I-134	3.49	1.01×10^{-3}	3.49
I-135	1.62×10^{1}	2.73	1.89×10^{1}
Rb-86	8.64×10^{-2}	1.62×10^{-3}	8.80×10^{-2}
Cs-134	8.80	1.68×10^{-1}	8.97
Cs-136	2.32	4.33×10^{-2}	2.37
Cs-137	5.01	9.56×10^{-2}	5.11
Total	2.32×10^{2}	1.25×10^{2}	3.56×10^{2}

Reference: APWR DCD Rev. 2 (MHI Oct 2009)

Table 7.1-26
Doses for APWR Steam System Piping Failure with Pre-Incident Iodine Spike

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	1.9×10^{-1}	—	1.77×10^{-1}	3.4×10^{-2}	—
0–8	—	1.0×10^{-1}	2.52×10^{-2}	—	2.5×10^{-3}
8–24	—	7.6×10^{-3}	3.02×10^{-2}	—	2.3×10^{-4}
Total	1.9×10^{-1}	1.1×10^{-1}	—	3.4×10^{-2}	2.8×10^{-3}
Limit	—	—	—	25	25

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 2 (MHI Oct 2009)

Table 7.1-27
Activity Releases for APWR Steam System Piping Failure with Accident-Initiated Iodine Spike

Isotope	Activity Release (Ci)		
	0–8 hr	8–24 hr	Total
Kr-85	3.21×10^{1}	2.40×10^{1}	5.61×10^{1}
Kr-85m	3.56×10^{-1}	8.77×10^{-2}	4.43×10^{-1}
Kr-87	9.12×10^{-2}	1.13×10^{-3}	9.23×10^{-2}
Kr-88	5.10×10^{-1}	6.46×10^{-2}	5.74×10^{-1}
Xe-133	1.08×10^{2}	8.03×10^{1}	1.88×10^{2}
Xe-135	7.61	1.33×10^{1}	2.09×10^{1}
I-131	5.05×10^{1}	6.50×10^{1}	1.16×10^{2}
I-132	9.89	1.49	1.14×10^{1}
I-133	7.65×10^{1}	8.09×10^{1}	1.57×10^{2}
I-134	3.77	9.11×10^{-3}	3.78
I-135	3.77×10^{1}	2.45×10^{1}	6.21×10^{1}
Rb-86	8.64×10^{-2}	1.62×10^{-3}	8.80×10^{-2}
Cs-134	8.80	1.68×10^{-1}	8.97
Cs-136	2.32	4.33×10^{-2}	2.37
Cs-137	5.01	9.56×10^{-2}	5.11
Total	3.43×10^{2}	2.90×10^{2}	6.33×10^{2}

Reference: APWR DCD Rev. 2 (MHI Oct 2009)

Table 7.1-28
Doses for APWR Steam System Piping Failure with Accident-Initiated Iodine Spike

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	3.2×10^{-1}	—	1.77×10^{-1}	5.7×10^{-2}	—
0–8	—	2.1×10^{-1}	2.52×10^{-2}	—	5.3×10^{-3}
8–24	—	6.5×10^{-2}	3.02×10^{-2}	—	2.0×10^{-3}
Total	3.2×10^{-1}	2.8×10^{-1}	—	5.7×10^{-2}	7.3×10^{-3}
Limit	—	—	—	2.5	2.5

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 2 (MHI Oct 2009)

Table 7.1-29
Activity Releases for APWR Locked Rotor Accident

Isotope	Activity Release (Ci)		
	0–8 hr	8–24 hr	Total
Kr-85	1.12×10^{2}	8.40×10^{1}	1.96×10^{2}
Kr-85m	6.40×10^{2}	1.58×10^{2}	7.98×10^{2}
Kr-87	5.02×10^{2}	6.21	5.08×10^{2}
Kr-88	1.37×10^{3}	1.74×10^{2}	1.55×10^{3}
Xe-133	6.87×10^{3}	4.96×10^{3}	1.18×10^{4}
Xe-135	1.61×10^{3}	7.67×10^{2}	2.37×10^{3}
I-131	8.81×10^{1}	2.32×10^{2}	3.20×10^{2}
I-132	1.94×10^{1}	8.35	2.77×10^{1}
I-133	9.85×10^{1}	2.17×10^{2}	3.15×10^{2}
I-134	6.46	1.10×10^{-1}	6.57
I-135	6.38×10^{1}	9.16×10^{1}	1.55×10^{2}
Rb-86	3.23×10^{-2}	8.66×10^{-2}	1.19×10^{-1}
Cs-134	3.24	8.78	1.20×10^{1}
Cs-136	8.72×10^{-1}	2.33	3.21
Cs-137	1.84	5.00	6.84
Total	1.14×10^{4}	6.71×10^{3}	1.81×10^{4}

Reference: APWR DCD Rev. 2 (MHI Oct 2009)

Table 7.1-30
Doses for APWR Locked Rotor Accident

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
10–12[a]~~0–2~~	4.9×10^{-1}	—	1.77×10^{-1}	8.7×10^{-2}	—
0–8	—	4.4×10^{-1}	2.52×10^{-2}	—	1.1×10^{-2}
8–24	—	2.5×10^{-1}	3.02×10^{-2}	—	7.5×10^{-3}
Total	4.9×10^{-1}	6.9×10^{-1}	—	8.7×10^{-2}	1.9×10^{-2}
Limit	—	—	—	2.5	2.5

(a) Worst case 2-hour period is 10–12 hours.

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 2 (MHI Oct 2009)

Table 7.1-31
Activity Releases for APWR Rod Ejection Accident

Isotope	Activity Release (Ci)				
	0–8 hr	8–24 hr	24–96 hr	96–720 hr	Total
Kr-85	2.63×10^{2}	2.50×10^{2}	1.90×10^{2}	1.63×10^{3}	2.33×10^{3}
Kr-85m	3.59×10^{3}	9.58×10^{2}	9.86	0	4.56×10^{3}
Kr-87	2.81×10^{3}	3.50×10^{1}	0	0	2.85×10^{3}
Kr-88	7.70×10^{3}	1.02×10^{3}	2.05	0	8.72×10^{3}
Xe-133	3.81×10^{4}	3.46×10^{4}	2.11×10^{4}	4.22×10^{4}	1.36×10^{5}
Xe-135	9.31×10^{3}	5.32×10^{3}	5.40×10^{2}	2.81	1.52×10^{4}
I-131	5.82×10^{2}	7.17×10^{2}	2.58×10^{2}	7.79×10^{2}	2.34×10^{3}
I-132	4.62×10^{2}	3.93×10^{1}	1.40×10^{-2}	0	5.01×10^{2}
I-133	1.12×10^{3}	1.06×10^{3}	1.13×10^{2}	1.13×10^{1}	2.30×10^{3}
I-134	4.95×10^{2}	5.15×10^{-1}	0	0	4.95×10^{2}
I-135	8.75×10^{2}	4.39×10^{2}	6.60	4.00×10^{-3}	1.32×10^{3}
Rb-86	4.16×10^{-1}	9.65×10^{-2}	0	0	5.13×10^{-1}
Cs-134	4.15×10^{1}	9.79	1.01×10^{-3}	0	5.13×10^{1}
Cs-136	1.13×10^{1}	2.60	1.00×10^{-6}	0	1.39×10^{1}
Cs-137	2.36×10^{1}	5.57	0	0	2.92×10^{1}
Total	6.53×10^{4}	4.45×10^{4}	2.22×10^{4}	4.46×10^{4}	1.77×10^{5}

Reference: APWR DCD Rev. 2 (MHI Oct 2009)

Table 7.1-32
Doses for APWR Rod Ejection Accident

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	5.1	—	1.77×10^{-1}	9.0×10^{-1}	—
0–8	—	3.2	2.52×10^{-2}	—	8.1×10^{-2}
8–24	—	8.8×10^{-1}	3.02×10^{-2}	—	2.7×10^{-2}
24–96	—	1.6×10^{-1}	2.97×10^{-2}	—	4.8×10^{-3}
96–720	—	1.7×10^{-1}	2.88×10^{-2}	—	4.9×10^{-3}
Total	5.1	4.4	—	9.0×10^{-1}	1.2×10^{-1}
Limit	—	—	—	6.3	6.3

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 2 (MHI Oct 2009)

Table 7.1-33
Activity Releases for APWR Small Break Outside Containment

Isotope	Activity Release (Ci), 0-8 hr
Kr-85	6.84×10^{2}
Kr-85m	1.25×10^{1}
Kr-87	7.05
Kr-88	2.26×10^{1}
Xe-133	2.32×10^{3}
Xe-135	7.70×10^{1}
I-131	1.72×10^{2}
I-132	7.98×10^{1}
I-133	2.93×10^{2}
I-134	4.33×10^{1}
I-135	1.85×10^{2}
Total	3.90×10^{3}

Reference: APWR DCD Rev. 2 (MHI Oct 2009)

Table 7.1-34
Doses for APWR Small Break Outside Containment

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	1.5	—	1.77×10^{-1}	2.7×10^{-1}	—
0–8	—	6.0×10^{-1}	2.52×10^{-2}	—	1.5×10^{-2}
Total	1.5	6.0×10^{-1}	—	2.7×10^{-1}	1.5×10^{-2}
Limit	—	—	—	2.5	2.5

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 2 (MHI Oct 2009)

Table 7.1-35
Activity Releases for APWR Steam Generator Tube Rupture with Pre-Incident Iodine Spike

Isotope	Activity Release (Ci)				
	0–8 hr	8–24 hr	24–96 hr	96–720 hr	Total
Kr-85	3.43×10^{3}	4.64×10^{1}	2.06×10^{2}	1.59×10^{3}	5.27×10^{3}
Kr-85m	6.17×10^{1}	9.70×10^{-2}	8.00×10^{-3}	0	6.18×10^{1}
Kr-87	3.40×10^{1}	0	0	0	3.40×10^{1}
Kr-88	1.11×10^{2}	6.00×10^{-2}	1.00×10^{-2}	0	1.11×10^{2}
Xe-133	1.16×10^{4}	1.44×10^{2}	5.06×10^{2}	9.44×10^{2}	1.32×10^{4}
Xe-135	3.75×10^{2}	2.18	6.70×10^{-1}	0	3.78×10^{2}
I-131	4.18×10^{2}	1.81	0	0	4.20×10^{2}
I-132	2.09×10^{2}	3.92×10^{-2}	0	0	2.09×10^{2}
I-133	7.16×10^{2}	2.24	0	0	7.18×10^{2}
I-134	1.28×10^{2}	6.00×10^{-5}	0	0	1.28×10^{2}
I-135	4.61×10^{2}	6.70×10^{-1}	0	0	4.62×10^{2}
Rb-86	4.54×10^{-3}	5.44×10^{-4}	0	0	5.09×10^{-3}
Cs-134	4.63×10^{-1}	5.63×10^{-2}	0	0	5.19×10^{-1}
Cs-136	1.22×10^{-1}	1.45×10^{-2}	0	0	1.37×10^{-1}
Cs-137	2.64×10^{-1}	3.21×10^{-2}	0	0	2.96×10^{-1}
Total	1.76×10^{4}	1.98×10^{2}	7.12×10^{2}	2.53×10^{3}	2.10×10^{4}

Reference: APWR DCD Rev. 2 (MHI Oct 2009)

Table 7.1-36
Doses for APWR Steam Generator Tube Rupture with Pre-Incident Iodine Spike

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	3.6	—	1.77×10^{-1}	6.4×10^{-1}	—
0–8	—	1.5	2.52×10^{-2}	—	3.8×10^{-2}
8–24	—	2.0×10^{-3}	3.02×10^{-2}	—	6.0×10^{-5}
24–96	—	2.1×10^{-4}	2.97×10^{-2}	—	6.2×10^{-6}
96–720	—	1.7×10^{-4}	2.88×10^{-2}	—	4.9×10^{-6}
Total	3.6	1.5	—	6.4×10^{-1}	3.8×10^{-2}
Limit	—	—	—	25	25

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 2 (MHI Oct 2009)

Table 7.1-37
Activity Releases for APWR Steam Generator Tube Rupture with Accident-Initiated Iodine Spike

Isotope	Activity Release (Ci)				
	0–8 hr	8–24 hr	24–96 hr	96–720 hr	Total
Kr-85	3.43×10^{3}	4.64×10^{1}	2.06×10^{2}	1.59×10^{3}	5.27×10^{3}
Kr-85m	6.17×10^{1}	9.70×10^{-2}	8.00×10^{-3}	0	6.18×10^{1}
Kr-87	3.40×10^{1}	0	0	0	3.40×10^{1}
Kr-88	1.11×10^{2}	6.00×10^{-2}	1.00×10^{-2}	0	1.11×10^{2}
Xe-133	1.16×10^{4}	1.45×10^{2}	5.06×10^{2}	9.44×10^{2}	1.32×10^{4}
Xe-135	3.70×10^{2}	3.82	6.70×10^{-1}	0	3.74×10^{2}
I-131	1.10×10^{2}	1.03×10^{1}	0	0	1.20×10^{2}
I-132	5.24×10^{1}	2.12×10^{-1}	0	0	5.26×10^{1}
I-133	1.87×10^{2}	1.27×10^{1}	0	0	2.00×10^{2}
I-134	3.05×10^{1}	1.06×10^{-3}	0	0	3.05×10^{1}
I-135	1.19×10^{2}	3.74	0	0	1.23×10^{2}
Rb-86	4.54×10^{-3}	5.44×10^{-4}	0	0	5.09×10^{-3}
Cs-134	4.63×10^{-1}	5.63×10^{-2}	0	0	5.19×10^{-1}
Cs-136	1.22×10^{-1}	1.45×10^{-2}	0	0	1.37×10^{-1}
Cs-137	2.64×10^{-1}	3.21×10^{-2}	0	0	2.96×10^{-1}
Total	1.61×10^{4}	2.22×10^{2}	7.12×10^{2}	2.53×10^{3}	1.96×10^{4}

Reference: APWR DCD Rev. 2 (MHI Oct 2009)

Table 7.1-38
Doses for APWR Steam Generator Tube Rupture with Accident-Initiated Iodine Spike

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	9.6×10^{-1}	—	1.77×10^{-1}	1.7×10^{-1}	—
0–8	—	4.1×10^{-1}	2.52×10^{-2}	—	1.0×10^{-2}
8–24	—	1.0×10^{-2}	3.02×10^{-2}	—	3.0×10^{-4}
24–96	—	2.1×10^{-4}	2.97×10^{-2}	—	6.2×10^{-6}
96–720	—	1.7×10^{-4}	2.88×10^{-2}	—	4.9×10^{-6}
Total	9.6×10^{-1}	4.2×10^{-1}	—	1.7×10^{-1}	1.1×10^{-2}
Limit	—	—	—	2.5	2.5

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 2 (MHI Oct 2009)

Table 7.1-39 (Sheet 2 of 2)
Activity Releases for APWR Loss-of-Coolant Accident

Isotope	Activity Release (Ci)				
	0–8 hr	8–24 hr	24–96 hr	96–720 hr	Total
Ru-103	7.62	9.83×10^{-2}	1.01×10^{-4}	0	7.72
Ru-105	3.14	1.12×10^{-2}	0	0	3.15
Ru-106	2.67	3.46×10^{-2}	0	0	2.70
Rh-105	4.61	5.41×10^{-2}	0	0	4.67
Y-90	7.44×10^{-2}	5.12×10^{-3}	6.06×10^{-6}	0	7.96×10^{-2}
Y-91	6.00×10^{-1}	8.54×10^{-3}	0	0	6.09×10^{-1}
Y-92	4.13	1.04×10^{-1}	0	0	4.24
Y-93	5.90×10^{-1}	4.32×10^{-3}	0	0	5.94×10^{-1}
Zr-95	7.55×10^{-1}	9.76×10^{-3}	0	0	7.65×10^{-1}
Zr-97	6.65×10^{-1}	6.12×10^{-3}	0	0	6.71×10^{-1}
Nb-95	7.60×10^{-1}	9.85×10^{-3}	1.01×10^{-5}	0	7.69×10^{-1}
La-140	1.76	1.43×10^{-1}	2.02×10^{-4}	0	1.90
La-141	4.25×10^{-1}	1.29×10^{-3}	0	0	4.27×10^{-1}
La-142	2.01×10^{-1}	7.07×10^{-5}	0	0	2.01×10^{-1}
Pr-143	6.74×10^{-1}	8.91×10^{-3}	1.00×10^{-5}	0	6.83×10^{-1}
Nd-147	2.80×10^{-1}	3.55×10^{-3}	0	0	2.83×10^{-1}
Am-241	7.51×10^{-5}	9.77×10^{-7}	0	0	7.60×10^{-5}
Cm-242	1.86×10^{-2}	2.41×10^{-4}	0	0	1.88×10^{-2}
Cm-244	2.26×10^{-3}	2.93×10^{-5}	0	0	2.29×10^{-3}
Ce-141	1.78	2.29×10^{-2}	0	0	1.80
Ce-143	1.63	1.78×10^{-2}	0	0	1.65
Ce-144	1.35	1.75×10^{-2}	0	0	1.36
Np-239	1.85×10^{1}	2.16×10^{-1}	1.00×10^{-5}	0	1.87×10^{1}
Pu-238	5.30×10^{-3}	6.88×10^{-5}	0	0	5.37×10^{-3}
Pu-239	4.00×10^{-4}	5.19×10^{-6}	0	0	4.05×10^{-4}
Pu-240	6.28×10^{-4}	8.14×10^{-6}	1.01×10^{-8}	0	6.36×10^{-4}
Pu-241	1.39×10^{-1}	1.81×10^{-3}	0	0	1.41×10^{-1}
Total	2.03×10^{5}	3.28×10^{5}	5.09×10^{5}	1.02×10^{6}	2.06×10^{6}

Reference: APWR DCD Rev. 2 (MHI Oct 2009)

Table 7.1-40
Doses for APWR Loss-of-Coolant Accident

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0.5–2.5[(a)]	1.3×10^{1}	—	1.77×10^{-1}	2.3	—
0–8	—	9.0	2.52×10^{-2}	—	2.3×10^{-1}
8–24	—	1.2	3.02×10^{-2}	—	3.6×10^{-2}
24–96	—	1.3	2.97×10^{-2}	—	3.9×10^{-2}
96–720	—	1.4	2.88×10^{-2}	—	4.0×10^{-2}
Total	1.3×10^{1}	1.3×10^{1}	—	2.3	3.4×10^{-1}
Limit	—	—	—	25	25

(a) Worst case 2-hour period is 0.5–2.5 hours

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 2 (MHI Oct 2009)

Table 7.1-41
Activity Releases for APWR Fuel Handling Accident

Isotope	Activity Release (Ci), 0–8 hr
Kr-85	1.20×10^{3}
Kr-85m	3.90×10^{2}
Kr-87	5.98×10^{-2}
Kr-88	1.25×10^{2}
Xe-133	9.90×10^{4}
Xe-135	2.21×10^{4}
I-131	3.67×10^{2}
I-132	2.75×10^{2}
I-133	2.31×10^{2}
I-134	2.71×10^{-6}
I-135	3.80×10^{1}
Total	1.24×10^{5}

Reference: APWR DCD Rev. 2 (MHI Oct 2009)

Table 7.1-42
Doses for APWR Fuel Handling Accident

Time (hr)	DCD Dose (rem TEDE)		X/Q Ratio	Site Dose (rem TEDE)	
	EAB	LPZ	Site to DCD	EAB	LPZ
0–2	3.3	—	1.77×10^{-1}	5.8×10^{-1}	—
0–8	—	1.4	2.52×10^{-2}	—	3.5×10^{-2}
Total	3.3	1.4	—	5.8×10^{-1}	3.5×10^{-2}
Limit	—	—	—	6.3	6.3

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 2 (MHI Oct 2009)

Table 7.1-43
Activity Releases for ABWR Main Steam Line Break

Isotope	Activity Release (MBq)	
	Equilibrium Activity	Pre-Incident Spike
I-131	7.29×10^4	1.46×10^6
I-132	7.10×10^5	1.42×10^7
I-133	5.00×10^5	9.99×10^6
I-134	1.40×10^6	2.79×10^7
I-135	7.29×10^5	1.46×10^7
Kr-83m	4.07×10^2	2.44×10^3
Kr-85m	7.18×10^2	4.29×10^3
Kr-85	2.26	1.36×10^1
Kr-87	2.44×10^3	1.47×10^4
Kr-88	2.46×10^3	1.48×10^4
Kr-89	9.88×10^3	5.92×10^4
Kr-90	2.55×10^3	1.55×10^4
Xe-131m	1.76	1.06×10^1
Xe-133m	3.39×10^1	2.04×10^2
Xe-133	9.47×10^2	5.70×10^3
Xe-135m	2.89×10^3	1.74×10^4
Xe-135	2.70×10^3	1.62×10^4
Xe-137	1.23×10^4	7.40×10^4
Xe-138	9.44×10^3	5.66×10^4
Xe-139	4.33×10^3	2.59×10^4

Reference: ABWR DCD Rev. 4 (GENE Mar 1997)

Table 7.1-44
Doses for ABWR Main Steam Line Break with Pre-Incident Iodine Spike

Location	Time (hr)	DCD Dose (Sv)		X/Q Ratio	Site Dose (rem)	
		W. Body	Thyroid	Site to DCD	W. Body	Thyroid
EAB	0–2	1.3×10^{-2}	5.1×10^{-1}	6.46×10^{-2}	8.4×10^{-2}	3.3
LPZ	0–8	—	—	3.87×10^{-3}	5.0×10^{-3}	2.0×10^{-1}
Limit	—	—	—	—	25	300

Reference: ABWR DCD Rev. 4 (GENE Mar 1997)

Table 7.1-45
Doses for ABWR Main Steam Line Break with Equilibrium Iodine Activity

Location	Time (hr)	DCD Dose (Sv)		X/Q Ratio	Site Dose (rem)	
		W. Body	Thyroid	Site to DCD	W. Body	Thyroid
EAB	0–2	6.2×10^{-4}	2.6×10^{-2}	6.46×10^{-2}	4.0×10^{-3}	1.7×10^{-1}
LPZ	0–8	—	—	3.87×10^{-3}	2.4×10^{-4}	1.0×10^{-2}
Limit	—	—	—	—	2.5	30

Reference: ABWR DCD Rev. 4 (GENE Mar 1997)

Table 7.1-46
Activity Releases for ABWR Small Break Outside Containment

Isotope	Activity Release (MBq)					
	1 min	10 min	1 hr	2 hr	4 hr	8 hr
I-131	6.36×10^{-1}	5.77×10^{1}	2.77×10^{4}	6.81×10^{4}	1.27×10^{5}	1.41×10^{5}
I-132	6.18	5.51×10^{2}	2.52×10^{5}	5.96×10^{5}	1.09×10^{6}	1.19×10^{6}
I-133	4.37	3.96×10^{2}	1.87×10^{5}	4.59×10^{5}	8.51×10^{5}	9.44×10^{5}
I-134	1.21×10^{1}	1.06×10^{3}	4.44×10^{5}	9.92×10^{5}	1.76×10^{6}	1.90×10^{6}
I-135	6.36	5.74×10^{2}	2.71×10^{5}	6.59×10^{5}	1.21×10^{6}	1.34×10^{6}

Reference: ABWR DCD Rev. 4 (GENE Mar 1997)

Table 7.1-47
Doses for ABWR Small Break Outside Containment

Location	Time (hr)	DCD Dose (Sv)		X/Q Ratio	Site Dose (rem)	
		W. Body	Thyroid	Site to DCD	W. Body	Thyroid
EAB	0–2	9.4×10^{-4}	4.8×10^{-2}	6.46×10^{-2}	6.1×10^{-3}	3.1×10^{-1}
LPZ	0–8	—	—	3.87×10^{-3}	3.6×10^{-4}	1.9×10^{-2}
Limit	—	—	—	—	2.5	30

Reference: ABWR DCD Rev. 4 (GENE Mar 1997)

Table 7.1-48 (Sheet 2 of 2)
Activity Releases for ABWR Loss-of-Coolant Accident

Isotope	Activity Release from Condenser (MBq)									
	1 min	10 min	1 hr	2 hr	4 hr	8 hr	12 hr	24 hr	96 hr	720 hr
I-131	0	0	7.0×10^{2}	1.2×10^{4}	1.2×10^{5}	8.5×10^{5}	2.4×10^{6}	1.2×10^{7}	1.8×10^{8}	2.0×10^{9}
I-132	0	0	8.1×10^{2}	1.1×10^{4}	7.0×10^{4}	2.4×10^{5}	3.5×10^{5}	4.4×10^{5}	4.4×10^{5}	4.4×10^{5}
I-133	0	0	1.5×10^{3}	2.4×10^{4}	2.3×10^{5}	1.5×10^{6}	3.7×10^{6}	1.5 x 107	7.4×10^{7}	8.9×10^{7}
I-134	0	0	8.5×10^{2}	8.5×10^{3}	3.0×10^{4}	4.8×10^{4}	4.8×10^{4}	4.8×10^{4}	4.8×10^{4}	4.8×10^{4}
I-135	0	0	1.3×10^{3}	2.1×10^{4}	1.7×10^{5}	9.3×10^{5}	2.0×10^{6}	5.2×10^{6}	7.4×10^{6}	7.4×10^{6}
Kr-83m	0	0	5.9×10^{3}	7.8×10^{4}	4.4×10^{5}	1.3×10^{6}	1.7×10^{6}	1.9×10^{6}	1.9×10^{6}	1.9×10^{6}
Kr-85	0	0	7.4×10^{2}	1.3×10^{4}	1.3×10^{5}	9.3×10^{5}	2.6×10^{6}	1.3×10^{7}	2.3×10^{8}	5.9×10^{9}
Kr-85m	0	0	1.5×10^{4}	2.3×10^{5}	1.8×10^{6}	8.5×10^{6}	1.6×10^{7}	3.0×10^{7}	3.6×10^{7}	3.6×10^{7}
Kr-87	0	0	2.0×10^{4}	2.4×10^{5}	1.1×10^{6}	2.4×10^{6}	2.7×10^{6}	2.8×10^{6}	2.8×10^{6}	2.8×10^{6}
Kr-88	0	0	3.7×10^{4}	5.6×10^{5}	3.7×10^{6}	1.4×10^{7}	2.3×10^{7}	3.1×10^{7}	3.2×10^{7}	3.2×10^{7}
Kr-89	0	0	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Xe-131m	0	0	4.1×10^{2}	6.7×10^{3}	6.7×10^{4}	4.8×10^{5}	1.3×10^{6}	6.7×10^{6}	1.0×10^{8}	1.3×10^{9}
Xe-133	0	0	1.4×10^{5}	2.4×10^{6}	2.3×10^{7}	1.6×10^{8}	4.4×10^{8}	2.2×10^{9}	3.0×10^{10}	1.8×10^{11}
Xe-133m	0	0	5.6×10^{3}	1.0×10^{5}	9.3×10^{5}	6.7×10^{6}	1.8×10^{7}	8.1×10^{7}	8.1×10^{8}	2.0×10^{9}
Xe-135	0	0	1.7×10^{4}	2.7×10^{5}	2.4×10^{6}	1.4×10^{7}	3.3×10^{7}	9.6×10^{7}	2.0×10^{8}	2.0 x 108
Xe-135m	0	0	2.9×10^{3}	1.0×10^{4}	1.3×10^{4}	1.3×10^{4}	1.3×10^{4}	1.3×10^{4}	1.3×10^{4}	1.3×10^{4}
Xe-137	0	0	3.4×10^{1}	3.5×10^{1}	3.5×10^{1}	3.5×10^{1}	3.5×10^{1}	3.5×10^{1}	3.5×10^{1}	3.5×10^{1}
Xe-138	0	0	1.0×10^{4}	3.2×10^{4}	3.7×10^{4}	3.7×10^{4}	3.7×10^{4}	3.7×10^{4}	3.7×10^{4}	3.7×10^{4}

Reference: ABWR DCD Rev. 4 (GENE Mar 1997)

Table 7.1-49
Doses for ABWR Loss-of-Coolant Accident

Location	Time (hr)	DCD Dose (Sv)		X/Q Ratio	Site Dose (rem)	
		W. Body	Thyroid	Site to DCD	W. Body	Thyroid
EAB	0–2	4.1×10^{-2}	1.9	6.46×10^{-2}	2.6×10^{-1}	1.2×10^{1}
	0–8	1.0×10^{-2}	3.1×10^{-1}	3.40×10^{-2}	3.4×10^{-2}	1.1
	8–24	8.0×10^{-3}	2.0×10^{-1}	4.08×10^{-2}	3.3×10^{-2}	8.2×10^{-1}
	24–96	1.1×10^{-2}	7.9×10^{-1}	6.10×10^{-2}	6.7×10^{-2}	4.8
	96–720	9.0×10^{-3}	1.1	1.08×10^{-1}	9.8×10^{-2}	1.2×10^{1}
LPZ	Total	3.8×10^{-2}	2.4	—	2.3×10^{-1}	1.9×10^{1}
Limit	—	—	—	—	25	300

Reference: ABWR DCD Rev. 4 (GENE Mar 1997)

Table 7.1-50
Activity Releases for ABWR Cleanup Water Line Break

Isotope	Activity Release (MBq)
I-131	8.1×10^4
I-132	1.9×10^5
I-133	2.3×10^5
I-134	3.2×10^5
I-135	2.5×10^5

Reference: ABWR DCD Rev. 4 (GENE Mar 1997)

Table 7.1-51
Doses for ABWR Cleanup Water Line Break

Location	Time (hr)	DCD Dose (Sv)		X/Q Ratio	Site Dose (rem)	
		W. Body	Thyroid	Site to DCD	W. Body	Thyroid
EAB	0–2	2.8×10^{-3}	3.0×10^{-1}	3.86×10^{-3}	1.1×10^{-3}	1.2×10^{-1}
LPZ	0–8	—	—	2.31×10^{-4}	6.5×10^{-5}	6.9×10^{-3}
Limit	—	—	—	—	25	300

Reference: ABWR DCD Rev. 4 (GENE Mar 1997)

Table 7.1-52
Activity Releases for ABWR Fuel Handling Accident

Isotope	Activity Release (MBq)			
	1 min	10 min	1 hr	2 hr
I-131	2.85×10^{5}	2.56×10^{6}	4.55×10^{6}	4.55×10^{6}
I-132	3.67×10^{5}	3.22×10^{6}	5.62×10^{6}	5.62×10^{6}
I-133	2.95×10^{5}	2.64×10^{6}	4.70×10^{6}	4.70×10^{6}
I-134	1.60×10^{-2}	1.36×10^{-1}	2.28×10^{-1}	2.28×10^{-1}
I-135	4.85×10^{4}	4.29×10^{5}	7.62×10^{5}	7.62×10^{5}
TOTAL	9.96×10^{5}	8.85×10^{6}	1.56×10^{7}	1.56×10^{7}
Kr-83m	1.52×10^{4}	1.32×10^{5}	2.33×10^{5}	2.38×10^{5}
Kr-85m	1.94×10^{5}	1.72×10^{6}	3.08×10^{6}	3.16×10^{6}
Kr-85	1.05×10^{6}	9.47×10^{6}	1.72×10^{7}	1.77×10^{7}
Kr-87	3.00×10^{1}	2.59×10^{2}	4.51×10^{2}	4.55×10^{2}
Kr-88	5.62×10^{4}	4.92×10^{5}	8.81×10^{5}	8.99×10^{5}
Kr-89	6.55×10^{-7}	2.77×10^{-6}	3.01×10^{-6}	3.01×10^{-6}
Xe-131m	1.84×10^{5}	1.65×10^{6}	3.00×10^{6}	3.09×10^{6}
Xe-133m	2.44×10^{6}	2.18×10^{7}	3.96×10^{7}	4.07×10^{7}
Xe-133	6.22×10^{7}	5.59×10^{8}	1.01×10^{9}	1.04×10^{9}
Xe-135m	7.25×10^{5}	5.44×10^{6}	8.18×10^{6}	8.18×10^{6}
Xe-135	1.42×10^{7}	1.27×10^{8}	2.29×10^{8}	2.36×10^{8}
Xe-137	1.45×10^{-6}	6.77×10^{-6}	7.66×10^{-6}	7.66×10^{-6}
Xe-138	1.46×10^{-6}	1.07×10^{-5}	1.59×10^{-5}	1.59×10^{-5}

Reference: ABWR DCD Rev. 4 (GENE Mar 1997)

Table 7.1-53
Doses for ABWR Fuel Handling Accident

Location	Time (hr)	DCD Dose (Sv)		X/Q Ratio	Site Dose (rem)	
		W. Body	Thyroid	Site to DCD	W. Body	Thyroid
EAB	0–2	1.2×10^{-2}	7.5×10^{-1}	6.46×10^{-2}	7.8×10^{-2}	4.8
LPZ	0–8	—	—	3.87×10^{-3}	4.6×10^{-3}	2.9×10^{-1}
Limit	—	—	—	—	6	75

Reference: ABWR DCD Rev. 4 (GENE Mar 1997)

Table 7.1-54
Activity Releases for ESBWR Main Steam Line Break

Isotope	Activity Release (Ci)	
	Equilibrium Iodine	Pre-Incident Iodine
Co-58	8.95×10^{-3}	8.95×10^{-3}
Co-60	1.79×10^{-2}	1.79×10^{-2}
Kr-85	9.48×10^{-4}	9.48×10^{-4}
Kr-85m	2.42×10^{-1}	2.42×10^{-1}
Kr-87	7.84×10^{-1}	7.84×10^{-1}
Kr-88	7.84×10^{-1}	7.84×10^{-1}
Sr-89	4.11×10^{-2}	4.11×10^{-2}
Sr-90	2.85×10^{-3}	2.85×10^{-3}
Sr-91	1.59	1.59
Sr-92	3.60	3.60
Y-90	2.85×10^{-3}	2.85×10^{-3}
Y-91	1.68×10^{-2}	1.68×10^{-2}
Y-92	2.18	2.18
Y-93	1.59	1.59
Zr-95	3.27×10^{-3}	3.27×10^{-3}
Nb-95	3.27×10^{-3}	3.27×10^{-3}
Mo-99	8.13×10^{-1}	8.13×10^{-1}
Tc-99m	8.13×10^{-1}	8.13×10^{-1}
Ru-103	8.21×10^{-3}	8.21×10^{-3}
Ru-106	1.26×10^{-3}	1.26×10^{-3}
Te-129m	1.68×10^{-2}	1.68×10^{-2}
Te-131m	4.02×10^{-2}	4.02×10^{-2}
Te-132	4.11×10^{-3}	4.11×10^{-3}
I-131	1.55	3.10×10^{1}
I-132	1.08×10^{1}	2.15×10^{2}
I-133	1.01×10^{1}	2.02×10^{2}
I-134	1.68×10^{1}	3.36×10^{2}
I-135	1.35×10^{1}	2.69×10^{2}
Xe-133	3.29×10^{-1}	3.29×10^{-1}
Xe-135	9.10×10^{-1}	9.10×10^{-1}
Cs-134	1.09×10^{-2}	1.09×10^{-2}
Cs-136	7.37×10^{-3}	7.37×10^{-3}
Cs-137	2.93×10^{-2}	2.93×10^{-2}
Ba-140	1.68×10^{-1}	1.68×10^{-1}
La-140	1.68×10^{-1}	1.68×10^{-1}
Ce-141	1.26×10^{-2}	1.26×10^{-2}
Ce-144	1.26×10^{-3}	1.26×10^{-3}
Np-239	3.27	3.27

Reference: ESBWR DCD Rev. 6 (GEH Aug 2009)

Table 7.1-55
Doses for ESBWR Main Steam Line Break with Pre-Incident Iodine Spike

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	0–2	2.6	4.43×10^{-2}	1.2×10^{-1}
LPZ	0–8	2.0×10^{-1}	2.79×10^{-2}	5.6×10^{-3}
Limit	—	—	—	25

Reference: ESBWR DCD Rev. 6 (GEH Aug 2009)

Table 7.1-56
Doses for ESBWR Main Steam Line Break with Equilibrium Iodine Activity

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	0–2	2.0×10^{-1}	4.43×10^{-2}	8.9×10^{-3}
LPZ	0–8	1.0×10^{-1}	2.79×10^{-2}	2.8×10^{-3}
Limit	—	—	—	2.5

Reference: ESBWR DCD Rev. 6 (GEH Aug 2009)

Table 7.1-57
Activity Releases for ESBWR Feedwater Line Break

Isotope	Activity Release (Ci)	
	Equilibrium Iodine	Pre-Incident Spike
I-131	1.08×10^{1}	2.16×10^{2}
I-132	7.50×10^{1}	1.50×10^{3}
I-133	7.03×10^{1}	1.41×10^{3}
I-134	1.17×10^{2}	2.34×10^{3}
I-135	9.37×10^{1}	1.87×10^{3}
Cs-134	7.75×10^{-2}	7.75×10^{-2}
Cs-136	5.25×10^{-2}	5.25×10^{-2}
Cs-137	2.09×10^{-1}	2.09×10^{-1}
Co-58	6.37×10^{-2}	6.37×10^{-2}
Co-60	1.27×10^{-1}	1.27×10^{-1}
Sr-89	2.92×10^{-1}	2.92×10^{-1}
Sr-90	2.03×10^{-2}	2.03×10^{-2}
Y-90	2.03×10^{-2}	2.03×10^{-2}
Sr-91	1.13×10^{1}	1.13×10^{1}
Sr-92	2.56×10^{1}	2.56×10^{1}
Y-91	1.19×10^{-1}	1.19×10^{-1}
Y-92	1.55×10^{1}	1.55×10^{1}
Y-93	1.13×10^{1}	1.13×10^{1}
Zr-95	2.33×10^{-2}	2.33×10^{-2}
Nb-95	2.33×10^{-2}	2.33×10^{-2}
Mo-99	5.78	5.78
Tc-99m	5.78	5.78
Ru-103	5.84×10^{-2}	5.84×10^{-2}
Ru-106	8.94×10^{-3}	8.94×10^{-3}
Te-129m	1.19×10^{-1}	1.19×10^{-1}
Te-131m	2.86×10^{-1}	2.86×10^{-1}
Te-132	2.92×10^{-2}	2.92×10^{-2}
Ba-140	1.19	1.19
La-140	1.19	1.19
Ce141	8.94×10^{-2}	8.94×10^{-2}
Ce-144	8.94×10^{-3}	8.94×10^{-3}
Np-239	2.33×10^{1}	2.33×10^{1}

Reference: ESBWR DCD Rev. 6 (GEH Aug 2009)

Table 7.1-58
Doses for ESBWR Feedwater Line Break with Pre-Incident Iodine Spike

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	0–2	1.8×10^{1}	4.43×10^{-2}	8.0×10^{-1}
LPZ	0–8	1.7	2.79×10^{-2}	4.7×10^{-2}
Limit	—	—	—	25

Reference: ESBWR DCD Rev. 6 (GEH Aug 2009)

Table 7.1-59
Doses for ESBWR Feedwater Line Break with Equilibrium Iodine Activity

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	0–2	1.1	4.43×10^{-2}	4.9×10^{-2}
LPZ	0–8	1.0×10^{-1}	2.79×10^{-2}	2.8×10^{-3}
Limit	—	—	—	2.5

Reference: ESBWR DCD Rev. 6 (GEH Aug 2009)

Table 7.1-60
Activity Releases for ESBWR Small Break Outside Containment with Pre-Incident Iodine Spike

Isotope	Activity Release (Ci)				
	0.5 hr	1 hr	2 hr	4 hr	6 hr
Co-58	4.32×10^{-4}	6.91×10^{-4}	1.21×10^{-3}	1.90×10^{-3}	1.96×10^{-3}
Co-60	8.64×10^{-4}	1.38×10^{-3}	2.42×10^{-3}	3.81×10^{-3}	3.93×10^{-3}
Sr-89	1.98×10^{-3}	3.17×10^{-3}	5.55×10^{-3}	8.74×10^{-3}	9.02×10^{-3}
Sr-90	1.38×10^{-4}	2.20×10^{-4}	3.85×10^{-4}	6.06×10^{-4}	6.26×10^{-4}
Sr-91	7.69×10^{-2}	1.23×10^{-1}	2.15×10^{-1}	3.39×10^{-1}	3.50×10^{-1}
Sr-92	1.74×10^{-1}	2.78×10^{-1}	4.87×10^{-1}	7.67×10^{-1}	7.91×10^{-1}
Y-90	1.38×10^{-4}	2.20×10^{-4}	3.85×10^{-4}	6.06×10^{-4}	6.26×10^{-4}
Y-91	8.09×10^{-4}	1.29×10^{-3}	2.26×10^{-3}	3.57×10^{-3}	3.68×10^{-3}
Y-92	1.05×10^{-1}	1.68×10^{-1}	2.94×10^{-1}	4.64×10^{-1}	4.78×10^{-1}
Y-93	7.69×10^{-2}	1.23×10^{-1}	2.15×10^{-1}	3.39×10^{-1}	3.50×10^{-1}
Zr-95	1.58×10^{-4}	2.52×10^{-4}	4.42×10^{-4}	6.95×10^{-4}	7.18×10^{-4}
Nb-95	1.58×10^{-4}	2.52×10^{-4}	4.42×10^{-4}	6.95×10^{-4}	7.18×10^{-4}
Mo-99	3.93×10^{-2}	6.28×10^{-2}	1.10×10^{-1}	1.73×10^{-1}	1.78×10^{-1}
Tc-99m	3.93×10^{-2}	6.28×10^{-2}	1.10×10^{-1}	1.73×10^{-1}	1.78×10^{-1}
Ru-103	3.97×10^{-4}	6.34×10^{-4}	1.11×10^{-3}	1.75×10^{-3}	1.80×10^{-3}
Ru-106	6.07×10^{-5}	9.71×10^{-5}	1.70×10^{-4}	2.67×10^{-4}	2.76×10^{-4}
Te-129m	8.09×10^{-4}	1.29×10^{-3}	2.26×10^{-3}	3.57×10^{-3}	3.68×10^{-3}
Te-131m	1.94×10^{-3}	3.11×10^{-3}	5.44×10^{-3}	8.56×10^{-3}	8.83×10^{-3}
Te-132	1.98×10^{-4}	3.17×10^{-4}	5.55×10^{-4}	8.74×10^{-4}	9.02×10^{-4}
I-131	1.46	2.34	4.09	6.44	6.65
I-132	1.02×10^{1}	1.63×10^{1}	2.85×10^{1}	4.48×10^{1}	4.63×10^{1}
I-133	9.54	1.53×10^{1}	2.67×10^{1}	4.20×10^{1}	4.34×10^{1}
I-134	1.59×10^{1}	2.54×10^{1}	4.45×10^{1}	7.01×10^{1}	7.23×10^{1}
I-135	1.27×10^{1}	2.03×10^{1}	3.56×10^{1}	5.60×10^{1}	5.78×10^{1}
Cs-134	5.26×10^{-4}	8.41×10^{-4}	1.47×10^{-3}	2.32×10^{-3}	2.39×10^{-3}
Cs-136	3.56×10^{-4}	5.70×10^{-4}	9.96×10^{-4}	1.57×10^{-3}	1.62×10^{-3}
Cs-137	1.42×10^{-3}	2.27×10^{-3}	3.96×10^{-3}	6.24×10^{-3}	6.44×10^{-3}
Ba-140	8.09×10^{-3}	1.29×10^{-2}	2.26×10^{-2}	3.57×10^{-2}	3.68×10^{-2}
La-140	8.09×10^{-3}	1.29×10^{-2}	2.26×10^{-2}	3.57×10^{-2}	3.68×10^{-2}
Ce-141	6.07×10^{-4}	9.71×10^{-4}	1.70×10^{-3}	2.67×10^{-3}	2.76×10^{-3}
Ce-144	6.07×10^{-5}	9.71×10^{-5}	1.70×10^{-4}	2.67×10^{-4}	2.76×10^{-4}
Np-239	1.58×10^{-1}	2.52×10^{-1}	4.42×10^{-1}	6.95×10^{-1}	7.18×10^{-1}

Reference: ESBWR DCD Rev. 6 (GEH Aug 2009)

Table 7.1-61
Doses for ESBWR Small Break Outside Containment with Pre-Incident Iodine Spike

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	0–2	3.4×10^{-1}	4.43×10^{-2}	1.5×10^{-2}
LPZ	0–720	1.0×10^{-1}	2.80×10^{-2}	2.8×10^{-3}
Limit	—	—	—	25

Reference: ESBWR DCD Rev. 6 (GEH Aug 2009)

Note: Although the DCD indicates that the LPZ dose extends to 720 hr, it does not provide the dose as a function of time. The site LPZ dose is estimated by multiplying the total DCD dose by the maximum X/Q ratio from Table 7.1-4.

Table 7.1-62
Activity Releases for ESBWR Small Break Outside Containment with Equilibrium Iodine Activity

Isotope	Activity Release (Ci)				
	0.5 hr	1 hr	2 hr	4 hr	6 hr
Co-58	4.32×10^{-4}	6.91×10^{-4}	1.21×10^{-3}	1.90×10^{-3}	1.96×10^{-3}
Co-60	8.64×10^{-4}	1.38×10^{-3}	2.42×10^{-3}	3.81×10^{-3}	3.93×10^{-3}
Sr-89	1.98×10^{-3}	3.17×10^{-3}	5.55×10^{-3}	8.74×10^{-3}	9.02×10^{-3}
Sr-90	1.38×10^{-4}	2.20×10^{-4}	3.85×10^{-4}	6.06×10^{-4}	6.26×10^{-4}
Sr-91	7.69×10^{-2}	1.23×10^{-1}	2.15×10^{-1}	3.39×10^{-1}	3.50×10^{-1}
Sr-92	1.74×10^{-1}	2.78×10^{-1}	4.87×10^{-1}	7.67×10^{-1}	7.91×10^{-1}
Y-90	1.38×10^{-4}	2.20×10^{-4}	3.85×10^{-4}	6.06×10^{-4}	6.26×10^{-4}
Y-91	8.09×10^{-4}	1.29×10^{-3}	2.26×10^{-3}	3.57×10^{-3}	3.68×10^{-3}
Y-92	1.05×10^{-1}	1.68×10^{-1}	2.94×10^{-1}	4.64×10^{-1}	4.78×10^{-1}
Y-93	7.69×10^{-2}	1.23×10^{-1}	2.15×10^{-1}	3.39×10^{-1}	3.50×10^{-1}
Zr-95	1.58×10^{-4}	2.52×10^{-4}	4.42×10^{-4}	6.95×10^{-4}	7.18×10^{-4}
Nb-95	1.58×10^{-4}	2.52×10^{-4}	4.42×10^{-4}	6.95×10^{-4}	7.18×10^{-4}
Mo-99	3.93×10^{-2}	6.28×10^{-2}	1.10×10^{-1}	1.73×10^{-1}	1.78×10^{-1}
Tc-99m	3.93×10^{-2}	6.28×10^{-2}	1.10×10^{-1}	1.73×10^{-1}	1.78×10^{-1}
Ru-103	3.97×10^{-4}	6.34×10^{-4}	1.11×10^{-3}	1.75×10^{-3}	1.80×10^{-3}
Ru-106	6.07×10^{-5}	9.71×10^{-5}	1.70×10^{-4}	2.67×10^{-4}	2.76×10^{-4}
Te-129m	8.09×10^{-4}	1.29×10^{-3}	2.26×10^{-3}	3.57×10^{-3}	3.68×10^{-3}
Te-131m	1.94×10^{-3}	3.11×10^{-3}	5.44×10^{-3}	8.56×10^{-3}	8.83×10^{-3}
Te-132	1.98×10^{-4}	3.17×10^{-4}	5.55×10^{-4}	8.74×10^{-4}	9.02×10^{-4}
I-131	7.31×10^{-2}	1.17×10^{-1}	2.05×10^{-1}	3.22×10^{-1}	3.33×10^{-1}
I-132	5.09×10^{-1}	8.14×10^{-1}	1.42	2.24	2.31
I-133	4.77×10^{-1}	7.63×10^{-1}	1.33	2.10	2.17
I-134	7.95×10^{-1}	1.27	2.22	3.50	3.61
I-135	6.36×10^{-1}	1.02	1.78	2.80	2.89
Cs-134	5.26×10^{-4}	8.41×10^{-4}	1.47×10^{-3}	2.32×10^{-3}	2.39×10^{-3}
Cs-136	3.56×10^{-4}	5.70×10^{-4}	9.96×10^{-4}	1.57×10^{-3}	1.62×10^{-3}
Cs-137	1.42×10^{-3}	2.27×10^{-3}	3.96×10^{-3}	6.24×10^{-3}	6.44×10^{-3}
Ba-140	8.09×10^{-3}	1.29×10^{-2}	2.26×10^{-2}	3.57×10^{-2}	3.68×10^{-2}
La-140	8.09×10^{-3}	1.29×10^{-2}	2.26×10^{-2}	3.57×10^{-2}	3.68×10^{-2}
Ce-141	6.07×10^{-4}	9.71×10^{-4}	1.70×10^{-3}	2.67×10^{-3}	2.76×10^{-3}
Ce-144	6.07×10^{-5}	9.71×10^{-5}	1.70×10^{-4}	2.67×10^{-4}	2.76×10^{-4}
Np-239	1.58×10^{-1}	2.52×10^{-1}	4.42×10^{-1}	6.95×10^{-1}	7.18×10^{-1}

Reference: ESBWR DCD Rev. 6 (GEH Aug 2009)

Table 7.1-63
Doses for ESBWR Small Break Outside Containment with Equilibrium Iodine Activity

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	0–2	1.0×10^{-1}	4.43×10^{-2}	4.4×10^{-3}
LPZ	0–720	1.0×10^{-1}	2.80×10^{-2}	2.8×10^{-3}
Limit	—	—	—	2.5

Reference: ESBWR DCD Rev. 6 (GEH Aug 2009)

Note: Although the DCD indicates that the LPZ dose extends to 720 hr, it does not provide the dose as a function of time. The site LPZ dose is estimated by multiplying the total DCD dose by the maximum X/Q ratio from Table 7.1-4.

Table 7.1-64
Activity Releases for ESBWR Cleanup Water Line Break

Isotope	Activity Release (Ci)	
	Equilibrium Iodine	Pre-Incident Spike
I-131	4.10	8.21×10^{1}
I-132	2.85×10^{1}	5.71×10^{2}
I-133	2.68×10^{1}	5.35×10^{2}
I-134	4.46×10^{1}	8.92×10^{2}
I-135	3.57×10^{1}	7.14×10^{2}
Cs-134	2.95×10^{-2}	2.95×10^{-2}
Cs-136	2.00×10^{-2}	2.00×10^{-2}
Cs-137	7.95×10^{-2}	7.95×10^{-2}
Co-58	2.42×10^{-2}	2.42×10^{-2}
Co-60	4.85×10^{-2}	4.85×10^{-2}
Sr-89	1.11×10^{-1}	1.11×10^{-1}
Sr-90	7.72×10^{-3}	7.72×10^{-3}
Y-90	7.72×10^{-3}	7.72×10^{-3}
Sr-91	4.31	4.31
Sr-92	9.76	9.76
Y-91	4.54×10^{-2}	4.54×10^{-2}
Y-92	5.90	5.90
Y-93	4.31	4.31
Zr-95	8.86×10^{-3}	8.86×10^{-3}
Nb-95	8.86×10^{-3}	8.86×10^{-3}
Mo-99	2.20	2.20
Tc-99m	2.20	2.20
Ru-103	2.23×10^{-2}	2.23×10^{-2}
Ru-106	3.41×10^{-3}	3.41×10^{-3}
Te-129m	4.54×10^{-2}	4.54×10^{-2}
Te-131m	1.09×10^{-1}	1.09×10^{-1}
Te-132	1.11×10^{-2}	1.11×10^{-2}
Ba-140	4.54×10^{-1}	4.54×10^{-1}
La-140	4.54×10^{-1}	4.54×10^{-1}
Ce141	3.41×10^{-2}	3.41×10^{-2}
Ce-144	3.41×10^{-3}	3.41×10^{-3}
Np-239	8.86	8.86

Reference: ESBWR DCD Rev. 6 (GEH Aug 2009)

Table 7.1-65
Doses for ESBWR Cleanup Water Line Break with Pre-Incident Iodine Spike

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	0–2	6.9	4.43×10^{-2}	3.1×10^{-1}
LPZ	0–8	7.0×10^{-1}	2.79×10^{-2}	2.0×10^{-2}
Limit	—	—	—	25

Reference: ESBWR DCD Rev. 6 (GEH Aug 2009)

Table 7.1-66
Doses for ESBWR Cleanup Water Line Break with Equilibrium Iodine Activity

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	0–2	4.0×10^{-1}	4.43×10^{-2}	1.8×10^{-2}
LPZ	0–8	1.0×10^{-1}	2.79×10^{-2}	2.8×10^{-3}
Limit	—	—	—	2.5

Reference: ESBWR DCD Rev. 6 (GEH Aug 2009)

Table 7.1-67 (Sheet 2 of 2)
Activity Releases for ESBWR Loss-of-Coolant Accident

Isotope	Activity Release (Ci)								
	0.5 hr	2 hr	8 hr	12 hr	24 hr	72 hr	96 hr	168 hr	720 hr
I-132	8.0	1.9×10^{2}	8.5×10^{2}	1.0×10^{3}	1.4×10^{3}	1.8×10^{3}	1.9×10^{3}	2.1×10^{3}	2.2×10^{3}
I-133	1.2×10^{1}	2.8×10^{2}	1.9×10^{3}	2.7×10^{3}	4.2×10^{3}	5.5×10^{3}	5.6×10^{3}	5.7×10^{3}	5.7×10^{3}
I-134	9.9	1.1×10^{2}	2.0×10^{2}	2.1×10^{2}	2.1×10^{2}	2.1×10^{2}	2.1×10^{2}	2.1×10^{2}	2.1×10^{2}
I-135	1.1×10^{1}	2.4×10^{2}	1.3×10^{3}	1.7×10^{3}	2.1×10^{3}	2.2×10^{3}	2.2×10^{3}	2.2×10^{3}	2.2×10^{3}
Xe-133	2.6×10^{1}	2.2×10^{3}	5.2×10^{4}	1.2×10^{5}	4.0×10^{5}	2.1×10^{6}	2.9×10^{6}	5.2×10^{6}	1.1×10^{7}
Xe-135	9.4	8.2×10^{2}	1.6×10^{4}	3.0×10^{4}	6.5×10^{4}	1.0×10^{5}	1.0×10^{5}	1.0×10^{5}	1.0×10^{5}
Cs-134	1.2	2.7×10^{1}	2.0×10^{2}	2.9×10^{2}	5.1×10^{2}	8.7×10^{2}	9.6×10^{2}	1.1×10^{3}	2.3×10^{3}
Cs-136	4.1×10^{-1}	8.7	6.3×10^{1}	9.4×10^{1}	1.6×10^{2}	2.7×10^{2}	2.9×10^{2}	3.4×10^{2}	5.0×10^{2}
Cs-137	7.9×10^{-1}	1.7×10^{1}	1.2×10^{2}	1.9×10^{2}	3.3×10^{2}	5.6×10^{2}	6.1×10^{2}	7.3×10^{2}	1.5×10^{3}
Ba-139	0	8.2	2.3×10^{1}	2.3×10^{1}	2.3×10^{1}	2.3×10^{1}	2.3×10^{1}	2.3×10^{1}	2.3×10^{1}
Ba-140	0	1.6×10^{1}	1.4×10^{2}	2.1×10^{2}	3.6×10^{2}	6.0×10^{2}	6.5×10^{2}	7.6×10^{2}	1.1×10^{3}
La-140	0	3.2×10^{-1}	8.8	1.9×10^{1}	5.9×10^{1}	1.9×10^{2}	2.3×10^{2}	3.3×10^{2}	7.4×10^{2}
La-141	0	1.2×10^{-1}	6.2×10^{-1}	7.4×10^{-1}	8.1×10^{-1}	8.2×10^{-1}	8.2×10^{-1}	8.2×10^{-1}	8.2×10^{-1}
La-142	0	7.8×10^{-2}	2.3×10^{-1}	2.4×10^{-1}	2.4×10^{-1}	2.4×10^{-1}	2.4×10^{-1}	2.4×10^{-1}	2.4×10^{-1}
Ce-141	0	3.9×10^{-1}	3.3	4.9	8.6	1.5×10^{1}	1.6×10^{1}	1.9×10^{1}	3.4×10^{1}
Ce-143	0	3.5×10^{-1}	2.8	4.0	6.4	8.9	9.1	9.3	9.4
Ce-144	0	3.2×10^{-1}	2.7	4.0	7.2	1.2×10^{1}	1.4×10^{1}	1.6×10^{1}	3.3×10^{1}
Pr-143	0	1.4×10^{-1}	1.2	1.8	3.2	5.6	6.1	7.3	1.1×10^{1}
Nd-147	0	6.3×10^{-2}	5.2×10^{-1}	7.8×10^{-1}	1.4	2.3	2.4	2.8	4.0
Np-239	0	4.6	3.7×10^{1}	5.4×10^{1}	9.1×10^{1}	1.4×10^{2}	1.4×10^{2}	1.5×10^{2}	1.6×10^{2}
Pu-238	0	9.6×10^{-4}	8.0×10^{-3}	1.2×10^{-2}	2.1×10^{-2}	3.7×10^{-2}	4.0×10^{-2}	4.9×10^{-2}	1.0×10^{-1}
Pu-239	0	1.1×10^{-4}	8.9×10^{-4}	1.3×10^{-3}	2.4×10^{-3}	4.1×10^{-3}	4.5×10^{-3}	5.4×10^{-3}	1.1×10^{-2}
Pu-240	0	1.4×10^{-4}	1.2×10^{-3}	1.7×10^{-3}	3.1×10^{-3}	5.3×10^{-3}	5.8×10^{-3}	7.0×10^{-3}	1.5×10^{-2}
Pu-241	0	4.4×10^{-2}	3.7×10^{-1}	5.6×10^{-1}	9.8×10^{-1}	1.7	1.9	2.2	4.6
Am-241	0	2.1×10^{-5}	1.8×10^{-4}	2.7×10^{-4}	4.7×10^{-4}	8.2×10^{-4}	9.1×10^{-4}	1.1×10^{-3}	2.4×10^{-3}
Cm-242	0	5.0×10^{-3}	4.2×10^{-2}	6.3×10^{-2}	1.1×10^{-1}	1.9×10^{-1}	2.1×10^{-1}	2.5×10^{-1}	5.1×10^{-1}
Cm-244	0	2.6×10^{-4}	2.2×10^{-3}	3.3×10^{-3}	5.8×10^{-3}	1.0×10^{-2}	1.1×10^{-2}	1.3×10^{-2}	2.8×10^{-2}

Reference: ESBWR DCD Rev. 6 (GEH Aug 2009)

Table 7.1-68
Doses for ESBWR Loss-of-Coolant Accident

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	2.3–4.3[(a)]	2.24×10^{1}	4.43×10^{-2}	9.91×10^{-1}
LPZ	0–8	6.93	2.79×10^{-2}	1.93×10^{-1}
	8–24	4.54	2.80×10^{-2}	1.27×10^{-1}
	24–96	4.72	2.73×10^{-2}	1.29×10^{-1}
	96–720	4.56	2.68×10^{-2}	1.22×10^{-1}
	Total	2.08×10^{1}	—	5.72×10^{-1}
Limit	—	—	—	25

(a) Worst case 2-hour period is 2.3–4.3 hours.

Note: Time-dependent LPZ doses and total LPZ and EAB doses correspond to the radiation doses in DCD Rev. 6 (GEH Aug 2009)

Table 7.1-69
Activity Releases for ESBWR Fuel Handling Accident

Isotope	Activity Release (Ci), 0–2 hr
I-131	1.37×10^{2}
I-132	7.01×10^{-2}
I-133	8.21×10^{1}
I-134	5.24×10^{-7}
I-135	1.28×10^{1}
Kr-85m	9.96×10^{1}
Kr-85	4.98×10^{2}
Kr-87	1.07×10^{-2}
Kr-88	2.85×10^{1}
Xe-133	3.23×10^{4}
Xe-135	2.01×10^{3}

Reference: ESBWR DCD Rev. 6 (GEH Aug 2009)

Table 7.1-70
Doses for ESBWR Fuel Handling Accident

Location	Time (hr)	DCD Dose (rem TEDE)	X/Q Ratio (Site to DCD)	Site Dose (rem TEDE)
EAB	0–2	4.1	4.43×10^{-2}	1.8×10^{-1}
LPZ	0–8	4.0×10^{-1}	2.79×10^{-2}	1.1×10^{-2}
Limit	—	—	—	6.3

Reference: ESBWR DCD Rev. 6 (GEH Aug 2009)

ENCLOSURE 2

SUMMARY OF REGULATORY COMMITMENTS

(Exelon Letter to USNRC No. NP-11-0003, dated January 13, 2011)

The following table identifies commitments made in this document. (Any other actions discussed in the submittal represent intended or planned actions. They are described to the NRC for the NRC's information and are not regulatory commitments.)

COMMITMENT	COMMITTED DATE	COMMITMENT TYPE	
		ONE-TIME ACTION (Yes/No)	Programmatic (Yes/No)
Exelon will revise the ESPA SSAR Chapter 15 and ER Chapter 7 to incorporate the changes shown in Enclosure 1, addressing the following items: (1) revisions to VCS ESPA SSAR Section 15.1 and ER 7.1.1 to remove the existing statements that the core source terms for the B&W mPower reactor design will be bounded by those for the other technologies proposed in the Plant Parameter Envelope (PPE), (2) revisions to VCS ESPA SSAR Section 15.1 and ER Section 7.1 to clarify that both the GE and Toshiba Advanced Boiling Water Reactor (ABWR) designs are being considered for the site; however, the existing PPE is based on the current ABWR certified design as described in 10 CFR 52 Appendix A, (3) revisions to VCS ESPA SSAR Section 15.2 and ER Section 7.1.2 to correct the referenced site acceptance criteria from 10 CFR 50.34 and 10 CFR 100 to 10 CFR 52.17(a)(1), and (4) revisions to VCS ESPA SSAR Chapter15 and ER Chapter 7 design-specific source term tables and design-specific accident dose consequence tables to include a reference to the appropriate reactor Design Control Document (DCD) revision number that these values are based on. Additionally, the enclosed page markups incorporate updates to the design basis source term release data and design basis accident site dose values associated with the AP1000 design to be consistent with the current Westinghouse AP1000 DCD, Revision 17.	Revision 1 of the ESPA SSAR and ER planned for no later than March 31, 2012	Yes	No