Constellation

Dresden Nuclear Power Station
6500 North Dresden Road
Morris, IL 60450

10 CFR 50.36a (a)(2)

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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Dresden Nuclear Power Station, Units 1, 2 and 3
Facility Operating License No. DPR-2
Renewed Facility Operating License Nos. DPR-19 and DPR-25
NRC Docket Nos. 50-010, 50-237, and 50-249

Subject: Dresden Nuclear Power Station 2021 Radioactive Effluent Release Report and Offsite Dose Calculation Manual

The Radioactive Effluent Release Report for January through December 2021 for Dresden Nuclear Power Station (DNPS) is submitted in accordance with Sections 6.9.A.4 and 5.6.3, "Radioactive Effluent Release Report," of the DNPS Unit 1 and Units 2 and 3 Technical Specifications, respectively and 10 CFR 50.36a, "Technical specifications on effluents from nuclear power reactors."

Should you have any questions concerning this letter, please contact Ken Mack, Regulatory Assurance Manager, at (815) 416-2800.

IE48
NMSS01
NRR
NMSS

Respectfully,

Patrick J. Boyle
Site Vice President
Dresden Nuclear Power Station

Attachment: DNPS 2021 Annual Radioactive Effluent Release Report

Dresden Nuclear Power Station

2021 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

(ARERR)

Docket Numbers: 50-010/50-237/50-249
Units 1, 2, 3

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DRESDEN NUCLEAR POWER STATION
2021 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT
DOCKET NUMBER: 505-010/50-237/50-249

Dresden Nuclear Power Station Units 1,2 and 3 License: Exelon Nuclear

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

EXECUTIVE SUMMARY

The Radiological Effluent Controls (REC) Program monitors and records all radioactive effluents released from the plant for the purpose of calculating a dose to a member of the public. The results are recorded in this report for the Dresden Nuclear Power Station from January 1 through December 31, 2021. The Radiological Environmental Monitoring Program (REMP) is a separate program that serves as a backup or independent verification of the REC Program. The REMP samples are analyzed for radioactivity associated with the operation of Dresden Nuclear Power Station by an outside vendor and the results are compared against historical REMP data as well as the calculations from the REC Program. The REMP results and comparisons are contained within the Annual Radiological Environmental Operating Report (AREOR) for the Site.

There were no regulatory effluent limit exceedances in 2021 and the resultant calculated dose to a member of the public for 2021 due to the uranium fuel cycle was 6.92E+00 mRem, which is 27.7% of the regulatory limit of 25 mRem/year. The annual organ dose from all effluent sources is 7.46E-02 mRem/yr which is 9.95E-02% of the 75 mRem/yr (Thyroid) limit. Additionally, the AREOR supported the effluent dose calculation and indicates that Units 1, 2, and 3 of the Dresden Nuclear Power Station did not result in any adverse environmental impact.

The total dose to the nearest member of the public is a calculation of the sum of the gaseous and liquid effluents, the direct radiological dose from all sources including; ISFSI pad, storage tanks, skyshine, and Carbon-14 based upon Equivalent Full-Power Operation in days. There are many variables to consider, and in all cases, the most conservative factors were used to ensure there is sufficient margin to maintain regulatory compliance.

Table 1: Summation of Total Dose:

Liquid Effluents (All Units):			
	Total Body	1.82E-08	mRem
Noble Gas (All Units):			
	Total Body	2.38E-03	mRem
Radioiodines, tritium and Particulate (All units):			
	Total Body	2.13E-03	mRem
Direct Radiation			
	GE Facility	1.70E-06	mRem
	Skyshine	4.27E+00	mRem
	ISFSI/ CST	2.63E+00	mRem
	C-14	9.73E-03	mRem
Total		**6.92E+00**	**mRem**

BACKGROUND

Dresden Nuclear Power Station, located in rural Grundy County in Northern Illinois, is home to the nation's first full-scale, privately financed nuclear power plant, which began operation in 1960. Capable of generating 210 megawatts of electricity before its retirement in 1978, Dresden Unit 1 is designated a Nuclear Historic Landmark by the American Nuclear Society. Dresden Units 2 and 3 began commercial operation in June 1970 and November 1971, respectively. In October of 2004, the Nuclear Regulatory Commission (NRC) renewed the operating licenses for both units for an additional 20 years, extending them to 2029 and 2031. Both units contain boiling water reactors designed by General Electric. The units generate a combined 1,845 net megawatts of electricity (MWe), which is enough power to support the electricity needs of more than 1 million average American homes.

Part of the regulatory requirements of nuclear operation is to maintain a Radiological Effluent Control (REC) Program to track and record all radioactive effluent releases to the environment and calculate a dose to the public from all uranium fuel sources to include direct doses from storage tanks and off-site facilities. This requires a knowledge not only of plant operation but of plant design and potential sources of radioactive effluent releases. There are two forms of releases; gaseous and liquid and these can be released continuously or by a batch process. Particulate and iodine monitors are installed on plant ventilation system effluents and are monitored continuously and analyzed weekly. The normal gaseous effluent release points are the 2/3 Chimney (a 300' elevated stack) and the 2/3 Reactor Building Ventilation Stack (150' mixed mode stack). These are examples of a continuous gaseous release point. A discrete volume that is released over a specific time period with a defined start and stop time is an example of a batch release. Effluent releases that are not typical or expected are categorized as "abnormal". These are documented in a Dresden Abnormal Release (DAR) report.

REGULTORY LIMITS

The NRC sets a Total Effective Dose Equivalent (TEDE) in 10CFR Part 20 Subpart D—Radiation Dose Limits for the Individual Members of the Public of 100 mRem/year. In 1977 the Environmental Protection Agency enacted 40 CFR Part 190 "Environmental Radiation Protection Standards for Nuclear Power Operations" which sets the annual dose equivalent to any member of the public at 25 millirem (0.25 millisievert (mSv)) to the whole body, 75 millirem (0.75 mSv) to the thyroid and 25 millirem (0.25 mSv) to any other organ.

These limits are incorporated into the site's Offsite Dose Calculation Manual (ODCM) which sets limits of:

Fission and activation gases:

A. Dose Rate (site)
   (1) Less than 500 mRem/year to the whole body.
   (2) Less than 3000 mRem/year to the skin.

B. Gamma Air Dose (each unit)
   (1) Less than or equal to 5 mrad/quarter.
   (2) Less than or equal to 10 mrad/year.

C. Beta Air Dose (each unit)
   (1) Less than or equal to 10 mrad/quarter.
   (2) Less than or equal to 20 mrad/year.

Iodine-131, Iodine-133, and all radionuclides in particulate form with half-lives greater than 8 days:

A. Dose Rate (site)
   (1) Less than 1500 mRem/year to any organ.

B. Dose (each unit)
   (1) Less than or equal to 7.5 mRem/quarter to any organ.
   (2) Less than or equal to 15 mRem/year to any organ.

Liquid effluents (each unit):

(1) Less than or equal to 1.5 mRem to the whole body during any calendar quarter.
(2) Less than or equal to 5 mRem to any organ during any calendar quarter.
(3) Less than or equal to 3 mRem to the whole body during any calendar year.
(4) Less than or equal to 10 mRem to any organ during any calendar year.

40CFR190 and 10CFR72 (all uranium fuel cycle operations in the region):

(1) Less than or equal to 25 mRem annual whole body dose.
(2) Less than or equal to 75 mRem annual thyroid dose.
(3) Less than or equal to 25 mRem annual dose to any other critical organ.

EFFLUENT CONCENTRATION LIMITS

Dose rates, rather than effluent concentrations, are used to calculate permissible release rates for gaseous effluents. The maximum permissible dose rates for gaseous releases are defined in Dresden Offsite Dose Calculation Manual (ODCM) Radiological Effluent Control (REC) Section 12.4.1.

Liquid effluent concentrations are limited per ODCM REC Section12.3.1 to 10 times the concentration specified in 10CFR20 Appendix B, Table 2, Column 2 for radionuclides other than dissolved or entrained noble gases and 2.00E-04 µCi/mL total activity for all dissolved or entrained noble gases.

The ODCM limits dose rates at or beyond the site boundary due to the release of noble gases to less than or equal to 500 mRem per year to the total body and less than or equal to 3,000 mRem per year to the skin, and average energy is not used to determine dose to the public. Compliance with these limits is demonstrated based on dose calculations using measured isotopic concentrations of effluent streams and not based on gross count rate measuring systems. Therefore, the average beta and gamma energies ($\bar{E}$) for gaseous effluents as described in Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," are not applicable.

EFFLUENT MONITORING

Gaseous Effluents

The 2/3 Chimney (elevated), 2/3 Reactor Building Vent (mixed mode), and the Unit 1 Chemical Cleaning Building (mixed mode) effluents are continuously sampled for iodine and particulates. These samples are changed weekly and analyzed by gamma spectroscopy. The particulate filters are composited and sent to a vendor for gross alpha, Sr-89, Sr-90, Ni-63 and Fe-55 analysis quarterly. Noble gas grab samples of the 2/3 Chimney and 2/3 Reactor Building Vent are obtained weekly and analyzed by gamma spectroscopy. Contributing streams of the 2/3 Chimney and 2/3 Reactor Building Vent are also sampled and analyzed by gamma spectroscopy. Tritium samples of the 2/3 Chimney and 2/3 Reactor Building Vent are obtained monthly and analyzed by liquid scintillation.

For the 2/3 Chimney and 2/3 Reactor Building Vent effluents, the resultant activity concentration and measured flowrate at the release points is used to calculate the curies released. For the Chemical Cleaning Building effluent, the design basis flows are used to calculate curies released.

The Unit 1 Main Turbine Floor is used as an area to work on contaminated equipment. The Unit 1 Fuel Building is used as a storage area and potentially as a work area. The ventilation

systems to these areas are no longer operational and the areas are at ambient pressure with the outside environment. The potential exists for airborne activity to be released to the environment through various points. Based on the work normally performed in these areas, an estimated 6.00E-06 Ci of Cs-137 was released via this path per month for a total of 7.20E-05 Ci during 2021.

The Unit 2/3 Heating Steam System has been contaminated in the past and occasionally contains low-level contamination. During normal operation, the condensate is converted to steam, a portion of which gets vented to the atmosphere. There was tritium identified above minimum detectable activity in 2021 for the month of December. An estimated 1.33E+03 uCi of tritium was released. This will continue to be monitored when the system is running.

The Chemistry Laboratory exhausts directly into the environment via its ventilation system and is not monitored. The activity concentration from the Offgas Recombiner samples taken weekly from each unit and the sample size (15 cc) was used to calculate a monthly activity released from each unit from the Chemistry Hot Lab fumehood. This activity was captured in the monthly 10CFR50 Appendix I calculation and is included in the noble gas totals in the Gaseous Release Tables 2.2.A(2) and 2.2.A(3) for Ground level releases.

Carbon-14

Carbon-14 activity released is determined using Electric Power Research Institute Report 1021106 Boiling Water Reactor proxy value of 5.1 Ci per GWth year, gaseous release fraction of 0.99%, a carbon dioxide fraction of 0.95, a reactor power rating of 2957 MWt for Units 2 and 3. The resultant dose due to C-14 was calculated using the EPRI approved C-14 worksheet. The equivalent full power days (EFPD) of operation of Unit 2 was: 336.0 EFPD and Unit 3 was: 344.3 which resulted in 15.34 Ci of C-14 from Unit 2 and 15.69 Ci from Unit 3 being produced in 2021. The calculated dose from C-14 produced from Unit 2 was: 4.81E-03 mrem/yr (Total Body-Child) and 4.92E-03 mrem/yr (Total Body-Child) for Unit 3 for a Station total of: 9.73E-03 mrem/yr.

Liquid Effluents

The Waste Surge Tank (WST) utilized for river discharges is analyzed for gamma-emitting nuclides by gamma spectroscopy and for tritium by liquid scintillation prior to discharge. A representative portion of this sample is saved and composited with other discharges that occur during the calendar month. The composite is sent to a vendor for analyses of gross alpha, Sr-89, Sr-90, Ni-63 and Fe-55. The tank volumes and activities are used to calculate the diluted activity released at the discharge point from batch discharges. There were no discharges from the Waste Surge Tank in 2021. Batch release data can be found in Table 4 of this report.

Containment Cooling Service Water (CCSW) is sampled from the Low-Pressure Coolant

Injection (LPCI) heat exchangers monthly and analyzed for gamma-emitting nuclides by gamma spectroscopy. These samples are composited quarterly and analyzed for tritium, gross alpha, Sr-89, Sr-90, Fe-55, and Ni-63. Results from the quarter are conservatively applied for each month of the quarter. Batch release volume is based on LPCI heat exchanger volume. There were no releases from this system in 2021.

On-site storm sewers are sampled and analyzed for tritium content. The CBG well tritium concentration measured during each month of 2021 was used to calculate the released activity for each month via the storm sewers. The volume was based on the monthly rain fall over a 100,000 sqft area of the Site. Low level tritium was detected throughout the 2021 year, and the total estimated tritium activity released via the storm sewers in 2021 was 1.725E-03 Ci in 3.162E+05 gallons of rain water.

Water in the Sewage Treatment Plant (STP) effluent is routinely sampled and analyzed for tritium, gross alpha, Sr-89, Sr-90, Fe-55, and Ni-63. Tritium was sampled monthly and was below the minimum detectable activity each month in the 2021 year.

Beginning in September 2019, groundwater from the West Tritium Remediation Well was monitored via the 2/3 Discharge Tunnel. Although this is a planned continuous release it is being mentioned here due to its relatively short duration over this life of the plant. An estimated 3.49E-03 Ci of tritium was released via this source in 2021 in 2.762E+05 gallons of ground water.

The estimated calculated dose from all of these releases was well below the regulatory limit of 25 mRem/yr for the whole body/ 75 mRem/yr Thyroid as well as all quarterly dose limits.

Estimated Total Errors

The estimated total errors were calculated as the square root of the sum of the squares of significant errors present in the sampling and analysis process.

Less than the Lower Limit of Detection (<LLD)

Samples are analyzed such that the ODCM LLD requirements are met. When a nuclide is not detected, then "<LLD" is reported.

Abnormal Releases

None

Changes to the ODCM

Revision 17 of the ODCM was approved in June 2021 and consisted of the below changes:

Page	
I-1.3-10	Deleted text allowing 25% extension time for actions.
I-12-2-5	Wording change for effluent monitoring instrument to remove cumulative dose REC.
I-12.3-8	Wording change to exclude cumulative dose REC.
I-12.6-9	Update to Table 12.6-1 for REMP sampling
I-B12.0-2	Removed reference to delaying surveillances for "operational convenience".
I-B-12.0-10	Removed reference to delaying surveillances for "operational convenience".
I-B12.4-1	Wording change to align with current Federal Register.
II.5.11	Update to Table 5.1 distance to nearest resident.
II.6.1 to II.6.11	Updated new REMP sampling location notes, Table 6.1, and REMP location maps.

Errata

Corrected pages are attached for the Annual Radioactive Effluent Release Report (ARERR) for calendar year 2019 in Attachment 1 (pages 8 and 9) and 2020 in Attachment 2 (pages 8 and 9). The reporting of Iodine-131 in gaseous releases for Units 2 and 3 at Dresden Station in the 2019 and 2020 Annual Radioactive Effluent Release Reports (ARERRs) were found to be in error. Section B in Tables 2.1(2), and 2.1(3) "Gaseous Effluents- Summation of All Effluent Releases" specifies the Total Release of I-131 in Curies (Ci), the average release rate and the Percent of ODCM Quarterly dose limit for each Unit for each quarter of the year. Dresden reported the total Iodine (all Iodine radionuclides) as total I-131 in the Summary Tables 2.1(2), and 2.1(3) rather than just I-131. This change does not affect any other pages or calculations related to these reports.

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

RELEASE SUMMARY

Table 2.1(1): Gaseous Effluents- Summation of All Effluent Releases Unit 1

		Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission & Activation Gases							
1	Total Release	Ci	N/A	N/A	N/A	N/A	1.31E+01
2	Average release rate for period	µCi/sec	N/A	N/A	N/A	N/A	
3	Percent of ODCM Quarterly dose limit (site)	% Gamma[1]	N/A	N/A	N/A	N/A	
		% Beta[2]	N/A	N/A	N/A	N/A	
B. Iodine-131							
1	Total release	Ci	N/A	N/A	N/A	N/A	2.60E+01
2	Average release rate for period	µCi/sec	N/A	N/A	N/A	N/A	
3	Percent of ODCM Quarterly dose limit (*)	%	N/A	N/A	N/A	N/A	
C. Particulates							
1	Particulates with half-life >8 days	Ci	1.80E-05	1.80E-05	1.80E-05	1.80E-05	2.94E+01
2	Average release rate for period	µCi/sec	2.28E-06	2.28E-06	2.28E-06	2.28E-06	
3	Percent of ODCM Quarterly dose limit (*)	%	9.00E-03	9.00E-03	9.00E-03	9.00E-03	
D. Tritium							
1	Total release	Ci	N/A	N/A	N/A	N/A	7.56E+00
2	Average release rate for period	µCi/sec	N/A	N/A	N/A	N/A	
3	Percent of ODCM Quarterly dose limit (*)	%	N/A	N/A	N/A	N/A	
E. Gross Alpha							
1	Total release	Ci	N/A	N/A	N/A	N/A	2.94E+01
2	Average release rate for period	µCi/sec	N/A	N/A	N/A	N/A	
F. Carbon14							
1	Total release	Ci	N/A	N/A	N/A	N/A	
2	Average release rate for period	µCi/sec	N/A	N/A	N/A	N/A	

1. Based upon a quarterly dose limit of 5.00 mRad/yr for the Site
2. Based upon a quarterly dose limit of 10.00 mRad/yr for the Site

* "Percent of ODCM quarterly dose limit" indicates combined total of Iodine-131, Particulates, and Tritium

Table 2.1(2): Gaseous Effluents- Summation of All Effluent Releases Unit 2

		Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission & Activation Gases							
1	Total Release	Ci	1.27E+01	1.20E+01	1.01E+01	7.97E+00	1.31E+01
2	Average release rate for period	µCi/sec	1.64E+00	1.53E+00	1.27E+00	1.00E+00	
3	Percent of ODCM Quarterly dose limit (site)	% Gamma[1]	1.24E-02	1.17E-02	9.37E-03	7.39E-03	
		% Beta[2]	2.57E-04	2.44E-04	1.92E-04	1.50E-04	
B. Iodine-131							
1	Total release	Ci	1.37E-04	2.35E-04	2.00E-04	9.75E-05	2.60E+01
2	Average release rate for period	µCi/sec	1.77E-05	2.99E-05	2.52E-05	1.23E-05	
3	Percent of ODCM Quarterly dose limit (*)	%	1.08E-01	1.81E-01	1.57E-01	7.70E-02	
C. Particulates							
1	Particulates with half-life >8 days	Ci	5.34E-04	3.12E-04	3.47E-04	2.37E-04	2.94E+01
2	Average release rate for period	µCi/sec	6.77E-05	3.95E-05	4.40E-05	3.00E-05	
3	Percent of ODCM Quarterly dose limit (*)	%	1.08E-01	1.81E-01	1.57E-01	7.70E-02	
D. Tritium							
1	Total release	Ci	5.43E+00	5.07E+01	3.98E+01	2.67E+00	7.56E+00
2	Average release rate for period	µCi/sec	6.99E-01	6.45E+00	5.01E+00	3.35E+00	
3	Percent of ODCM Quarterly dose limit (*)	%	1.08E-01	1.81E-01	1.57E-01	7.70E-02	
E. Gross Alpha							
1	Total release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.94E+01
2	Average release rate for period	µCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
F. Carbon14							
1	Total release	Ci	5.28E+00	3.40E+00	3.73E+00	2.94E+00	
2	Average release rate for period	µCi/sec	6.79E-01	4.32E-01	4.70E-01	3.69E-01	

1. Based upon a quarterly dose limit of 5.00 mRad/yr for the Site
2. Based upon a quarterly dose limit of 10.00 mRad/yr for the Site

* "Percent of ODCM quarterly dose limit" indicates combined total of Iodine-131, Particulates, and Tritium

Table 2.1(3): Gaseous Effluents- Summation of All Effluent Releases Unit 3

		Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission & Activation Gases							
1	Total Release	Ci	1.84E+00	2.56E+00	2.09E+00	3.51E+01	1.31E+01
2	Average release rate for period	µCi/sec	2.36E-01	3.25E-01	2.63E-01	4.42E+00	
3	Percent of ODCM Quarterly dose limit (site)	% Gamma[1]	1.89E-03	2.63E-03	2.04E-03	2.42E-02	
		% Beta[2]	3.49E-05	4.59E-05	3.97E-05	6.01E-04	
B. Iodine-131							
1	Total release	Ci	1.04E-05	2.12E-05	5.82E-05	5.78E-05	2.60E+01
2	Average release rate for period	µCi/sec	1.34E-06	2.70E-06	7.32E-06	7.27E-06	
3	Percent of ODCM Quarterly dose limit (*)	%	9.24E-03	1.64E-02	4.71E-02	4.66E-02	
C. Particulates							
1	Particulates with half-life >8 days	Ci	3.77E-05	2.75E-05	1.02E-04	1.59E-04	2.94E+01
2	Average release rate for period	µCi/sec	4.85E-06	3.49E-06	1.28E-05	2.00E-05	
3	Percent of ODCM Quarterly dose limit (*)	%	9.24E-03	1.64E-02	4.71E-02	4.66E-02	
D. Tritium							
1	Total release	Ci	3.85E-01	5.34E+00	1.18E+01	3.77E+00	7.56E+00
2	Average release rate for period	µCi/sec	4.95E-02	6.79E-01	1.49E+00	4.75E-01	
3	Percent of ODCM Quarterly dose limit (*)	%	9.24E-03	1.64E-02	4.71E-02	4.66E-02	
E. Gross Alpha							
1	Total release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.94E+01
2	Average release rate for period	µCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
F. Carbon14							
1	Total release	Ci	5.28E+00	3.68E+00	3.76E+00	2.97E+00	
2	Average release rate for period	µCi/sec	6.79E-01	4.68E-01	4.73E-01	3.74E-01	

1. Based upon a quarterly dose limit of 5.00 mRad/yr for the Site
2. Based upon a quarterly dose limit of 10.00 mRad/yr for the Site

* "Percent of ODCM quarterly dose limit" indicates combined total of Iodine-131, Particulates, and Tritium

Lower Limits of Detectability for Gaseous Effluents

Fission / Activation Gases	µCi/cc
Kr-87	1.00E-04
Kr-88	1.00E-04
Xe-133	1.00E-04
Xe-133m	1.00E-04
Xe-135	1.00E-04
Xe-138	1.00E-04
Iodines	
I-131	1.00E-12
I-133	1.00E-10
Particulates	
Sr-89	1.00E-11
Sr-90	1.00E-11
Mn-54	1.00E-11
Co-58	1.00E-11
Fe-59	1.00E-11
Co-60	1.00E-11
Zn-65	1.00E-11
Mo-99	1.00E-11
Cs-134	1.00E-11
Cs-137	1.00E-11
Ce-141	1.00E-11
Ce-144	1.00E-11
Other	
H-3	1.00E-06
Gross Alpha	1.00E-11

The above limits are the ODCM required Lower Limits of Detection (LLD).

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

Table 2.2.A(1) Gaseous Effluents Release Point: Unit 1 Ground Level

Nuclides Released		Continuous Mode				Batch Mode			
	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. Fission gases									
Kr-85	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-85m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-87	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-88	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-138	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ar-41	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
2. Iodines									
I-131	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
3. Particulates									
Sr-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	1.80E-05	1.80E-05	1.80E-05	1.80E-05	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
cr-51	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	1.80E-05	1.80E-05	1.80E-05	1.80E-05	<LLD	<LLD	<LLD	<LLD
4. Tritium									
H-3 Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
5. Gross Alpha									
Gross Alpha Total	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
6. Carbon 14									
C-14 Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

Table 2.2.A (2) Gaseous Effluents Release Point: Unit 2 Ground Level

Nuclides Released		Continuous Mode				Batch Mode			
	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. Fission gases									
Kr-85	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-85m	Ci	1.12E-07	1.30E-07	1.16E-07	4.18E-08	<LLD	<LLD	<LLD	<LLD
Kr-87	Ci	6.44E-07	7.17E-07	6.21E-07	2.25E-07	<LLD	<LLD	<LLD	<LLD
Kr-88	Ci	4.14E-07	4.77E-07	4.37E-07	1.51E-07	<LLD	<LLD	<LLD	<LLD
Xe-131m	Ci	1.14E-06	1.25E-06	0.00E+00	0.00E+00	<LLD	<LLD	<LLD	<LLD
Xe-133	Ci	4.00E-08	5.21E-08	4.19E-08	1.31E-08	<LLD	<LLD	<LLD	<LLD
Xe-133m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135	Ci	5.73E-07	6.61E-07	5.99E-07	2.25E-07	<LLD	<LLD	<LLD	<LLD
Xe-135m	Ci	1.14E-06	1.25E-06	1.45E-06	4.61E-07	<LLD	<LLD	<LLD	<LLD
Xe-138	Ci	4.48E-06	5.26E-06	5.92E-06	1.78E-06	<LLD	<LLD	<LLD	<LLD
Ar-41	Ci	4.19E-08	3.87E-08	4.19E-08	2.20E-08	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	8.59E-06	9.83E-06	9.23E-06	2.92E-06	<LLD	<LLD	<LLD	<LLD
2. Iodines									
I-131	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-132	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
3. Particulates									
Br-82	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cr-51	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-57	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Te-123m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Hf-181	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Fe-59	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zn-65	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zr-95	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Nb-95	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sn-117m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

Sb-124	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sb-125	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
4. Tritium									
H-3 Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
5. Gross Alpha									
Gross Alpha Total	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
6. Carbon 14									
C-14 Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

Table 2.2.A(3) Gaseous Effluents Release Point: Unit 3 Ground Level

Nuclides Released		Continuous Mode				Batch Mode			
	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. Fission gases									
Kr-85	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-85m	Ci	1.51E-08	1.56E-08	2.04E-08	2.41E-08	<LLD	<LLD	<LLD	<LLD
Kr-87	Ci	8.04E-08	9.31E-08	1.08E-07	1.37E-07	<LLD	<LLD	<LLD	<LLD
Kr-88	Ci	5.71E-08	5.27E-08	7.07E-08	8.75E-08	<LLD	<LLD	<LLD	<LLD
Xe-131m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-133	Ci	1.99E-09	1.25E-09	2.15E-09	9.53E-10	<LLD	<LLD	<LLD	<LLD
Xe-135	Ci	9.81E-08	9.78E-08	1.22E-07	1.48E-07	<LLD	<LLD	<LLD	<LLD
Xe-135m	Ci	2.10E-07	2.17E-07	2.82E-07	3.30E-07	<LLD	<LLD	<LLD	<LLD
Xe-138	Ci	7.73E-07	7.75E-07	1.07E-06	1.17E-06	<LLD	<LLD	<LLD	<LLD
Ar-41	Ci	2.45E-08	1.85E-08	2.83E-08	2.58E-08	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	1.26E-06	1.27E-07	1.70E-06	1.92E-06	<LLD	<LLD	<LLD	<LLD
2. Iodines									
I-131	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
3. Particulates									
Sr-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cr-51	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-57	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Te-123m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Hf-181	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Fe-59	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zn-65	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zr-95	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Nb-95	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sn-117m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sb-124	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sb-125	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

4. Tritium									
H-3 Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
5. Gross Alpha									
Gross Alpha Total	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
6. Carbon 14									
C-14 Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

Table 2.2.B(1) Gaseous Effluents Release Point: Unit 1 Elevated

Nuclides Released		Continuous Mode				Batch Mode			
	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. Fission gases									
Kr-85	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-85m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-87	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-88	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-138	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ar-41	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
2. Iodines									
I-131	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
3. Particulates									
Sr-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cr-51	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
4. Tritium									
H-3 Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
5. Gross Alpha									
Gross Alpha Total	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
6. Carbon 14									
C-14 Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

Table 2.2.B(2) Gaseous Effluents Release Point: Unit 2 Elevated

Nuclides Released		Continuous Mode				Batch Mode			
	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. Fission gases									
Kr-85	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-85m	Ci	2.33E-01	1.76E-01	3.77E-01	3.56E-01	<LLD	<LLD	<LLD	<LLD
Kr-87	Ci	3.93E-01	3.54E-01	2.31E-01	1.56E-01	<LLD	<LLD	<LLD	<LLD
Kr-88	Ci	2.75E-01	2.41E-01	2.35E-01	1.92E-01	<LLD	<LLD	<LLD	<LLD
Xe-133	Ci	7.76E-01	6.41E-01	6.66E-01	9.25E-01	<LLD	<LLD	<LLD	<LLD
Xe-135	Ci	2.82E-01	6.04E-01	8.38E-01	2.03E-01	<LLD	<LLD	<LLD	<LLD
Xe-135m	Ci	1.94E+00	1.71E+00	1.32E+00	9.23E-01	<LLD	<LLD	<LLD	<LLD
Xe-138	Ci	8.58E+00	8.05E+00	5.81E+00	4.70E+00	<LLD	<LLD	<LLD	<LLD
Ar-41	Ci	2.35E-01	2.55E-01	6.42E-01	5.12E-01	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	1.27E+01	1.20E+01	1.01E+01	7.97E+00	<LLD	<LLD	<LLD	<LLD
2. Iodines									
I-131	Ci	1.37E-04	2.35E-04	1.99E-04	9.52E-05	<LLD	<LLD	<LLD	<LLD
I-133	Ci	1.26E-03	1.60E-03	1.54E-03	4.80E-04	<LLD	<LLD	<LLD	<LLD
I-135	Ci	1.13E-03	1.95E-03	2.84E-03	0.00E+00	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	2.53E-03	3.78E-03	4.58E-03	5.75E-04	<LLD	<LLD	<LLD	<LLD
3. Particulates									
Zn-65	Ci	3.32E-06	0.00E+00	7.37E-05	1.32E-05	<LLD	<LLD	<LLD	<LLD
Sr-89	Ci	2.33E-04	1.06E-04	1.26E-04	3.19E-05	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	2.06E-04	1.92E-04	1.68E-05	5.88E-06	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cr-51	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	<LLD	<LLD	2.60E-05	2.83E-05	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	<LLD	<LLD	4.25E-05	7.94E-06	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	3.90E-05	<LLD	5.46E-05	8.40E-05	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	1.88E-05	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sn-117m	Ci	3.39E-05	1.33E-05	7.77E-06	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	5.34E-04	3.12E-04	3.47E-04	1.71E-04	<LLD	<LLD	<LLD	<LLD
4. Tritium									
H-3 Total for Period	Ci	4.72E+00	5.04E+01	3.97E+01	1.76E+00	<LLD	<LLD	<LLD	<LLD
5. Gross Alpha									
Gross Alpha Total	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
6. Carbon 14									
C-14 Total for Period	Ci	5.28E+00	3.40E+00	3.73E+00	2.94E+00	<LLD	<LLD	<LLD	<LLD

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

Table 2.2.B(3) Gaseous Effluents Release Point: Unit 3 Elevated

Nuclides Released		Continuous Mode				Batch Mode			
	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. Fission gases									
Kr-85	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-85m	Ci	2.99E-02	1.29E-01	5.21E-02	2.06E+00	<LLD	<LLD	<LLD	<LLD
Kr-87	Ci	3.42E-02	4.11E-02	4.40E-02	3.16E+00	<LLD	<LLD	<LLD	<LLD
Kr-88	Ci	2.07E-02	6.04E-02	3.04E-02	5.47E+00	<LLD	<LLD	<LLD	<LLD
Xe-133	Ci	1.15E-01	2.06E-01	1.77E-01	1.72E+00	<LLD	<LLD	<LLD	<LLD
Xe-135	Ci	3.29E-02	3.43E-02	3.99E-02	1.80E+01	<LLD	<LLD	<LLD	<LLD
Xe-135m	Ci	2.44E-01	2.65E-01	2.87E-01	3.71E-01	<LLD	<LLD	<LLD	<LLD
Xe-138	Ci	9.85E-01	1.06E+00	1.19E+00	2.17E+00	<LLD	<LLD	<LLD	<LLD
Ar-41	Ci	3.75E-01	7.67E-01	2.71E-01	2.12E+00	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	1.84E+00	2.56E+00	2.09E+00	3.51E+01	<LLD	<LLD	<LLD	<LLD
2. Iodines									
I-131	Ci	9.56E-06	2.12E-05	5.68E-05	5.58E-05	<LLD	<LLD	<LLD	<LLD
I-133	Ci	8.90E-05	1.43E-04	4.62E-04	2.61E-04	<LLD	<LLD	<LLD	<LLD
I-135	Ci	7.98E-05	7.98E-05	7.98E-05	7.98E-05	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	1.78E-04	2.44E-04	5.99E-04	3.97E-04	<LLD	<LLD	<LLD	<LLD
3. Particulates									
Zn-65	Ci	2.46E-07	<LLD	1.63E-05	1.17E-05	<LLD	<LLD	<LLD	<LLD
Sr-89	Ci	1.64E-05	9.95E-06	3.82E-05	2.49E-05	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	1.45E-05	1.65E-05	1.55E-05	1.38E-05	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cr-51	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	<LLD	<LLD	5.65E-06	1.31E-05	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	<LLD	<LLD	9.53E-06	1.33E-06	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	2.74E-06	<LLD	1.43E-05	4.29E-05	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	1.45E-06	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sn-117m	Ci	2.38E-06	1.02E-06	2.11E-06	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	3.77E-05	2.75E-05	1.02E-04	1.08E-04	<LLD	<LLD	<LLD	<LLD
4. Tritium									
H-3 Total for Period	Ci	3.34E-01	5.32E+00	1.18E+01	2.20E+00	<LLD	<LLD	<LLD	<LLD
5. Gross Alpha									
Gross Alpha Total	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
6. Carbon 14									
C-14 Total for Period	Ci	5.28E+00	3.68E+00	3.76E+00	2.97E+00	<LLD	<LLD	<LLD	<LLD

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

Table 2.2.C(1) Gaseous Effluents Release Point: Unit 1 Mixed Mode

Nuclides Released		Continuous Mode				Batch Mode			
	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. Fission gases									
Kr-85	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-85m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-87	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-88	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-138	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ar-41	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
2. Iodines									
I-131	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
3. Particulates									
Sr-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cr-51	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
4. Tritium									
H-3 Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
5. Gross Alpha									
Gross Alpha Total	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
6. Carbon 14									
C-14 Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

Table 2.2.C(2) Gaseous Effluents Release Point: Unit 2 Mixed Mode

Nuclides Released		Continuous Mode				Batch Mode			
	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. Fission gases									
Kr-85	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-85m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-87	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-88	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-138	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ar-41	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
2. Iodines									
I-131	Ci	<LLD	<LLD	1.06E-06	2.25E-06	<LLD	<LLD	<LLD	<LLD
I-133	Ci	3.57E-06	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	3.57E-06	<LLD	1.06E-06	2.25E-06	<LLD	<LLD	<LLD	<LLD
3. Particulates									
Sr-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	<LLD	<LLD	<LLD	3.92E-05	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cr-51	Ci	<LLD	<LLD	<LLD	4.35E-06	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	<LLD	<LLD	<LLD	1.61E-06	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Fe-59	Ci	<LLD	<LLD	<LLD	1.53E-05	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	<LLD	<LLD	<LLD	4.88E-06	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sn-117m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	<LLD	<LLD	6.54E-05	<LLD	<LLD	<LLD	<LLD
4. Tritium									
H-3 Total for Period	Ci	7.14E-01	2.93E-01	9.01E-02	9.04E-01	<LLD	<LLD	<LLD	<LLD
5. Gross Alpha									
Gross Alpha Total	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
6. Carbon 14									
C-14 Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

Table 2.2.C(3) Gaseous Effluents Release Point: Unit 3 Mixed Mode

Nuclides Released		Continuous Mode				Batch Mode			
	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. Fission gases									
Kr-85	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-85m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-87	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Kr-88	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135	Ci	4.57E-06	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-138	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ar-41	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	4.57E-06	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
2. Iodines									
I-131	Ci	8.83E-07	<LLD	1.42E-06	1.96E-06	<LLD	<LLD	<LLD	<LLD
I-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	8.83E-07	<LLD	1.42E-06	1.96E-06	<LLD	<LLD	<LLD	<LLD
3. Particulates									
Sr-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	<LLD	<LLD	<LLD	3.41E-05	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cr-51	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	<LLD	<LLD	<LLD	1.02E-06	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	<LLD	<LLD	<LLD	7.93E-06	<LLD	<LLD	<LLD	<LLD
Fe-59	Ci	<LLD	<LLD	<LLD	8.50E-06	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sn-117m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-144	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	<LLD	<LLD	<LLD	5.15E-05	<LLD	<LLD	<LLD	<LLD
4. Tritium									
H-3 Total for Period	Ci	5.15E-02	2.51E-02	1.88E-02	1.57E+00	<LLD	<LLD	<LLD	<LLD
5. Gross Alpha									
Gross Alpha Total	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
6. Carbon 14									
C-14 Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

Table 3.1(1) Liquid Effluents- Summation of All Releases: Unit 1

		Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission & Activation Gases							
1	Total Release	Ci	N/A	N/A	N/A	N/A	1.95E+01
2	Average Concentration	µCi/mL	N/A	N/A	N/A	N/A	
3	Percent of ODCM Quarterly dose limit	%	N/A	N/A	N/A	N/A	
B. Tritium							
1	Total release	Ci	N/A	N/A	N/A	N/A	2.37E+00
2	Average Concentration	µCi/mL	N/A	N/A	N/A	N/A	
3	Percent of ODCM Quarterly dose limit	%	N/A	N/A	N/A	N/A	
C. Dissolved and Entrained Gases							
1	Total release	Ci	N/A	N/A	N/A	N/A	2.03E+01
2	Average Concentration	µCi/mL	N/A	N/A	N/A	N/A	
3	Percent of ODCM Quarterly dose limit	%	N/A	N/A	N/A	N/A	
D. Gross Alpha							
1	Total release	Ci	N/A	N/A	N/A	N/A	2.00E+01
2	Average Concentration	µCi/mL	N/A	N/A	N/A	N/A	
E. Liquid Release Volume							
1	Total Release	Liters	N/A	N/A	N/A	N/A	
F. Dilution Volume							
1	Total Release	Liters	N/A	N/A	N/A	N/A	

Table 3.1(2) Liquid Effluents- Summation of All Releases: Unit 2

		Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission & Activation Gases							
1	Total Release	Ci	N/A	N/A	N/A	N/A	1.95E+01
2	Average Concentration	µCi/mL	N/A	N/A	N/A	N/A	
3	Percent of ODCM Quarterly dose limit	%	N/A	N/A	N/A	N/A	
B. Tritium							
1	Total release	Ci	1.90E-03	3.56E-04	1.16E-04	1.18E-04	2.37E+00
2	Average Concentration	µCi/mL	8.01E-13	4.51E-13	2.94E-13	1.49E-13	
3	Percent of ODCM Quarterly dose limit	%	4.62E-07	8.68E-08	2.83E-08	2.87E-08	
C. Dissolved and Entrained Gases							
1	Total release	Ci	N/A	N/A	N/A	N/A	2.03E+01
2	Average Concentration	µCi/mL	N/A	N/A	N/A	N/A	
3	Percent of ODCM Quarterly dose limit	%	N/A	N/A	N/A	N/A	
D. Gross Alpha							
1	Total release	Ci	N/A	N/A	N/A	N/A	2.00E+01
2	Average Concentration	µCi/mL	N/A	N/A	N/A	N/A	
E. Liquid Release Volume							
1	Total Release	Liters	6.17E+05	2.46E+05	7.26E+04	9.33E+04	
F. Dilution Volume							
1	Total Release	Liters	2.37E+12	7.89E+11	3.95E+11	7.89E+11	

Table 3.1 (3) Liquid Effluents- Summation of All Releases: Unit 3

		Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission & Activation Gases							
1	Total Release	Ci	N/A	N/A	N/A	N/A	1.95E+01
2	Average Concentration	µCi/mL	N/A	N/A	N/A	N/A	
3	Percent of ODCM Quarterly dose limit	%	N/A	N/A	N/A	N/A	
B. Tritium							
1	Total release	Ci	1.90E-03	3.56E-04	1.16E-04	1.18E-04	2.37E+00
2	Average Concentration	µCi/mL	8.01E-13	4.51E-13	2.94E-13	1.49E-13	
3	Percent of ODCM Quarterly dose limit	%	4.62E-07	8.68E-08	2.83E-08	2.87E-08	
C. Dissolved and Entrained Gases							
1	Total release	Ci	N/A	N/A	N/A	N/A	2.03E+01
2	Average Concentration	µCi/mL	N/A	N/A	N/A	N/A	
3	Percent of ODCM Quarterly dose limit	%	N/A	N/A	N/A	N/A	
D. Gross Alpha							
1	Total release	Ci	N/A	N/A	N/A	N/A	2.00E+01
2	Average Concentration	µCi/mL	N/A	N/A	N/A	N/A	
E. Liquid Release Volume							
1	Total Release	Liters	6.17E+05	2.46E+05	7.26E+04	9.33E+04	
F. Dilution Volume							
1	Total Release	Liters	2.37E+12	7.89E+11	3.95E+11	7.89E+11	

Lower Limits of Detection for Liquid Effluents

Fission and Activation Gase	µCi/mL
Kr-87	1.00E-05
Kr-88	1.00E-05
Xe-133	1.00E-05
Xe-133m	1.00E-05
Xe-135	1.00E-05
Xe-138	1.00E-05
Iodines	
I-131	1.00E-06
Particulates	
Fe-55	1.00E-06
Sr-89	5.00E-08
Sr-90	5.00E-08
Mn-54	5.00E-07
Co-58	5.00E-07
Fe-59	5.00E-07
Co-60	5.00E-07
Zn-65	5.00E-07
Mo-99	5.00E-07
Cs-134	5.00E-07
Cs-137	5.00E-07
Ce-141	5.00E-07
Ce-144	5.00E-06
Other	
H-3	1.00E-05
Gross Alpha	1.00E-07

The above limits are the ODCM required Lower Limits of Detection (LLD).

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

Table 3.2(1) Liquid Effluents Release Point: Unit 1

Nuclides Released		Continuous Mode				Batch Mode			
	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Sr-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-131	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Fe-59	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zn-65	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cr-51	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zr-95	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Nb-95	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Tc-99m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Fe-55	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
H-3	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Ci								
	Ci								
Total for Period	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

Table 3.2(2) Liquid Effluents Release Point: Unit 2

Nuclides Released		Continuous Mode				Batch Mode			
	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Sr-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-131	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Fe-59	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zn-65	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cr-51	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zr-95	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Nb-95	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Tc-99m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Fe-55	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
H-3	Ci	1.90E-03	3.56E-04	1.16E-04	1.18E-04	<LLD	<LLD	<LLD	<LLD
	Ci								
	Ci								
Total for Period	Ci	1.90E-03	3.56E-04	1.16E-04	1.18E-04	<LLD	<LLD	<LLD	<LLD
Xe-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

Table 3.2(3) Liquid Effluents Release Point: Unit 3

Nuclides Released		Continuous Mode				Batch Mode			
	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Sr-89	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-134	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-131	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Fe-59	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zn-65	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mn-54	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cr-51	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zr-95	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Nb-95	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mo-99	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Tc-99m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ba-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
La-140	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ce-141	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Fe-55	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
H-3	Ci	1.90E-03	3.56E-04	1.16E-04	1.18E-04	<LLD	<LLD	<LLD	<LLD
	Ci								
	Ci								
Total for Period	Ci	1.90E-03	3.56E-04	1.16E-04	1.18E-04	<LLD	<LLD	<LLD	<LLD
Xe-133	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Xe-135	Ci	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

Table 4 Batch and Abnormal Release Totals Site

Batch Releases

A. Liquid Releases

		Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
1. Number of Batch Releases		0	0	0	0	0
2. Total duration of batch releases	min	N/A	N/A	N/A	N/A	N/A
3. Maximum batch release duration	min	N/A	N/A	N/A	N/A	N/A
4. Average batch release duration	min	N/A	N/A	N/A	N/A	N/A
5. Minimum batch release duration	min	N/A	N/A	N/A	N/A	N/A

B. Gaseous Releases

		Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
1. Number of Batch Releases		0	0	0	0	0
2. Total duration of batch releases	min	N/A	N/A	N/A	N/A	N/A
3. Maximum batch release duration	min	N/A	N/A	N/A	N/A	N/A
4. Average batch release duration	min	N/A	N/A	N/A	N/A	N/A
5. Minimum batch release duration	min	N/A	N/A	N/A	N/A	N/A

Abnormal Releases

A. Liquid Releases	Units	Annual
1. Number of Abnormal Releases		0
2. Total Activity	Ci	0.00E+00

B. Gaseous Releases	Units	Annual
1. Number of Abnormal Releases		0
2. Total Activity	Ci	0.00E+00

RADIOLOGICAL IMPACT ON MAN

Table 5 Total Body Dose from Gaseous and Liquid Effluents

		Unit 1	Unit 2	Unit 3	Site
Liquid	mRem	N/A	9.09E-09	9.09E-09	1.82E-08
Gaseous	mRad	N/A	1.36E-03	1.03E-03	2.38E-03
Radioiodines, tritium and Particulates	mRem	1.04E-03	7.15E-04	3.84E-04	2.13E-03
C-14	mRem	N/A	1.24E-03	1.27E-03	2.51E-03

Table 5.1 Organ Dose from Gaseous and Liquid Effluents

		Unit 1	Unit 2	Unit 3	Site
Liquid	mRem	N/A	9.09E-09	9.09E-09	1.82E-08
Gaseous (Skin)	mRad	N/A	2.31E-03	1.75E-03	4.06E-03
Radioiodines, tritium and Particulates	mRem	2.707E-03 (Liver)	3.927 E-03 (Thyroid)	8.945E-03 (Thyroid)	1.56E-02

Table 6 Solid Waste Shipped Offsite for Burial or Disposal (Not irradiated fuel)

1- Types of Waste

Types of Waste	Total Quantity (m^3)	Total Activity (Ci)	Period	Est. Total Error %
a. Spent resins, filter sludges, evaporator bottoms, etc.	5.67E+01	1.45E+02	01/01-12/31	± 25
b. Dry compressible waste, contaminated equip., etc.	4.44E+02	3.89E-01	01/01-12/31	± 25
c. Irradiated components, control rods, etc.	0.00E+00	0.00E+00	01/01-12/31	± 25
d. Other (describe)	3.65E+01	5.29E-03	01/01-12/31	± 25

2- Estimate of major nuclide composition (by waste type)

Major Nuclide Composition	%
Resins, Filters, and Evap Bottoms	
a. Cs-137 (5.61E+00 Ci)	3.85
Fe-55 (4.21E+01 Ci)	28.96
Co-60 (8.71E+01 Ci)	59.86
Ni-63 (6.99E+00 Ci)	4.81
Dry Active Waste	
b. Mn-54 (2.80E-02 Ci)	7.19
Fe-55 (1.71E-01 Ci)	43.97
Co-58 (7.81E-03)	2.00
Co-60 (1.45E-01 Ci)	37.21
Zn-65 (1.25E-02 Ci)	3.20
Cr-51 (1.36E-02 Ci)	3.48
Irradiated Components	
c. None	
Other	
d. Mn-54 (4.23E-04 Ci)	7.98
Fe-55 (2.11E-03 Ci)	39.86
Co-58 (1.08E-04 Ci)	2.03

Co-60 (2.01E-03 Ci)	38.03
Zn-65 (1.83E-04 Ci)	3.45
Cs-137 (6.69E-05 Ci)	1.26
Cr-51 (1.40E-04 Ci)	2.65

3- Solid Waste Disposition

Number of Shipments	Mode of Transportation	Destination
8	Ground	Energy Solutions--Oak Ridge, TN
14	Ground	Energy Solutions--Clive, UT
1	Ground	Philotechnics, Ltd

CHANGES TO THE PROCESS CONTROL PROGRAM

The Process Control Program procedure (RW-AA-100) Rev 12 was revised last on 8/17/2017. There have been no new changes for the 2021 year.

DIRECT RADIATION

There are five identified sources of direct radiation dose that meets the definition referenced in 10CFR72.104 and must be added to the gaseous and liquid effluents dose. They are:

1. Skyshine
2. West Independent Spent Fuel Storage Installation (ISFSI) Pad
3. East ISFSI Pad
4. Condensate Storage Tanks (CST)
5. General Electric Facility located southwest of the plant on Collins Road.

Skyshine

The radioactivity source that results in the most significant offsite radiation dose at the Dresden Station is skyshine resulting from ^{16}N decay inside turbines and steam piping.

The ^{16}N that produces the skyshine effect is formulated through neutron activation of the oxygen atoms in the reactor coolant as the coolant passes through the operating reactor core. The ^{16}N travels with the steam produced in the reactor to the steam-driven turbine. While the ^{16}N is in transport, it radioactively decays with a half-life of about 7 seconds and produces 6-7 MeV gamma rays. Typically, offsite dose points are shielded from a direct view of components containing ^{16}N, but there can be skyshine at offsite locations due to scattering of gamma rays off the mass of air above the steam lines and turbine.

The dose rate due to skyshine has been found to have the following dependencies:

1. The dose rate decreases as distance from the station increases.
2. The dose rate increases non-linearly as the power production level increases.
3. The dose rate increases when hydrogen is added to the reactor coolant, an action taken to improve reactor coolant chemistry characteristics.

To calculate offsite dose due to skyshine in a given time period, Dresden Station must track the following parameters:

1. The total gross energy E_h produced with hydrogen being added.
2. The total gross energy E_o produced without hydrogen being added.

The turbines at the site are sufficiently close to each other that energy generated by the two operating units may be summed. Because the hydrogen addition system is normally in-service during plant operation, the conservative assumption that all power is generated during hydrogen addition can be used.

An initial estimate of skyshine dose is calculated using equation 5-1 on page II.5.4 in the Dresden Offsite Dose Calculation Manual with the following assumptions from Table 5.1 on page II.5-11:

$$D_{sky} = (K)(E_o - M_h E_h)((OF_1 * SF_1 e^{-0.007*R1}) + (OF_2 * SF_2 e^{-0.007*R2}) \qquad (5\text{-}1)$$

Table 6.1: Parameters for Calculations of N-16 Skyshine Radiation from Dresden Units 2 and 3

Location Number K	Activity	Occupancy Hours (OH)	Occupancy Factor (OF)	Shielding Factor (SF)	Distance (R)
1	Living at Home	8344	0.95	0.7	800
2	Fishing	416	0.05	1	610

These parameters are used to obtain an initial estimate of skyshine dose to the maximally exposed member of the public using Equation 5-1. If desired, more realistic parameters could be used in place of these to refine the estimate. For example, one could determine whether the nearest resident really fishes the specified number of hours at the specified location.

a. The amount of time in a year that a maximally exposed fisherman would spend fishing near the site is estimated as 12 hours per week for 8 months per year. This yields an estimate of:

[12 hours/week] x [(8 months/yr)/(12 months/yr)] x [52 weeks/yr] = 416 hours/yr

The remaining time is assumed to be spent at the nearest residence.

b. Distance to nearest residence (See ODCM Table 4-1).

c. Estimated from a drawing of the site.

d. The OF_k is the quotient of the number of hours a location is occupied and the number of hours in a year. Thus OH_k/8760 hours = OF_k rounded to the 0.01 digit.

A survey of the nearest residents revealed that as they do enjoy fishing, they spend far less time than the above estimate in Table 6.1 above. In addition, because they live on the Kankakee River, they enjoy fishing at their homes rather than the designated 610 meters from the plant. As such, these assumptions have been adjusted in order to calculate a more accurate dose to the nearest resident at 868 meters from the plant with 8000 occupancy hours per year. This yielded a dose from Unit 2 due to skyshine of 2.110 mRem and 2.163 mRem from Unit 3 for a total of 4.273 mRem for the Site.

Independent Spent Fuel Storage Installation

There are currently two ISFSI pads (east and west) located within the Protected area of the Dresden station. These casks contain the spent fuel from the reactor, and the pad is designed to store the spent fuel until a more suitable location is available. Optically stimulated luminescence dosimeters (OSLD) are placed on the fence around the pads and exchanged semi-annually to measure the direct dose from the ISFSI pad. The dose from each location is summed to acquire an annual dose for that specific location a known distance from the casks.

The equation for a point source is used ($DR_1*D_1^2= DR_2*D_2^2$) to calculate the annual dose to the nearest member of the public. The OSLD with the highest annual reading was used because they have a lesser contribution by percent of background radiation lending to more accuracy in the dose attributable only to the ISFSI pad

Table 7: West ISFSI Pad Dose Calculations

	H1 (mrem)	H2 (mrem)	DR_1 (ft)	D_1 (ft)	D_2 (ft)	DR_2 (mrem)
23	153.6	162.5	316.1	136	2640	0.84
24	480.9	970.3	1451.2	91	2640	1.72
25	324.9	628	952.9	98	2640	1.31
26	106.2	176.6	282.8	90	2640	0.33
27	238.7	427.7	666.4	61	2640	0.36
28	167.5	275.6	443.1	117	2640	0.87

Figure 1: West ISFSI Pad

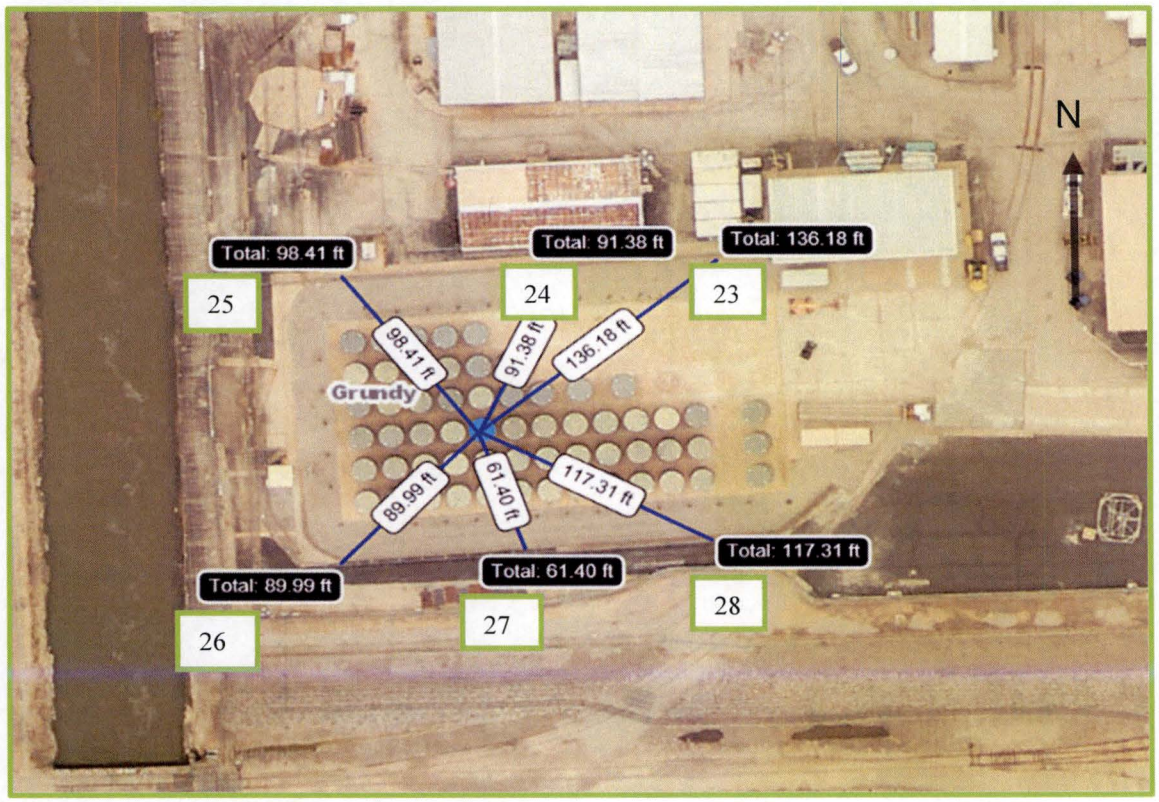
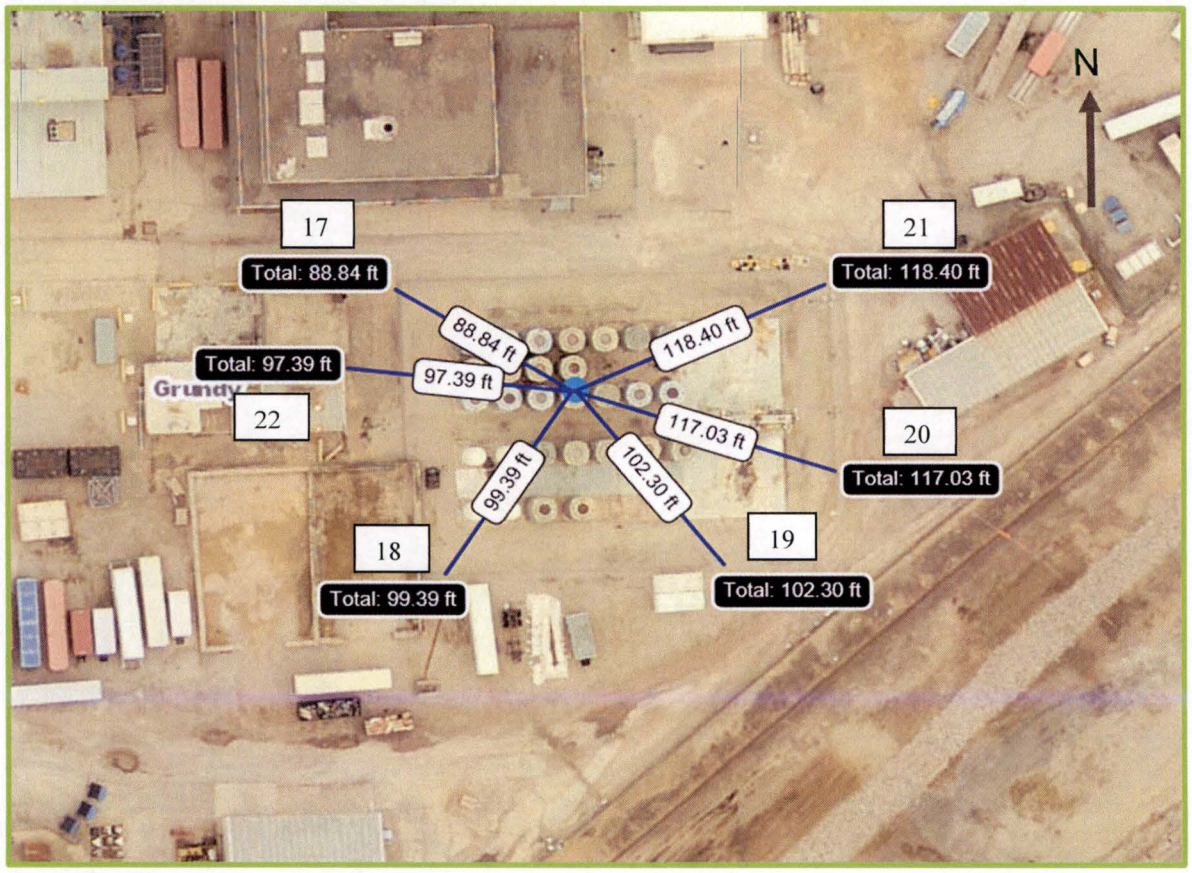


Table 7.1: East ISFSI Pad Dose Calculations

	H1 (mrem)	H2 (mrem)	DR_1 (mrem/yr)	D_1 (ft)	D_2 (ft)	DR_2 (mrem/yr)
17	78.8	90.2	169	88.8	2660	0.19
18	62.6	66.9	129.5	99.4	2660	0.18
19	59.6	79.8	139.4	102.3	2660	0.21
20	84.5	97.4	181.9	117.0	2660	0.35
21	201.8	252.1	453.9	118.4	2660	0.90
22	74.3	98.4	172.7	97.4	2660	0.23

Figure 2: East ISFSI Pad



The highest annual dose received from the ISFSI pads were location 21 and 24. These results and distances from the center of the pad was used to calculate a dose of 1.72E+00 mRem/yr for the West pad and 9.00E-01 mRem/yr for the East pad. This resulted in a combined annual

dose of 2.62E+00 mRem/ yr. due to direct radiation from storage of spent fuel on the IFSFI pads.

Condensate Storage Tank (CST)

The Condensate Storage Tanks (A and B) are a source of make-up water and has become contaminated through the operation of the plant. Although the level of contamination of the water inside the tank isn't at a level to produce a measurable dose rate, tanks are specifically listed in 40CFR190 and a calculation of the annual dose to the nearest resident must be performed.

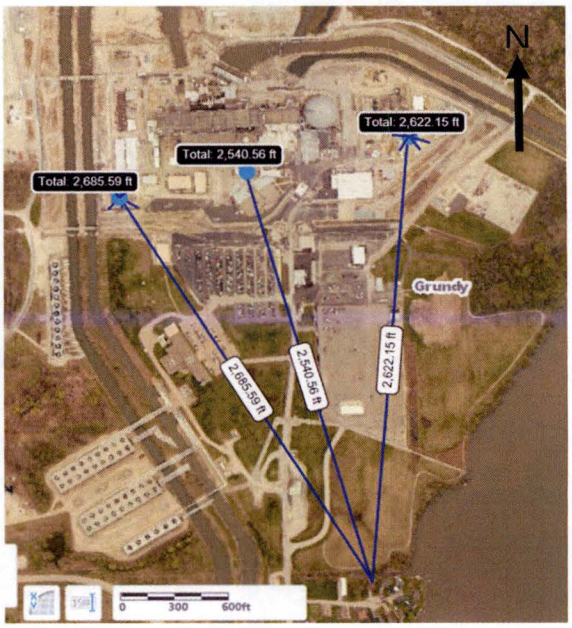
A direct radiation dosimeter (07), was placed on the northeast perimeter fence of the 2/3 Condensate Storage Tank identical to those on the ISFSI pad, and as such will use the same methodology to calculate an annual dose.

Table 7.2: CST Dose Calculations

	H1 (mrem)	H2 (mrem)	DR_1 (mrem/yr)	D_1 (ft)	D_2 (ft)	DR_2 (mrem/yr)
7	144.2	167.4	311.6	17	2540	0.014

Figure 3: 2/3 Condensate Storage Tanks

Figure 4: Distance to Nearest Resident



The approximate distance from the dosimeter on the fence to the edge of the tank is 17 ft. Using the same equation and the distance to the nearest residence (2543 ft.) $DR_1*D_1^2=DR_2*D_2^2$ it yields an annual dose of 1.40E-02 mRem/year. These calculations are very conservative because the measured dose is almost entirely from background and not from the plant or storage tanks.

GE Hitachi Nuclear Energy Facility

This facility is located southwest of the Dresden Nuclear Power Station on Collins Rd and is the location of a de facto high-level radioactive waste storage site that holds 772 tons of spent nuclear fuel. The used fuel from various nuclear generating sites across the country are stored in a spent fuel pool. The following table was taken from the NRC Technical Specifications for Safety Renewed License SNM-2500 for the GE Hitachi Energy Americas LLC Appendix A:

Since the source of radiation from the site is from the Uranium fuel cycle, the site is also required to ensure that the requirements of 40CFR190 and 10CFR72 are met. Therefore, an Annual Operating Report is generated and submitted to the NRC to demonstrate that the regulatory limits are not exceeded to members of the public.

40CFR190 states that the annual whole-body dose to a member of the public shall not exceed 25 mRem/yr from all sources of the uranium fuel cycle. This distinction dictates that the sum of the dose from the operation of the Dresden Nuclear Power Station and the GE Hitachi Nuclear Energy site cannot cause a member of the public to exceed a whole-body dose of 25 mRem/year. As a result, communication from the two sites is necessary to exchange the calculated dose contributions to ensure this requirement is met. The dose contribution from the GE Hitachi site for the 2021 year was: 1.20E-01 mRem/yr.

Attachment 1

2019 Errata Data

2019 Original

DRESDEN NUCLEAR POWER STATION
2019 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT
Docket Numbers: 50-010/50-237/50-249

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

Table 2.1(2): Gaseous Effluents- Summation of All Effluent Releases **Unit 2**

		Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission & Activation Gases							
1	Total Release	Ci	3.15E+02	2.13E+01	4.15E+01	1.65E+01	1.31E+01
2	Average release rate for period	µCi/sec	4.00E+01	2.70E+00	5.26E+00	2.09E+00	
3	Percent of ODCM Quarterly dose limit (site)	% Gamma[1]	1.99E-01	1.31E-02	2.70E-02	1.41E-02	
		% Beta[2]	4.85E-03	3.15E-04	6.03E-04	3.76E-04	
B. Iodine-131							
1	Total release	Ci	3.36E-04	9.44E-04	1.50E-03	1.08E-03	2.60E+01
2	Average release rate for period	µCi/sec	4.26E-05	1.20E-04	1.91E-04	1.37E-04	
3	Percent of ODCM Quarterly dose limit (*)	%	2.19E-01	2.89E-01	3.92E-01	2.88E-01	
C. Particulates							
1	Particulates with half-life >8 days	Ci	6.65E-04	3.78E-04	4.57E-04	5.28E-04	2.94E+01
2	Average release rate for period	µCi/sec	8.43E-05	4.80E-05	5.79E-05	6.70E-05	
3	Percent of ODCM Quarterly dose limit (*)	%	2.19E-01	2.89E-01	3.92E-01	2.88E-01	
D. Tritium							
1	Total release	Ci	3.60E+00	1.49E+01	1.38E+01	6.54E+00	7.56E+00
2	Average release rate for period	µCi/sec	4.56E-01	1.89E+00	1.75E+00	8.29E-01	
3	Percent of ODCM Quarterly dose limit (*)	%	2.19E-01	2.89E-01	3.92E-01	2.88E-01	
E. Gross Alpha							
1	Total release	Ci	N/A	N/A	N/A	N/A	2.94E+01
2	Average release rate for period	µCi/sec	N/A	N/A	N/A	N/A	
F. Carbon14							
1	Total release	Ci	3.69E+00	3.73E+00	4.38E+00	2.79E+00	
2	Average release rate for period	µCi/sec	4.68E-01	4.73E-01	5.56E-01	3.54E-01	

1. Based upon a quarterly dose limit of 5.00 mRad/yr for the Site
2. Based upon a quarterly dose limit of 10.00 mRad/yr for the Site
* "Percent of ODCM annual dose limit" indicates combined total of Iodine-131, Particulates, and Tritium

2019 Original

DRESDEN NUCLEAR POWER STATION
2019 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT
Docket Numbers: 50-010/50-237/50-249

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

Table 2.1(3): Gaseous Effluents- Summation of All Effluent Releases **Unit 3**

		Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission & Activation Gases							
1	Total Release	Ci	3.01E+01	3.77E+00	3.00E+00	3.13E+00	1.31E+01
2	Average release rate for period	µCi/sec	3.82E+00	4.78E-01	3.81E-01	3.97E-01	
3	Percent of ODCM Quarterly dose limit (site)	% Gamma[1]	2.02E-02	2.88E-03	3.02E-03	3.24E-03	
		% Beta[2]	5.41E-04	6.28E-05	6.04E-05	7.17E-05	
B. Iodine-131							
1	Total release	Ci	1.11E-04	2.59E-04	2.77E-04	2.21E-04	2.60E+01
2	Average release rate for period	µCi/sec	1.40E-05	3.29E-05	3.51E-05	2.81E-05	
3	Percent of ODCM Quarterly dose limit (*)	%	1.63E-01	1.48E-01	1.74E-01	1.01E-01	
C. Particulates							
1	Particulates with half-life >8 days	Ci	1.66E-04	1.04E-04	8.56E-05	1.11E-04	2.94E+01
2	Average release rate for period	µCi/sec	2.10E-05	1.31E-05	1.09E-05	1.41E-05	
3	Percent of ODCM Quarterly dose limit (*)	%	1.63E-01	1.48E-01	1.74E-01	1.01E-01	
D. Tritium							
1	Total release	Ci	1.23E+00	4.96E+00	3.02E+00	1.35E+00	7.56E+00
2	Average release rate for period	µCi/sec	1.56E-01	6.29E-01	3.83E-01	1.72E-01	
3	Percent of ODCM Quarterly dose limit (*)	%	1.63E-01	1.48E-01	1.74E-01	1.01E-01	
E. Gross Alpha							
1	Total release	Ci	N/A	N/A	N/A	N/A	2.94E+01
2	Average release rate for period	µCi/sec	N/A	N/A	N/A	N/A	
F. Carbon14							
1	Total release	Ci	3.69E+00	3.73E+00	4.38E+00	2.54E+00	
2	Average release rate for period	µCi/sec	4.68E-01	4.73E-01	5.56E-01	3.22E-01	

1. Based upon a quarterly dose limit of 5.00 mRad/yr for the Site
2. Based upon a quarterly dose limit of 10.00 mRad/yr for the Site
* "Percent of ODCM annual dose limit" indicates combined total of Iodine-131, Particulates, and Tritium

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

2019 Corrected

Table 2.1(2): Gaseous Effluents- Summation of All Effluent Releases Unit 2

		Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission & Activation Gases							
1	Total Release	Ci	3.15E+02	2.13E+01	4.15E+01	1.65E+01	1.31E+01
2	Average release rate for period	µCi/sec	4.00E+01	2.70E+00	5.26E+00	2.09E+00	
3	Percent of ODCM Quarterly dose limit (site)	% Gamma[1]	1.99E-01	1.31E-02	2.70E-02	1.41E-02	
		% Beta[2]	4.85E-03	3.15E-04	6.03E-04	3.76E-04	
B. Iodine-131							
1	Total release	Ci	1.34E-04	3.65E-04	4.99E-04	2.90E-04	2.60E+01
2	Average release rate for period	µCi/sec	1.72E-05	4.64E-05	6.28E-05	3.65E-05	
3	Percent of ODCM Quarterly dose limit (*)	%	2.19E-01	2.89E-01	3.92E-01	2.88E-01	
C. Particulates							
1	Particulates with half-life >8 days	Ci	6.65E-04	3.78E-04	4.57E-04	5.28E-04	2.94E+01
2	Average release rate for period	µCi/sec	8.43E-05	4.80E-05	5.79E-05	6.70E-05	
3	Percent of ODCM Quarterly dose limit (*)	%	2.19E-01	2.89E-01	3.92E-01	2.88E-01	
D. Tritium							
1	Total release	Ci	3.60E+00	1.49E+01	1.38E+01	6.54E+00	7.56E+00
2	Average release rate for period	µCi/sec	4.56E-01	1.89E+00	1.75E+00	8.29E-01	
3	Percent of ODCM Quarterly dose limit (*)	%	2.19E-01	2.89E-01	3.92E-01	2.88E-01	
E. Gross Alpha							
1	Total release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.94E+01
2	Average release rate for period	µCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
F. Carbon14							
1	Total release	Ci	3.69E+00	3.73E+00	4.38E+00	2.79E+00	
2	Average release rate for period	µCi/sec	4.68E-01	4.73E-01	5.56E-01	3.54E-01	

1. Based upon a quarterly dose limit of 5.00 mRad/yr for the Site
2. Based upon a quarterly dose limit of 10.00 mRad/yr for the Site

* "Percent of ODCM quarterly dose limit" indicates combined total of Iodine-131, Particulates, and Tritium

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

2019 Corrected

Table 2.1(3): Gaseous Effluents- Summation of All Effluent Releases Unit 3

		Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission & Activation Gases							
1	Total Release	Ci	3.01E+01	3.77E+00	3.00E+00	3.13E+00	1.31E+01
2	Average release rate for period	µCi/sec	3.82E+00	4.78E-01	3.81E-01	3.97E-01	
3	Percent of ODCM Quarterly dose limit (site)	% Gamma[1]	2.02E-02	2.88E-03	3.02E-03	3.24E-03	
		% Beta[2]	5.41E-04	6.28E-05	6.04E-05	7.17E-05	
B. Iodine-131							
1	Total release	Ci	4.49E-05	9.76E-05	9.15E-05	4.47E-05	2.60E+01
2	Average release rate for period	µCi/sec	5.77E-06	1.24E-05	1.15E-05	5.63E-06	
3	Percent of ODCM Quarterly dose limit (*)	%	1.63E-01	1.48E-01	1.74E-01	1.01E-01	
C. Particulates							
1	Particulates with half-life >8 days	Ci	1.66E-04	1.04E-04	8.56E-05	1.11E-04	2.94E+01
2	Average release rate for period	µCi/sec	2.10E-05	1.31E-05	1.09E-05	1.41E-05	
3	Percent of ODCM Quarterly dose limit (*)	%	1.63E-01	1.48E-01	1.74E-01	1.01E-01	
D. Tritium							
1	Total release	Ci	1.23E+00	4.96E+00	3.02E+00	1.35E+00	7.56E+00
2	Average release rate for period	µCi/sec	1.56E-01	6.29E-01	3.83E-01	1.72E-01	
3	Percent of ODCM Quarterly dose limit (*)	%	1.63E-01	1.48E-01	1.74E-01	1.01E-01	
E. Gross Alpha							
1	Total release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.94E+01
2	Average release rate for period	µCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
F. Carbon14							
1	Total release	Ci	3.69E+00	3.73E+00	4.38E+00	2.54E+00	
2	Average release rate for period	µCi/sec	4.68E-01	4.73E-01	5.56E-01	3.22E-01	

1. Based upon a quarterly dose limit of 5.00 mRad/yr for the Site
2. Based upon a quarterly dose limit of 10.00 mRad/yr for the Site

* "Percent of ODCM quarterly dose limit" indicates combined total of Iodine-131, Particulates, and Tritium

Attachment 2

2020 Errata Data

2020 Original

DRESDEN NUCLEAR POWER STATION
2020 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT
Docket Numbers: 50-010/50-237/50-249

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

Table 2.1(2): Gaseous Effluents- Summation of All Effluent Releases **Unit 2**

		Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission & Activation Gases							
1	Total Release	Ci	1.94E+01	1.75E+01	1.78E+01	1.74E+01	1.31E+01
2	Average release rate for period	µCi/sec	2.45E+00	2.22E+00	2.26E+00	2.20E+00	
3	Percent of ODCM Quarterly dose limit (site)	% Gamma[1]	1.82E-02	1.62E-02	1.57E-02	1.73E-02	
		% Beta[2]	3.71E-04	3.37E-04	3.40E-04	1.40E-03	
B. Iodine-131							
1	Total release	Ci	6.52E-04	4.36E-03	5.95E-03	2.99E-03	2.60E+01
2	Average release rate for period	µCi/sec	8.27E-05	5.53E-04	7.56E-04	3.79E-04	
3	Percent of ODCM Quarterly dose limit (*)	%	2.30E-03	2.61E-03	2.14E-03	6.13E-03	
C. Particulates							
1	Particulates with half-life >8 days	Ci	1.89E-04	4.36E-03	5.65E-04	7.07E-04	2.94E+01
2	Average release rate for period	µCi/sec	2.39E-05	5.52E-05	7.17E-05	8.97E-05	
3	Percent of ODCM Quarterly dose limit (*)	%	2.30E-03	2.61E-03	2.14E-03	6.13E-03	
D. Tritium							
1	Total release	Ci	4.42E+00	8.04E+00	6.41E+00	4.87E+00	7.56E+00
2	Average release rate for period	µCi/sec	5.61E-01	1.02E+00	8.13E-01	6.18E-01	
3	Percent of ODCM Quarterly dose limit (*)	%	2.30E-03	2.61E-03	2.14E-03	6.13E-03	
E. Gross Alpha							
1	Total release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.94E+01
2	Average release rate for period	µCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
F. Carbon14							
1	Total release	Ci	5.26E+00	3.66E+00	3.76E+00	3.75E+00	
2	Average release rate for period	µCi/sec	6.79E-01	4.65E-01	4.73E-01	4.72E-01	

1. Based upon a quarterly dose limit of 5.00 mRad/yr for the Site
2. Based upon a quarterly dose limit of 10.00 mRad/yr for the Site
* "Percent of ODCM annual dose limit" indicates combined total of Iodine-131, Particulates, and Tritium

2020 Original

DRESDEN NUCLEAR POWER STATION
2020 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT
Docket Numbers: 50-010/50-237/50-249

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

Table 2.1(3): Gaseous Effluents- Summation of All Effluent Releases **Unit 3**

		Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission & Activation Gases							
1	Total Release	Ci	3.40E+00	3.71E+00	4.04E+00	2.14E+00	1.31E+01
2	Average release rate for period	µCi/sec	4.31E-01	4.71E-01	5.12E-01	2.72E-01	
3	Percent of ODCM Quarterly dose limit (site)	% Gamma[1]	3.25E-03	3.66E-03	3.86E-03	2.05E-03	
		% Beta[2]	6.62E-05	7.16E-05	7.11E-05	4.15E-05	
B. Iodine-131							
1	Total release	Ci	5.37E-04	1.45E-03	1.11E-03	2.85E-04	2.60E+01
2	Average release rate for period	µCi/sec	6.81E-05	1.84E-04	1.40E-04	3.61E-05	
3	Percent of ODCM Quarterly dose limit (*)	%	1.51E-03	9.38E-04	8.39E-04	1.48E-03	
C. Particulates							
1	Particulates with half-life >8 days	Ci	1.51E-04	1.53E-04	1.16E-04	7.98E-05	2.94E+01
2	Average release rate for period	µCi/sec	1.91E-05	1.94E-05	1.47E-05	1.01E-05	
3	Percent of ODCM Quarterly dose limit (*)	%	1.51E-03	9.38E-04	8.39E-04	1.48E-03	
D. Tritium							
1	Total release	Ci	3.20E+00	2.82E+00	1.13E+00	3.57E-01	7.56E+00
2	Average release rate for period	µCi/sec	4.06E-01	3.57E-01	1.44E-01	4.53E-02	
3	Percent of ODCM Quarterly dose limit (*)	%	1.51E-03	9.38E-04	8.39E-04	1.48E-03	
E. Gross Alpha							
1	Total release	Ci	N/A	N/A	N/A	N/A	2.94E+01
2	Average release rate for period	µCi/sec	N/A	N/A	N/A	N/A	
F. Carbon14							
1	Total release	Ci	5.28E+00	3.72E+00	3.45E+00	3.05E+00	
2	Average release rate for period	µCi/sec	6.79E-01	4.73E-01	4.40E-01	3.84E-01	

1. Based upon a quarterly dose limit of 5.00 mRad/yr for the Site
2. Based upon a quarterly dose limit of 10.00 mRad/yr for the Site
* "Percent of ODCM annual dose limit" indicates combined total of Iodine-131, Particulates, and Tritium

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

2020 Corrected

Table 2.1(2): Gaseous Effluents- Summation of All Effluent Releases Unit 2

		Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission & Activation Gases							
1	Total Release	Ci	1.94E+01	1.75E+01	1.78E+01	1.74E+01	1.31E+01
2	Average release rate for period	µCi/sec	2.45E+00	2.22E+00	2.26E+00	2.20E+00	
3	Percent of ODCM Quarterly dose limit (site)	% Gamma[1]	1.82E-02	1.62E-02	1.57E-02	1.73E-02	
		% Beta[2]	3.71E-04	3.37E-04	3.40E-04	1.40E-03	
B. Iodine-131							
1	Total release	Ci	9.58E-05	2.72E-04	3.49E-04	3.16E-04	2.60E+01
2	Average release rate for period	µCi/sec	1.22E-05	3.45E-05	4.40E-05	3.98E-05	
3	Percent of ODCM Quarterly dose limit (*)	%	2.30E-03	2.61E-03	2.14E-03	6.13E-03	
C. Particulates							
1	Particulates with half-life >8 days	Ci	1.89E-04	4.36E-03	5.66E-04	7.07E-04	2.94E+01
2	Average release rate for period	µCi/sec	2.39E-05	5.52E-05	7.17E-05	8.97E-05	
3	Percent of ODCM Quarterly dose limit (*)	%	2.30E-03	2.61E-03	2.14E-03	6.13E-03	
D. Tritium							
1	Total release	Ci	4.42E+00	8.04E+00	6.41E+00	4.87E+00	7.56E+00
2	Average release rate for period	µCi/sec	5.61E-01	1.02E+00	8.13E-01	6.18E-01	
3	Percent of ODCM Quarterly dose limit (*)	%	2.30E-03	2.61E-03	2.14E-03	6.13E-03	
E. Gross Alpha							
1	Total release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.94E+01
2	Average release rate for period	µCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
F. Carbon14							
1	Total release	Ci	5.28E+00	3.66E+00	3.76E+00	3.75E+00	
2	Average release rate for period	µCi/sec	6.79E-01	4.66E-01	4.73E-01	4.72E-01	

1. Based upon a quarterly dose limit of 5.00 mRad/yr for the Site
2. Based upon a quarterly dose limit of 10.00 mRad/yr for the Site

* "Percent of ODCM quarterly dose limit" indicates combined total of Iodine-131, Particulates, and Tritium

Dresden Nuclear Power Station Units 1,2, 3 Licensee: Exelon Generation Company, LLC

2020 Corrected

Table 2.1(3): Gaseous Effluents- Summation of All Effluent Releases Unit 3

		Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission & Activation Gases							
1	Total Release	Ci	3.40E+00	3.71E+00	4.04E+00	2.14E+00	1.31E+01
2	Average release rate for period	µCi/sec	4.31E-01	4.71E-01	5.12E-01	2.72E-01	
3	Percent of ODCM Quarterly dose limit (site)	% Gamma[1]	3.25E-03	3.66E-03	3.86E-03	2.06E-03	
		% Beta[2]	6.62E-05	7.16E-05	7.11E-05	4.15E-05	
B. Iodine-131							
1	Total release	Ci	6.58E-05	9.77E-05	6.48E-05	2.87E-05	2.60E+01
2	Average release rate for period	µCi/sec	8.37E-06	1.24E-05	8.15E-06	3.61E-06	
3	Percent of ODCM Quarterly dose limit (*)	%	1.51E-03	9.38E-04	8.39E-04	1.48E-03	
C. Particulates							
1	Particulates with half-life >8 days	Ci	1.51E-04	1.53E-04	1.16E-04	7.98E-05	2.94E+01
2	Average release rate for period	µCi/sec	1.91E-05	1.94E-05	1.47E-05	1.01E-05	
3	Percent of ODCM Quarterly dose limit (*)	%	1.51E-03	9.38E-04	8.39E-04	1.48E-03	
D. Tritium							
1	Total release	Ci	3.20E+00	2.82E+00	1.13E+00	3.57E-01	7.56E+00
2	Average release rate for period	µCi/sec	4.06E-01	3.57E-01	1.44E-01	4.53E-02	
3	Percent of ODCM Quarterly dose limit (*)	%	1.51E-03	9.38E-04	8.39E-04	1.48E-03	
E. Gross Alpha							
1	Total release	Ci	N/A	N/A	N/A	N/A	2.94E+01
2	Average release rate for period	µCi/sec	N/A	N/A	N/A	N/A	
F. Carbon14							
1	Total release	Ci	5.28E+00	3.72E+00	3.49E+00	3.05E+00	
2	Average release rate for period	µCi/sec	6.79E-01	4.73E-01	4.40E-01	3.84E-01	

1. Based upon a quarterly dose limit of 5.00 mRad/yr for the Site
2. Based upon a quarterly dose limit of 10.00 mRad/yr for the Site

* "Percent of ODCM quarterly dose limit" indicates combined total of Iodine-131, Particulates, and Tritium

Attachment 3

RADIOACTIVE GROUNDWATER PROTECTION PLAN (RGPP)

875 North Easton Road
Suite 10
Doylestown, PA 18902
215-230-8282 (Phone)
215-230-8283 (Fax)
www.amoed.com

AMO ENVIRONMENTAL DECISIONS
Environmental Risk & Remediation Consultants

Geologists
Hydrogeologists
GIS Analysts
Environmental Scientists

February 28, 2022

Ahmed, Anjum S.

Digitally signed by Ahmed, Anjum S.
Date: 2022.03.31 10:59:24 -05'00'

Constellation Energy Company, LLC
Dresden Generating Station
6500 North Dresden Road
Morris, IL 60450-9709

Subject: 2021 Annual RGPP Monitoring Report
Summary of Results and Conclusions
Dresden Generating Station
Morris, Illinois

This letter report presents the summary of Radiologic Groundwater Protection Plan (RGPP) results for the 2021 groundwater and surface water monitoring rounds conducted at the Constellation Dresden Generating Station. RGPP data for previous monitoring rounds is summarized in AMO's semi-annual/quarterly reports.

Background

In 2006, Conestoga-Rovers & Associates (CRA) was retained by Exelon Nuclear to perform a hydrogeologic investigation at the Dresden Generating Station to evaluate whether groundwater at or near the Station has been impacted by releases of radionuclides. Prior to performing the investigation, CRA evaluated available information concerning historic releases, as well as components, structures, and areas of the facility that have the potential to release radioactive liquid to the environment.

The results of the 2006 investigation for groundwater samples collected within the protected area identified that almost half of the 39 wells showed measurable concentrations of tritium. This tritium comes from historic spills from above ground tanks and leaks of underground lines within the protected area. Groundwater samples collected outside the protected area showed no detectable tritium for 24 of the 26 wells. The two exceptions for the wells outside the protected area include wells DSP 149(R) and DSP-159-I (M).

The results of the fleet wide study for the Dresden Generating Station (the Station) are presented in the report, entitled *Hydrogeologic Investigation Report, Fleetwide Assessment, Dresden Generating Station, Braceville, Illinois* (Conestoga-Rovers & Associates, September 2006). The referenced report also provides detailed descriptions of the Station's location, surrounding features and land use, subsurface geology and hydrogeology, and a summary of groundwater use in the area of the Station.

GHD completed three five-year update hydrogeologic investigation reports for the Station (*NEI 07-07, Hydrogeologic Investigation Report*, dated May 2011, December 2015, and December 2020). The reports summarized station activities since the 2006 hydrogeologic investigation report, including changes at the Station as well as RGPP sampling activities and groundwater flow. Relevant conclusions from the 2020 report are:

- Tritium is not migrating off the Station at concentrations greater than the State of Illinois criteria of 200 pCi/L.
- Tritium concentrations in groundwater were detected at concentrations greater than the USEPA drinking water standard. The maximum tritium concentration at the end of 2019 was 33,850 pCi/L

(MD-11). Tritium concentrations greater than the USEPA drinking water standard were limited to the "B" CST, south of the Unit 3 Turbine Building.

- No gamma-radionuclides associated with licensed plant operations were detected at concentrations greater than their respective LLDs.
- Select transuranics U-233/234 and U-238 were occasionally detected in several wells since 2016. The concentrations are considered background.
- In 2019, Ni-63 was consistently detected in monitoring well MW-DN-101I and MW-DN-119I. Per revision 9 of the RGPP, and to investigate Ni-63 in groundwater, the Station includes Ni-63 and Fe-55 analysis for all Source wells and all Long-Term Shutdown wells currently sampled as part of the RGPP.
- In 2019, multiple Sr-90 concentrations were detected above its LLD. Sr-90 was detected in samples collected from MW-DN-105S three of the four sampling rounds in 2019. Sr-90 was also detected in DSP-108 during the second quarter 2019 RGPP sampling round.
- AFE-1 remains an ongoing tritium source to groundwater. No new AFEs were identified based on results between 2006 and 2015.
- Extraction well RW-DN-100S continued to withdraw tritiated water from the "B" CST area. Up until August/September 2019, groundwater withdrawal from RW-DN-100S was on an intermittent basis. Continuous groundwater extraction of RW-DN-100S began in September 2019. As of the date of the report, over one million gallons of groundwater was extracted from RW-DN-100S. The extracted groundwater is discharged to the Kankakee River through a permitted outfall (Outfall 002).

The next hydrogeologic investigation update is due by the end of 2025.

"B" Condensate Storage Tank

Elevated tritium concentrations in surface water (Sewage Treatment Plant (STP) samples and RGPP surface water samples), shallow aquifer samples, and intermediate aquifer samples were detected during the 2nd quarter 2014 RGPP sampling round. The source of the tritiated groundwater was determined to be the "B" Condensate Storage Tank (CST) south of the Turbine Buildings. The groundwater sample collected from shallow aquifer well MD-11, which is in the immediate vicinity of the CST, had a tritium concentration of approximately 1.5 million pCi/L. Subsequent samples collected from MD-11 have had a maximum tritium concentration of approximately 2.3 million pCi/L (June 27, 2014). The CST was taken out of service and water from the CST removed. The CST was inspected and subsequently repaired in August 2015.

A tritium monitoring plan was developed and implemented in June 2014, with weekly sampling of surface water, storm sewer water, sewer treatment plant water, shallow aquifer groundwater, and intermediate aquifer groundwater to evaluate and delineate the tritium plume. A modified tritium monitoring plan was implemented in November 2014. Based on tritium data collected, the plume was relatively small and only encompassed the area between the CST and Turbine Building.

Two groundwater extraction wells (RW-DN-100S and RW-DN-101S) were installed in January 2015 to assist in the mitigation of tritiated groundwater in the area of the CST. Aquifer testing was completed on the two extraction wells near the end of 2015. Results of the aquifer test concluded that only RW-DN-100S produced sufficient water to operate as a viable groundwater extraction well. RW-DN-100S began intermittent operation during the 1st quarter 2016 and continued operating intermittently through August 2019. In August 2019, the extraction well began pumping groundwater on a continuous basis. The extracted water is discharged to the

Kankakee River through NPDES permitted Outfall 002. Overall, tritium concentrations in the area of the CST continue to decrease since the CST was repaired.

As of the end of 2021, the maximum tritium concentration in the area of the CST was approximately 12,300 pCi/L (MD-11).

MW-DN-119I Nickel 63

The sample collected from monitoring well MW-DN-119I, was analyzed for for tritium, gamma-radionuclides, gross-alpha and beta (dissolved and suspended), and strontium 89 and 90. Gross-beta (dissolved) was the only parameter detected at a concentration greater than their respective LLDs (detected at 124 pCi/L). Prior to the 2nd quarter 2017 sampling round, gross-beta (dissolved) concentrations in samples collected from MW-DN-119I ranged between 19.6 pCi/L and 28.9 pCi/L.

Due to the elevated gross-beta detection, the sample was analyzed for hard-to detects. Hard-to-detect radionuclide Nickel-63 was detected at a concentration over 50 pCi/L. An investigation into the source of the Nickel-63 was completed and additional samples collected from MW-DN-119I and surrounding wells. Results and recommendations of the evaluation are included in AMO's *Evaluation of Nickel -63 detections in MW-DN-119I Update* (March 28, 2018). As a result of the detection of Nickel-63, samples collected from MW-DN-119I are analyzed for hard-to-detects quarterly.

As of the end of 2021, the Ni-63 concentration in MW-DN-119I showed a decreasing trend.

Current RGPP Summary

In 2020, Exelon modified the corporate RGPP to include modified sample location designations and modified analytical procedural requirements. The newly adapted RGPP sample location designations include Background, Long-Term Shutdown, Mid-Field, Perimeter, and Source wells. Sample frequency and analyses are outlined below:

- Background – Annually for tritium; and every two years for gamma-radionuclide analyses.
- Long-Term Shutdown – Quarterly for tritium; annually for Fe-55, Ni-63, Sr-89, and Sr-90 analyses; and every two years for gamma-radionuclide and gross-alpha (dissolved and suspended).
- Mid-Field – Semi-annually for tritium, and every two years for gamma-radionuclide analysis.
- Perimeter - Annually for tritium, and every two years for gamma-radionuclide analyses.
- Source – Quarterly for tritium; annually for Sr-89 & Sr-90 analyses; every two years for gamma-radionuclide and gross-alpha (dissolved and suspended); and every five years for Fe-55 and Ni-63, starting in 2021.

Dresden Generating Station had a total of 59 wells (20 Background wells, 18 Source wells, six Mid-Field wells, ten Long-Term Shutdown wells, and five perimeter wells), that are sampled as part of the Station RGPP (EN-DR-408-4160 Revision 10). Figure 1a shows the shallow aquifer RGPP sample locations and Figure 1b shows the intermediate aquifer RGPP sample locations.

RGPP sampling at the Station is performed by ATI, under contract to Exelon. Laboratory testing is performed by Teledyne Brown Engineering. The laboratory data, field data, and depth to water readings are uploaded to the RACER website, which is a data repository for the RGPP sampling rounds. The uploaded data is used by AMO to evaluate the quarterly RGPP data.

Gross-Alpha Alert Level

At Dresden Generating Station, gross-alpha (dissolved and suspended fractions) was analyzed annually from 2011 through 2019. In 2020, gross-alpha data was evaluated to establish an Alert Level for the dissolved and suspended gross-alpha fractions. The gross alpha data was evaluated by looking at the average concentration for each gross-alpha fraction for each well. Statistical outlier results were considered during the gross-alpha evaluation. An outlier is a value that is significantly higher or lower than most of the results, that can skew the results and not reflect the true dataset. Therefore, outlier results are not factored into the average gross-alpha concentrations. Outliers were established using methods an online website such as *wikihow.com/Calculate-Outliers*. Additional websites identified similar statistical models for removing outlier data.

EN-DR-408-4160 (Revision 9) established an Alert Level of three times the ongoing average gross-alpha concentration for each RGPP monitoring well that had gross-alpha analyzed more than one time and that will continue to be monitored for during future RGPP sampling rounds. According to the EN-DR-408-4160 (Revision 10), samples from the eighteen Source designated sample points and ten Long-Term Shutdown designated wells will be analyzed once every two years for gross alpha dissolved and suspended fraction in the future. The Alert Level will be able to account for fluctuations in naturally occurring alpha activity in the area of wells, while identifying an outlier that may be indicative of a potential release. Beginning in 2021, select transuranics were analyzed if a gross alpha concentration exceeded the Alert Level in a particular well, to ensure that licensed material is not present in groundwater. If the results of the select transuranics analysis showed no unusual activity, the gross-alpha result that triggered the select transuranics analysis, was incorporated into the ongoing average concentration for that well.

Table 1 provides a gross-alpha (dissolved and suspended) results summary as well as the average concentration and Alert Level for each well. Gross-alpha analysis was performed on samples collected from Long-Term Shutdown designated wells and Source designated wells during the 2nd quarter 2021 RGPP sampling round. The sample collected from MW-DN-116S had a gross-alpha (suspended) concentration of 3.35 pCi/L, which exceeded the Alert Level of 2.37 pCi/L, established for that well. Therefore, the 2nd quarter 2021 RGPP sample collected from MW-DN-116S was analyzed for select transuranics. Select transuranics were not detected in the sample collected from MW-DN-116S during the 2nd quarter 2021 RGPP sampling round.

Gross-alpha (dissolved and suspended) detections from other wells sampled during the 2nd quarter 2021 RGPP sampling round did not exceed the Alert Level. All Long-Term Shutdown and Source designated wells will have gross-alpha analysis performed again in 2023.

ANI completed a corporate audit in 2020 and informed Exelon that it needed to analyze a sample from the well with the highest gross-alpha result for select transuranics to ensure that the Alert Level is conservative enough to ensure that no unusual transuranics are present when the gross-alpha concentrations do not exceed the Alert Level. To satisfy the ANI request, the well with the highest average gross-alpha (dissolved) concentration (DSP-125) will need to be analyzed for select transuranics by the end of the 3rd quarter 2022.

Gamma-Radionuclides

Gamma-radionuclide analysis has been performed on RGPP samples (quarterly to annually) at Dresden Generating Station since 2006. This extensive sampling and analysis produced over 16,800 data records for the Station. Gamma-radionuclides have not been detected at concentrations greater than their respective LLDs, in RGPP samples submitted to the vendor laboratory since 2006. Therefore, in the 2020 RGPP, gamma-radionuclide analysis frequency was reduced from annual to every two years.

Samples collected from all wells were analyzed for gamma-radionuclides during the 2nd quarter 2021 RGPP sampling round. Gamma radionuclides were not detected at concentrations greater than their respective LLDs

in the samples collected in 2021. All wells will have gamma-radionuclide analysis performed again in 2023.

Select Transuranics

Select transuranics analysis is procedurally required annually for RGPP sample locations that were identified as Elevated designated wells in the historic EN-DR-408-4160 revisions and continued additional evaluation is warranted. Additionally, as part of the current EN-DR-408-4160 (Revision 10), select transuranics analysis is also warranted if a gross alpha concentration exceeds the Alert Level in a particular well.

Select transuranics analysis was performed on former Elevated designated wells MD-11, MW-DN-124S, and MW-DN-124I, during the 2nd quarter 2021 RGPP sampling round. Additionally, select transuranics analysis was performed on MW-DN-111S, MW-DN-116S, MW-DN-119I, and extraction well RW-DN-100S during the 2nd quarter 2021 RGPP sampling round. Select Transuranics were not detected at concentrations greater than their respective LLDs in the samples collected during the 2nd quarter 2021 RGPP sampling round. Table 2 provides a summary of select transuranics results (U-233/234 and U-238) since 2006.

Hard-to-Detects (Fe-55 and Ni-63)

Hard-to-detect analysis (Fe-55 and Ni-63) is procedurally required annually for RGPP sample locations that were identified as Elevated designated wells in the historic EN-DR-408-4160 revisions and continued additional evaluation is warranted, as well as Long-Term Shutdown designated wells. Additionally, as part of the current EN-DR-408-4160 (Revision 9), hard-to-detect analysis is warranted on samples collected from Source designated wells once every 5 years, starting in 2021.

In 2021, samples collected from the nine Long-Term Shutdown designated wells, one former Elevated designated well, and eighteen Source designated wells were analyzed for hard-to-detects (Fe-55 and Ni-63). Ni-63 was detected in the sample collected from Long-Term Shutdown well MW-DN-119I during the 2nd quarter 2021 RGPP sampling round at 11.3 pCi/L. Ni-63 was not detected in the other samples collected during the 2nd quarter 2021 RGPP sampling round.

Sr-89 and Sr-90

Sr-89 and Sr-90 have been an annual procedurally required analysis on Detection, Long-Term Shutdown, and Elevated designated wells since sample point designations became part of the RGPP in 2010. EN-DR-408-4160 (Revision 9) states that Sr-89 and 90 analyses should be performed annually for Source and Long-Term Shutdown designated sample locations. If a positive result is reported, samples collected from the wells with Sr-89 and Sr-90 detections will be analyzed quarterly to evaluate the activity in the area of the well. In 2021, samples were collected from the eighteen Source designated wells, nine Long-Term Shutdown designated wells, and one Mid-Field designated well (former Elevated designation) were analyzed for Sr-89 and Sr-90.

In 2021, Sr-90 was detected in the samples collected from MW-DN-105S and DSP-108 at 3.20 pCi/L and 1.50 pCi/L, respectively.

Precipitation Recapture

Dresden Generating Station is a Boiling Water Reactor (BWR) generating station. The RGPP requires BWR generating stations to sample precipitation on a semi-annual basis. The RGPP states that a minimum of eight samples should be collected from within the protected area in a manner that surrounds the Turbine Building and Reactor Building as well as ancillary structures that could vent tritiated vapor to the atmosphere.

In 2021, Three sample rounds were completed between March and November to evaluate if tritium was present in the atmosphere at the Station. Eight onsite samples were collected during each sampling round. A summary of 2021 precipitation recapture results is presented in Table 3 and a summary of historic precipitation recapture results is provided in Appendix A.

During the March 2021 precipitation recapture sampling round, only the sample collected from FW-1 had a tritium detection (404 pCi/L) greater than 200 pCi/L. Tritium was only detected in the sample collected from FW-3 during the August 2021 sampling round, at 421 pCi/L. Tritium was only detected in the samples collected from FW-1 and FW-3 during the November 2021 sampling round, at 215 pCi/L and 239 pCi/L, respectively.

Summary of 2021 RGPP Sampling Rounds

March 2021 RGPP Sampling Round Activities (1st Quarter 2021)

Data Summary

A total of 28 groundwater samples were collected during the 1st quarter 2021 sampling round. A sample was not collected from MW-DN-117I due to the well being inaccessible during the 1st quarter 2021. Per the RGPP, the Background, Perimeter, and Mid-Field designated wells were not sampled during the 1st quarter 2021 RGPP sampling round. All samples were analyzed for tritium.

Tritium was detected in five shallow aquifer samples with a maximum tritium concentration of 12,900 pCi/L (MD-11). Tritium was detected in five intermediate aquifer samples with a maximum tritium concentration of 15,300 pCi/L (MW-DN-124I).

The tritium concentration in samples collected from MW-DN-111S showed an increasing trend. While the increased tritium activity could be the result of legacy releases at the Station, it was recommended that the Station evaluate potential sources of the tritium activity in the area of the well.

The Station continued to implement the tritium monitoring plan for the "B" Condensate Storage Tank (CST). The tritium concentrations in the area of the CST showed a decreasing trend at the Station. While the tritium concentration in MD-11 decreased from its maximum reported tritium concentration of approximately 2.29 million pCi/L, an elevated concentration persists in the area of the CST. Tritium concentrations in samples collected from wells (other than MD-11) used to monitor the CST leak have decreased to less than 2,000 pCi/L, indicating the extent of the CST leak is confined to a small geographic area south of the Turbine Building.

AMO concluded that since the CST responsible for the release was repaired, there does not appear to be an active source of tritium to groundwater at the Station. Note that high existing tritium concentrations present a masking effect for detections of a new leak in the area of the CST.

Water Elevations

All groundwater sample locations had depth to water measurements collected during the 1st quarter 2021 sampling round. The 1st quarter 2021 groundwater elevation data was compared to the 1st quarter 2020 sampling round to evaluate if changes in groundwater elevations occurred that may have an effect on groundwater flow direction. The variations in groundwater elevations have no significant effect on groundwater flow direction. Based on comparison of groundwater elevations, the wells sampled effectively monitored groundwater conditions at the Station.

May 2021 RGPP Sampling Round Activities (2nd Quarter 2021)

Data Summary

A total of 57 groundwater samples were collected during the 2nd quarter 2021 sampling round. Samples were not collected from MW-DN-106S, MW-DN-108I, and MW-DN-117I due to the wells being damaged or inaccessible during the 2nd quarter 2021. All samples were analyzed for tritium and gamma-radionuclides. The samples collected from Long-Term Shutdown and Source designated wells were also analyzed for gross-alpha, hard-to-detects (Fe-55 and Ni-63), and Sr-89 and Sr-90.

Tritium was detected in six shallow aquifer samples with a maximum tritium concentration of 11,900 pCi/L (MD-11). Tritium was detected in thirteen intermediate aquifer samples with a maximum tritium concentration of 15,000 pCi/L (MW-DN-124I).

The tritium concentration in samples collected from MW-DN-111S continued to show an increasing trend. The 2nd quarter 2021 RGPP tritium sample result of 5,530 pCi/L is the highest tritium concentration reported for this well, dating back to 2006. A subsequent sample collected in June showed a decreased tritium concentration of 3,180 pCi/L. While the increased tritium activity could be the result of legacy releases at the Station, the Station evaluated potential sources of the tritium in the area of the well and found no potential known sources.

The Station continued to implement the tritium monitoring plan for the "B" Condensate Storage Tank (CST). The tritium concentrations in the area of the CST showed a decreasing trend at the Station. Tritium concentrations in samples collected from wells (other than MD-11) used to monitor the CST leak have generally decreased to less than 1,000 pCi/L, indicating the extent of the CST leak is confined to a small geographic area south of the Turbine Building.

Samples collected from all wells were analyzed for gamma-radionuclides during the 2nd quarter 2021 RGPP sampling round. Gamma radionuclides were not detected at concentrations greater than their respective LLDs in the samples collected in 2021.

Gross-alpha analysis was performed on samples collected from Long-Term Shutdown designated wells and Source designated wells during the 2nd quarter 2021 RGPP sampling round. The sample collected from MW-DN-116S had a gross-alpha (suspended) concentration of 3.35 pCi/L, which exceeded the Alert Level of 2.37 pCi/L, established for that well. Therefore, the 2nd quarter 2021 RGPP sample collected from MW-DN-116S was analyzed for select transuranics. Select transuranics were not detected in the sample collected from MW-DN-116S during the 2nd quarter 2021 RGPP sampling round.

Select transuranics analysis was performed on former Elevated designated wells MD-11, MW-DN-124S, and MW-DN-124I, during the 2nd quarter 2021 RGPP sampling round. Additionally, select transuranics analysis was performed on MW-DN-111S, MW-DN-116S, MW-DN-119I, and extraction well RW-DN-100S during the 2nd quarter 2021 RGPP sampling round. Select Transuranics were not detected at concentrations greater than their respective LLDs in the samples collected during the 2nd quarter 2021 RGPP sampling round.

Ni-63 continued to be detected in the sample collected from Long-Term Shutdown well MW-DN-119I during the 2nd quarter 2021 RGPP sampling round at 11.3 pCi/L. However, Ni-63 concentrations in the well show a decreasing trend over time. Ni-63 was not detected in the other samples collected during the 2nd quarter 2021 RGPP sampling round.

Sr-90 continued to be detected in the samples collected from MW-DN-105S and DSP-108 at 3.20 pCi/L and 1.50 pCi/L, respectively. Detected Concentrations of SR-90 have ranged from 1.09 pCi/L to 4.93 pCi/L in MW-DN-105S. Detected concentrations of SR-90 have ranged from 1.09 pCi/L to 2.64 pCi/L in DSP-108.

AMO concluded that since the CST responsible for the release was repaired, there does not appear to be an active source of tritium to groundwater at the Station. Note that high existing tritium concentrations present a masking effect for detections of a new leak in the area of the CST.

All groundwater sample locations had depth to water measurements collected during the 2nd quarter 2021 sampling round. The 2nd quarter 2021 sampling round groundwater elevation data was compared to the 3rd quarter 2020 sampling round to evaluate if changes in groundwater elevations occurred that may have an effect on groundwater flow direction. The 3rd quarter 2020 groundwater elevation were used because the 2nd quarter 2020 RGPP sampling round was cancelled due to the Covid-19 pandemic. The variations in groundwater elevations have no significant effect on groundwater flow direction. Based on comparison of groundwater elevations, the wells sampled effectively monitored groundwater conditions at the facility.

August 2021 RGPP Sampling Round Activities (3rd Quarter 2021)

Data Summary

A total of 29 groundwater samples were collected during the 3rd quarter 2021 sampling round. Per the RGPP, the Background, Perimeter, and Mid-Field designated wells were not sampled during the 3rd quarter 2021 RGPP sampling round. Additionally, a sample was not collected from MW-DN-117I due to inaccessibility. All samples were analyzed for tritium.

Tritium was detected in four shallow aquifer samples with a maximum concentration of 9,440 pCi/L (MD-11). Tritium was detected in eight intermediate aquifer samples with a maximum concentration of 12,900 pCi/L (MW-DN-124I).

The tritium concentration in MW-DN-111S decreased from 5,530 to 2,270 between the 2nd and 3rd quarter RGPP sampling round.

The Station continued to implement the tritium monitoring plan for the "B" Condensate Storage Tank (CST). The tritium concentrations in the area of the CST showed a decreasing trend at the Station. Tritium concentrations in samples collected from wells (other than MD-11) used to monitor the CST leak have generally decreased to less than 1,000 pCi/L, indicating the extent of the CST leak is confined to a small geographic area south of the Turbine Building.

AMO concluded that since the CST responsible for the release was repaired, there does not appear to be an active source of tritium to groundwater at the Station. Note that high existing tritium concentrations present a masking effect for detections of a new leak in the area of the CST.

Water Elevations

All groundwater sample locations had depth to water measurements collected during the 3rd quarter 2021 sampling round. The 3rd quarter 2021 sampling round groundwater elevation data was compared to the 3rd quarter 2020 sampling round to evaluate if changes in groundwater elevations occurred that may have an effect on groundwater flow direction. The variations in groundwater elevations have no significant effect on groundwater flow direction. Based on comparison of groundwater elevations, the wells sampled effectively monitored groundwater conditions at the facility.

November 2021 RGPP Sampling Round Activities (4th Quarter 2021)

Data Summary

A total of 33 groundwater samples were collected during the 4th quarter 2021 sampling round. Samples were not collected from MW-DN-117I and MW-DN-141S due to the wells being inaccessible at the time of the 4th quarter 2021 RGPP sampling. All samples were analyzed for tritium.

Tritium was detected in nine shallow aquifer samples with a maximum concentration of 12,300 pCi/L (MD-11). Tritium was detected in nine intermediate aquifer samples with a maximum concentration of 14,100 pCi/L (MW-DN-124I).

The tritium concentration in MW-DN-111S remained relative unchanged between the 3rd and 4th quarter RGPP sampling rounds.

The Station continued to implement the tritium monitoring plan for the "B" CST. Tritium concentrations in samples collected from wells (other than MD-11) used to monitor the CST leak have generally decreased to less than 1,000 pCi/L, indicating the extent of the CST leak is confined to a small geographic area south of the Turbine Building.

AMO concluded that since the CST responsible for the release was repaired, there does not appear to be an active source of tritium to groundwater at the Station. Note that high existing tritium concentrations present a masking effect for detections of a new leak in the area of the CST.

Water Elevations

All sampled groundwater locations had depth to water measurements collected during the 4th quarter 2021 sampling round. Groundwater elevations and groundwater flow direction for the shallow aquifer are provided on Figure 2a and groundwater elevations and groundwater flow direction for the intermediate aquifer are provided on Figure 2b. Based on the groundwater flow depicted on figures 2a and 2b, the wells sampled effectively monitored groundwater conditions at the facility.

2022 RGPP Sample Locations

The 2021 RGPP sample locations effectively monitored Systems, Structures, and Components of the Station. Therefore, RGPP sample locations identified in Attachment 1 of EN-DR-408-4160 (Revision 10) should continue to be sampled in accordance with Attachment 2 of EN-DR-408-4160 (Revision 10). Additionally, as mentioned in the *Gross Alpha Alert Level* section of this report, a sample from DSP-125 should be analyzed for select transuranics by the end of the third quarter 2022.

Summary of 2021 RGPP Conformance

The Station conformed with its RGPP with respect to sampling protocol for 2021 with the exception of not sampling MW-DN-106S, MW-DN-108I, MW-DN-117I and MW-DN-141S due to inaccessibility or well damage. According to Station personnel, repairs and accessibility issues were not addressed in 2021, based on the proposed closure of the Station. However, the Station is no longer ceasing operations and plan to address the well accessibility and damage in 2022.

Conclusions

Based on the review of the data collected during the 2021 RGPP sampling rounds AMO concludes:

- The Station continued to implement the tritium monitoring plan for the "B" CST. The tritium concentrations in the area of the CST showed a decreasing trend at the Station through 2020. While the tritium concentration in MD-11 decreased from its maximum reported tritium concentration of approximately 2.29 million pCi/L, an elevated concentration persists in the area of the CST. However, tritium concentrations in samples collected from wells (other than MD-11) used to monitor the CST leak have generally decreased to less than 1,000 pCi/L, indicating the extent of the CST leak is confined to a small geographic area south of the Turbine Building.

- Gamma-radionuclides were not detected at concentrations greater than their respective LLDs in 2021.

- The sample collected from MW-DN-116S had a gross-alpha (suspended) concentration of 3.35 pCi/L, which exceeded the Alert Level of 2.37 pCi/L, established for that well. Therefore, the 2nd quarter 2021 RGPP sample collected from MW-DN-116S was analyzed for select transuranics. Select transuranics were not detected in the sample collected from MW-DN-116S during the 2nd quarter 2021 RGPP sampling round.

- Select Transuranics were not detected at concentrations greater than their respective LLDs in the samples collected during the 2nd quarter 2021 RGPP sampling round.

- Ni-63 continued to be detected in the sample collected from Long-Term Shutdown well MW-DN-119I during the 2nd quarter 2021 RGPP sampling round at 11.3 pCi/L. However, Ni-63 concentrations in the well show a decreasing trend over time.

- Sr-90 continued to be detected in the samples collected from MW-DN-105S and DSP-108 at 3.20 pCi/L and 1.50 pCi/L, respectively. However, Sr-90 concentrations remained in the historic ranges for each well.

- There does not appear to be an active source of tritium to groundwater at the Station since the repair of the CST. Note that high existing tritium concentrations present a masking effect for detections of a new leak in the area of the CST.

- Based on the evaluation of groundwater flow direction, the wells sampled effectively monitored groundwater conditions at the facility.

Please call me at 215-230-8282 if you have questions.

Respectfully,

AMO Environmental Decisions

Ralph T. Golia, P.G.
Principal
Hydrogeologist

attachments

File

Dresden Generating Station
Constellation Energy Company

Table 1
Summary of Gross-Alpha Results

SITE	Well ID	Well Average (-Outliers)	ALERT LEVEL	Gross Alpha - Dissolved Results																												
				2011				2012			2013			2014		2015		2016				2017			2018				2019		2021
				Feb	Mar	Jun	Dec	Mar	May	Jun	Mar	Jun	Jul	May	Jun	Jun	Nov	May	Jun	Aug	Oct	Feb	May	Nov	Feb	Jun	Sep	Nov	May	Dec	May
Dresden	DSP-105	1.71	5.14	--	--	--	--	--	0.611	--	--	1.15	--	--	3.06	1.9	--	--	2.5	--	--	--	1.79	--	--	1.31	--	--	1.39	--	--
	DSP-106	1.30	3.69	--	--	--	--	--	1.04	--	--	0.744	--	--	2.84	1.61	--	--	1.77	--	--	--	1.53	--	--	1.07	--	--	1.1	--	1.5
	DSP-107	1.68	5.04	1.05	--	--	--	--	0.847	--	--	1.03	--	--	2.96	1.74	--	2.72	--	--	--	--	2.73	--	--	1.17	--	--	1.21	--	1.35
	DSP-108	3.93	11.79	--	--	--	--	--	1.05	--	--	1.37	7.87	--	12.4	5.79	--	--	2.95	--	--	--	3.84	--	--	4.71	--	--	3.2	--	4.59
	DSP-122	5.42	16.26	6.93	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.91
	DSP-123	2.00	6.00	0.893	--	--	--	--	1.99	--	--	1.71	--	2.45	--	2.81	--	2.63	--	--	--	--	1.7	--	--	1.86	--	--	1.95	--	5.29
	DSP-124	2.25	6.74	0.91	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.58
	DSP-125	8.01	24.03	--	--	4.93	--	--	9.1	--	--	6.84	--	6.81	--	35.4	--	--	12.6	--	--	--	10.7	--	--	5.11	--	--	9.6	--	6.41
	MD-11	1.20	3.61	--	--	6.17	--	--	--	--	--	--	--	--	--	--	0.977	--	--	--	1.22	1.67	--	1.22	1.21	--	--	0.978	0.996	1.59	0.978
	MW-DN-101-I	2.74	8.23	--	--	--	--	--	2.39	--	--	1.25	--	2.32	--	1.26	--	3.05	--	--	--	--	4.81	--	--	4.6	--	--	1.86	--	3.14
	MW-DN-101-S	4.71	14.14	--	--	--	--	--	6.2	--	--	1.54	--	5.96	--	4.33	--	8.7	--	--	--	--	6.55	--	--	4.28	--	--	3.3	--	1.55
	MW-DN-102-I	2.30	6.89	--	--	0.675	--	--	--	1.46	--	1.29	--	--	3.03	4.08	--	2.63	--	--	--	--	13.8	--	--	4.46	--	--	0.758	--	--
	MW-DN-102-S	19.59	58.78	--	--	9.44	--	--	--	13.9	--	15.6	--	--	19.9	28.3	--	51.8	--	--	--	--	35.2	--	--	20.2	--	--	14.2	--	--
	MW-DN-104-S	5.00	14.99	2.44	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.55
	MW-DN-105-S	#DIV/0!	#DIV/0!	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.2
	MW-DN-106-S	#DIV/0!	#DIV/0!	--	--	1.42	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW-DN-107-S	5.71	17.13	--	--	--	6.37	9.86	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.895
	MW-DN-108-I	1.53	4.58	1.39	--	--	--	--	1.13	--	--	0.828	--	1.73	--	1.87	--	2.22	--	--	--	--	3.35	--	--	--	--	--	--	--	--
	MW-DN-109-I	3.13	9.39	--	--	--	--	--	1.04	--	--	0.499	--	0.936	--	3.81	--	4.29	--	--	--	--	4.02	--	--	3.79	--	--	3.71	--	6.06
	MW-DN-109-S	4.64	13.93	--	--	--	--	--	3.74	--	--	2.74	--	4.01	--	1.97	--	6.52	--	--	--	--	5.93	--	--	5.15	--	--	5.17	--	6.57
	MW-DN-111-S	#DIV/0!	#DIV/0!	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.816
	MW-DN-113-I	2.31	6.93	--	--	0.485	--	--	--	0.531	--	3.87	--	--	1.54	1.53	--	8.9	--	--	--	--	3.91	--	--	3.66	--	--	2.95	--	--
	MW-DN-113-S	2.24	6.71	--	--	2.34	--	--	--	1.76	--	2.56	--	--	2.08	1.45	--	3.02	--	--	--	--	3.16	--	--	2.1	--	--	1.65	--	--
	MW-DN-114-S	#DIV/0!	#DIV/0!	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.12
	MW-DN-115-S	#DIV/0!	#DIV/0!	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.42
	MW-DN-116-I	3.01	9.04	--	--	--	--	--	3.31	--	--	1.64	--	3.01	--	4.16	--	3.77	--	--	--	--	3.79	--	--	1.68	--	--	2.74	--	--
	MW-DN-116-S	2.97	8.90	--	--	--	--	--	2.53	--	--	3.55	--	1.15	--	5.21	--	4.83	--	--	--	--	3.82	--	--	1.57	--	--	2.08	--	1.97
	MW-DN-117-I	1.06	3.19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	1.24	0.884	--	1.13	--
	MW-DN-118-S	1.27	3.80	--	--	--	--	--	0.745	--	--	1.24	--	--	1.84	0.897	--	4.81	--	--	--	--	2.34	--	--	0.551	--	--	1.11	--	1.41
	MW-DN-119-I	3.04	9.11	--	--	--	--	--	1.86	--	--	3.62	--	2.42	--	3.18	--	--	4.44	--	--	--	28.9	6.25	--	2.95	--	3.85	2.24	3.29	2.53
	MW-DN-119-S	3.26	9.78	--	--	--	--	--	2.35	--	--	1.55	--	4.23	--	4.95	--	--	7.23	--	--	--	1.57	--	--	3.03	--	--	2.98	--	1.44
	MW-DN-122-I	#DIV/0!	#DIV/0!	--	1.41	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	MW-DN-124-I	3.99	11.98	2.13	--	--	--	--	--	2	--	3.35	--	--	9.99	4.06	--	5.33	--	--	--	--	7.19	--	--	3.74	--	--	4.15	--	3.99
	MW-DN-124-S	4.21	12.63	--	--	--	--	--	--	2.63	--	1.71	--	--	4.74	5.76	--	5.77	--	--	--	--	6.35	--	--	3.72	--	--	2.96	--	4.26
	MW-DN-125-S	3.03	9.09	--	--	--	--	--	--	2.62	--	1.83	--	--	4.83	1.38	--	--	3.63	--	--	--	30	--	--	5.32	--	--	1.6	--	--
	MW-DN-126-S	6.94	20.83	--	--	--	--	--	--	11.5	--	12.7	--	--	13.1	6.66	--	4.16	--	--	--	--	6.85	--	--	1.56	--	--	3.46	--	2.5
	MW-DN-127-S	2.45	7.35	--	--	--	--	--	2.1	--	--	2.36	--	--	5.27	1.09	--	2.03	--	--	--	--	5.89	--	--	0.476	--	--	0.393	--	--
	MW-DN-134-S	2.78	8.33	--	--	--	--	--	--	--	1.65	2.62	--	--	3.65	3.77	--	4.38	--	--	--	--	1.06	--	--	2.88	--	--	2.21	--	--
	MW-DN-135-S	2.48	7.44	--	--	--	--	--	--	--	2.81	4.2	--	--	1.64	1.7	--	3.21	--	--	--	--	2.06	--	--	1.5	--	--	2.71	--	--
	MW-DN-136-S	4.93	14.78	--	--	--	--	--	--	--	2.31	3.28	--	--	4.51	6.46	--	7.85	--	--	--	--	3.65	--	--	3.27	--	--	8.84	--	4.16
	MW-DN-137-S	4.88	14.63	--	--	--	--	--	--	--	8.52	1.58	--	--	4.9	--	5.57	6.65	--	--	--	--	5.46	--	--	3.43	--	--	2.89	--	--
	MW-DN-140-S	3.85	11.54	--	--	--	--	--	--	--	6.59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.1
	MW-DN-141-S	0.90	2.69	--	--	--	--	--	--	--	0.837	0.769	--	2.08	--	1.33	--	1.12	--	--	--	--	0.78	--	--	0.722	--	--	0.852	--	0.757
	MW-DN-142-S	4.56	13.67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.27	--	--	2.98	--	--	4.31	--	--	3.66	--	--
	MW-DN-143-S	3.10	9.31	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.16	--	--	4.71	--	--	3.06	--	--	2.48	--	--
	MW-DN-144-S	3.66	10.97	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.17	--	--	4.76	--	--	3.27	--	--	2.43	--	--
-	RW-DN-100-S	#DIV/0!	#DIV/0!	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.57
	RW-DN-101-S	#DIV/0!	#DIV/0!	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Results in pCi/L

Dresden Generating Station
Constellation Energy Company

Table 1
Summary of Gross-Alpha Results

SITE	Well ID	Well Average (-Outliers)	ALERT LEVEL	Gross Alpha - Suspended Results																													
				2011				2012			2013			2014		2015		2016				2017			2018				2019		2021
				Feb	Mar	Jun	Dec	Mar	May	Jun.	Mar	Jun	Jul	May	Jun	Jun	Nov	May	Jun.	Aug	Oct	Feb	May	Nov	Feb	Jun	Sep	Nov	May	Dec	May
Dresden	DSP-105	0.86	2.59	--	--	--	--	--	0.82	--	--	0.793	--	--	0.63	0.923	--	--	0.599	--	--	--	0.617	--	--	1.13	--	--	1.39	--	
	DSP-106	0.73	2.20	--	--	--	--	--	0.809	--	--	0.793	--	--	0.63	0.923	--	--	0.599	--	--	--	0.617	--	--	1.13	--	--	4.28	--	0.367
	DSP-107	0.62	1.87	0.345	--	--	--	--	0.349	--	--	0.361	--	--	0.63	0.918	--	4.74	--	--	--	--	0.618	--	--	1.13	--	--	0.896	--	0.367
	DSP-108	0.71	2.13	--	--	--	--	--	0.348	--	--	0.361	0.851	--	0.63	0.933	--	--	0.605	--	--	--	0.619	--	--	1.14	--	--	0.897	--	1.83
	DSP-122	1.32	3.97	0.245	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.4
	DSP-123	0.66	1.99	0.614	--	--	--	--	0.347	--	--	0.601	--	1.9	--	0.923	--	0.608	--	--	--	--	0.617	--	--	1.16	--	--	0.719	--	0.369
	DSP-124	0.76	2.29	0.616	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.912
	DSP-125	1.67	5.00	--	--	1.28	--	--	0.66	--	--	1.69	--	1.9	--	0.892	--	--	2.88	--	--	--	2.21	--	--	1.65	--	--	3.72	--	1.84
	MD-11	0.67	2.00	--	--	0.639	--	--	--	--	--	--	--	--	--	--	0.711	--	--	--	0.777	0.347	--	0.822	0.624	--	--	0.844	0.898	0.628	0.366
	MW-DN-101-I	0.83	2.48	--	--	--	--	--	0.78	--	--	0.267	--	1.24	--	0.923	--	1.04	--	--	--	--	0.62	--	--	1.14	--	--	0.719	--	0.717
	MW-DN-101-S	1.89	5.67	--	--	--	--	--	1.12	--	--	0.695	--	1.24	--	0.962	--	3.41	--	--	--	--	13.55	--	--	1.73	--	--	3.82	--	2.14
	MW-DN-102-I	1.02	3.05	--	--	2	--	--	--	0.495	--	0.496	--	--	0.63	0.359	--	0.361	--	--	--	--	2.33	--	--	1.73	--	--	0.752	--	
	MW-DN-102-S	2.82	8.45	--	--	3.58	--	--	--	1.8	--	1.88	--	--	0.63	2.14	--	4.99	--	--	--	--	3.8	--	--	1.37	--	--	5.16	--	
	MW-DN-104-S	2.11	6.32	0.62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.59
	MW-DN-105-S	#DIV/0!	#DIV/0!	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.58
	MW-DN-106-S	#DIV/0!	#DIV/0!	--	--	1.17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	MW-DN-107-S	3.40	10.20	--	--	--	2.5	6.96	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.742
	MW-DN-108-I	2.12	6.37	0.64	--	--	--	--	0.781	--	--	0.608	--	1.24	--	1.15	--	8.33	--	--	--	--	36.3	--	--	--	--	--	--	--	
	MW-DN-109-I	1.02	3.05	--	--	--	--	--	0.502	--	--	0.604	--	1.24	--	0.51	--	0.357	--	--	--	--	1.84	--	--	1.6	--	--	1.48	--	3.56
	MW-DN-109-S	1.46	4.39	--	--	--	--	--	0.396	--	--	0.503	--	1.24	--	0.508	--	2.05	--	--	--	--	1.84	--	--	1.6	--	--	1.48	--	3.56
	MW-DN-111-S	#DIV/0!	#DIV/0!	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.517
	MW-DN-113-I	2.70	8.09	--	--	1.18	--	--	--	0.499	--	1.3	--	--	1.21	0.361	--	20.18	--	--	--	--	1.85	--	--	7.89	--	--	7.27	--	
	MW-DN-113-S	4.70	14.10	--	--	0.649	--	--	--	1.63	--	0.446	--	--	2.47	3.24	--	15.7	--	--	--	--	7.59	--	--	8.62	--	--	1.94	--	
	MW-DN-114-S	#DIV/0!	#DIV/0!	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.931
	MW-DN-115-S	#DIV/0!	#DIV/0!	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.06
	MW-DN-116-I	0.70	2.11	--	--	--	--	--	1.02	--	--	0.503	--	1.24	--	0.503	--	0.374	--	--	--	--	0.623	--	--	0.627	--	--	0.726	--	
	MW-DN-116-S	1.07	3.22	--	--	--	--	--	0.69	--	--	0.502	--	1.24	--	0.506	--	0.746	--	--	--	--	1.02	--	--	0.871	--	--	0.747	--	3.35
	MW-DN-117-I	0.82	2.46	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.807	--	--	0.491	0.831	--	1.15	
	MW-DN-118-S	0.73	2.20	--	--	--	--	--	0.622	--	--	0.491	--	--	1.79	0.511	--	0.938	--	--	--	--	0.809	--	--	0.862	--	--	0.892	--	1.66
	MW-DN-119-I	0.88	2.65	--	--	--	--	--	0.62	--	--	1.03	--	2.83	--	0.515	--	--	0.912	--	--	--	2.78	0.85	--	0.501	--	0.981	1.54	1.03	0.849
	MW-DN-119-S	2.55	7.64	--	--	--	--	--	0.622	--	--	0.557	--	1.24	--	0.509	--	--	2.38	--	--	--	3.73	--	--	4.28	--	--	5.52	--	4.07
	MW-DN-122-I	#DIV/0!	#DIV/0!	--	3.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	MW-DN-124-I	1.28	3.83	0.345	--	--	--	--	--	0.491	--	0.665	--	--	1.21	1.28	--	1.73	--	--	--	--	2.78	--	--	1.5	--	--	1.5	--	4.33
	MW-DN-124-S	1.94	5.82	--	--	--	--	--	--	0.356	--	0.49	--	--	1.21	1.28	--	2.41	--	--	--	--	2.87	--	--	3.46	--	--	0.982	--	4.4
	MW-DN-125-S	1.14	3.43	--	--	--	--	--	--	0.362	--	0.798	--	--	1.21	1.94	--	--	0.739	--	--	--	2.87	--	--	1.51	--	--	1.44	--	
	MW-DN-126-S	1.75	5.24	--	--	--	--	--	--	1.33	--	1.5	--	--	1.21	1.29	--	1.79	--	--	--	--	2.77	--	--	1.5	--	--	2.57	--	4.54
	MW-DN-127-S	0.92	2.77	--	--	--	--	--	0.817	--	--	0.488	--	--	1.21	1.34	--	0.731	--	--	--	--	0.815	--	--	0.862	--	--	1.13	--	
	MW-DN-134-S	0.72	2.15	--	--	--	--	--	--	--	0.925	0.513	--	--	0.657	0.345	--	0.721	--	--	--	--	0.807	--	--	0.866	--	--	0.886	--	
	MW-DN-135-S	0.75	2.25	--	--	--	--	--	--	--	1.08	0.538	--	--	0.657	0.345	--	0.721	--	--	--	--	0.843	--	--	0.932	--	--	0.884	--	
	MW-DN-136-S	1.13	3.39	--	--	--	--	--	--	--	0.4	0.545	--	--	0.657	0.346	--	2.55	--	--	--	--	1.76	--	--	1.36	--	--	1.43	--	4.33
	MW-DN-137-S	1.41	4.24	--	--	--	--	--	--	--	1.25	0.645	--	--	1.1	--	0.351	2.5	--	--	--	--	2.61	--	--	1.42	--	--	1.44	--	
	MW-DN-140-S	1.18	3.54	--	--	--	--	--	--	--	1.49	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.869
	MW-DN-141-S	0.82	2.45	--	--	--	--	--	--	--	0.973	0.513	--	1.24	--	0.504	--	0.894	--	--	--	--	0.83	--	--	1.03	--	--	0.884	--	0.909
	MW-DN-142-S	1.16	3.49	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.62	--	--	0.591	--	--	1.47	--	--	1.43	--	
	MW-DN-143-S	1.26	3.78	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.819	--	--	1.81	--	--	1.43	--	--	0.982	--	
	MW-DN-144-S	1.89	5.66	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.23	--	--	1.85	--	--	1.44	--	--	1.02	--	
	RW-DN-100-S	#DIV/0!	#DIV/0!	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.68
	RW-DN-101-S	#DIV/0!	#DIV/0!	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

Explanation:

2.83 Historic data outlier removed from the calculation of the average concentration that was used to calculate the Alert Level.

3.35 Alert Level Exceedance where select transuranics were analyzed and found to be less than their respective LLDs The result is now used in generating the Alert Level.

3.56 Alert Level Exceedance However, the result is ND and less than LLD

Results in pCi/L

Dresden Generating Station
Constellation Energy Company

Table 2
Summary of U-233/234
and U238 Results

U-233/234 Results

Station	Well ID	2011 Feb	2011 Mar	2011 Jun	2011 Dec	2012 Mar	2012 Jun	2013 Mar	2013 Jun	2014 Jun	2015 Jun	2015 Nov	2016 May	2016 Oct	2017 Feb	2017 May	2017 Nov	2018 Jan	2018 Feb	2018 Jun	2018 Oct	2018 Nov	2019 Mar	2019 May	2019 Aug	2019 Dec	2020 Mar	2020 Jul	2020 Nov	2021 May
Dresden	DSP-107	0.09023																												
	DSP-122	0.1733																												
	DSP-123	0.1647																												
	DSP-124	0.03502																												
	DSP-125			0.1329																										
	MD-11			0.05616								0.1496		0.1019	0.03347		0.1252		0.1154			0.1121		0.04995		0.1377			0.1474	0.1156
	MW-DN-101-I																	0.3894	0.05872	0.4567		0.2605	0.527	0.4477	0.2788	0.5173	0.2971			
	MW-DN-102-I			0.5784																										
	MW-DN-102-S			0.1116																										
	MW-DN-104-S	0.8506																												
	MW-DN-106-S			1.091																										
	MW-DN-107-S				0.371	0.9135																								
	MW-DN-108-I	0.3799																												
	MW-DN-111S																													0.03651
	MW-DN-113-I			0.09059																										
	MW-DN-113-S			0.544																										
	MW-DN-116-S																													0.07296
	MW-DN-119-I																0.8408	0.09179		0.1428	0.0229	0.0217	0.04698	0.1045	0.1441	0.1718	0.1187	0.08836		0.06477
	MW-DN-122-I		0.324																											
	MW-DN-124-I	0.05192					0.06465	0.08076	0.1292	0.143	0.08868		0.1273			0.104				0.1055				0.03858					0.1186	0.1395
	MW-DN-124-S							0.05753	0.9742	0.1876	0.7096		0.03498			0.113				0.02586				0.1175					0.1191	0.1802
	RW-DN-100S																													0.1454
	SW-DN-101			0.4082																										
	SW-DN-102			0.441																										
	SW-DN-103			0.6737																										
	SW-DN-104			0.7946																										
	SW-DN-105			0.553																										
	SW-DN-106			0.489																										

U-238 Results

Station	Well ID	2011 Feb	2011 Mar	2011 Jun	2011 Dec	2012 Mar	2012 Jun	2013 Mar	2013 Jun	2014 Jun	2015 Jun	2015 Nov	2016 May	2016 Oct	2017 Feb	2017 May	2017 Nov	2018 Jan	2018 Feb	2018 Jun	2018 Oct	2018 Nov	2019 Mar	2019 May	2019 Aug	2019 Dec	2020 Mar	2020 Jul	2020 Nov	2021 May
Dresden	DSP-107	0.07626																												
	DSP-122	0.1605																												
	DSP-123	0.0743																												
	DSP-124	0.06065																												
	DSP-125			0.1879																										
	MD-11			0.07942								0.1058		0.09531	0.05797		0.1252		0.1233			0.1068		0.06118		0.1124			0.1575	0.03103
	MW-DN-101-I																	0.1488	0.08303	0.1215		0.1775	0.2164	0.1499	0.1993	0.124	0.1755			
	MW-DN-102-I			0.1066																										
	MW-DN-102-S			0.1116																										
	MW-DN-104-S	0.4353																												
	MW-DN-106-S			0.845																										
	MW-DN-107-S				0.4338	0.6638																								
	MW-DN-108-I	0.2105																												
	MW-DN-111S																													0.06802
	MW-DN-113-I			0.06406																										
	MW-DN-113-S			0.2991																										
	MW-DN-116-S																													0.07296
	MW-DN-119-I																0.4422	0.1124		0.08746	0.04265	0.0217	0.08136	0.08333	0.1556	0.1403	0.1346	0.1141		0.1295
	MW-DN-122-I		0.3512																											
	MW-DN-124-I	0.1465					0.07465	0.08076	0.0914	0.1891	0.05121		0.2437			0.1644				0.08823				0.122					0.08389	0.1801
	MW-DN-124-S							0.04069	0.3889	0.1532	0.2626		0.1399			0.04273				0.1274				0.06283					0.1191	0.1472
	RW-DN-100S																													0.1781
	SW-DN-101			0.5516																										
	SW-DN-102			0.5302																										
	SW-DN-103			0.4086																										
	SW-DN-104			0.4812																										
	SW-DN-105			0.3978																										
	SW-DN-106			0.5952																										

Notes:
1 - If a sample was re-analyzed on a particular date, only the highest concentration is noted.

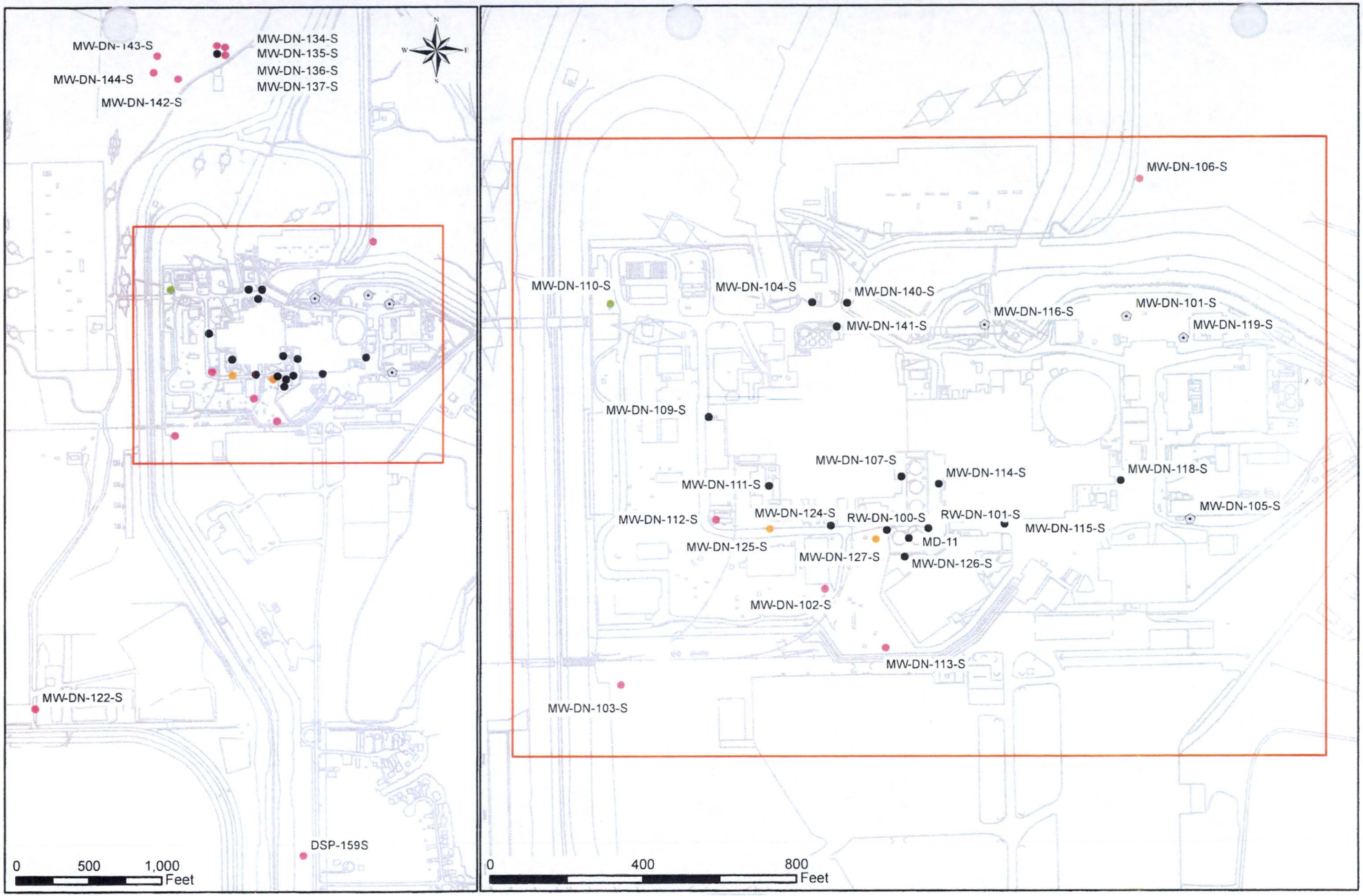
Results in pCi/L

AMO Environmental Decision

Table 3
Summary of 2021 Precipitation Results

Sample Location	Sample Date	Directional Sector	Result	Qual
FW-1	3/9/2021	NW	404	+
FW-1	8/12/2021	NW	177	U
FW-1	11/10/2021	NW	215	+
FW-10	3/8/2021	E	187	U
FW-10	8/11/2021	E	161	U
FW-10	11/9/2021	E	186	U
FW-11	3/8/2021	ESE	182	U
FW-11	8/10/2021	ESE	169	U
FW-11	11/9/2021	ESE	181	U
FW-12	3/11/2021	SSE	186	U
FW-12	8/12/2021	SSE	173	U
FW-12	11/9/2021	SSE	187	U
FW-2	3/11/2021	NNE	184	U
FW-2	8/11/2021	NNE	176	U
FW-2	11/9/2021	NNE	192	+
FW-3	3/11/2021	NNW	182	U
FW-3	8/11/2021	NNW	421	+
FW-3	11/9/2021	NNW	239	+
FW-4	3/11/2021	SW	180	U
FW-4	8/12/2021	SW	176	U
FW-4	11/8/2021	SW	193	U
FW-5	3/11/2021	NE	182	U
FW-5	8/10/2021	NE	169	U
FW-5	11/8/2021	NE	177	U

Explanation:
U - Tritium not detected at a concentration greater than the laboratory detection limit.
+ - Tritium detected at a Concentration greater than the laboratory detection limit.
- All results presented in pCi/L.

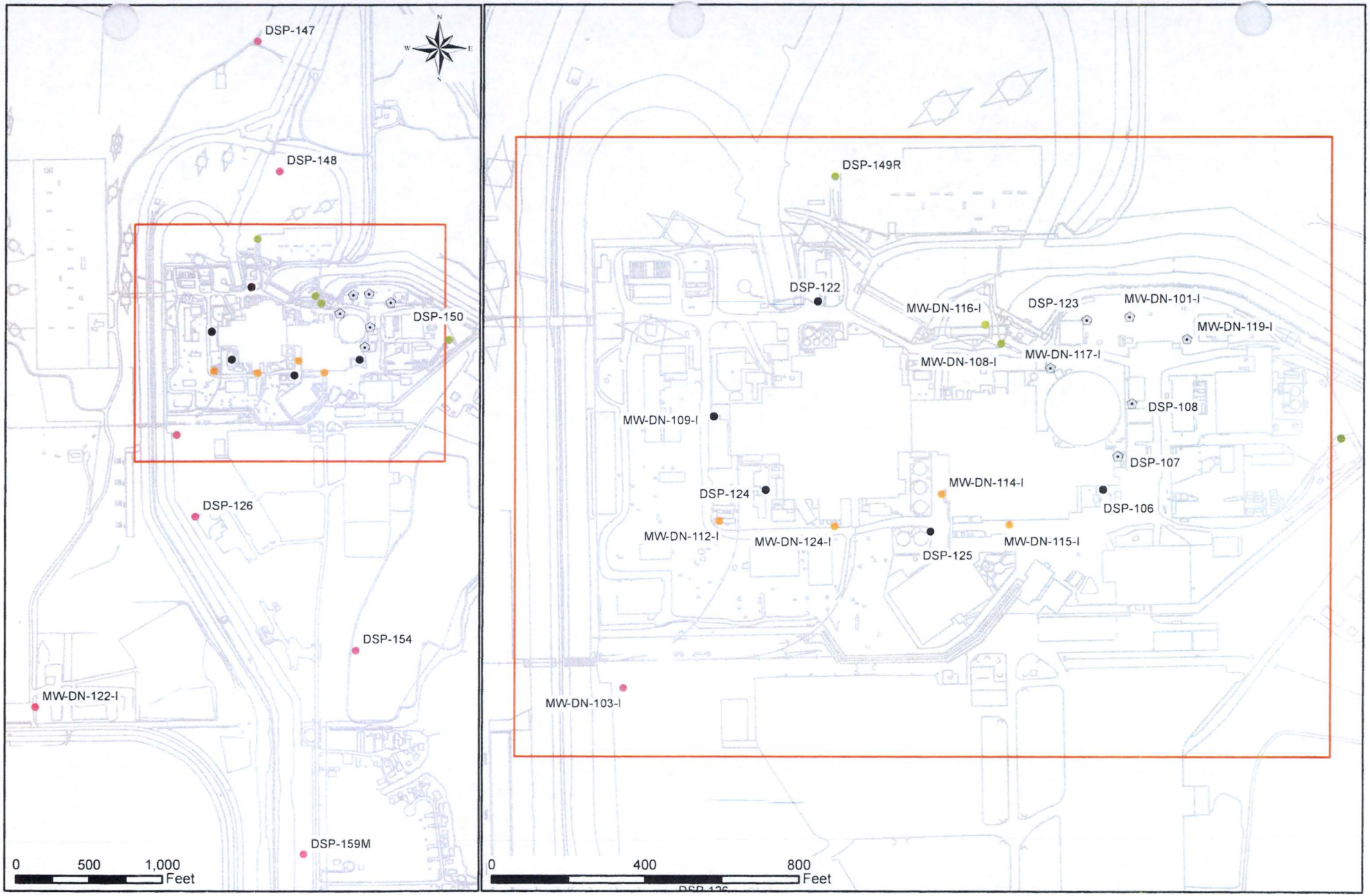


Explanation:

Shallow Aquifer RGPP Monitoring Location

- Background
- Long-Term Shutdown
- Mid-Field
- Perimeter
- Source

Figure 1a
RGPP Sample Locations
Shallow Aquifer
Exelon Corporation
Dresden Generating Station

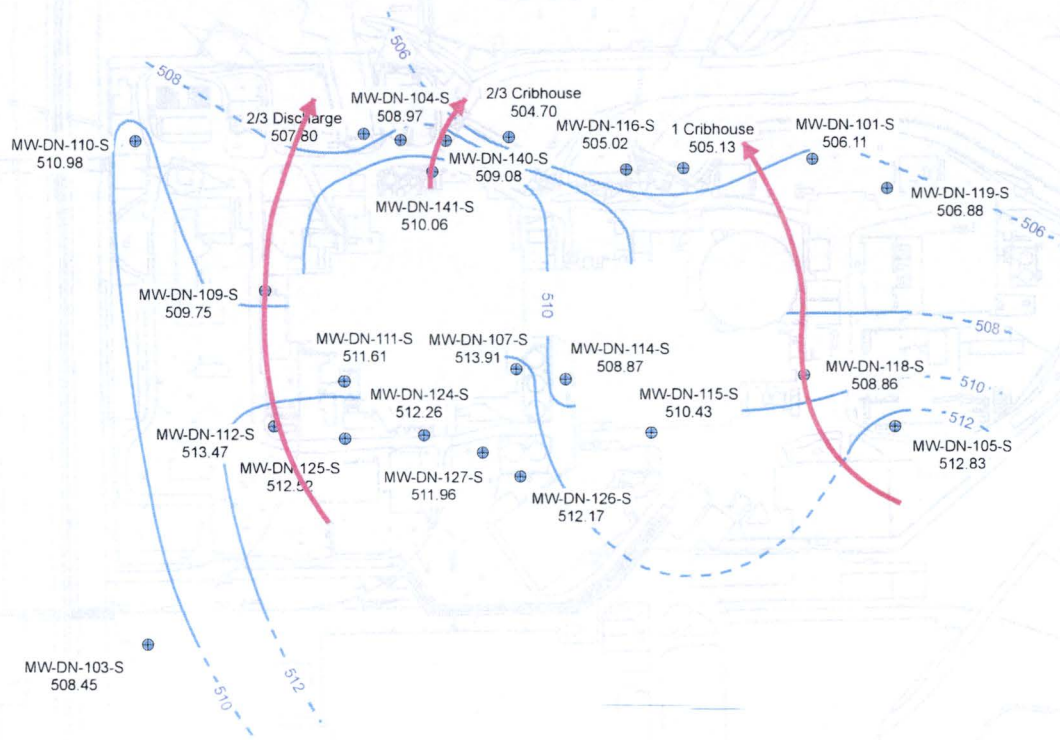


Explanation:

Intermediate Aquifer RGPP Monitoring Location

- Background
- Long-Term Shutdown
- Mid-Field
- Perimeter
- Source

Figure 1b
RGPP Sample Locations
Intermediate Aquifer
Exelon Corporation
Dresden Generating Station

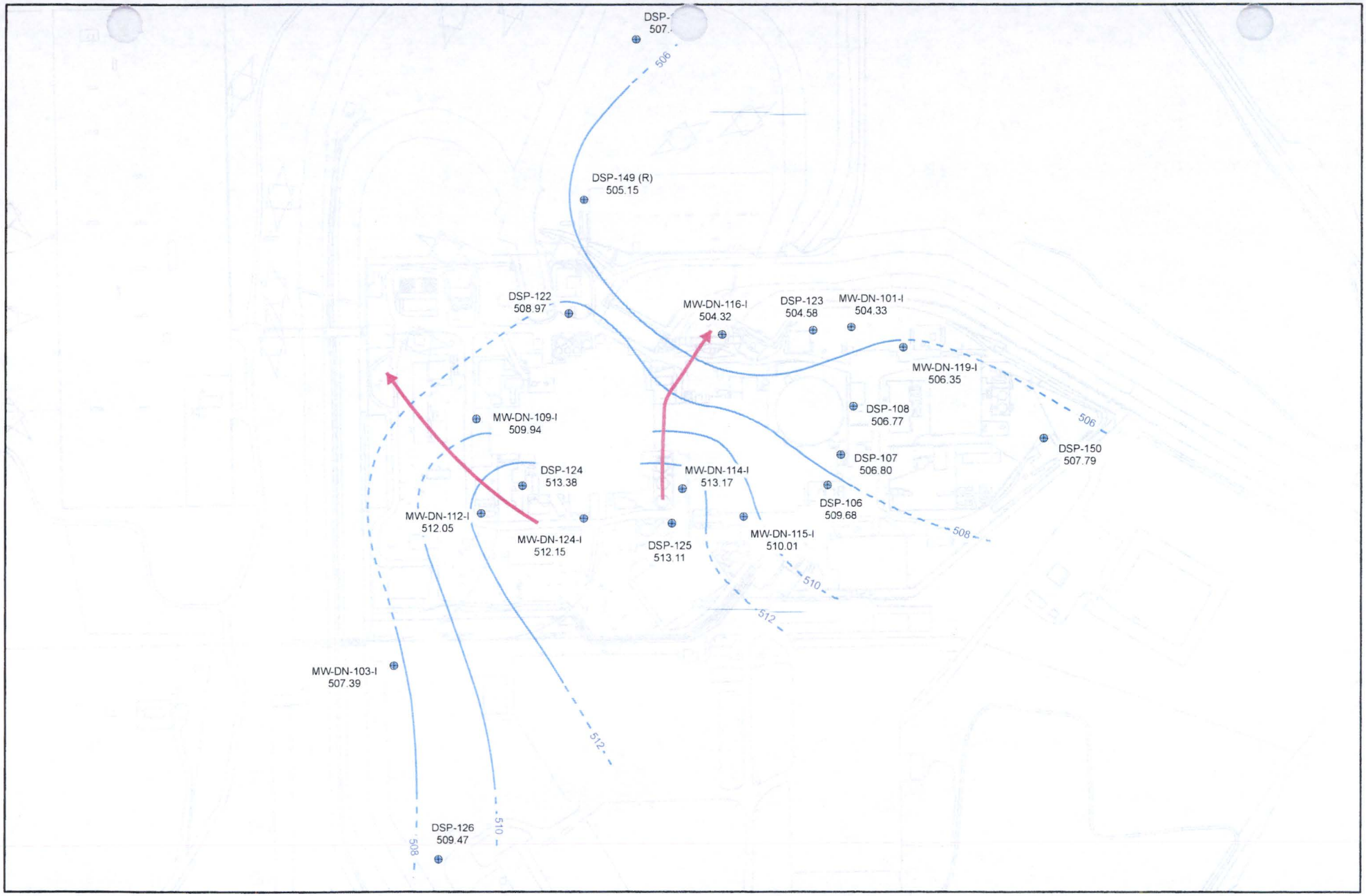


Explanation:

- 4th Qtr. 2021 RGPP Shallow Aquifer Monitoring Locaiton
- Groundwater Elevation Contour
- Inferred Groundwater Elevation Contour
- Estimated groundwater flow direction

508.45 - Groundwater elevation with respect to mean sea level

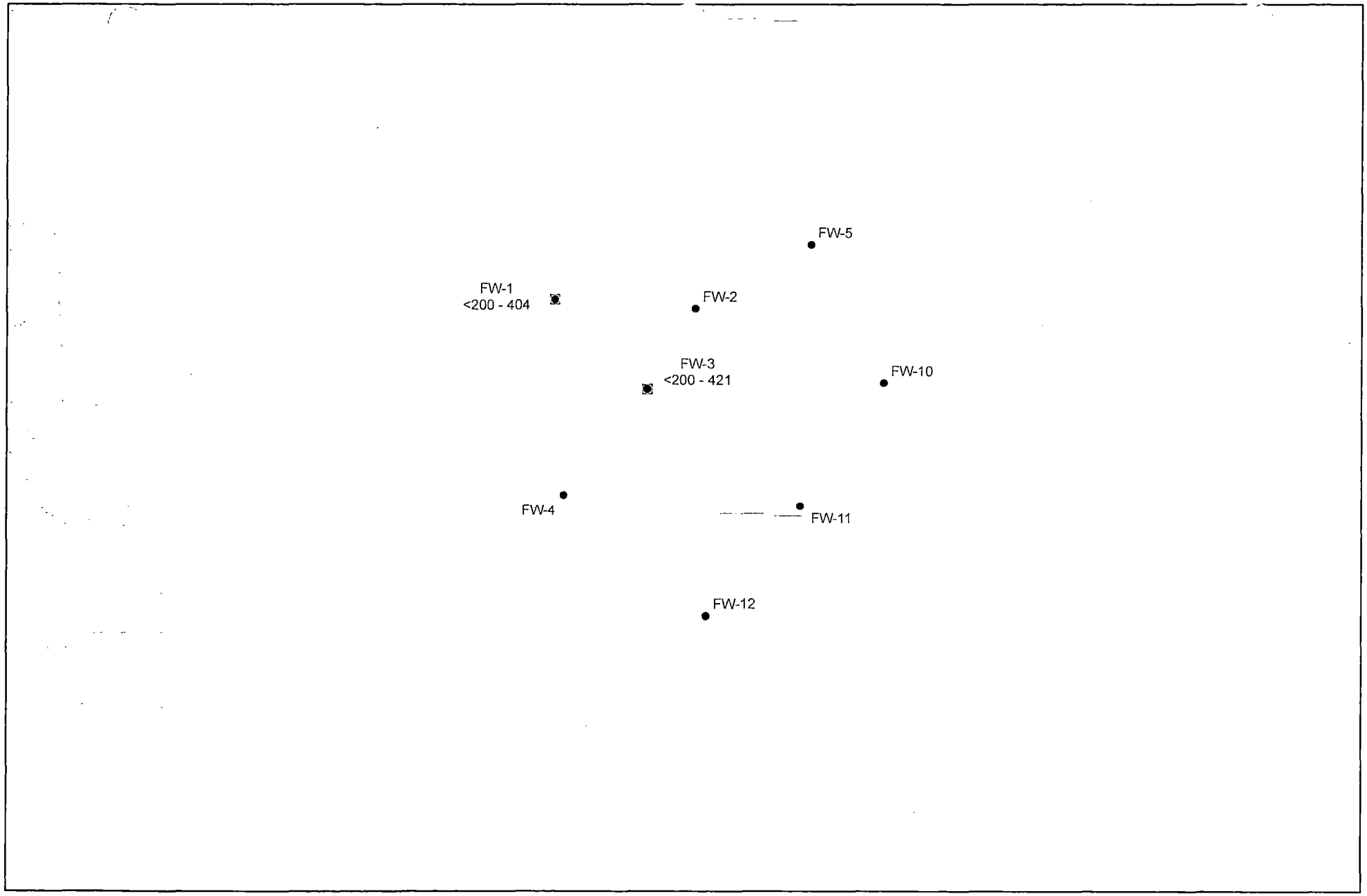
Figure 2a
4th Quarter 2021 (November) RGPP
Groundwater Elevations and
Water Elevation Contours
Surface Water and Shallow Aquifer
Exelon Corporation
Dresden Generating Station



Explanation:

- 4th Qtr. 2021 RGPP Intermediate Aquifer Monitoring Location
- Groundwater Elevation Contour
- Inferred Groundwater Elevation Contour
- Estimated groundwater flow direction
- 508.45 - Groundwater elevation with respect to mean sea level

Figure 2b
4th Quarter 2021 (November) RGPP
Groundwater Elevations and
Water Elevation Contours
Intermediate Aquifer
Exelon Corporation
Dresden Generating Station



Explanation:

2021 Precipitation Recapture Sample Locations

- ■ Result >200 pCi/L
- ● Result <200 pCi/L

404 - Tritium concentration in pico-curies per liter (pCi/L).

- Precipitation sampling completed in March, August, and November in 2021.

Figure 3
2021 Precipitation Recapture
Sample Locations
Exelon Corporation
Dresden Generating Station

Appendix A
Summary of 2011 - 2021 Precipitation Sample Tritium Results

Sample ID	Date	Directional Sector	Result	Qual	Units
RB-1	7/28/2011	NW	400	+	pCi/L
RB-10	7/28/2011	E	630	+	pCi/L
RB-11	7/28/2011	ESE	300	+	pCi/L
RB-12	7/28/2011	SSE	100	U	pCi/L
RB-2	7/28/2011	NNE	630	+	pCi/L
RB-3	7/28/2011	NNW	200	U	pCi/L
RB-4	7/28/2011	SW	100	U	pCi/L
RB-5	7/28/2011	NE	100	U	pCi/L
RB-6	7/28/2011	ENE	200	U	pCi/L
RB-7	7/28/2011	SE	200	U	pCi/L
RB-8	7/28/2011	S	100	U	pCi/L
RB-9	7/28/2011	SSW	100	U	pCi/L
RB-1	10/21/2011	NW	300	+	pCi/L
RB-10	10/21/2011	E	0	U	pCi/L
RB-11	10/21/2011	ESE	200	+	pCi/L
RB-12	10/21/2011	SSE	100	U	pCi/L
RB-2	10/21/2011	NNE	300	+	pCi/L
RB-3	10/21/2011	NNW	300	+	pCi/L
RB-4	10/21/2011	SW	400	+	pCi/L
RB-5	10/21/2011	NE	300	+	pCi/L
RB-6	10/21/2011	ENE	200	U	pCi/L
RB-7	10/21/2011	SE	200	U	pCi/L
RB-8	10/21/2011	S	100	U	pCi/L
RB-9	10/21/2011	SSW	0	U	pCi/L
RB-1	1/11/2012	NW	400	+	pCi/L
RB-10	1/11/2012	E	300	+	pCi/L
RB-11	1/11/2012	ESE	100	U	pCi/L
RB-12	1/11/2012	SSE	300	+	pCi/L
RB-2	1/11/2012	NNE	600	+	pCi/L
RB-3	1/11/2012	NNW	600	+	pCi/L
RB-4	1/11/2012	SW	500	+	pCi/L
RB-5	1/11/2012	NE	400	+	pCi/L
RB-6	1/11/2012	ENE	300	+	pCi/L
RB-7	1/11/2012	SE	400	+	pCi/L
RB-8	1/11/2012	S	300	+	pCi/L
RB-9	1/11/2012	SSW	100	U	pCi/L
RB-1	5/23/2012	NW	191	U	pCi/L
RB-10	5/23/2012	E	199	U	pCi/L
RB-11	5/30/2012	ESE	168	U	pCi/L
RB-12	5/30/2012	SSE	167	U	pCi/L
FW-1	6/6/2013	NW	161	U	pCi/L
FW-10	6/7/2013	E	160	U	pCi/L
FW-11	6/13/2013	ESE	169	U	pCi/L
FW-12	6/14/2013	SSE	168	U	pCi/L
FW-1	5/29/2014	NW	194	U	pCi/L
FW-10	5/30/2014	E	191	U	pCi/L
FW-11	5/30/2014	ESE	194	U	pCi/L
FW-12	5/30/2014	SSE	196	U	pCi/L
FW-1	6/1/2015	NW	190	U	pCi/L
FW-10	6/2/2015	E	188	U	pCi/L
FW-11	6/3/2015	ESE	182	U	pCi/L
FW-12	6/8/2015	SSE	175	U	pCi/L
FW-1	06/07/2016	NW	181	U	pCi/L
FW-10	06/01/2016	E	183	U	pCi/L
FW-11	06/01/2016	ESE	181	U	pCi/L
FW-12	06/01/2016	SSE	182	U	pCi/L
FW-1	05/15/2017	NW	177	U	pCi/L
FW-10	05/23/2017	E	177	U	pCi/L
FW-11	05/17/2017	ESE	175	U	pCi/L
FW-12	05/24/2017	SSE	178	U	pCi/L
FW-1	06/12/2018	NW	193	U	pCi/L

Appendix A
Summary of 2011 - 2021 Precipitation Sample Tritium Results

Sample ID	Date	Directional Sector	Result	Qual	Units
FW-10	06/12/2018	E	193	U	pCi/L
FW-11	06/12/2018	ESE	196	U	pCi/L
FW-12	06/02/2018	SSE	196	U	pCi/L
FW-1	5/28/2019	NW	188	U	pCi/L
FW-10	5/28/2019	E	181	U	pCi/L
FW-11	5/28/2019	ESE	186	U	pCi/L
FW-12	5/28/2019	SSE	187	U	pCi/L
FW-1	11/12/2020	NW	207	+	pCi/L
FW-10	11/12/2020	E	170	U	pCi/L
FW-11	11/12/2020	ESE	175	U	pCi/L
FW-12	11/12/2020	SSE	276	U	pCi/L
FW-11	3/8/2021	ESE	182	U	pCi/L
FW-10	3/8/2021	E	187	U	pCi/L
FW-1	3/9/2021	NW	404	+	pCi/L
FW-4	3/11/2021	SW	180	U	pCi/L
FW-12	3/11/2021	SSE	186	U	pCi/L
FW-2	3/11/2021	NNE	184	U	pCi/L
FW-3	3/11/2021	NNW	182	U	pCi/L
FW-5	3/11/2021	NE	182	U	pCi/L
FW-11	8/10/2021	ESE	169	U	pCi/L
FW-5	8/10/2021	NE	169	U	pCi/L
FW-10	8/11/2021	E	161	U	pCi/L
FW-2	8/11/2021	NNE	176	U	pCi/L
FW-3	8/11/2021	NNW	421	+	pCi/L
FW-1	8/12/2021	NW	177	U	pCi/L
FW-4	8/12/2021	SW	176	U	pCi/L
FW-12	8/12/2021	SSE	173	U	pCi/L
FW-4	11/8/2021	SW	193	U	pCi/L
FW-5	11/8/2021	NE	177	U	pCi/L
FW-12	11/9/2021	SSE	187	U	pCi/L
FW-11	11/9/2021	ESE	181	U	pCi/L
FW-10	11/9/2021	E	186	U	pCi/L
FW-2	11/9/2021	NNE	192	+	pCi/L
FW-3	11/9/2021	NNW	239	+	pCi/L
FW-1	11/10/2021	NW	215	+	pCi/L

OFFSITE DOSE CALCULATION MANUAL

(CY-DR-170-301)

DRESDEN STATION

UNITS 1, 2, 3

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OFFSITE DOSE CALCULATION MANUAL

Part I, RADIOACTIVE EFFLUENT CONTROLS

DRESDEN STATION

UNITS 1, 2, 3

1.0 USE AND APPLICATION

1.1 Definitions

----------NOTE----------
The defined terms of this section appear in capitalized type and are applicable throughout these Offsite Dose Calculation Manual (ODCM) Controls and Bases.

Term	Definition
ACTION	ACTIONS shall be that part of a Control that prescribes Required Actions to be taken under designated Conditions within specified Completion Times.
CHANNEL CALIBRATION	A CHANNEL CALIBRATION shall be the adjustment, as necessary, of the channel output such that it responds within the necessary range and accuracy to known values of the parameter that the channel monitors. The CHANNEL CALIBRATION shall encompass the entire channel, including the sensors and alarm, display and interlock and/or trip functions, and shall include the CHANNEL FUNCTIONAL TEST. Calibration of instrument channels with resistance temperature detector (RTD) or thermocouple sensors may consist of an in-place qualitative assessment of sensor behavior and normal calibration of the remaining adjustable devices in the channel. The CHANNEL CALIBRATION may be performed by means of any series of sequential, overlapping, or total channel steps so that the entire channel is calibrated.
CHANNEL CHECK	A CHANNEL CHECK shall be the qualitative assessment, by observation, of channel behavior during operation. This determination shall include, where possible, comparison of the channel indication and/or status with other indications and/or status derived from independent instrument channels measuring the same parameter.
CHANNEL FUNCTIONAL TEST	A CHANNEL FUNCTIONAL TEST shall be the injection of a simulated or actual signal into the channel as close to the sensor as practicable to verify FUNCTIONALITY, including alarm and/or trip functions and channel failure trips. The CHANNEL FUNCTIONAL TEST may be performed by means of any series of sequential, overlapping, or total channel steps so that the entire channel is tested.
CONTINUOUS SAMPLING	Uninterrupted sampling with the exception of interruptions of short duration (no longer than 2 hours) for required surveillances or repair.
DOSE EQUIVALENT I-131	DOSE EQUIVALENT I-131 shall be as defined in the Units 2/3 Technical Specifications.

(continued)

1.1 Definitions (continued)

FUNCTIONAL - FUNCTIONALITY	Functionality is an attribute of structures, systems, or components (SSCs) that is not controlled by Technical Specifications (TSs). An SSC is FUNCTIONAL or has FUNCTIONALITY when it is capable of performing its specified safety function, as set forth in the Current Licensing Basis. FUNCTIONALITY does not apply to specified safety functions, but does apply to the ability of non-TS SSCs to perform other specified functions that have a necessary support function.
GASEOUS RADWASTE TREATMENT SYSTEM	Any system designed and installed to reduce radioactive gaseous effluents by collecting primary coolant system offgases from the main condenser evacuation system and providing for delay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.
MEMBER OF THE PUBLIC	Any individual, except when that individual is receiving an OCCUPATIONAL DOSE.
MODE	A MODE shall correspond to any one inclusive combination of mode switch position, average reactor coolant temperature, and reactor vessel head closure bolt tensioning specified in Technical Specifications with fuel in the reactor vessel.
OCCUPATIONAL DOSE	The dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to radiation and/or to radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person. Occupational dose does not include dose from background radiation, as a patient from medical practices, from voluntary participation in medical research programs, or as a member of the public.
OFFSITE DOSE CALCULATION MANUAL (ODCM)	The ODCM shall contain the methodology and parameters used in the calculation of offsite doses resulting from radioactive gaseous and liquid effluents, in the calculation of gaseous and liquid effluent monitoring Alarm/Trip Setpoints, and in the conduct of the Environmental Radiological Monitoring Program. The ODCM shall also contain (1) the Radioactive Effluent Controls and Radiological Environmental Monitoring Programs and (2) descriptions of the information that should be included in the Annual Radiological Environmental Operating and Radioactive Effluent Release Reports.
PROCESS CONTROL PROGRAM (PCP)	The PCP shall contain the current formulas, sampling, analyses, test, and determinations to be made to ensure that processing and packaging of solid radioactive wastes based on demonstrated processing of actual or simulated wet solid wastes will be accomplished in such a way as to assure compliance with 10 CFR Parts 20, 61, and 71, Federal and State regulations, burial ground requirements, and other requirements governing the disposal of solid radioactive waste.

(continued)

1.1 Definitions (continued)

PUBLIC DOSE	PUBLIC DOSE means the dose received by a member of the public from exposure to radiation or radioactive material released by a licensee, or to any other source of radiation under the control of a licensee. Public dose does not include occupational dose or doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with 10CFR35.75, or from voluntary participation in medical research programs.
PURGE - PURGING	PURGE or PURGING shall be any controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is required to purify the confinement.
RADIOLOGICAL EFFLUENT CONTROLS (RECs)	A compilation of the various regulatory requirements, surveillance and bases, commitments and/or components of the radiological effluent and environmental monitoring programs for Dresden Station.
RATED THERMAL POWER (RTP)	RTP shall be a total reactor core heat transfer rate to the reactor coolant of 2957 MWt.
REACTOR POWER OPERATION	REACTOR POWER OPERATION is any operation with the mode switch in the "Startup/Hot Standby" or "Run" position with the reactor critical and above 1% rated thermal power.
REPORTABLE EVENT	A REPORTABLE EVENT shall be any of those conditions specified in 10CFR50.73.
RESTRICTED AREA	The RESTRICTED AREA is the area defined in ODCM Part II Figure 1-3 to which access is controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials, and does not include any area within the SITE BOUNDARY used for residential quarters or for industrial, commercial, institutional, and/or recreational purposes.
SITE BOUNDARY	The SITE BOUNDARY shall be that line beyond which the land is not owned, leased, or otherwise controlled by licensee as defined in ODCM Part II Figure 1-2.
SOURCE CHECK	A SOURCE CHECK shall be the qualitative assessment of channel response when the channel sensor is exposed to a source of increased radioactivity.

(continued)

1.1 Definitions (continued)

UNRESTRICTED AREA	An UNRESTRICTED AREA shall be any area at or beyond the SITE BOUNDARY, access to which is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials, or any area within the SITE BOUNDARY used for residential quarters or for industrial, commercial, institutional, and/or recreational purposes. Defined in ODCM Part II Figure 1-3.
VENTILATION EXHAUST TREATMENT SYSTEM	A VENTILATION EXHAUST TREATMENT SYSTEM shall be any system designed and installed to reduce the gaseous radioiodine or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal adsorbers and/or HEPA filters for the purpose of removing iodines or particulates from the gaseous exhaust stream prior to the release to the environment. Such a system is not considered to have any effect on noble gas effluents. Engineered Safety Features Atmospheric Cleanup Systems are not considered to be VENTILATION EXHAUST TREATMENT SYSTEM components.
VENTING	VENTING shall be the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration, or other operating condition, in such a manner that replacement air or gas is not provided or required during VENTING. Vent, used in system names, does not imply a VENTING process.

Table 1.1-1
Compliance Matrix

Regulation	Dose / Component / Limit	ODCM Equation	RECS	Technical Specification
10 CFR 50 Appendix I	1. Gamma air dose and beta air dose due to airborne radioactivity in effluent plume.	4-9 4-10	12.4.2	(1) 6.8.D.4.h (2/3) 5.5.4.h
	2. Total body and skin dose due to airborne radioactivity in effluent plume are reported only if certain gamma and beta air dose criteria are exceeded:	4-11 4-12	N/A	N/A
	a. Projected doses due to gaseous release, when averaged over 31 days, exceed 0.3 mrem to any organ.	N/A	12.4.5	(1) 6.8.D.4.f (2/3) 5.5.4.f
	b. Projected doses due to liquid release, when averaged over 31 days, exceed 0.06 mrem to the total body or 0.2 mrem to any organ.	N/A	12.3.3	(1) 6.8.D.4.f (2/3) 5.5.4.f
	3. Organ dose for all four age groups due to iodines and particulates in effluent plume. All pathways are considered.	4-13	12.4.3	(1) 6.8.D.4.i (2/3) 5.5.4.i
	4. Organ dose for all four age groups due to radioactivity in liquid effluents.	3-3	12.3.2	(1) 6.8.D.4.d (2/3) 5.5.4.d
	5. Implement environmental monitoring program, including, Land Use Census, Interlaboratory Comparison Program, and Annual Radiological Environmental Operating Report:	N/A	12.6 12.9.3	(1) 6.9.A.3 (2/3) 5.6.2
10CFR20	1. TEDE, totaling all deep dose equivalent components (direct, ground, and plume shine) and organ dose (all pathways, both airborne and liquid-borne).	5-4	12.5.2	(1) 6.8.D.4.d (2/3) 5.5.4.c
40CFR190 (now by reference, also part of 10CFR20)	1. Whole body dose due to direct dose, ground, and plume shine from all uranium fuel cycle sources at a station.	5-2	12.5.1	(1) 6.8.D.4.j (2/3) 5.5.4.j
	2. Organ doses due to all pathways.	5-3		
Technical Specifications	1. Functional capability of effluent monitoring instrumentation.	N/A	12.2	(1) 6.8.D.4.a (2/3) 5.5.4.a
	2. "Instantaneous" concentration limits for liquid effluents.	3-2	12.3.1	(1) 6.8.D.4.b (2/3) 5.5.4.b
	3. Determination of cumulative and projected doses from site effluents.	N/A	12.3.2 12.4.2	(1) 6.8.D.4.e (2/3) 5.5.4.e
	4. "Instantaneous" whole body, skin, and organ dose rates due to radioactivity in airborne effluents.	4-1 4-2 4-3	12.4.1	(1) 6.8.D.4.g (2/3) 5.5.4.g
	5. Radioactive Effluent Release Report	N/A	12.9.4	(1) 6.9.A.4 (2/3) 5.6.3

1.0 USE AND APPLICATION

1.2 Logical Connectors

PURPOSE	The purpose of this section is to explain the meaning of logical connectors. Logical connectors are used in ODCM to discriminate between, and yet connect, discrete Conditions, Required Actions, Completion Times, Surveillances, and Frequencies. The only logical connectors that appear in ODCM are AND and OR. The physical arrangement of these connectors constitutes logical conventions with specific meanings.
BACKGROUND	Several levels of logic may be used to state Required Actions. These levels are identified by the placement (or nesting) of the logical connectors and by the number assigned to each Required Action. The first level of logic is identified by the first digit of the number assigned to a Required Action and the placement of the logical connector in the first level of nesting (i.e., left justified with the number of the Required Action). The successive levels of logic are identified by additional digits of the Required Action number and by successive indentations of the logical connectors. When logical connectors are used to state a Condition, Completion Time, Surveillance, or Frequency, only the first level of logic is used, and the logical connector is left justified with the statement of the Condition, Completion Time, Surveillance, or Frequency.
EXAMPLES	The following examples illustrate the use of logical connectors.

(continued)

EXAMPLES (continued)

EXAMPLE 1.2-1

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Control not met.	A.1 Verify . . . AND A.2 Restore . . .	

In this example, the logical connector AND is used to indicate that, when in Condition A, both Required Actions A.1 and A.2 must be completed.

(continued)

EXAMPLES (continued)

EXAMPLE 1.2-2

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Control not met.	A.1 Trip . . . OR A.2.1 Verify . . . AND A.2.2.1 Reduce . . . OR A.2.2.2 Perform . . . OR A.3 Align	

This example represents a more complicated use of logical connectors. Required Actions A.1, A.2 and A.3 are alternate choices, only one of which must be performed as indicated by the use of the logical connector OR and the left justified placement. Any one of these three ACTIONS may be chosen. If A.2 is chosen, then both A.2.1 and A.2.2 must be performed as indicated by the logical connector AND. Required Action A.2.2 is met by performing A.2.2.1 or A.2.2.2. The indented position of the logical connector OR indicates that A.2.2.1 and A.2.2.2 are alternative choices, only one of which must be performed.

1.0 USE AND APPLICATION

1.3 Completion Times

PURPOSE	The purpose of this section is to establish the Completion Time convention and to provide guidance for its use.
BACKGROUND	ODCM Radiological Effluent Controls (RECs) specify minimum requirements for ensuring safe operation of the unit as allowed by Technical Specifications (TS) 6.8.D.4 (Unit 1) and 5.5.4 (Units 2 and 3). The ACTIONS associated with a REC state Conditions that typically describe the ways in which the requirements of the REC can fail to be met. Specified with each stated Condition are Required Action(s) and Completion Time(s).
DESCRIPTION	The Completion Time is the amount of time allowed for completing a Required Action. It is referenced to the discovery of a situation (e.g., non-functional equipment or variable not within limits) that requires entering an ACTIONS Condition unless otherwise specified, providing the unit is in a MODE or specified condition stated in the Applicability of the REC. Unless otherwise specified, the Completion Time begins when a senior licensed operator on the operating shift crew with responsibility for plant operations makes the determination that a REC is **NOT** met and ACTIONS Condition is entered. The "otherwise specified" exceptions are varied, such as a Required Action Note or Surveillance Requirement Note that provides an alternative time to perform specific tasks, such as testing, without starting the Completion Time. While utilizing the Note, should a Condition be applicable for any reason not addressed by the Note, the Completion Time begins. Should the time allowance in the Note be exceeded, the Completion Time begins at that point. The exceptions may also be incorporated into the Completion Time. For example, LCO 3.8.1, "AC Sources – Operating," Required Action B.3, requires declaring required feature(s) supported by an inoperable diesel generator, inoperable when the redundant required feature(s) are inoperable. The Completion Time states, "4 hours from discovery of Condition B concurrent with inoperability of redundant required feature(s)." In this case the Completion Time does not begin until the conditions in the Completion Time are satisfied. Required Actions must be completed prior to the expiration of the specified Completion Time. An ACTIONS Condition remains in effect and the Required Actions apply until the Condition no longer exists or the unit is not within the REC Applicability. ***********NOTE*********** The example above regarding LCO 3.8.1, "AC Sources – Operating" is an example referenced in Standard Technical Specifications. In Dresden Technical Specifications, the corresponding Required Action is B.2, there is no equivalent to this example in the Dresden Station ODCM RECs.

(continued)

DESCRIPTION (continued)

If situations are discovered that require entry into more than one Condition at a time within a single REC (multiple Conditions), the Required Actions for each Condition must be performed within the associated Completion Time. When in multiple Conditions, separate Completion Times are tracked for each Condition starting from the discovery of the situation that required entry into the Condition, unless otherwise specified.

Once a Condition has been entered, subsequent divisions, subsystem, components or variables expressed in the Condition, discovered to be non-functional or not within limits, will not result in separate entry into the Condition unless specifically stated. The Required Actions of the Condition continue to apply to each additional failure, with Completion Times based on initial entry into the Condition, unless otherwise specified.

However, when a subsequent division, subsystem, component, or variable expressed in the Condition is discovered to be non-functional or not within limits, the Completion Time(s) may be extended. To apply this Completion Time extension, two criteria must first be met. The subsequent loss of FUNCTIONALITY:

a. Must exist concurrent with the first loss of FUNCTIONALITY; and

b. Must remain non-functional or not within limits after the first loss of FUNCTIONALITY is resolved.

The total Completion Time allowed for completing a Required Action to address the subsequent loss of FUNCTIONALITY shall be limited to the more restrictive of either:

a. The stated Completion Time, as measured from the initial entry into the Condition, plus an additional 24 hours; or

b. The stated Completion Time as measured from discovery of the subsequent loss of FUNCTIONALITY.

The above Completion Time extension does not apply to those RECs that have exceptions that allow completely separate re-entry into the Condition (for each division, subsystem, component, or variable expressed in the Condition) and separate tracking of Completion Times based on this re-entry. These exceptions are stated in individual RECs.

The above Completion Time extension does not apply to a Completion Time with a modified "time zero." This modified "time zero" may be expressed as a repetitive time (i.e., "once per 8 hours," where the Completion Time is referenced from a previous completion of the Required Action versus the time of Condition entry) or as a time modified by the phrase "from discovery..." Example 1.3-3 illustrates one use of this type of Completion Time. The 10 day Completion Time specified for Condition A and B in Example 1.3-3 may not be extended.

EXAMPLES The following examples illustrate the use of Completion Times with different types of Conditions and changing Conditions.

EXAMPLES

EXAMPLE 1.3-1

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. Required Action and associated Completion Time not met.	B.1 Be in MODE 3. AND B.2 Be in MODE 4.	12 hours 36 hours

Condition B has two Required Actions. Each Required Action has its own separate Completion Time. Each Completion Time is referenced to the time that Condition B is entered.

The Required Actions of Condition B are in to be in MODE 3 within 12 hours AND in MODE 4 within 36 hours. A total of 12 hours is allowed for reaching MODE 3 and a total of 36 hours (not 48 hours) is allowed for reaching MODE 4 from the time that Condition B was entered. If MODE 3 is reached within 6 hours, the time allowed for reaching MODE 4 is the next 30 hours because the total time allowed for reaching Mode 4 is 36 hours.

If Condition B is entered while in MODE 3, the time allowed for reaching MODE 4 is the next 36 hours.

(continued)

EXAMPLES (continued)

EXAMPLE 1.3-2

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One monitor non-functional.	A.1 Restore monitor to FUNCTIONAL status.	7 days
B. Required Action and associated Completion Time not met.	B.1 Be in MODE 3. AND B.2 Be in MODE 4.	12 hours 36 hours

When a monitor is declared non-functional, Condition A is entered. If the monitor is not restored to FUNCTIONAL status within 7 days, Condition B is also entered and the Completion Time clocks for Required Action B.1 and B.2 start. If the non-functional monitor is restored to FUNCTIONAL status after Condition B is entered, Condition A and B are exited, and therefore, the Required Actions of Condition B may be terminated.

When a second monitor is declared non-functional while the first monitor is still non-functional, Condition A is not re-entered for the second monitor. REC 12.0.3 is entered, since the ACTIONS do not include a Condition for more than one non-functional monitor. The Completion Time clock for Condition A does not stop after REC 12.0.3 is entered, but continues to be tracked from the time Condition A was initially entered.

While in REC 12.0.3, if one of the non-functional monitors is restored to FUNCTIONAL status and the Completion Time for Condition A has not expired, REC 12.0.3 may be exited and operation continued in accordance with Condition A.

(continued)

EXAMPLES (continued)

EXAMPLE 1.3-2 (continued)

While in REC 12.0.3, if one of the non-functional monitors is restored to FUNCTIONAL status and the Completion Time for Condition A has expired, REC 12.0.3 may be exited and operation continued in accordance with Condition B. The Completion Time for Condition B is tracked from the time the Condition A Completion Time expired.

On restoring one of the monitors to FUNCTIONAL status, the Condition A Completion Time is not reset, but continues from the time the first monitor was declared non-functional. This Completion Time may be extended if the monitor restored to FUNCTIONAL status was the first non-functional monitor. A 24 hour extension to the stated 7 days is allowed, provided this does not result in the second monitor being non-functional for > 7 days.

(continued)

EXAMPLES (continued)

EXAMPLE 1.3-3

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One Function X subsystem non-functional.	A.1 Restore Function X subsystem to FUNCTIONAL status.	7 days AND 10 days from discovery of failure to meet the Control
B. One Function Y subsystem non-functional.	B.1 Restore Function Y subsystem to FUNCTIONAL status.	72 hours AND 10 days from discovery to meet Control
C. One Function X subsystem non-functional. AND One Function Y subsystem non-functional.	C.1 Restore Function X subsystem to FUNCTIONAL status. OR C.2 Restore Function Y subsystem to FUNCTIONAL status.	72 hours 72 hours

(continued)

EXAMPLES (continued)

EXAMPLE 1.3-3 (continued)

When one Function X subsystem and one Function Y subsystem are non-functional, Condition A and Condition B are concurrently applicable. The Completion Times for Condition A and Condition B are tracked separately for each subsystem, starting from the time each subsystem was declared non-functional and the Condition was entered. A separate Completion Time is established for Condition C and tracked from the time the second subsystem was declared non-functional (i.e., the time the situation described in Condition C was discovered).

If Required Action C.2 is completed within the specified Completion Time, Conditions B and C are exited. If the Completion Time for Required Action A.1 has not expired, operation may continue in accordance with Condition A. The remaining Completion Time in Condition A is measured from the time the affected subsystem was declared non-functional (i.e., initial entry into Condition A).

The Completion Times of Conditions A and B are modified by a logical connector, with a separate 10 day Completion Time measured from the time it was discovered the REC was not met. In this example, without the separate Completion Time, it would be possible to alternate between Conditions A, B, and C in such a manner that operation could continue indefinitely without ever restoring systems to meet the REC. The separate Completion Time modified by the phrase "from discovery of failure to meet the Control" is designed to prevent indefinite continued operation while not meeting the REC. This Completion Time allows for an exception to the normal "time zero" for beginning the Completion Time "clock." In this instance, the Completion Time "time zero" is specified as commencing at the time the REC was initially not met, instead of at the time the associated Condition was entered.

(continued)

EXAMPLES (continued)

EXAMPLE 1.3-4

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more instruments non-functional.	A.1 Restore instrument(s) to FUNCTIONAL status.	4 hours
B. Required Action and associated Completion Time not met.	B.1 Be in MODE 3. AND B.2 Be in MODE 4.	12 hours 36 hours

A single Completion Time is used for any number of instruments non-functional at the same time. The Completion Time associated with Condition A is based on the initial entry into Condition A and is not tracked on a per instrument basis. Declaring subsequent instruments non-functional, while Condition A is still in effect, does not trigger the tracking of separate Completion Times.

Once one of the instruments has been restored to FUNCTIONAL status, the Condition A Completion Time is not reset, but continues from the time the first instrument was declared non-functional. The Completion Time may be extended if the instrument restored to FUNCTIONAL status was the first non-functional instrument. The Condition A Completion Time may be extended for up to 4 hours provided this does not result in any subsequent instrument being non-functional for > 4 hours.

If the Completion Time of 4 hours expires while one or more instruments are still non-functional, Condition B is entered.

(continued)

EXAMPLES (continued)

EXAMPLE 1.3-5

ACTIONS

----------NOTE----------
Separate Condition entry is allowed for each non-functional instrument.

CONDITION		REQUIRED ACTION		COMPLETION TIME
A.	One or more instruments non-functional.	A.1	Restore instrument(s) to FUNCTIONAL status.	4 hours
B.	Required Action and associated Completion Time not met.	B.1	Be in MODE 3.	12 hours
		AND		
		B.2	Be in MODE 4.	36 hours

The Note above the ACTIONS Table is a method of modifying how the Completion Time is tracked. If this method of modifying how the Completion Time is tracked was applicable only to a specific Condition, the Note would appear in that Condition rather than at the top of the ACTIONS Table.

The Note allows Condition A to be entered separately for each non-functional instrument, and Completion Times tracked on a per instrument basis. When an instrument is declared non-functional, Condition A is entered and its Completion Time starts. If subsequent instruments are declared non-functional, Condition A is entered for each instrument and separate Completion Times start and are tracked for each instrument.

If the Completion Time associated with an instrument in Condition A expires, Condition B is entered for that instrument. If the Completion Times associated with subsequent instruments in Condition A expire, Condition B is entered separately for each instrument and separate Completion Times start and are tracked for each instrument. If an instrument that caused entry into Condition B is restored to FUNCTIONAL status, Condition B is exited for that instrument.

Since the Note in this example allows multiple Condition entry and tracking of separate Completion Times, Completion Time extensions do not apply.

(continued)

EXAMPLES (continued)

EXAMPLE 1.3-6

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One channel non-functional.	A.1 Perform RSR 12.x.x.x. OR A.2 Reduce THERMAL POWER to ≤ 50% RTP.	Once per 8 hours 8 hours
B. Required Action and associated Completion Time not met.	B.1 Be in MODE 3.	12 hours

Entry into Condition A offers a choice between Required Action A.1 and A.2. The initial 8 hour interval of Required Action A.1 begins when Condition A is entered and the initial performance of Required Action A.1 must be completed within the first 8 hour interval. If Required Action A.1 is followed and the Required Action is not met within the Completion Time Condition B is entered. If Required Action A.2 is followed and the Completion Time of 8 hours is not met, Condition B is entered. LCM 6/21

If after entry into Condition B, Required Action A.1 or A.2 is met, Condition B is exited and operation may then continue in Condition A.

(continued)

EXAMPLES (continued)

EXAMPLE 1.3-7

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One subsystem non-functional.	A.1 Verify affected subsystem isolated.	1 hour AND Once per 8 hours thereafter
	AND	
	A.2 Restore subsystem to FUNCTIONAL status.	72 hours
B. Required Action and associated Completion Time not met.	B.1 Be in MODE 3.	12 hours
	AND	
	B.2 Be in MODE 4.	36 hours

Required Action A.1 has two Completion Times. The 1 hour Completion Time begins at the time the Condition is entered and each "Once per 8 hours thereafter" interval begins upon performance of Required Action A.1.

If after Condition A is entered, Required Action A.1 is not met within either the initial 1 hour or any subsequent 8 hour interval from the previous performance (plus the extension allowed by RSR 12.0.2), Condition B is entered. The Completion Time clock for Condition A does not stop after Condition B is entered but continues from the time Condition A was initially entered. If Required Action A.1 is met after Condition B is entered, Condition B is exited and operation may continue in accordance with Condition A, provided the Completion Time for Required Action A.2 has not expired.

IMMEDIATE COMPLETION TIME

When "Immediately" is used as a Completion Time, the Required Action should be pursued without delay and in a controlled manner.

1.0 USE AND APPLICATION

1.4 Frequency

PURPOSE

The purpose of this section is to define the proper use and application of Frequency requirements.

DESCRIPTION

Each ODCM Radiological Effluent Surveillance Requirement (RSR) has a specified Frequency in which the Surveillance must be met in order to meet the associated ODCM REC. An understanding of the correct application of the specified Frequency is necessary for compliance with the RSR.

The "specified Frequency" is referred to throughout this section and each of the Requirements of Section 12.0, ODCM Radiological Effluent Surveillance Requirement (RSR) Applicability. The "specified Frequency" consists of the requirements of the Frequency column of each RSR, as well as certain Notes in the Surveillance column that modify performance requirements.

Sometimes special situations dictate when the requirements of a Surveillance are to be met. They are "otherwise stated" conditions allowed by RSR 12.0.1. They may be stated as clarifying Notes in the Surveillance, as part of the Surveillance, or both. Example 1.4-4 discusses these special situations.

Situations where a Surveillance could be required (i.e., its Frequency could expire), but where it is not possible or not desired that it be performed until sometime after the associated REC is within its Applicability, represent potential RSR 12.0.4 conflicts. To avoid these conflicts, the RSR (i.e., the Surveillance or the Frequency) is stated such that it is only "required" when it can be and should be performed. With a RSR satisfied, RSR 12.0.4 imposes no restriction.

The use of "met" or "performed" in these instances conveys specified meanings. A Surveillance is "met" only when the acceptance criteria are satisfied. Known failure of the requirements of a Surveillance, even without a Surveillance specifically being "performed," constitutes a Surveillance not "met." "Performance" refers only to the requirement to specifically determine the ability to meet the acceptance criteria. RSR 12.0.4 restrictions would not apply if both the following conditions are satisfied:

a. The Surveillance is not required to be performed; and

b. The Surveillance is not required to be met or, even if required to be met, is not known to be failed.

(continued)

1.0 USE AND APPLICATION

1.4 Frequency

EXAMPLES

The following examples illustrate the various ways that Frequencies are specified. In these examples, the Applicability of the REC (REC not shown) is MODES 1, 2, and 3.

EXAMPLE 1.4-1

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
Perform CHANNEL CHECK	12 hours

Example 1.4-1 contains the type of RSR most often encountered in the ODCM. The Frequency specifies an interval (12 hours) during which the associated Surveillance must be performed at least one time. Performance of the Surveillance initiates the subsequent interval. Although the Frequency is stated as 12 hours, an extension of the time interval to 1.25 times the interval specified in the Frequency is allowed by RSR 12.0.2 for operational flexibility. The measurement of this interval continues at all times, event when the RSR is not required to be met per RSR 12.0.1 (such as when the equipment is non-functional, a variable is outside specified limits, or the unit is outside the Applicability of the REC). If the interval specified by RSR 12.0.2 is exceeded while the unit is in a MODE or other specified condition in the Applicability of the REC, and the performance of the Surveillance is not otherwise modified (refer to Examples 1.4-3 and 1.4-4), then RSR 12.0.3 becomes applicable. 6/2021

If the interval as specified by RSR 12.0.2 is exceeded while the unit is not in a MODE or other specified condition in the Applicability of the REC for which performance of the RSR is required, the Surveillance must be performed within the Frequency requirements of RSR 12.0.2 prior to entry into the MODE or other specified condition. Failure to do so would result in a violation of RSR 12.0.4.

(continued)

EXAMPLES

EXAMPLE 1.4-2

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
Verify flow is within limits.	Once within 12 hours after ≥ 25% RTP AND 24 hours thereafter

Example 1.4-2 has two Frequencies. The first is a one time performance Frequency, and the second is of the type shown in Example 1.4-1. The logical connector "AND" indicates that both Frequency requirements must be met. Each time reactor power is increased from a power level < 25% RTP to ≥ 25% RTP, the Surveillance must be performed within 12 hours.

The use of "once" indicates a single performance will satisfy the specified Frequency (assuming no other Frequencies are connected by "AND"). This type of Frequency does not qualify for the extension allowed by RSR 12.0.2.

"Thereafter" indicates future performances must be established per RSR 12.0.2, but only after a specified condition is first met (i.e., the "once" performance in this example). If reactor power decreases to < 25% RTP, the measurement of both intervals stops. New intervals start upon reactor power reaching 25% RTP.

(continued)

EXAMPLES

EXAMPLE 1.4-3

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
----------NOTE---------- Not required to be performed until 12 hours after ≥ 25% RTP. ----------	
Perform channel adjustment.	7 days

The interval continues whether or not the unit operation is < 25% RTP between performances.

As the Note modifies the required performance of the Surveillance, it is construed to be part of the "specified Frequency." Should the 7 day interval be exceeded while operation is < 25% RTP, this Note allows 12 hours after power reaches ≥ 25% RTP to perform the Surveillance. The Surveillance is still considered to be within the "specified Frequency." Therefore, if the Surveillance were not performed within the 7 day interval (plus the extension allowed by RSR 12.0.2), but operation was < 25% RTP, it would not constitute a failure of the RSR or failure to meet the REC. Also, no violation of RSR 12.0.4 occurs when changing MODES, even with the 7 day Frequency not met, provided operation does not exceed 12 hours with power ≥ 25% RTP.

Once the unit reaches 25% RTP, 12 hours would be allowed for completing the Surveillance. If the Surveillance were not performed within this 12-hour interval, there would then be a failure to perform a Surveillance within the specified Frequency, and the provisions of RSR 12.0.3 would apply.

(continued)

1.0 USE AND APPLICATION

1.4 Frequency

EXAMPLES

EXAMPLE 1.4-4

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
----------NOTE---------- Only required to be met in MODE 1. ----------	
Verify leakage rates are within limits.	24 hours

Example 1.4-4 specifies that the requirements of this Surveillance do not have to be met until the unit is in MODE 1. The interval measurement for the Frequency of this Surveillance continues at all times, as described in Example 1.4-1. However, the Note constitutes an "otherwise stated" exception to the Applicability of this Surveillance. Therefore, if the Surveillance were not performed within the 24 hour interval (plus the extension allowed by RSR 12.0.2), but the unit was not in MODE 1, there would be no failure of the RSR nor failure to meet the REC. Therefore, no violation of RSR 12.0.4 occurs when changing MODES, even with the 24 hour Frequency exceeded, provided the MODE change was not made into MODE 1. Prior to entering MODE 1 (assuming again that the 24 hour Frequency were not met), RSR 12.0.4 would require satisfying the RSR.

1.0 USE AND APPLICATION

1.5 REC and RSR Implementation

The requirements of the Technical Specifications shall take precedence over this ODCM, should any differences occur.

The ODCM provides those limitations upon plant operations which are part of the licensing basis for the station but do not meet the criteria for continued inclusion in the Technical Specifications.

It also provides information that supplements the Technical Specifications by implementing the following Technical Specification requirements:

a. Unit 1
   1. 6.8.A.6, ODCM Implementation
   2. 6.8.D.4, Radioactive Effluent Controls Program
   3. 6.9.A.3, Annual Radiological Environmental Operating Report
   4. 6.9.A.4, Radioactive Effluent Release Report
   5. 6.14, ODCM

b. Units 2 and 3
   1. 5.5.1, ODCM
   2. 5.5.4, Radioactive Effluent Controls Program
   3. 5.6.2, Annual Radiological Environmental Operating Report
   4. 5.6.3, Radioactive Effluent Release Report

RECs and RSRs are implemented the same as Technical Specifications (see 12.0 Applicability). However, RECs and RSRs are treated as plant procedures and are not part of the Technical Specifications. Therefore the following exceptions apply:

a. Violations of the Action or Surveillance requirements in a REC are not reportable as conditions prohibited by, or deviations from, the Technical Specifications per 10 CFR 50.72 or 10 CFR 50.73.

b. Power reduction or plant shutdowns required to comply with the Actions of a REC are not reportable per 10 CFR 50.72 or 10 CFR 50.73.

2.0 through 11.0 NOT USED

INTENTIONALLY BLANK

Sections 2.0 through 11.0 are not used in the RECs in order to maintain the original ODCM numbering convention.

12 CONTROLS AND SURVEILLANCE REQUIREMENTS

12.0 RADIOLOGICAL EFFLUENT CONTROL (REC) APPLICABILITY

REC 12.0.1 RECs shall be met during the MODES or other specified conditions in the Applicability, except as provided in REC 12.0.2.

REC 12.0.2 Upon discovery of a failure to meet a REC, the Required Actions of the associated Conditions shall be met, except as provided in REC 12.0.5.

If the REC is met or is no longer applicable prior to expiration of the specified Completion Time(s), completion of the Required Action(s) is not required, unless otherwise stated.

REC 12.0.3 When a REC is not met and the associated ACTIONS are not met, an associated ACTION is not provided, or if directed by the associated ACTIONS, action shall be initiated within 1 hour to:

a. Implement appropriate compensatory actions as needed;

b. Verify that the plant is not in an unanalyzed condition or that a required safety function is not compromised by the loss of FUNCTIONALITY; and

c. Within 12 hours, obtain Station Duty Officer approval of the compensatory actions and the plan for exiting REC 12.0.3.

Exceptions to this REC are stated in the individual RECs.

Where corrective measures are completed that permit operation in accordance with the REC or ACTIONS, completion of the actions required by REC 12.0.3 is not required.

REC 12.0.3 is only applicable in Modes 1, 2, and 3.

REC 12.0.4 When a REC is not met, entry into a MODE or other specified condition in the Applicability shall only be made:

a. When the associated ACTIONS to be entered permit continued operation in the MODE or other specified condition in the Applicability for an unlimited period of time;

b. After performance of a risk assessment addressing non-functional systems and components, consideration of the results, determination of the acceptability of entering the MODE or other specified condition in the Applicability, and establishment of risk management actions, if appropriate (exceptions to the REC are stated in the individual RECs); or

c. When an allowance is stated in the individual value, parameter, or other REC.

This REC shall not prevent changes in MODES or other specified conditions in the Applicability that are required to comply with ACTIONS or that are part of a shutdown of the unit.

(continued)

12.0 REC APPLICABILITY

REC 12.0.5	Equipment removed from service or declared non-functional to comply with ACTIONS may be returned to service under administrative control solely to perform testing required to demonstrate its FUNCTIONALITY or the FUNCTIONALITY of other equipment. This is an exception to REC 12.0.2 for the system returned to service under administrative control to perform the testing required to demonstrate FUNCTIONALITY.
REC 12.0.6	RECs, including associated ACTIONS, shall apply to each unit individually, unless otherwise indicated. Whenever the REC refers to a system or component that is shared by both units, the ACTIONS will apply to both units simultaneously.

12.0 RADIOLOGICAL EFFLUENT SURVEILLANCE REQUIREMENT (RSR) APPLICABILITY

RSR 12.0.1	Radiological Effluent Surveillance Requirements (RSRs) shall be met during the MODES or other specified conditions in the Applicability for individual RECs, unless otherwise stated in the RSR. Failure to meet a Surveillance, whether such failure is experienced during the performance of the Surveillance or between performances of the Surveillance, shall be failure to meet the REC. Failure to perform a Surveillance within the specified Frequency shall be failure to meet the REC except as provided in RSR 12.0.3. Surveillances do not have to be performed on non-functional equipment or variables outside specified limits.
RSR 12.0.2	The specified Frequency for each RSR is met if the Surveillance is performed within 1.25 times the interval specified in the Frequency, as measured from the previous performance or as measured from the time a specified condition of the Frequency is met. For Frequencies specified as "once," the above interval extension does not apply. Exceptions to this RSR are stated in the individual RSRs.
RSR 12.0.3	If it is discovered that a Surveillance was not performed within its specified Frequency, then compliance with the requirement to declare the REC not met may be delayed, from the time of discovery, up to 24 hours or up to the limit of the specified Frequency, whichever is greater. This delay period is permitted to allow performance of the Surveillance. The delay period is only applicable when there is reasonable expectation the surveillance will be met when performed. A risk evaluation shall be performed for any Surveillance delayed greater than 24 hours and the risk impact shall be managed. If the RSR is not performed within the delay period, the REC must immediately be declared not met, and the applicable Condition(s) must be entered. When the Surveillance is performed within the delay period and the Surveillance is not met, the REC must immediately be declared not met, and the applicable Condition(s) must be entered.
RSR 12.0.4	Entry into a MODE or other specified condition in the Applicability of a REC shall only be made when the REC's RSR have been met within their specified Frequency, except as provided by RSR 12.0.3. When a REC is not met due to RSRs not having been met, entry into a MODE or other specified condition in the Applicability shall only be made in accordance with REC 12.0.4. This provision shall not prevent entry into MODES or other specified conditions in the Applicability that are required to comply with ACTIONS or that are part of a shutdown of the unit.
RSR 12.0.5	RSRs shall apply to each unit individually, unless otherwise indicated.

12.1 NOT USED

INTENTIONALLY BLANK

Section 12.1 is not used in the RECs in order to maintain the original ODCM numbering convention.

12.2 INSTRUMENTATION

12.2.1 RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

REC 12.2.1 The following conditions shall be met:

a. The effluent monitoring instrumentation in Table 12.2-1 shall be FUNCTIONAL with their alarm setpoints set to ensure the limits of REC 12.3.1 are not exceeded; AND

b. The effluent monitoring instrument alarm setpoints shall be determined and adjusted in accordance with the methodology and parameters in the ODCM.

APPLICABILITY: When flow is present in the system.

ACTIONS

----------NOTES----------

1. Separate Condition entry is allowed for each instrument.
2. REC 12.0.4 is not applicable.
3. All deviations are reported in the Radioactive Effluent Release Report.
4. When Radioactive Liquid Effluent Monitoring Instrumentation is inoperative due to system backwash or purge, entry into the associated Conditions and Required Actions may be delayed for up to 2 hours.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Number of instrument channels FUNCTIONAL less than required by Table 12.2-1.	A.1 Enter the Condition referenced in Table 12.2-1 for the instrument channel.	Immediately
B. Radioactive liquid effluent monitoring instrument channel alarm setpoint less conservative than required.	B.1 Suspend the release of radioactive liquid effluents monitored by the affected instrument channel.	Immediately
	OR	
	B.2 Declare the affected instrument channel non-functional.	Immediately
	OR	
	B.3 Change the affected instrument setpoint so it is acceptably conservative.	Immediately

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. As required by Required Action A.1 and referenced in Table 12.2-1.	C.1.1 Analyze two independent samples of tank's contents for principle gamma emitters, dissolved and entrained gases, I-131, and H-3 at LLDs specified in Table 12.3-2.	Prior to release
	AND	
	C.1.2 Perform independent verification of the release rate calculations and discharge line valve line-up using at least two technically qualified members of the facility staff.	Prior to release
	AND	
	C.2 Return the instrument channel to FUNCTIONAL status.	30 days
D. As required by Required Action A.1 and referenced in Table 12.2-1.	D.1 Analyze affected effluent grab samples for principle gamma emitters and I-131 at LLDs specified in Table 12.3-2.	Once per 12 hours
	AND	
	D.2 Return the instrument channel to FUNCTIONAL status.	30 days
E. Required Action C.2 or D.2 and associated Completion Time not met.	E.1 Explain why the loss of functionality was not corrected in a timely manner in the Radioactive Effluent Release Report.	In accordance with Units 2/3 TS 5.6.3.

12.2.1 SURVEILLANCE REQUIREMENTS

----------NOTE----------
CHANNEL CHECK, CHANNEL FUNCTIONAL TEST, and CHANNEL CALIBRATION are not required when the instruments are NOT required to be FUNCTIONAL or are tripped.

	SURVEILLANCE REQUIREMENT	FREQUENCY
RSR 12.2.1.1	Perform CHANNEL CHECK.	24 hours
RSR 12.2.1.2	Perform CHANNEL FUNCTIONAL TEST, which may be performed by using trip check and test circuitry associated with the monitor chassis. This test shall also demonstrate that control room annunciation occurs if any of the following conditions exist: 1. Instrument indicates measured levels above the Alarm setpoint, or 2. Circuit failure, or 3. Instrument indicates a downscale failure, or 4. Instrument controls not set in Operate mode.	92 days
RSR 12.2.1.3	Perform SOURCE CHECK, which may be performed by observing instrument response during a discharge.	24 months
RSR 12.2.1.4	Perform SOURCE CHECK.	24 months
RSR 12.2.1.5	Perform CHANNEL CALIBRATION, which shall include performance of a CHANNEL FUNCTIONAL CHECK and SOURCE CHECK.	24 months

Table 12.2-1
RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION
UNITS 2 & 3

INSTRUMENT	REQUIRED CHANNELS PER INSTRUMENT	CONDITION REFERENCED FROM REQUIRED ACTION A.1	SURVEILLANCE REQUIREMENT
1. Radioactivity Monitors Providing Alarm But Not Providing Automatic Termination of Release			
a. Liquid Radwaste Effluent Gross Activity Monitor	1	C	RSR 12.2.1.1 RSR 12.2.1.2 RSR 12.2.1.3 RSR 12.2.1.5
b. Service Water Effluent Gross Activity Monitor (Unit 2)	1	D	RSR 12.2.1.1 RSR 12.2.1.2 RSR 12.2.1.4 RSR 12.2.1.5
c. Service Water Effluent Gross Activity Monitor (Unit 3)	1	D	RSR 12.2.1.1 RSR 12.2.1.2 RSR 12.2.1.4 RSR 12.2.1.5

12.2 INSTRUMENTATION

12.2.2 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

REC 12.2.2 The following conditions shall be met:

a. The effluent monitoring instrumentation in Table 12.2-2 shall be FUNCTIONAL with alarm setpoints set to ensure the limits of REC 12.4.1 are not exceeded; LCM 6/21

b. The effluent monitoring instrument alarm setpoints shall be determined in accordance with the methodology and parameters in the ODCM.

APPLICABILITY: As shown in Table 12.2-2.

ACTIONS

----------NOTES----------

1. Separate Condition entry is allowed for each instrument channel.
2. REC 12.0.4 is not applicable.
3. All deviations are reported in the Radioactive Effluent Release Report.
4. Channels may be removed from service for short durations without implementing REQUIRED ACTIONS as long as CONTINUOUS SAMPLING requirements are met.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Number of instrument channels FUNCTIONAL less than required by Table 12.2-2.	A.1 Enter the Condition referenced in Table 12.2-2 for the instrument channel.	Immediately
B. Radioactive gaseous effluent monitoring instrument channel alarm setpoint less conservative than required.	B.1 Suspend the release of radioactive gaseous effluents monitored by the affected instrument channel.	Immediately
	OR	
	B.2 Declare the affected instrument channel non-functional.	Immediately
	OR	
	B.3 Change the affected instrument channel setpoint so it is acceptably conservative.	Immediately

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. As required by Required Action A.1 and referenced in Table 12.2-2.	C.1.1 Verify at least one Reactor Building Vent Exhaust Duct Radiation Monitor is FUNCTIONAL in each affected pathway.	Immediately
	OR	
	C.1.2 Suspend release of radioactive effluents via this pathway.	Immediately
	AND	
	C.2 Restore instrument channel to FUNCTIONAL status.	30 days
D. As required by Required Action A.1 and referenced in Table 12.2-2.	D.1 Establish CONTINUOUS SAMPLING with auxiliary sampling equipment as required in Table 12.4-1.	Immediately
	AND	
	D.2 Restore instrument channel to FUNCTIONAL status.	30 days
E. As required by Required Action A.1 and referenced in Table 12.2-2.	E.1 Estimate flow rate.	Once per 4 hours
	AND	
	E.2 Restore instrument channel to FUNCTIONAL status.	30 days

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
F. Not used.	F.1 Not used.	NA
G. As required by Required Action A.1 and referenced in Table 12.2-2.	G.1.1 Obtain noble gas grab sample. AND G.1.2 Analyze sample for principle gamma emitters at LLDs specified in Table 12.4-1. AND G.2 Restore instrument channel to FUNCTIONAL status.	Once per 8 hours Within 24 hours of sampling 30 days
H. As required by Required Action A.1 and referenced in Table 12.2-2.	H.1.1 Verify low-range noble gas monitoring is FUNCTIONAL and on scale. OR H.1.2 Initiate alternate monitoring[1]. AND H.2 Restore instrument channel to FUNCTIONAL status.	Immediately 72 hours 21 days
I. ---------NOTE--------- Required Action I.1 shall be completed if this condition is entered. ---------- Required ACTION and associated Completion Time of Condition H.2 not met.	I.1 Prepare and submit a written report to the NRC outlining the plans, actions taken, and procedures used to provide for the loss of sampling capability.	30 days

[1] See Bases for acceptable methods of alternate monitoring.

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
J. As required by Required Action A.1 and referenced in Table 12.2-2.	J.1.1 Verify affected offgas charcoal filter treatment system is NOT bypassed. AND J.1.2 Verify Unit 2/3 Chimney Monitoring requirements of Table 12.2-2 are met. AND J.1.3 Restore Offgas Radiation Monitoring function.	Immediately Immediately 72 hours
K. Required Action J.1 and associated Completion Time not met.	K.1.1 Monitor MSL Radiation Monitors and 2/3 Chimney Effluent Monitors for Adverse Trends. AND K.1.2 Obtain Offgas Recombiner Outlet Sample and verify gross gamma activity rate is ≤ 252,700 μCi/s after 30 minute Decay. AND K.2 Restore Offgas Radiation Monitoring function.	Immediately AND Once per 4 hours thereafter 4 hours AND Once per 24 hours thereafter 30 days
L. Required Action K.1 and associated Completion Time not met.	L.1 Enter REC 12.0.3	Immediately

M. Required Action C.2, D.2, E.2, G.2, H.2, or K.2 and associated Completion Time not met.	M.1 Explain why the loss of functionality was not corrected in a timely manner in the Radioactive Effluent Release Report.	In accordance with Units 2/3 TS 5.6.3 or Unit 1 TS 6.9.A.4.

12.2.2 SURVEILLANCE REQUIREMENTS

----------NOTE----------
CHANNEL CHECK, CHANNEL FUNCTIONAL TEST, and CHANNEL CALIBRATION are not required when the instruments are NOT required to be FUNCTIONAL or are tripped.

	SURVEILLANCE REQUIREMENT	FREQUENCY
RSR 12.2.2.1	Perform CHANNEL CHECK.	24 hours
RSR 12.2.2.2	Perform CHANNEL CHECK to verify FUNCTIONALITY of the sampler; that the sampler is in place and functioning properly.	24 hours
RSR 12.2.2.3	Perform SOURCE CHECK.	31 days
RSR 12.2.2.4	Perform SOURCE CHECK.	24 months
RSR 12.2.2.5	Perform CHANNEL FUNCTIONAL TEST, which shall also demonstrate that control room annunciation occurs if any of the following conditions exist: 1. Instrument indicates measured levels above the Alarm setpoint, or 2. Circuit failure, or 3. Instrument indicates a downscale failure, or 4. Instrument controls not set in Operate mode.	92 days
RSR 12.2.2.6	Perform CHANNEL CALIBRATION, which shall include performance of a CHANNEL FUNCTIONAL TEST.	18 months
RSR 12.2.2.7	Perform CHANNEL CALIBRATION, which shall include performance of a CHANNEL FUNCTIONAL TEST.	24 months

Table 12.2-2 (Page 1 of 3)
RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	APPLICABLE MODES OR OTHER SPECIFIED CONDITION	REQUIRED CHANNELS PER INSTRUMENT	CONDITION REFERENCED FROM REQUIRED ACTION A.1	SURVEILLANCE REQUIREMENTS
1. 2/3 Reactor Building Ventilation System				
a. Unit 2/3 Reactor Building Vent Monitoring SPING				
1) Noble Gas Monitor Low, Mid, High Range	(a)	1	C	RSR 12.2.2.1 RSR 12.2.2.3 RSR 12.2.2.5 RSR 12.2.2.6
2) Iodine Sampler	(a)	1	D	RSR 12.2.2.2
3) Particulate Sampler	(a)	1	D	RSR 12.2.2.2
4) System Flow Rate Monitor	(a)	1	E	RSR 12.2.2.1 RSR 12.2.2.5 RSR 12.2.2.7
5) Sampler Flow Rate Monitor	(a)	1	E	RSR 12.2.2.1 RSR 12.2.2.5 [e] RSR 12.2.2.7
b. Unit 2 Reactor Building Vent Monitoring				
1) Exhaust Duct Radiation Monitor		Per Technical Specification 3.3.6.2		
2) Iodine Sampler	(b)	1	D	RSR 12.2.2.2
3) Particulate Sampler	(b)	1	D	RSR 12.2.2.2
4) Sampler Flow Rate Monitor	(b)	1	E	RSR 12.2.2.1 RSR 12.2.2.5 [e] RSR 12.2.2.7
c. Unit 3 Reactor Building Vent Monitoring				
1) Exhaust Duct Radiation Monitor		Per Technical Specification 3.3.6.2		
2) Iodine Sampler	(b)	1	D	RSR 12.2.2.2
3) Particulate Sampler	(b)	1	D	RSR 12.2.2.2
4) Sampler Flow Rate Monitor	(b)	1	E	RSR 12.2.2.1 RSR 12.2.2.5 [e] RSR 12.2.2.7

(continued)

(a) At all times.
(b) During effluent releases via this pathway when the 2/3 Reactor Building Vent SPING Iodine or Particulate Sampler is non-functional.
(e) CHANNEL FUNCTIONAL TEST shall be performed on local switches providing low flow alarm.

Table 12.2-2 (Page 2 of 3)
RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	APPLICABLE MODES OR OTHER SPECIFIED CONDITION	REQUIRED CHANNELS PER INSTRUMENT	CONDITION REFERENCED FROM REQUIRED ACTION A.1	SURVEILLANCE REQUIREMENTS
2. Main Stack System				
a. Unit 1 Chimney Monitoring				
1) Iodine Sampler	(f)	1	D	RSR 12.2.2.2
2) Particulate Sampler	(f)	1	D	RSR 12.2.2.2
b. Unit 2/3 Chimney Monitoring				
1) SPING / GE Noble Gas Monitor Low Range (3 channels available)	(a)	1	G	RSR 12.2.2.1 RSR 12.2.2.3 RSR 12.2.2.5 RSR 12.2.2.6
2) SPING Noble Gas Monitor Mid, High Range	(a)	1	H	RSR 12.2.2.1 RSR 12.2.2.3 RSR 12.2.2.5 RSR 12.2.2.6
3) Iodine Sampler	(a)	1	D	RSR 12.2.2.2
4) Particulate Sampler	(a)	1	D	RSR 12.2.2.2
5) System Flow Rate Monitor	(a)	1	E	RSR 12.2.2.1 RSR 12.2.2.5 RSR 12.2.2.7
6) Sampler Flow Rate Monitor	(a)	1	E	RSR 12.2.2.1 RSR 12.2.2.5[e] RSR 12.2.2.7

(continued)

(a) At all times.
(e) CHANNEL FUNCTIONAL TEST shall be performed on local switches providing low flow alarm.
(f) During operation of the Unit 1 Gaseous Monitoring System.

Table 12.2-2 (Page 3 of 3)
RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	APPLICABLE MODES OR OTHER SPECIFIED CONDITION	REQUIRED CHANNELS PER INSTRUMENT	CONDITION REFERENCED FROM REQUIRED ACTION A.1	SURVEILLANCE REQUIREMENTS
3. Condenser Air Ejector Radioactivity Monitor (Prior to Input to Holdup System)				
a. Unit 2 Offgas Recombiner Outlet Monitoring				
1) Radiation Activity Monitor (2 channels available)	(c)	1[g]	J	RSR 12.2.2.1 RSR 12.2.2.4 RSR 12.2.2.5 RSR 12.2.2.7
b. Unit 3 Offgas Recombiner Outlet Monitoring				
1) Radiation Activity Monitor (2 channels available)	(c)	1[g]	J	RSR 12.2.2.1 RSR 12.2.2.4 RSR 12.2.2.5 RSR 12.2.2.7
4. Decontamination Building Ventilation System				
a. Unit 1 Chemical Cleaning Building Monitoring				
1) Iodine Sampler	(d)	1	D	RSR 12.2.2.2
2) Particulate Sampler	(d)	1	D	RSR 12.2.2.2

(c) During operation of the Steam Jet Air Ejector for the applicable unit.
(d) During operation of Chemical Cleaning Building or Interim Radwaste Storage Facility ventilation system.
(g) Only one of two channels is required to be operable for this function. With both channels non-functional ensure required actions are completed.

12.3 LIQUID EFFLUENTS

12.3.1 LIQUID EFFLUENT CONCENTRATION

REC 12.3.1 The maximum concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS (see Part II Figure 1-3) shall be limited to:

a. 10 times the concentration specified in 10 CFR 20 Appendix B, Table 2, Column 2 for radionuclides other than dissolved or entrained noble gases; AND

b. 2×10^{-4} microCurie/ml total activity for all dissolved or entrained noble gases.

APPLICABILITY: At all times.

ACTIONS

----------NOTE----------
REC 12.0.3 and REC 12.0.4 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. ----------NOTE---------- Required Action A.2 shall be completed if this condition is entered. ---------- Concentration of radioactive material released to UNRESTRICTED AREAS exceeding limits of REC 12.3.1.	A.1 Restore the concentration of radioactive material to within limits (decrease release rate and / or increase dilution flow).	Immediately
	AND	
	A.2 Notify the NRC as required by 10 CFR 20.2203	30 days

12.3.1 SURVEILLANCE REQUIREMENTS

SURVEILLANCE REQUIREMENT		FREQUENCY
RSR 12.3.1.1	Perform representative radioactive liquid sampling.	In accordance with Table 12.3-2
RSR 12.3.1.2	Perform radioactive liquid activity analysis.	In accordance with Table 12.3-2
RSR 12.3.1.3	Evaluate each liquid radwaste effluent batch using the calculational methods of the ODCM to ensure concentrations are within the limits of REC 12.3.1. Base the release rate on the circulating water flow rate at the time of discharge.	Prior to each release

Table 12.3-1

Table deleted.

Table 12.3-2
RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM
(Page 1 of 3)

LIQUID RELEASE TYPE	MINIMUM SAMPLING REQUIREMENTS(1)	MINIMUM ANALYSIS FREQUENCY(1)	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD)(2) (µCi/ml)
A. Batch Release Tanks(3) (Units 2, 3 only)	Prior to release, each batch	Prior to release, each batch	Principal Gamma Emitters(4)	$5x10^{-7}$
			I-131	$1x10^{-6}$
			H-3	$1x10^{-5}$
	Prior to release, one batch per 31 days	31 days	Dissolved & Entrained Gases(5) (Gamma emitters)	$1x10^{-5}$
	Prior to release, each batch	31 days Composite(6)	Gross Alpha	$1x10^{-7}$
	Prior to release, each batch	92 days Composite(6)	Sr-89, Sr-90	$5x10^{-8}$
			Fe-55	$1x10^{-6}$
B. Plant Continuous Releases(7) (Units 2, 3 only)	31 days (Grab Sample)	31 days	Principal Gamma Emitters(4)	$5x10^{-7}$
			I-131	$1x10^{-6}$
			Dissolved & Entrained Gases(5) (Gamma emitters)	$1x10^{-5}$
			H-3	$1x10^{-5}$
	31 days (Grab Sample)	31 days	Gross Alpha	$1x10^{-7}$
	92 days (Grab Sample)	92 days	Sr-89, Sr-90	$5x10^{-8}$
			Fe-55	$1x10^{-6}$
C. Above Ground Liquid Storage Tanks	See Technical Requirements Manual	See Technical Requirements Manual	Principal Gamma Emitters(4)	$5x10^{-7}$
			Dissolved & Entrained Gases(5) (Gamma emitters)	$1x10^{-5}$

Table 12.3-2 (Page 2 of 3)
RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM
TABLE NOTATION

(1) RSR 12.0.2 and RSR 12.0.3 are applicable to the Radioactive Liquid Waste Sampling and Analysis Program sampling and analysis frequencies.

(2) The LLD is defined, for purposes of these specifications, as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66 s_b}{E \cdot V \cdot 2.22x10^6 \cdot Y \cdot e^{-\lambda \Delta t}}$$

Where:

LLD = the lower limit of detection (microcuries per unit mass or volume),

4.66 = $2k\sqrt{2}$, where k is the statistical student's "t" factor for a one-tailed distribution with infinite degrees of freedom at a confidence level of 95%,

s_b = the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (counts per minute),

$$= \frac{\sqrt{TotalCounts}}{t_b}$$

t_b = background counting time (minutes)

E = the counting efficiency (counts per disintegration),

V = the sample size (units of mass or volume),

2.22×10^6 = the number of disintegrations per minute per microcuries,

Y = the fractional radiochemical yield, when applicable,

λ= the radioactive decay constant for the particular radionuclide (sec $^{-1}$), and

Δt = the elapsed time between the midpoint of sample collection and the time of counting (sec).

Typical values of E, V, Y, and Δt should be used in the calculation.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of the measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

(3) A batch release is the discharge of liquid wastes of a discrete volume. Prior to sampling for analyses, each batch shall be isolated and then thoroughly mixed to assure representative sampling.

Table 12.3-2 (Page 3 of 3)

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM TABLE NOTATION

(4) The principal gamma emitters for which the LLD control applies are the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, and Ce-141. Ce-144 shall also be measured, but with an LLD of $5x10^{-6}$. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Radioactive Effluent Release Report.

(5) The dissolved and entrained gases (gamma emitters) for which the LLD specification applies are the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported.

(6) A composite sample is one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged and in which the method of sampling employed results in a specimen that is representative of the liquids released.

(7) A continuous release is the discharge of liquid wastes of a non-discrete volume; e.g., from a volume or system that has an input flow during the continuous release.

12.3 LIQUID EFFLUENTS

12.3.2 DOSE FROM LIQUID EFFLUENTS

REC 12.3.2.1 The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive material in liquid effluents released, from each unit, to UNRESTRICTED AREAS shall be limited to:

a. ≤ 1.5 mrem to the total body and ≤ 5.0 mrem to any organ during any calendar quarter; and

b. ≤ 3.0 mrem to the total body and ≤ 10.0 mrem to any organ during any calendar year.

REC 12.3.2.2 The projected annual total body or any internal organ dose calculated at the nearest downstream community water system from all radioactive material in liquid effluents released from the station shall be limited to <2.0 mrem.

APPLICABILITY: At all times.

ACTIONS

----------NOTE----------

REC 12.0.3 and REC 12.0.4 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Calculated dose or dose commitment exceeds two times (2x) limits of REC 12.3.2.1.a or b.	A.1 Enter condition A of 12.5.1.	Immediately
B. ----------NOTE---------- Required Action B.1 shall be completed if this condition is entered. ---------- Projected dose at the nearest downstream community water system exceeds required limits of REC 12.3.2.2.	B.1 Submit a report to the community water system operator, with copy to the NRC, to assist the operator in meeting 40 CFR 141, EPA Primary Drinking Water Standards.	30 days

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. ----------NOTE---------- Required Action C.1 shall be completed if this condition is entered. ---------- Calculated dose or dose commitment from the release of radioactive materials in liquid effluents exceeds required limits of REC 12.3.2.1.a or b.	C.1 Submit a Special Report, pursuant to 10CFR50 Appendix I, Section IV.A to the NRC that identifies the cause(s) for exceeding limits, corrective actions taken to reduce releases of radioactive materials in liquid effluents, and proposed actions taken to assure future releases are in compliance with REC 12.3.2.1.a and b.	30 days from the end of the quarter during which the release occurred

12.3.2 SURVEILLANCE REQUIREMENTS

----------NOTES----------

1. Only required to be performed if liquid releases have occurred since the last performance of these RSRs.
2. RSR 12.0.2 is not applicable

SURVEILLANCE REQUIREMENT		FREQUENCY
RSR 12.3.2.1	Determine cumulative dose contributions from liquid effluents for the current calendar quarter and the current calendar year in accordance with the methodology and parameters in the ODCM.	31 days
RSR 12.3.2.2	Determine projected dose contributions from liquid effluents in accordance with the methodology in the ODCM.	31 days
RSR 12.3.2.3	Determine cumulative and projected dose contributions from liquid effluents at the nearest community water system considering only the drinking water pathway in accordance with the methodology and parameters in the ODCM.	92 days

12.3 LIQUID EFFLUENTS

12.3.3 LIQUID RADWASTE TREATMENT SYSTEMS

REC 12.3.3 The Liquid Radwaste Treatment System shall be FUNCTIONAL and appropriate portions of the system shall be used to reduce releases of radioactivity when the projected doses due to the liquid effluent, from each unit, to UNRESTRICTED AREAS would exceed:

a. ≤ 0.06 mrem to the total body, or

b. ≤ 0.2 mrem to any organ

in a 31-day period, which is 2% of annual guidelines of 10 CFR 50, Appendix I.

APPLICABILITY: At all times.

ACTIONS

----------NOTES----------

REC 12.0.3 and REC 12.0.4 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. ----------NOTE---------- Required Action A.1 shall be completed if this condition is entered. ---------- Radioactive liquid waste being discharged without treatment and in excess of the limits of REC 12.3.3 and any portion of the Liquid Radwaste Treatment System not in operation.	A.1 Submit a Special Report to the NRC that includes an explanation of why liquid radwaste was discharged without treatment, identification of non-functional equipment or subsystems, and the reason for the loss of FUNCTIONALITY, action(s) taken to restore the non-functional equipment to FUNCTIONAL status, summary description of action(s) taken to prevent recurrence, and duration, volume, and curie content of the release.	30 days

12.3.3 SURVEILLANCE REQUIREMENTS

SURVEILLANCE REQUIREMENT	FREQUENCY
----------NOTES---------- 1. Liquid Radwaste Treatment System shall be considered FUNCTIONAL by meeting REC 12.3.1 a and b. 2. Dose projections are performed per RSR 12.3.2.2. ----------	LCM 6/21

12.4 GASEOUS EFFLUENTS

12.4.1 GASEOUS EFFLUENT DOSE RATES

REC 12.4.1 The dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the SITE BOUNDARY shall be limited to the following:

a. For noble gases: ≤ 500 mrem/year to the total body and ≤3000 mrem/year to the skin; and

b. For Iodine-131, for Iodine-133, for tritium, and for all radionuclides in particulate form with half-lives greater than 8 days: ≤ 1500 mrem/year to any organ.

APPLICABILITY: At all times.

ACTIONS

----------NOTE----------

REC 12.0.3 and REC 12.0.4 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Dose rates due to radioactive material in gaseous effluents at or beyond the SITE BOUNDARY exceed limits of REC 12.4.1.	A.1 Restore release rate to within REC 12.4.1 limits. AND A.2 Notify the NRC as required by 10 CFR 20.2203.	Immediately 30 days

12.4.1 SURVEILLANCE REQUIREMENTS

SURVEILLANCE REQUIREMENT		FREQUENCY
RSR 12.4.1.1	Determine the dose rate due to radioactive materials in the form of noble gases, I-131, I-133, tritium, and particulates with half lives > 8 days released in gaseous effluents from the site is within the prescribed limits in accordance with methodology and parameters in the ODCM by obtaining representative samples and performing analyses.	In accordance with Table 12.4-1

Table 12.4-1 (Page 1 of 3)
RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

GASEOUS RELEASE TYPE	SAMPLING FREQUENCY(1)	MINIMUM ANALYSIS FREQUENCY(1)	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD)(2) (µCi/ml)
A. 2/3 Chimney and 2/3 Reactor Building Ventilation Stack	31 days(3) Grab Sample	31 days	Principal Gamma Emitters (4)	$1x10^{-4}$
	Continuous(5)	Noble Gas Monitor	Noble Gases	$1x10^{-6}$
B. 2/3 Chimney and 2/3 Reactor Building Ventilation Stack	31 days Grab Sample	31 days	Tritium (oxide)	$1x10^{-6}$
C. 1 Chimney(9), 1 Chemical Cleaning Building Stack(6), 2/3 Chimney, and 2/3 Reactor Building Ventilation Stack	Continuous(5)	7 days (7) Charcoal Sample	I-131	$1x10^{-12}$
			I-133	$1x10^{-10}$
	Continuous(5)	7 days (7) Particulate Sample	Principal Gamma Emitters (4)	$1x10^{-11}$
	Continuous(5)	92 days Composite Particulate Sample	Sr-89, Sr-90 Gross Alpha(8)	$1x10^{-11}$

Table 12.4-1 (Page 2 of 3)

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

TABLE NOTATION

(1) RSR 12.0.2 and RSR 12.0.3 are applicable to the Radioactive Gaseous Waste Sampling and Analysis Program sampling and analysis frequencies.

(2) The LLD is defined, for purposes of these specifications, as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66 s_b}{E \cdot V \cdot 2.22x10^6 \cdot Y \cdot e^{-\lambda \Delta t}}$$

Where:

LLD = the lower limit of detection (microcuries per unit mass or volume),

4.66 = $2k\sqrt{2}$, where k is the statistical student's "t" factor for a one-tailed distribution with infinite degrees of freedom at a confidence level of 95%,

s_b = the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (counts per minute),

$$= \frac{\sqrt{TotalCounts}}{t_b}$$

t_b = background counting time (minutes)

E = the counting efficiency (counts per disintegration),

V = the sample size (units of mass or volume),

2.22×10^6 = the number of disintegrations per minute per microcuries,

Y = the fractional radiochemical yield, when applicable,

λ= the radioactive decay constant for the particular radionuclide (sec^{-1}), and

Δt = the elapsed time between the midpoint of sample collection and the time of counting (sec).

Typical values of E, V, Y, and Δt should be used in the calculation.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of the measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

Table 12.4-1 (Page 3 of 3)

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

TABLE NOTATION

(3) Noble gas sampling and analyses of the 1) 2/3 Reactor Building Ventilation Stack or the affected unit Reactor Building Ventilation system and 2) 2/3 Chimney shall also be performed following shutdown, startup, or a thermal power change exceeding 20% RTP within a 1-hour period unless 1) analysis shows that the DOSE EQUIVALENT I-131 concentration in the primary coolant has not increased more than a factor of 5, and 2) the noble gas activity monitor shows that effluent activity has not increased by more than a factor of 3.

(4) The principal gamma emitters for which the LLD specification applies are the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 for gaseous emissions, and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141, and Ce-144 for particulate emissions. Other peaks that are measurable and identifiable by gamma ray spectrometry, together with the above nuclides, shall be also identified and reported when an actual analysis is performed on a sample.

(5) The ratio of sample flow rate to the sampled stream flow rate or to the system design flow rate shall be known for the time period covered by each dose or dose rate calculation made in accordance with REC 12.4.1, REC 12.4.2, and REC 12.4.3.

(6) Sampling of the Chemical Cleaning Building Stack is not required if the Chemical Cleaning and Interim Radwaste Storage Facility (IRSF) ventilation systems are not running.

(7) Samples shall be changed at least once per 7 days and the analyses completed within 48 hours after changing, or after removal from sampler. Sampling of the 1) 2/3 Reactor Building Ventilation Stack or the affected unit Reactor Building Ventilation system and 2) 2/3 Chimney shall also be performed within 24 hours following each shutdown, startup, or thermal power level change exceeding 20% RTP within a 1-hour period and analyses shall be completed within 48 hours of changing. This requirement does not apply if 1) analysis shows that the DOSE EQUIVALENT I-131 concentration in the primary coolant has not increased more than a factor of 5, and 2) the noble gas activity monitor shows that effluent activity has not increased by more than a factor of 3. When samples collected for 24 hours or less are analyzed, the corresponding LLDs may be increased by a factor of 10.

(8) For radionuclides not determined in each batch or weekly composite, the dose contribution to the current calendar quarter or calendar year cumulative summation may be estimated by assuming an average monthly concentration based on the previous monthly or quarterly composite analyses. However, for reporting purposes, the calculated dose contributions shall be based on the actual composite analyses when possible.

(9) Sampling of the Unit 1 Chimney is not required if the Unit 1 Gaseous Monitoring System is not discharging via the Unit 1 Chimney.

12.4 GASEOUS EFFLUENTS

12.4.2 DOSE FROM NOBLE GASES

REC 12.4.2 The air dose due to noble gases released in gaseous effluents, from each unit, to areas at or beyond the SITE BOUNDARY shall be limited to the following:

a. For gamma radiation, ≤ 5 mrad during any calendar quarter;
b. For beta radiation, ≤ 10 mrad during any calendar quarter;
c. For gamma radiation, ≤ 10 mrad during any calendar year; and
d. For beta radiation, ≤ 20 mrad during any calendar year.

APPLICABILITY: At all times.

ACTIONS

----------NOTE----------
REC 12.0.3 and REC 12.0.4 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Calculated dose or dose commitment exceeds two times (2x) limits of REC 12.4.2.	A.1 Enter condition A of 12.5.1.	Immediately
B. ----------NOTE---------- Required Action A.1 shall be completed if this condition is entered. ---------- Calculated air dose at or beyond the SITE BOUNDARY from radioactive noble gases in gaseous effluents exceeds limits.	B.1 Submit a Special Report, pursuant to 10CFR50 Appendix I, Section IV.A to the NRC that identifies cause(s) for exceeding the limit(s), defines the corrective actions taken to reduce the releases, and the proposed corrective actions to assure that subsequent releases are within limits.	30 days from the end of the quarter during which the release occurred

12.4.2 SURVEILLANCE REQUIREMENTS

----------NOTE----------

RSR 12.0.2 is not applicable.

SURVEILLANCE REQUIREMENT		FREQUENCY
RSR 12.4.2.1	Determine cumulative dose contributions for the current calendar quarter and current calendar year from noble gases in accordance with the methodology and parameters in the ODCM.	31 days
RSR 12.4.2.2	Determine projected dose contributions for noble gases in accordance with the methodology in the ODCM.	31 days

12.4 GASEOUS EFFLUENTS

12.4.3 DOSE FROM IODINE-131, IODINE-133, TRITIUM, AND RADIOACTIVE MATERIALS IN PARTICULATE FORM

REC 12.4.3 The dose to a MEMBER OF THE PUBLIC from iodine-131, iodine-133, tritium and all radionuclides in particulate form with half lives > 8 days in gaseous effluents released, from each unit, to areas at or beyond the SITE BOUNDARY shall be limited to:

a. ≤ 7.5 mrem to any organ during any calendar quarter; and
b. ≤ 15 mrem to any organ during any calendar year.

APPLICABILITY: At all times.

ACTIONS

----------NOTE----------
REC 12.0.3 and REC 12.0.4 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Calculated dose or dose commitment exceeds two times (2x) limits of REC 12.4.3.	A.1 Enter condition A of 12.5.1.	Immediately
B. ----------NOTE---------- Required Action A.1 shall be completed if this condition is entered. ---------- Calculated dose from the release of iodine-131, iodine-133, tritium, and radionuclides in particulate form, with half-lives > 8 days in gaseous effluents exceeds limits.	B.1 Submit a Special Report, pursuant to 10CFR50 Appendix I, Section IV.A to the NRC that identifies cause(s) for exceeding limit(s), corrective actions taken, and proposed corrective actions to assure that subsequent releases are within limits.	30 days from the end of the quarter during which the release occurred

12.4.3 SURVEILLANCE REQUIREMENTS

----------NOTE----------

RSR 12.0.2 is not applicable

SURVEILLANCE REQUIREMENT		FREQUENCY
RSR 12.4.3.1	Determine cumulative dose contributions for the current calendar quarter and current calendar year from iodine-131, iodine-133, tritium, and radionuclides in particulate form with half-lives > 8 days in accordance with the methodology and parameters in the ODCM.	31 days
RSR 12.4.3.2	Determine projected dose contributions from iodine-131, iodine-133, tritium, and radionuclides in particulate form with half-lives > 8 days in accordance with the methodology in the ODCM.	31 days

12.4 GASEOUS EFFLUENTS

12.4.4 GASEOUS RADWASTE TREATMENT SYSTEM

REC 12.4.4 The GASEOUS RADWASTE TREATMENT SYSTEM shall be in operation.

APPLICABILITY: Whenever the Main Condenser Air Ejector system is in operation and the unit is above 30% RTP.

ACTIONS

----------NOTE----------
REC 12.0.3 and REC 12.0.4 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. ----------NOTE---------- Required Action A.1 shall be completed if this condition is entered. ---------- Gaseous radwaste from the main condenser air ejector system is being discharged without treatment (i.e., all charcoal beds) for more than 7 days in a calendar quarter.	A.1 Submit a Special Report to the NRC that includes identification of non-functional equipment or subsystems and reason for loss of FUNCTIONALITY, action(s) taken to restore the non-functional equipment to FUNCTIONAL status, length of time REC 12.4.4 was not met, waste discharge volume and curie content that was not processed but required processing, and summary description of action(s) taken to prevent a recurrence.	30 days

12.4.4 SURVEILLANCE REQUIREMENTS

SURVEILLANCE REQUIREMENT	FREQUENCY
----------NOTE---------- Dose projections for this REC are performed per RSR 12.4.2.2 and RSR 12.4.3.2. ----------	

12.4 GASEOUS EFFLUENTS

12.4.5 VENTILATION EXHAUST TREATMENT SYSTEM

REC 12.4.5 The VENTILATION EXHAUST TREATMENT SYSTEM shall be FUNCTIONAL and appropriate portions of this system shall be used to reduce releases of radioactivity when the projected doses in 31 days due gaseous effluent releases, from each unit, to areas at or beyond the SITE BOUNDARY would exceed:

a. 0.2 mrad to air from gamma radiation, or
b. 0.4 mrad to air from beta radiation, or
c. 0.3 mrem to any organ of a MEMBER OF THE PUBLIC.

APPLICABILITY: At all times.

ACTIONS

----------NOTE----------
REC 12.0.3 and REC 12.0.4 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. ----------NOTE---------- Required Action A.1 shall be completed if this condition is entered. ---------- Radioactive gaseous waste discharged without treatment and in excess of the above limits.	A.1 Submit a Special Report to the NRC that includes identification of non-functional equipment or subsystems and reason for loss of FUNCTIONALITY, action(s) taken to restore the non-functional equipment to FUNCTIONAL status, and summary description of action(s) taken to prevent a recurrence.	30 days

12.4.5 SURVEILLANCE REQUIREMENTS

SURVEILLANCE REQUIREMENT	FREQUENCY

----------NOTES----------

1. The installed VENTILATION EXHAUST TREATMENT SYSTEMS shall be considered FUNCTIONAL by meeting REC 12.4.1, and either REC 12.4.2 or REC 12.4.3.
2. Dose projections for this REC are performed per RSR 12.4.2.2 and RSR 12.4.3.2.

12.4 GASEOUS EFFLUENTS

12.4.6 MARK I CONTAINMENT

REC 12.4.6 VENTING or PURGING of the containment drywell atmosphere shall meet the requirements of REC 12.4.1, REC 12.4.2, and REC 12.4.3, AND shall be:

a. Through the Reactor Building Ventilation Exhaust System OR Standby Gas Treatment System IF drywell atmosphere activity is:

i. < 7.2×10^{-9} µCi/cc I-131 AND

ii. < 7.9×10^{-9} µCi/cc beta / gamma (total particulate).

OR

iii. Verify projected dose due to VENTING or PURGING is within the limits of REC 12.4.1, REC 12.4.2, and REC 12.4.3 prior to venting.

OR

b. Through the Standby Gas Treatment System.

APPLICABILITY: During VENTING or PURGING of the containment drywell.

ACTIONS

----------NOTE----------

REC 12.0.3 and REC 12.0.4 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Requirement of REC 12.4.6 not met.	A.1 Suspend VENTING or PURGING of the containment drywell.	Immediately
B. Drywell atmosphere activity is ≥ 3.5×10^{-7} µCi/cc I-131 or is ≥ 3.9×10^{-6} µCi/cc beta / gamma (total particulate).	B.1 Verify projected dose due to VENTING or PURGING is within the limits of REC 12.4.1, REC 12.4.2, and REC 12.4.3.	Prior to VENTING or PURGING of containment drywell.

12.4.6 SURVEILLANCE REQUIREMENTS

SURVEILLANCE REQUIREMENT		FREQUENCY
RSR 12.4.6.1	Verify primary containment VENTING or PURGING is through required effluent release pathway of REC 12.4.6.	Prior to VENTING or PURGING of containment drywell.

12.5 TOTAL DOSE

12.5.1 40CFR190 DOSE LIMITS FOR MEMBERS OF THE PUBLIC

REC 12.5.1 The annual (calendar year) dose or dose commitment to any MEMBER OF THE PUBLIC due to releases of radioactivity and to radiation from uranium fuel cycle sources within 8 kilometers shall be:

a. ≤ 25 mrem to the total body;
b. ≤ 75 mrem to the thyroid; and
c. ≤ 25 mrem to any other critical organ.

APPLICABILITY: At all times.

ACTIONS

----------NOTE----------
REC 12.0.3 and REC 12.0.4 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. As required by Required Action A.1 of REC 12.3.2, REC 12.4.2 or REC 12.4.3	----------NOTE---------- Calculations shall include direct radiation contributions from the units (including outside storage tanks, etc.). ---------- A.1 Determine whether the limits of 12.5.1 have been exceeded.	Immediately
B. ----------NOTE---------- Required Action B.1 shall be completed if this condition is entered. ---------- Calculated dose or dose commitment exceeds the limits of 12.5.1.	B.1 Submit a Special Report to the NRC that defines the corrective actions taken to reduce subsequent releases to prevent recurrence of exceeding the limits and includes a schedule for achieving conformance with the limits. The report, as defined in 10 CFR 20.2203, shall include an analysis that estimates the radiation exposure (dose) to a MEMBER OF THE PUBLIC from uranium fuel cycle sources, including all effluent pathways and direct radiation for the calendar year that includes the release(s) covered by this report.	30 days

(continued)

ACTIONS (Continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. ----------NOTE---------- Required Action C.1 shall be completed if this condition is entered. ---------- Calculated dose or dose commitment exceeds the limits of 12.5.1 AND the release condition resulting in exceeding 12.5.1 limits is NOT corrected.	C.1 Submit a request to the NRC for a variance in accordance with the provisions of 40 CFR 190 and a request for an exemption from 10 CFR 72.104 as part of the report for Required Action B.1. Submittal of the report as described in this Required Action is considered a timely request, and a variance is granted until staff action on the request is complete.	30 days

12.5.1 SURVEILLANCE REQUIREMENTS

SURVEILLANCE REQUIREMENT	FREQUENCY

----------NOTES----------

1. Surveillance testing for determination of dose contributions from liquid effluents for this REC is performed per RSR 12.3.2.1.
2. Surveillance testing for determination of dose contributions from gaseous effluents for this REC is performed per RSR 12.4.2.1 and RSR 12.4.3.1.
3. Surveillance testing for determination of dose contributions from direct radiation for this REC is performed by REMP TLD monitoring per RSR 12.6.1.2.

12.5 TOTAL DOSE

12.5.2 10CFR20 DOSE LIMITS FOR MEMBERS OF THE PUBLIC

REC 12.5.2 Operations shall be conducted such that:

a. Total Effective Dose Equivalent (TEDE) to individual MEMBERS OF THE PUBLIC does not exceed 100 mrem/year; and

b. The dose in any unrestricted area from external sources does not exceed 2 mrem in any one hour.

APPLICABILITY: At all times.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. ----------NOTE---------- Required Action A.1 shall be completed if this Condition is entered. ---------- Dose limit of REC Item a exceeded.	A.1 Submit a report to the NRC in accordance with 10 CFR 20.2203.	30 days
B. ----------NOTE---------- Required Action B.1 shall be completed if this Condition is entered. ---------- Dose limit of REC Item b exceeded.	B.1 Submit a report to the NRC in accordance with 10 CFR 20.2203.	30 days

12.5.2 SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
RSR 12.5.2.1	Calculate the Total Dose to individual MEMBERS OF THE PUBLIC in accordance with the ODCM.	As part of the Radioactive Effluent Release Report per Units 2/3 TS 5.6.3 and Unit 1 TS 6.9.A.4
RSR 12.5.2.2	Determine and/or evaluate direct radiation exposures in unrestricted areas.	12 months

12.6 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

12.6.1 MONITORING PROGRAM

REC 12.6.1 The Radiological Environmental Monitoring Program (REMP) shall be conducted as specified in Table 12.6-1.

APPLICABILITY: At all times.

ACTIONS

----------NOTE----------
REC 12.0.3 and REC 12.0.4 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. REMP not being conducted as specified in Table 12.6-1	A.1 Submit to the NRC a description of the reasons for not conducting the REMP as required and the plans for preventing a recurrence.	As part of the Annual Radiological Environmental Operating Report per Units 2/3 TS 5.6.2 and Unit 1 TS 6.9.A.3.
B. ----------NOTE---------- Required Action B.1 shall be completed if this condition is entered. ---------- Level of radioactivity as the result of plant effluents in an environmental sampling medium at a specified location exceeds the Reporting Levels of Table 12.6-2 when averaged over any calendar quarter.	B.1 Submit a Special Report to the NRC that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions to be taken to reduce radioactive effluents so that the potential annual dose to a MEMBER OF THE PUBLIC is less than the calendar year limits of REC 12.3.2.1, REC 12.4.2, or REC 12.4.3. The methodology and parameters used to estimate the potential annual dose shall be indicated in this report.	30 days

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. ----------NOTE---------- Required Action C.1 shall be completed if this condition is entered. ---------- More than one radionuclide in Table 12.6-2 is detected in the sampling medium. <u>AND</u> $\frac{C(1)}{RL(1)} + \frac{C(2)}{RL(2)} + \geq 1.0$ where: C = concentration RL = reporting level	C.1 Submit a Special Report to the NRC that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions to be taken to reduce radioactive effluents so that the potential annual dose to a MEMBER OF THE PUBLIC is less than the calendar year limits of REC 12.3.2.1, REC 12.4.2, or REC 12.4.3. The methodology and parameters used to estimate the potential annual dose shall be indicated in this report.	30 days

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
D. ----------NOTE---------- Required Actions D.1 and D.2 shall be completed if this condition is entered. ----------	----------NOTE---------- Only required if the radionuclides detected are the result of plant effluents. ----------	
Radionuclides other than those in Table 12.6-2 are detected and the potential annual dose to a MEMBER OF THE PUBLIC is greater than or equal to the calendar year limits of REC 12.3.2.1, or REC 12.4.2, or REC 12.4.3.	D.1 Submit a Special Report to the NRC that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions to be taken to reduce radioactive effluents so that the potential annual dose to a MEMBER OF THE PUBLIC is less than the calendar year limits of REC 12.3.2.1, REC 12.4.2, or REC 12.4.3. The methodology and parameters used to estimate the potential annual dose shall be indicated in this report.	30 days
	AND	
	----------NOTE---------- Only required if the radionuclides detected are **NOT** the result of plant effluents. ----------	
	D.2 Report and describe the condition in the Annual Radiological Environmental Operating Report.	As part of the Annual Radiological Environmental Operating Report per Units 2/3 TS 5.6.2 and Unit 1 TS 6.9.A.3.

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
E. ----------NOTE---------- Required Actions E.1 and E.2 shall be completed if this condition is entered. ---------- Milk or fresh leafy vegetation samples unavailable from one or more of the locations required by Table 12.6-1.	----------NOTE---------- Specific locations from which samples are unavailable may be deleted from the REMP after completion of Required Action E.1. ----------	
	E.1 Identify specific locations for obtaining replacement samples and add them to the REMP.	30 days
	AND	
	E.2 Submit documentation for a change in the ODCM including a revised figure(s) and table for the ODCM reflecting the new location(s) with supporting information identifying the cause of the unavailability of samples and justifying the selection of the new location(s) for obtaining samples.	As part of the Radioactive Effluent Release Report per Units 2/3 TS 5.6.3 and Unit 1 TS 6.9.A.4
F. ----------NOTE---------- Required Actions F.1 and F.2 shall be completed if this condition is entered. ---------- It is not possible or practicable to continue to obtain samples of the media of choice at the most desired location or time.	F.1 Choose suitable alternative media and locations for the particular pathway in question and make appropriate substitutions.	30 days
	AND	
	F.2 Submit documentation for a change in the ODCM including a revised figure(s) and table for the ODCM reflecting the new location(s) with supporting information identifying the cause of the unavailability of samples for the pathway and justifying the selection of the new location(s) for obtaining samples.	As part of the Radioactive Effluent Release Report per Units 2/3 TS 5.6.3 and Unit 1 TS 6.9.A.4

12.6.1 SURVEILLANCE REQUIREMENTS

SURVEILLANCE REQUIREMENT		FREQUENCY
----------NOTES---------- 1. Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, or malfunction of automatic sampling equipment. 2. If equipment malfunction occurs, an effort shall be made to complete corrective actions prior to the end of the next sampling period. ----------		
RSR 12.6.1.1	Collect REMP samples pursuant to Table 12.6-1 from the specific locations given in the Table and figures in the ODCM.	In accordance with Table 12.6-1
RSR 12.6.1.2	Analyze REMP samples pursuant to the requirements of Table 12.6-1 and the detection capabilities required by Table 12.6-3.	In accordance with Table 12.6-1

Table 12.6-1 (Page 1 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/ OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS[1]	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
1. Direct Radiation[2]	Forty routine monitoring stations, either with two or more dosimeters or with one instrument for measuring and recording dose rate continuously, placed as follows: a. Indicator- Inner Ring One in each meteorological sector, in the general area of the SITE BOUNDARY (within 3.2 km / 2 mi); b. Indicator- Outer Ring One in each meteorological sector, in the 5 to 10 km (3 to 6.2 mi) range; and c. Other One at each Airborne location given in parts 2.a. and 2.b. d. Control One at the Airborne Control location given in part 2.c.	Quarterly	Gamma dose quarterly.

Table 12.6-1 (Page 2 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/ OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS[1]	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
2. Airborne			
Radioiodine and Particulates	Samples from a total of eight locations: a. Indicator- Near Field Samples from locations within 5 km (3 mi) in four different sectors. b. Indicator- Far Field Samples from locations between 5 and 10 km (3 and 6.2 mi) in four different sectors. c. Control One sample from a control location within 10 to 30 km (6.2 to 18.6 mi).	Continuous sampler operation with sample collection weekly, or more frequently if required due to dust loading.	Radioiodine Canister: I-131 analysis weekly. Particulate Sampler: Gross beta analysis following filter change;[3] and gamma isotopic analysis[4] of composite (by location) quarterly.
3. Waterborne			
a. Surface Water[5]	a. Indicator One sample downstream b. Control One sample upstream	Composite sample over 1-month period.	Gross beta and gamma isotopic analysis[4] monthly. Composite for tritium analysis quarterly.
b. Ground/ Well	a. Indicator Samples from one source, only if likely to be affected.[7]	Quarterly	Gamma isotopic[4] and tritium analysis quarterly.

Table 12.6-1 (Page 3 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/ OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS[1]	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
3. Waterborne (continued)			
c. Drinking	a. Indicator One sample from each community drinking water supply that could be affected by the station discharge within 10 km (6.2 mi) downstream of discharge. b. Control One surface water sample upstream of discharge.	Composite sample over 2-week period[6] when I-131 analysis is performed; monthly composite otherwise when monitoring is required.	I-131[4] analysis on each composite when the dose calculated for the consumption of the water is greater than 1 mrem per year[8]. Composite for gross beta and gamma isotopic analyses[4] monthly. Composite for tritium analysis quarterly.
	Note: Currently there are no community drinking water supplies that could be affected by the station discharge within 10 km (6.2 mi) of the station discharge. Therefore, no Drinking Water monitoring is required at this time.		
d. Sediment from Shoreline	a. Indicator One sample from downstream[5] area within 10 km (6.2 mi).	Semiannually.	Gamma isotopic analysis[4] semiannually.
e. Dredging Spoils	a. Indicator One sample of sediment from dredging within 1 mile downstream of station discharge point.	Annually when dredging occurs within the past 12 months.	Gamma isotopic analysis[4] annually.

Table 12.6-1 (Page 4 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/ OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS[1]	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS	
4. Ingestion				
a. Milk [9]	a. Indicator Samples from milking animals from a maximum of three locations within 5 km (3.1 mi) distance. b. Control One sample from milking animals at a control location within 10 to 30 km (6.2 to 18.6 mi).	Semimonthly when animals are on pasture (May through October), monthly at other times (November through April).	Gamma isotopic[4] and I-131[4] analysis on each sample.	LCM 6/21
b. Fish	a. Indicator Representative samples of commercially and recreationally important species in vicinity of plant discharge area. b. Control Representative samples of commercially and recreationally important species in areas not influenced by plant discharge.	Two times annually.	Gamma isotopic analysis[4] on edible portions	
c. Food Products	a. Indicator One sample of each principal class of food products from any areas that is irrigated by water in which liquid plant wastes have been discharged.	At time of harvest	Gamma isotopic[4] analysis on each sample.	LCM 6/21

Table 12.6-1 (Page 5 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/ OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS[1]	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
4. Ingestion (continued)			
d. Vegetation[10]	----------NOTE---------- These vegetation samples are only required if milk sampling is not performed. ---------- a. Indicator Samples of 3 different types of broadleaf vegetation within 8 Km (5 miles) in the highest D/Q sector. b. Control Sample of 3 different types of broadleaf vegetation 15 to 30 Km (9.4 to 18.7 miles) in the lowest D/Q sector.	Monthly during growing season (typically July through October)	Gamma isotopic[4] and I-131 analysis on each sample.

Table 12.6-1 (Page 6 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM TABLE NOTATIONS

(1) Specific parameters of distance and direction from the centerline of the midpoint of the Unit 2 and Unit 3 reactors and additional description where pertinent, shall be provided for each and every sample location in Part II, Table 6-1 and Figures 6-1 and 6-2, except for vegetation due to location variability. Refer to NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," October 1978, and to Radiological Assessment Branch Technical Position, Revision 1, November 1979. Deviations are permitted from the required sampling schedule if specimens are unobtainable due to circumstances such as hazardous conditions, seasonal unavailability, and malfunction of automatic sampling equipment. If specimens are unobtainable due to sampling equipment malfunction, effort shall be made to complete corrective action prior to the end of the next sampling period. All deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Operating Report. It is recognized that, at times, it may not be possible or practical to continue to obtain samples of the media of choice at the most desired location or time. In these instances suitable alternative media and locations may be chosen for the particular pathway in question and appropriate substitutions made within 30 days in the REMP given in the ODCM. Submit in the next Annual Radioactive Effluent Release Report documentation for a change in the ODCM including a revised figure(s) and table for the ODCM reflecting the new location(s) with supporting information identifying the cause of the unavailability of samples for the pathway and justifying the selection of the new location(s) for obtaining samples.

(2) One or more instruments, such as a pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of, or in addition to, integrating dosimeters. For the purposes of this table, a thermoluminescent dosimeter (TLD) is considered to be one phosphor; two or more phosphors in a packet are considered as two or more dosimeters. Film badges shall not be used as dosimeters for measuring direct radiation. (The 40 locations is not an absolute number. The number of direct radiation monitoring stations may be reduced according to geographical limitations; e.g., at an ocean site, some sectors will be over water so that the number of dosimeters may be reduced accordingly. The frequency of analysis or readout for TLD systems will depend upon the characteristics of the specific system used and should be selected to obtain optimum dose information with minimal fading.)

(3) Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air particulate samples is greater than 10 times the yearly mean of control samples, gamma isotopic analysis shall be performed on the individual samples.

(4) Gamma isotopic analysis means the identification and quantification of gamma emitting radionuclides that may be attributable to the effluents from the facility. I-131 analysis means the use of separation and counting procedures specific to this radionuclide.

(5) The "upstream sample" shall be taken at a distance beyond significant influence of the discharge. The "downstream" sample shall be taken in an area beyond but near the mixing zone. "Upstream" samples in an estuary must be taken far enough upstream to be beyond the plant influence.

(6) A composite sample is one in which the quantity (aliquot) of liquid sampled is proportional to the quantity of flowing liquid and in which the method of sampling employed results in a specimen that is representative of the liquid flow.

(7) Groundwater samples shall be taken when this source is tapped for drinking or irrigation purposes in areas where the hydraulic gradient or recharge properties are suitable for contamination.

(8) The dose shall be calculated for the maximum organ and age group, using the methodology and parameters in the ODCM

(9) If milking animals are not found in the designated indicator locations, or if the owners decline to participate in the REMP, all milk sampling may be discontinued. If no indicator milk sample is available, then vegetation samples, as described in 4.d Vegetation; must be obtained per the approved REMP collection schedule.

(10) Collect broadleaf vegetation during growing season, when available.

Table 12.6-2

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

ANALYSIS	WATER (pCi/l)	AIRBORNE PARTICULATE OR GASES (pCi/m^3)	FISH (pCi/kg, wet)	MILK (pCi/l)	FOOD PRODUCTS (pCi/kg, wet)
H-3	20,000*				
Mn-54	1,000		30,000		
Fe-59	400		10,000		
Co-58	1,000		30,000		
Co-60	300		10,000		
Zn-65	300		20,000		
Zr-Nb-95	400***				
I-131	2**	0.9		3	100
Cs-134	30	10	1,000	60	1,000
Cs-137	50	20	2,000	70	2,000
Ba-La-140	200***			300	

* For drinking water samples. This is 40 CFR Part 141 value. If no drinking water pathway exists, a value of 30,000 pCi/l may be used.
** If no drinking water pathway exists, a value of 20 pCi/l may be used.
*** Total of parent and daughter.

Table 12.6-3 (Page 1 of 3)

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS[1][2]

LOWER LIMIT OF DETECTION (LLD) [3]

ANALYSIS	WATER (pCi/l)	AIRBORNE PARTICULATE OR GASES (pCi/m^3)	FISH (pCi/kg, wet)	MILK (pCi/l)	FOOD PRODUCTS (pCi/kg, wet)	SEDIMENT (pCi/kg, dry)
Gross Beta	4	0.01				
H-3	2,000					
Mn-54	15		130			
Fe-59	30		260			
Co-58	15		130			
Co-60	15		130			
Zn-65	30		260			
Zr-95	30					
Nb-95	15					
I-131[4]	1*	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-140	60			60		
La-140	15			15		

* If no drinking water pathway exists, a value of 15 pCi/l may be used.

Table 12.6-3 (Page 2 of 3)

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS LOWER LIMIT OF DETECTION (LLD) TABLE NOTATIONS

(1) This list does not mean that only these nuclides are to be considered. Other peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radiological Environmental Operating Report.

(2) Required detection capabilities for thermoluminescent dosimeters used for environmental measurements shall be in accordance with the recommendations of Regulatory Guide 4.13.

(3) The Lower Limit of Detection (LLD) is defined, for purposes of these controls, as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66 s_b}{E \cdot V \cdot 2.22 \cdot Y \cdot e^{-\lambda \Delta t}}$$

LLD = the "a priori" lower limit of detection (picoCuries per unit mass or volume),

4.66 = $2k\sqrt{2}$, where k is the statistical student's "t" factor for a one-tailed distribution with infinite degrees of freedom at a confidence level of 95%,

s_b = the standard deviation of the background counting rate or of the counting rate of a blank sample, as appropriate (counts per minute),

= $\frac{\sqrt{\text{Total Counts}}}{t_b}$

t_b = background counting time (minutes)

E = the counting efficiency (counts per disintegration),

V = the sample size (units of mass or volume),

2.22 = the number of disintegrations per minute per picoCurie,

Y = the fractional radiochemical yield, when applicable,

λ = the radioactive decay constant for the particular radionuclide (sec^{-1}),

t_b = counting time of the background or blank (minutes), and

Δt = the elapsed time between sample collection or end of the sample collection period, and the time of counting (sec).

Typical values of E, V, Y, and Δt should be used in the calculation.

Table 12.6-3 (Page 3 of 3)

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS[1] LOWER LIMIT OF DETECTION (LLD)[2][3] TABLE NOTATIONS

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unavoidable small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors shall be identified and described in the Annual Radiological Environmental Operating Report.

(4) This LLD applies only to analyses where nuclide-specific separation and counting procedures are required per Table 12.6-1.

12.6 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

12.6.2 LAND USE CENSUS

REC 12.6.2 A Land Use Census shall be conducted and shall identify within a distance of 8 km (5 miles) the location in each of the 16 meteorological sectors of the nearest livestock, the nearest milk animal (including an enumeration and feed sources), and the nearest residence. The nearest industrial facility shall also be documented if closer than the nearest residence. For dose calculations, a garden will be assumed at the nearest residence in each sector.

APPLICABILITY: At all times.

ACTIONS

----------NOTE----------

REC 12.0.3 and REC 12.0.4 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Land Use Census identifies a location(s) which yields a calculated dose or dose commitment greater than the values currently being calculated in REC 12.4.3.	A.1 Identify the new location(s) in the applicable Radioactive Effluent Release Report.	As part of the Radioactive Effluent Release Report per Units 2/3 TS 5.6.3 and Unit 1 TS 6.9.A.4
B. ----------NOTE---------- Required Action B.1 shall be completed if this condition is entered. ---------- Land use census identifies a location which yields a calculated dose or dose commitment (via the same exposure pathway) 20% greater than at a location from which samples are currently being obtained in accordance with REC 12.6.1.	B.1 Add the new location to the Radiological Environmental Monitoring Program. AND B.2 Submit documentation for a change in the ODCM including a revised figure(s) and table(s) for the ODCM reflecting the new location(s) with information supporting the change in sampling locations. The sampling location(s), excluding the control station location, having the lowest calculated dose or dose commitment(s), via the same exposure pathway, may be deleted from the radiological environmental monitoring program after October 31 of the year in which Land Use Census was conducted.	30 days As part of the Radioactive Effluent Release Report per Units 2/3 TS 5.6.3 and Unit 1 TS 6.9.A.4

12.6.2 SURVEILLANCE REQUIREMENTS

SURVEILLANCE REQUIREMENT		FREQUENCY
RSR 12.6.2.1	Conduct a Land Use Census during the growing season by a door-to-door survey, aerial survey, by consulting local agriculture authorities, or by some other appropriate means.	12 months
RSR 12.6.2.2	Include the results of the Land Use Census in the Annual Radiological Environmental Operating Report.	As part of the Annual Radiological Environmental Operating Report per Units 2/3 TS 5.6.2 and Unit 1 TS 6.9.A.3.

12.6 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

12.6.3 INTER-LABORATORY COMPARISON PROGRAM

REC 12.6.3 Analyses shall be performed on radioactive materials supplied as part of an Interlaboratory Comparison Program that correspond to samples required by Table 12.6-1 or a media that is equivalent.

APPLICABILITY: At all times.

ACTIONS

----------NOTE----------
REC 12.0.3 and REC 12.0.4 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Requirements of REC 12.6.3 not met.	A.1 Report corrective actions to prevent recurrence to the NRC in the Annual Radiological Environmental Operating Report.	As part of the Annual Radiological Environmental Operating Report per Units 2/3 TS 5.6.2 and Unit 1 TS 6.9.A.3.

12.6.3 SURVEILLANCE REQUIREMENTS

SURVEILLANCE REQUIREMENT		FREQUENCY
RSR 12.6.3.1	Include a summary of the results of the Interlaboratory Comparison Program in the Annual Radiological Environmental Operating Report.	As part of the Annual Radiological Environmental Operating Report per Units 2/3 TS 5.6.2 and Unit 1 TS 6.9.A.3.

12.7 METEOROLOGICAL MONITORING PROGRAM (NOT APPLICABLE)

12.8 ON-SITE GROUNDWATER AND STORM SEWER MONITORING

12.8.1 ON-SITE GROUNDWATER AND STORM SEWER MONITORING

REC 12.8.1 On-site groundwater and storm sewers shall be sampled and analyzed for tritium to provide indication of unmonitored or abnormal radioactive releases.

APPLICABILITY: At all times.

ACTIONS

----------NOTE----------
REC 12.0.3 and REC 12.0.4 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Detectable tritium is found in site groundwater OR storm sewers.	A.1 Initiate corrective action in accordance with the site Corrective Action Program.	Immediately.
B. Detectable tritium activity is found in the site storm sewers.	B.1 Report the release of activity in the Annual Radioactive Effluent Release Report.	As part of the Radioactive Effluent Release Report per Units 2/3 TS 5.6.3 and Unit 1 TS 6.9.A.4.

12.8.1 SURVEILLANCE REQUIREMENTS

SURVEILLANCE REQUIREMENT		FREQUENCY
RSR 12.8.1.1	Perform on-site storm sewer water and groundwater monitoring for tritium at the detection capability of Table 12.6-3.	12 months.

12.9 ADMINISTRATIVE REQUIREMENTS

12.9.1 Station Operating Records

Records and/or logs shall be kept in a manner convenient for review and shall be retained per site procedures.

12.9.2 Offsite Dose Calculation Manual (ODCM)

12.9.2.1 The ODCM shall contain the methodology and parameters used in the calculation of offsite doses resulting from radioactive gaseous and liquid effluents, in the calculation of gaseous and liquid effluent monitoring alarm and trip setpoints, and in the conduct of the Radiological Environmental Monitoring Program.

12.9.2.2 The ODCM shall also contain (1) the Radioactive Effluent Controls and Radiological Environmental Monitoring Programs (described in ODCM Sections 12.2 - 12.6) and (2) descriptions of the information that should be included in the Annual Radiological Environmental Operating and Radioactive Effluent Release Reports required by Unit 1 Technical Specification 6.9, Units 2 and 3 Technical Specifications 5.6.2 and 5.6.3, and ODCM Sections 12.9.3 and 12.9.4.

12.9.2.3 Licensee initiated changes to the ODCM:

1) Shall be documented and records of reviews performed shall be retained. This documentation shall contain:

   a. Sufficient information to support the change(s) together with the appropriate analyses or evaluations justifying the change(s), and

   b. A determination that the change(s) maintain the levels of radioactive effluent control required by 10 CFR 20.1302, 40 CFR 190, 10 CFR 50.36a, and 10 CFR 50, Appendix I, and do not adversely impact the accuracy or reliability of effluent, dose, or setpoint calculations;

2) Shall become effective after approval of the station manager; and

3) Shall be submitted to the NRC in the form of a complete, legible copy of the entire ODCM as a part of or concurrent with the Radioactive Effluent Release Report for the period of the report in which any change in the ODCM was made. Each change shall be identified by markings in the margin of the affected pages, clearly indicating the area of the page that was changed, and shall indicate the date (i.e., month and year) the change was implemented.

12.9.3 Annual Radiological Environmental Operating Report

----------NOTE----------

A single submittal may be made for a multiple unit station. The submittal should combine sections common to all units at the station.

For Unit 1, Routine Annual Radiological Environmental Operating Reports covering the decommissioning activities of the unit during the previous calendar year shall be submitted in accordance with Section 6.9.A.3 of the Unit 1 Technical Specifications.

For Units 2 and 3, Routine Annual Radiological Environmental Operating Reports covering the operation of the unit during the previous calendar year shall be submitted in accordance with Section 5.6.2 of the Units 2 and 3 Technical Specifications.

The Annual Radiological Environmental Operating Report shall be consistent with the objectives outlined in the Offsite Dose Calculation Manual (ODCM), and in 10 CFR 50, Appendix I, Sections IV.B.2, IV.B.3, and IV.C and shall include:

12.9.3.1 Summaries, interpretations, and an analysis of trends of the results of the Radiological Environmental Monitoring Program for the reporting period, including a comparison with previous environmental surveillance reports, and an assessment of the observed impacts of the plant operation on the environment.

12.9.3.2 Results of the land use census required by RSR 12.6.2.2.

12.9.3.3 Results of analysis of all radiological environmental samples and of all environmental radiation measurements taken during the period pursuant to the locations specified in the tables and figures in Part II, Section 6 of the ODCM, as well as summarized and tabulated results of these analyses and measurements in the format of the table in the Radiological Assessment Branch Technical Position, Revision 1, November 1979. In the event that some individual results are not available for inclusion with the report, the report shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted as soon as possible in a supplementary report.

12.9.3.4 A summary description of the radiological environmental monitoring program.

12.9.3.5 At least two legible maps (one map shall cover stations near the site boundary; a second shall include the more distant stations) covering all sampling locations keyed to a table giving distances and directions from the centerline of the two operating reactors.

12.9.3.6 Results of licensee (i.e., contracted vendor) participation Interlaboratory Comparison Program described in Section REC 12.6.3.

12.9.3.7 A discussion of all deviations from the sampling schedule of Table 12.6-1.

12.9.3.8 A discussion of all analyses in which the LLD required by Table 12.6-3 was not achievable.

12.9.4 Annual Radioactive Effluent Release Report

----------NOTE----------

A single submittal may be made for a multiple unit station. The submittal should combine sections common to all units at the station; however, for units with separate radwaste systems, the submittal shall specify the releases of radioactive material from each unit.

For Unit 1, the Radioactive Effluent Release Reports covering the decommissioning activities of the unit during the previous calendar year shall be submitted in accordance with Section 6.9.A.4 of the Unit 1 Technical Specifications.

For Units 2 and 3, the Radioactive Effluent Release Reports covering the operation of the unit during the previous calendar year shall be submitted in accordance with Section 5.6.3 of the Units 2 and 3 Technical Specifications.

The Annual Radioactive Effluent Release Report shall be consistent with the objectives outlined in the ODCM and Process Control Program (PCP) and in conformance with 10 CFR 50.36a and 10 CFR 50, Appendix I, Section IV.B.1 and shall include:

12.9.4.1 A summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit as outlined in Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents for Light-Water-Cooled Nuclear Power Plants," Revision 1, June 1974, with data summarized on a quarterly basis following the format of Appendix B thereof.

12.9.4.2 An annual summary of hourly meteorological data collected over the previous year in the form of cumulative joint frequency distributions of wind speed, wind direction, and atmospheric stability for the quarterly periods. In lieu of submission with the Annual Radioactive Effluent Release Report, the licensee has the option of retaining this summary of required meteorological data on site in a file that shall be provided to the NRC upon request.

12.9.4.3 An assessment of the radiation doses due to the radioactive liquid and gaseous effluents released from the station during the previous calendar year. The meteorological conditions concurrent with the time of release of radioactive materials in gaseous effluents, as determined by sampling frequency and measurement, or approximate or conservative approximate methods (including the use of historical average meteorological data), shall be used for determining the gaseous pathway doses. The assessment of radiation dose shall be performed in accordance with the methodology and parameters in the ODCM.

12.9.4.4 An assessment of radiation doses to the likely most exposed MEMBER OF THE PUBLIC from reactor releases and other nearby uranium fuel cycle sources, including doses from primary effluent pathways and direct radiation, for the previous calendar year to show conformance with 40 CFR 190, Environmental Radiation Protection Standards for Nuclear Power Operation.

12.9.4.5 The following information for each class of solid waste (as defined by 10 CFR Part 61) shipped offsite during the report period:

1) Container volume
2) Total curie content (specify whether determined by measurement or estimate)
3) Principle radionuclides (specify whether determined by measurement or estimate)
4) Source of waste and processing employed (e.g., dewatered spent resin, compacted dry waste, evaporator bottoms)
5) Type of container (e.g., LSA, Type A, Type B, Large Quantity)
6) Solidification agent or absorbent (e.g., cement, urea formaldehyde)

12.9.4.6 A list and description of unplanned releases from the site to UNRESTRICTED AREAS of radioactive materials in gaseous and liquid effluents made during the reporting period.

12.9.4.7 Significant changes made to the PCP during the reporting period.

12.9.4.8 Changes to the ODCM, as well as a listing of new locations for dose calculations and/or environmental monitoring identified by the Land Use Census pursuant to Unit 1 Technical Specification 6.14.A.3 and Units 2 and 3 Technical Specification 5.5.1.

12.9.4.9 Major changes to radioactive liquid, gaseous, and solid waste treatment systems as described in Section 12.9.5 if not submitted as part of the annual FSAR update.

12.9.5 Major Changes to Radioactive Liquid, Gaseous, and Solid Waste Treatment Systems

----------NOTE----------
This information may be submitted as part of the annual FSAR update.

12.9.5.1 Licensee initiated major changes to the radioactive waste systems (liquid, gaseous, and solid):

1) Shall be reported to the Commission in the Radioactive Effluent Release Report for the period in which the evaluation was reviewed by the Plant Operations Review Committee (PORC). The discussion of each change shall contain:

   a. A summary of the evaluation that led to the determination that the change could be made in accordance with 10 CFR Part 50.59;

   b. Sufficient detailed information to totally support the reason for the change without benefit of additional or supplemental information;

   c. A detailed description of the equipment, components, and process involved and the interfaces with other plant systems;

   d. An evaluation of the change, which shows the predicted releases of radioactive materials in liquid and gaseous effluents and/or quantity of solid waste that differ from those previously predicted in the license application and amendments thereto;

   e. An evaluation of the change, which shows the expected maximum exposures to individual in the UNRESTRICTED AREA and to the general population that differ from those previously predicted in the license application and amendments thereto;

   f. A comparison of the predicted releases of radioactive materials, in liquid and gaseous effluents and in solid waste, to the actual releases for the period in which the changes were made;

   g. An estimate of the exposure to plant operating personnel as a result of the change; and

   h. Documentation of the fact that the change was reviewed and found acceptable by the PORC.

2) Shall become effective upon review and acceptance by the PORC.

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B 1.0 BASES

General

The BASES contained in the succeeding pages summarize the reasons for the RECs but are not part of these RECs.

It is expected that releases of radioactive material in effluents will be kept at small fractions of the limits specified in Section 20.1302 of 10 CFR, Part 20. At the same time, the licensee is permitted the flexibility of operation, compatible with consideration of health and safety, to assure that the public is provided a dependable source of power even under unusual operating conditions which may temporarily result in releases higher than such small fractions, but still within the limits specified in Section 20.1302 of 10 CFR, Part 20. It is expected that in using this operational flexibility under unusual operating conditions the licensee will exert his best efforts to keep levels of radioactive material in effluents as low as practicable.

B 12.0 OFFSITE DOSE CALCULATION MANUAL (ODCM) RADIOLOGICAL EFFLUENT CONTROL (REC) APPLICABILITY

BASES

RECs

REC 12.0.1 through REC 12.0.6 establish the general requirements applicable to all RECs in Sections 12.1 through 12.8 and apply at all times, unless otherwise stated.

REC 12.0.1

REC 12.0.1 establishes the Applicability statement within each individual REC as the requirement for when the REC is required to be met (i.e., when the unit is in the MODES or other specified conditions of the Applicability statement of each REC).

REC 12.0.2

REC 12.0.2 establishes that upon discovery of a failure to meet a REC, the associated ACTIONS shall be met. The Completion Time of each Required Action for an ACTIONS Condition is applicable from the point in time that an ACTIONS Condition is entered. The Required Actions establish those remedial measures that must be taken within specified Completion Times when the requirements of a REC are not met. This REC establishes that:

a. Completion of the Required Actions within the specified Completion Times constitutes compliance with a REC; and

b. Completion of the Required Actions is not required when a REC is met within the specified Completion Time, unless otherwise specified.

There are two basic types of Required Actions. The first type of Required Action specifies a time limit in which the REC must be met. This time limit is the Completion Time to restore a non-functional system or component to FUNCTIONAL status or to restore variables to within specified limits. If this type of Required Action is not completed within the specified Completion Time, inclusion in an NRC report may be required or place the unit in a condition in which the REC is not applicable. (Whether stated as a Required Action or not, correction of the entered Condition is an action that may always be considered upon entering ACTIONS.) The second type of Required Action specifies the remedial measures that permit continued operation of the unit that is not further restricted by the Completion Time. In this case, compliance with the Required Actions provides an acceptable level of safety for continued operation.

Completing the Required Actions is not required when a REC is met or is no longer applicable, unless otherwise stated in the individual RECs.

(continued)

REC 12.0.2 (continued)

The nature of some Required Actions of some Conditions necessitates that, once the Condition is entered, the Required Actions must be completed even though the associated Condition no longer exists. The individual REC's ACTIONS specify the Required Actions where this is the case. An example of this is in REC 12.3.1, Liquid Effluent Concentration.

The Completion Times of the Required Actions are also applicable when a system or component is removed from service intentionally. The reasons for intentionally relying on the ACTIONS include, but are not limited to, performance of Surveillances, preventive maintenance, corrective maintenance, or investigation of operational problems. Entering ACTIONS for these reasons must be done in a manner that does not compromise safety. Additionally, if intentional entry into ACTIONS would result in redundant equipment being non-functional, alternatives should be used instead. Doing so limits the time both subsystems/divisions of a function are non-functional and limits the time conditions exist which may result in REC 12.0.3 being entered. Individual RECs may specify a time limit for performing a RSR when equipment is removed from service or bypassed for testing. In this case, the Completion Times of the Required Actions are applicable when this time limit expires, if the equipment remains removed from service or bypassed. LCM 6/21

When a change in MODE or other specified condition is required to comply with Required Actions, the unit may enter a MODE or other specified condition in which another REC becomes applicable. In this case, the Completion Times of the associated Required Actions would apply from the point in time that the new REC becomes applicable and the ACTIONS Condition(s) are entered.

REC 12.0.3

REC 12.0.3 establishes the actions that must be implemented when a REC is not met and:

a. An associated Required Action and Completion Time is not met and no other Condition applies; or

b. The condition of the unit is not specifically addressed by the associated ACTIONS. This means that no combination of Conditions stated in the ACTIONS can be made that exactly corresponds to the actual condition of the unit. Sometimes, possible combinations of Conditions are such that entering REC 12.0.3 is warranted; in such cases, the ACTIONS specifically state a Condition corresponding to such combinations and also that REC 12.0.3 be entered immediately.

(continued)

REC 12.0.3 (continued)

Upon entering REC 12.0.3, 1 hour is allowed to initiate actions to implement appropriate compensatory actions and verify the plant is not in an unanalyzed condition or that a required safety function is not compromised. Within 12 hours, Station Duty Officer approval of the compensatory actions and the plan for exiting REC 12.0.3 must be obtained. The use and interpretation of specified times to complete the actions of REC 12.0.3 are consistent with the discussion of Section 1.3, Completion Times.

The actions required in accordance with REC 12.0.3 may be terminated and REC 12.0.3 exited if any of the following occurs:

a. The REC is now met.

b. A Condition exists for which the Required Actions have now been performed.

c. ACTIONS exist that do not have expired Completion Times. These Completion Times are applicable from the point in time that the Condition is initially entered and not from the time REC 12.0.3 is exited.

In MODES 1, 2, and 3, REC 12.0.3 provides actions for Conditions not covered in other Requirements. The requirements of REC 12.0.3 do not apply in MODES 4 and 5 because the unit is already in the most restrictive Condition. The requirements of REC 12.0.3 do not apply in other specified conditions of the Applicability (unless in MODE 1, 2, or 3) because the ACTIONS of individual RECs sufficiently define the remedial measures to be taken.

REC 12.0.4

REC 12.0.4 establishes limitations on changes in MODES or other specified conditions in the Applicability when a REC is not met. It allows placing the unit in a MODE or other specified condition stated in that Applicability (e.g., Applicability desired to be entered) when unit conditions are such that the requirements of the REC would not be met, in accordance with REC 12.0.4.a, REC 12.0.4.b, and REC 12.0.4.c.

REC 12.0.4.a allows entry into a MODE or other specified condition in the Applicability with the REC not met when the associated ACTIONS to be entered permit continued operation in the MODE or other specified condition in the Applicability for an unlimited period of time. Compliance with Required Actions that permit continued operation of the unit for an unlimited period of time in a MODE or other specified condition provides an acceptable level of safety for continued operation. This is without regard to the status of the unit before or after the MODE change. Therefore, in such cases, entry into a MODE or other specified condition in the Applicability may be made in accordance with the provisions of the Required Actions.

(continued)

REC 12.0.4 (continued)

REC 12.0.4.b allows entry into a MODE or other specified condition in the Applicability with the REC not met after performance of a risk assessment addressing non-functional systems and components, consideration of the results, determination of the acceptability of entering the MODE or other specified condition in the Applicability, and establishment of risk management actions, if appropriate.

The risk assessment may use quantitative, qualitative, or blended approaches, and the risk assessment will be conducted using the plant program, procedures, and criteria in place to implement 10 CFR 50.65(a)(4), which requires that risk impacts of maintenance activities be assessed and managed. The risk assessment, for the purposes of REC 12.0.4.b, must take into account all non-functional Technical Specification equipment regardless of whether the equipment is included in the normal 10 CFR 50.65(a)(4) risk assessment scope. The risk assessments will be conducted using the procedures and guidance endorsed by Regulatory Guide 1.182, "Assessing and Managing Risk Before Maintenance Activities at Nuclear Power Plants." Regulatory Guide 1.182 endorses the guidance in Section 11 of NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants." These documents address general guidance for conduct of the risk assessment, quantitative and qualitative guidelines for establishing risk management actions, and example risk management actions. These include actions to plan and conduct other activities in a manner that controls overall risk, increased risk awareness by shift and management personnel, actions to reduce the duration of the condition, actions to minimize the magnitude of risk increases (establishment of backup success paths or compensatory measures), and determination that the proposed MODE change is acceptable. Consideration should also be given to the probability of completing restoration such that the requirements of the REC would be met prior to the expiration of ACTIONS Completion Times that would require exiting the Applicability.

REC 12.0.4.b may be used with single, or multiple systems and components unavailable. NUMARC 93-01 provides guidance relative to consideration of simultaneous unavailability of multiple systems and components.

The results of the risk assessment shall be considered in determining the acceptability of entering the MODE or other specified condition in the Applicability, and any corresponding risk management actions. The REC 12.0.4.b risk assessments do not have to be documented.

(continued)

REC 12.0.4 (continued)

The ODCM allows continued operation with equipment unavailable in MODE 1 for the duration of the Completion Time. Since this is allowable, and since in general the risk impact in that particular MODE bounds the risk of transitioning into and through the applicable MODES or other specified conditions in the Applicability of the REC, the use of the REC 12.0.4.b allowance should be generally acceptable, as long as the risk is assessed and managed as stated above.

REC 12.0.4.c allows entry into a MODE or other specified condition in the Applicability with the REC not met based on a Note in the Specification which states REC 12.0.4.c is applicable. These specific allowances permit entry into MODES or other specified conditions in the Applicability when the associated ACTIONS to be entered do not provide for continued operation for an unlimited period of time and a risk assessment has not been performed. This allowance may apply to all the ACTIONS or to a specific Required Action of a REC. The risk assessments performed to justify the use of REC 12.0.4.b usually only consider systems and components. For this reason, REC 12.0.4.c is typically applied to RECs which describe values and parameters.

The provisions of this REC should not be interpreted as endorsing the failure to exercise the good practice of restoring systems or components to FUNCTIONAL status before entering an associated MODE or other specified condition in the Applicability.

The provisions of REC 12.0.4 shall not prevent changes in MODES or other specified conditions in the Applicability that are required to comply with ACTIONS. In addition, the provisions of REC 12.0.4 shall not prevent changes in MODES or other specified conditions in the Applicability that result from any unit shutdown. In this context, a unit shutdown is defined as a change in MODE or other specified condition in the Applicability associated with transitioning from MODE 1 to MODE 2, MODE 2 to MODE 3, and MODE 3 to MODE 4.

Upon entry into a MODE or other specified condition in the Applicability with the REC not met, REC 12.0.1 and REC 12.0.2 require entry into the applicable conditions and Required Actions until the Condition is resolved, until the REC is met, or until the unit is not within the Applicability of the REC.

(continued)

REC 12.0.4 (continued)

Surveillances do not have to be performed on the associated non-functional equipment (or on variables outside the specified limits), as permitted by RSR 12.0.1. Therefore, utilizing REC 12.0.4 is not a violation of RSR 12.0.1 or RSR 12.0.4 for any Surveillances that have not been performed on non-functional equipment. However, RSRs must be met to ensure FUNCTIONALITY prior to declaring the associated equipment FUNCTIONAL (or variable within limits) and restoring compliance with the affected REC.

REC 12.0.5

REC 12.0.5 establishes the allowance for restoring equipment to service under administrative controls when it has been removed from service or declared non-functional to comply with ACTIONS. The sole purpose of this Requirement is to provide an exception to REC 12.0.2 (e.g., to not comply with the applicable Required Action(s)) to allow the performance of required testing to demonstrate:

a. The FUNCTIONALITY of the equipment being returned to service; or

b. The FUNCTIONALITY of other equipment.

The administrative controls ensure the time the equipment is returned to service in conflict with the requirements of the ACTIONS is limited to the time absolutely necessary to perform the required testing to demonstrate FUNCTIONALITY. This REC does not provide time to perform any other preventive or corrective maintenance.

An example of demonstrating the FUNCTIONALITY of the equipment being returned to service is reopening a containment isolation valve that has been closed to comply with Required Actions and must be reopened to perform the required testing.

An example of demonstrating the FUNCTIONALITY of other equipment is taking a non-functional channel or trip system out of the tripped condition to prevent the trip function from occurring during the performance of required testing on another channel in the other trip system. A similar example of demonstrating the FUNCTIONALITY of other equipment is taking an non-functional channel or trip system out of the tripped condition to permit the logic to function and indicate the appropriate response during the performance of required testing on another channel in the same trip system.

(continued)

REC 12.0.6	REC 12.0.6 establishes the applicability of each REC to Unit 1, Unit 2, and Unit 3 operation. Whenever a requirement applies to only one unit, or is different for each unit, this will be identified in the appropriate section of the REC (e.g., Applicability, RSR, etc.) with parenthetical reference, Notes, or other appropriate presentation within the body of the requirement.

B 12.0 RADIOLOGICAL EFFLUENT SURVEILLANCE REQUIREMENT (RSR) APPLICABILITY

BASES

RSRs

RSR 12.0.1 through RSR 12.0.5 establish the general requirements applicable to all Requirements in 12.1 through 12.8 and apply at all times, unless otherwise stated.

RSR 12.0.1

RSR 12.0.1 establishes the requirement that RSRs must be met during the MODES or other specified conditions in the Applicability for which the requirements of the REC apply, unless otherwise specified in the individual RSRs. This RSR is to ensure that Surveillances are performed to verify the FUNCTIONALITY of systems and components, and that variables are within specified limits. Failure to meet a Surveillance within the specified Frequency, in accordance with RSR 12.0.2, constitutes a failure to meet a REC.

Systems and components are assumed to be FUNCTIONAL when the associated RSRs have been met. Nothing in this RSR, however, is to be construed as implying that systems or components are FUNCTIONAL when:

a. The systems or components are known to be non-functional, although still meeting the RSRs; or

b. The requirements of the Surveillance(s) are known to be not met between required Surveillance performances.

Surveillances do not have to be performed when the unit is in a MODE or other specified condition for which the requirements of the associated REC are not applicable, unless otherwise specified.

Unplanned events may satisfy the requirements (including applicable acceptance criteria) for a given RSR. In this case, the unplanned event may be credited as fulfilling the performance of the RSR.

Surveillances, including Surveillances invoked by Required Actions, do not have to be performed on non-functional equipment because the ACTIONS define the remedial measures that apply. Surveillances have to be met and performed in accordance with RSR 12.0.2, prior to returning equipment to FUNCTIONAL status.

(continued)

RSR 12.0.1 (continued)

Upon completion of maintenance, appropriate post maintenance testing is required to declare equipment FUNCTIONAL. This includes ensuring applicable Surveillances are not failed and their most recent performance is in accordance with RSR 12.0.2. Post maintenance testing may not be possible in the current MODE or other specified conditions in the Applicability due to the necessary unit parameters not having been established. In these situations, the equipment may be considered FUNCTIONAL provided testing has been satisfactorily completed to the extent possible and the equipment is not otherwise believed to be incapable of performing its function. This will allow operation to proceed to a MODE or other specified condition where other necessary post maintenance tests can be completed.

RSR 12.0.2

RSR 12.0.2 establishes the requirements for meeting the specified Frequency for Surveillances and any Required Action with a Completion Time that requires the periodic performance of the Required Action on a "once per..." interval.

RSR 12.0.2 permits a 25% extension of the interval specified in the Frequency. This extension facilitates Surveillance scheduling and considers plant operating conditions that may not be suitable for conducting the Surveillance (e.g., transient conditions or other ongoing Surveillance or maintenance activities).

The 25% extension does not significantly degrade the reliability that results from performing the Surveillance at its specified Frequency. This is based on the recognition that the most probable result of any particular Surveillance being performed is the verification of conformance with the RSRs. The exceptions to RSR 12.0.2 are those Surveillances for which the 25% extension of the interval specified in the Frequency does not apply. These exceptions are stated in the individual RECs. The requirements of regulations and the Technical Specifications (TS) take precedence over the ODCM. Therefore, when a test interval is specified in the regulations or TS, the test interval cannot be extended by the ODCM, and the RSR includes a Note in the Frequency stating "RSR 12.0.2 is not applicable."

As stated in RSR 12.0.2, the 25% extension also does not apply to the initial portion of a periodic Completion Time that requires performance on a "once per..." basis. The 25% extension applies to each performance after the initial performance. The initial performance of the Required Action, whether it is a particular Surveillance or some other remedial action, is considered a single action with a single Completion Time. One reason for not allowing the 25% extension to this Completion Time is that such an action usually verifies that no loss of function has occurred by checking the status of redundant or diverse components or accomplishes the function of the non-functional equipment in an alternative manner.

BASES

RSR 12.0.3

RSR 12.0.3 establishes the flexibility to defer declaring affected equipment non-functional or an affected variable outside the specified limits when a Surveillance has not been completed within the specified Frequency. A delay period of up to 24 hours or up to the limit of the specified Frequency, whichever is greater, applies from the point in time that it is discovered that the Surveillance has not been performed in accordance with RSR 12.0.2, and not at the time that the specified Frequency was not met. This delay period provides adequate time to complete Surveillances that have been missed. This delay period permits the completion of a Surveillance before complying with Required Actions or other remedial measures that might preclude completion of the Surveillance.

The basis for this delay period includes consideration of unit conditions, adequate planning, availability of personnel, the time required to perform the Surveillance, the safety significance of the delay in completing the required Surveillance, and the recognition that the most probable result of any particular Surveillance being performed is the verification of conformance with the requirements.

When a Surveillance with a Frequency based not on time intervals, but upon specified unit conditions, operating situations, or requirements of regulations (e.g., prior to each release) is discovered to not have been performed when specified, RSR 12.0.3 allows for the full delay period of up to the specified Frequency to perform the Surveillance. However, since there is not a time interval specified, the missed Surveillance should be performed at the first reasonable opportunity.

RSR 12.0.3 provides a time limit for, and allowances for the performance of, Surveillances that become applicable as a consequence of MODE changes imposed by Required Actions.

Failure to comply with specified Frequencies for RSRs is expected to be an infrequent occurrence. While up to 24 hours or the limit of the specified Frequency is provided to perform the missed Surveillance, it is expected that the missed Surveillance will be performed at the first reasonable opportunity. The determination of the first reasonable opportunity should include consideration of the impact on plant risk (from delaying the Surveillance as well as any plant configuration changes required or shutting the plant down to perform the Surveillance) and impact on any analysis assumptions, in addition to unit conditions, planning, availability of personnel, and the time required LCM 6/21

(continued)

BASES

RSR 12.0.3 (continued)

to perform the Surveillance. This risk impact should be managed through the program in place to implement 10 CFR 50.65(a)(4) and its implementation guidance, NRC Regulatory Guide 1.182, "Assessing and Managing Risk Before Maintenance Activities at Nuclear Power Plants."

This Regulatory Guide addresses consideration of temporary and aggregate risk impacts, determination of risk management action thresholds, and risk management action up to and including plant shutdown. The missed Surveillance should be treated as an emergent condition as discussed in the Regulatory Guide. The risk evaluation may use quantitative, qualitative, or blended methods. The degree of depth and rigor of the evaluation should be commensurate with the importance of the component. Missed Surveillances for important components should be analyzed quantitatively. If the results of the risk evaluation determine the risk increase is significant, this evaluation should be used to determine the safest course of action. All missed Surveillances will be placed in the station's Corrective Action Program.

If a Surveillance is not completed within the allowed delay period, then the equipment is considered non-functional or the variable then is considered outside the specified limits and the Completion Times of the Required Actions for the applicable REC Conditions begin immediately upon expiration of the delay period. If a Surveillance is failed within the delay period, then the equipment is non-functional, or the variable is outside the specified limits and the Completion Times of the Required Actions for the applicable REC Conditions begin immediately upon the failure of the Surveillance.

Completion of the Surveillance within the delay period allowed by this RSR, or within the Completion Time of the ACTIONS, restores compliance with RSR 12.0.1.

RSR 12.0.4

RSR 12.0.4 establishes the requirement that all applicable RSRs must be met before entry into a MODE or other specified condition in the Applicability.

This RSR ensures that system and component FUNCTIONALITY requirements and variable limits are met before entry into MODES or other specified conditions in the Applicability for which these systems and components ensure safe operation of the unit. The provisions of this RSR should not be interpreted as endorsing the failure to exercise the good practice of restoring systems or components to FUNCTIONAL status before entering an associated MODE or other specified condition in the Applicability.

A provision is included to allow entry into a MODE or other specified condition in the Applicability when a REC is not met due to Surveillance not being met in accordance with REC 12.0.4.

(continued)

RSR 12.0.4 (continued)

However, in certain circumstances, failing to meet a RSR will not result in RSR 12.0.4 restricting a MODE change or other specified condition change. When a system, subsystem, division, component, device, or variable is non-functional or outside its specified limits, the associated RSR(s) are not required to be performed, per RSR 12.0.1, which states that surveillances do not have to be performed on non-functional equipment. When equipment is non-functional, RSR 12.0.4 does not apply to the associated RSR(s) since the requirement for the RSR(s) to be performed is removed. Therefore, failing to perform the RSRs within the specified Frequency does not result in a RSR 12.0.4 restriction to changing MODES or other specified conditions of the Applicability. However, since the REC is not met in this instance, REC 12.0.4 will govern any restrictions that may (or may not) apply to MODE or other specified condition changes. RSR 12.0.4 does not restrict changing MODES or other specified conditions of the Applicability when a Surveillance has not been performed within the specified Frequency, provided the requirement to declare the REC not met has been delayed in accordance with RSR 12.0.3.

The provisions of RSR 12.0.4 shall not prevent entry into MODES or other specified conditions in the Applicability that are required to comply with ACTIONS. In addition, the provisions of RSR 12.0.4 shall not prevent changes in MODES or other specified conditions in the Applicability that result from any unit shutdown. In this context, a unit shutdown is defined as a change in MODE or other specified condition in the Applicability associated with transitioning from MODE 1 to MODE 2, MODE 2 to MODE 3, and MODE 3 to MODE 4.

The precise requirements for performance of RSRs are specified such that exceptions to RSR 12.0.4 are not necessary. The specific time frames and conditions necessary for meeting the RSRs are specified in the Frequency, in the Surveillance, or both. This allows performance of Surveillances when the prerequisite condition(s) specified in a Surveillance procedure require entry into the MODE or other specified condition in the Applicability of the associated REC prior to the performance or completion of a Surveillance. A Surveillance that could not be performed until after entering the REC's Applicability would have its Frequency specified such that it is not "due" until the specific conditions needed are met. Alternately, the RSR may be stated in the form of a Note, as not required (to be met or performed) until a particular event, condition, or time has been reached. Further discussion of the specific formats of RSRs' annotation is found in Section 1.4, Frequency.

RSR 12.0.5

RSR 12.0.5 establishes the applicability of each RSR to Unit 1, Unit 2 and Unit 3 operation. Whenever a requirement applies to only one unit, or is different for each unit, this will be identified with parenthetical reference, Notes, or other appropriate presentation within the RSR.

B 12.1 NOT USED

INTENTIONALLY BLANK

B 12.2 INSTRUMENTATION

B 12.2.1 Radioactive Liquid Effluent Monitoring Instrumentation

BASES

The radioactive liquid effluent monitoring instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in liquid effluents during actual or potential releases of liquid effluents. The Alarm/Trip Setpoints for these instruments shall be calculated in accordance with the methodology and parameters in the ODCM to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20 and the limits of the RECs. The FUNCTIONALITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

REC 12.2.1 implements Technical Specification 5.5.4.a for liquid effluent monitoring instrumentation.

B 12.2 INSTRUMENTATION

B 12.2.2 Radioactive Gaseous Effluent Monitoring Instrumentation

BASES

The radioactive gaseous effluent monitoring instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in gaseous effluents during actual or potential releases of gaseous effluents. The Alarm/Trip Setpoints for these instruments shall be calculated and adjusted in accordance with the methodology and parameters in the ODCM to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20 and the limits of the RECs. The FUNCTIONALITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

In the event the 2/3 Chimney mid- and high-range noble gas monitoring channels are not FUNCTIONAL, verifying that a low-range noble gas monitoring channel is FUNCTIONAL and on scale ensures accurate monitoring of station effluents using existing instrumentation equipped with appropriate alarm capability. In the event that all 2/3 Chimney noble gas monitoring channels are NON-FUNCTIONAL, alternate monitoring in the form of noble gas grab sampling can be performed per Required Actions G.1.1 and G.1.2 as dose rates allow. Under circumstances of increased effluent activity, alternate monitoring can be performed by using the Plant Parameter Display System (PPDS) to access the Illinois Emergency Management Agency's Gaseous Effluent Monitoring System (GEMS), preferred, if available, or by estimating gaseous activity from sample line dose rate measurements using station procedures (e.g., CY-DR-150-8902).

REC 12.2.2 implements Technical Specification 5.5.4.a for gaseous effluent monitoring instrumentation.

Condenser Air Ejector Radioactivity Monitors

The main condenser offgas gross gamma activity rate is an SAFETY ANALYSES initial condition of the Main Condenser Offgas System failure event. The analysis assumes a gross failure in the Main Condenser Offgas System that results in the rupture of the Main Condenser Offgas System pressure boundary. The gross gamma activity rate is controlled to ensure that, during the event, the calculated offsite doses will be well within the limits of 10 CFR 50.67.

Functions 3.a and 3.b are designed to ensure the the requirements of TS 3.7.6 (252,700 μCi/s gross gamma activity) are met. The channels provide monitoring functions only. The Offgas trip function is not required by the ODCM. There are two channels per Offgas Recombiner Outlet Monitoring Function. Only one channel is required for monitoring function of the condenser air ejector effluents. In the event of a loss of function, restoration of one channel is required within 72 hours. This is consistent with the requirements of TS 3.7.6 for the main condenser offgas gross gamma activity rate. Otherwise, samples must be obtained and analyzed to ensure that main condenser offgas gross gamma activity rate is within required limits. The Offgas Treatment system consists of the Charcoal Adsorbers whether in series or parallel operation with the adsorber bypass valve closed.

B 12.3 LIQUID EFFLUENTS

B 12.3.1 Liquid Effluent Concentration

BASES

REC 12.3.1 is provided to ensure that the concentration of radioactive materials released in liquid waste effluents to UNRESTRICTED AREAS will be less than ten (10) times the concentration levels specified in Appendix B, Table 2, Column 2 to 10 CFR Part 20. This instantaneous limitation provides additional assurance that the levels of radioactive materials in bodies of water in UNRESTRICTED AREAS will result in exposure within: (1) the Section II.A design objectives of Appendix I, 10 CFR 50, to a MEMBER OF THE PUBLIC, and (2) the limits of 10 CFR 20.1301 to the population. The concentration limits for dissolved or entrained noble gases is based upon the assumption that Xe-135 is the controlling isotope and its MPC in air (submersion) was converted to an equivalent concentration in water using the methods described in International Commission on Radiological Protection (ICRP) Publication 2.

REC 12.3.1 applies to the release of radioactive material in liquid effluents from the site at all times.

The required detection capabilities for radioactive materials in liquid waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD, and other detection limits can be found in Currie, L. A., "Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements," NUREG/CR-4007 (September 1984), and in the HASL Procedures Manual, HASL-300.

In addition, this limit is associated with 40 CFR Part 141 with regard to concentration limits at the nearest downstream community water supply. The results of the analyses of RSR 12.3.1.1, 12.3.1.2, and 12.3.1.3 shall be used with the calculational methods in the ODCM to assure that the concentrations at the point of release are maintained within the limits of this REC.

The limits of REC 12.3.1 are derived from 10 CFR Part 20.

REC 12.3.1 implements Technical Specification 5.5.4.b. and 5.5.4.c for liquid effluents.

B.12.3 LIQUID EFFLUENTS

B 12.3.2 Dose from Liquid Effluents

BASES

REC 12.3.2 is provided to implement the requirements of Sections II.A, III.A and IV.A of Appendix I, 10 CFR Part 50. The REC implements the guides set forth in Section II.A of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in liquid effluents will be kept "as low as is reasonably achievable." Also, for freshwater sites with drinking water supplies which can be potentially affected by plant operations, there is reasonable assurance that the operation of the facility will not result in radionuclide concentrations in the finished drinking water that are in excess of the requirements of 40 CFR Part 141. The dose calculation methodology and parameters in the ODCM implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The equations specified in the ODCM for calculating the doses due to the actual release rates of radioactive materials in liquid effluents are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977 and Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1977. NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," October 1978 provides methods for dose calculations consistent with Regulatory Guides 1.109 and 1.113.

REC 12.3.2.1 applies to the release of radioactive materials in liquid effluents from each unit at the site. For units with shared Radwaste Systems, the liquid effluents from the shared systems are to be proportioned among the units sharing that system.

REC 12.3.2.2 applies to the release of radioactive materials in liquid effluents from the station.

In the event there is a release that exceeds or is projected to exceed the limits specified in REC 12.3.2. or 12.3.3, a special report is required to be submitted to the NRC within 30 days. If there is an unexpected release and doses are unknown, a dose calculation and projection should be performed to ensure that public doses are maintained below the specified limits and As Low As Reasonably Achievable. The cumulative dose contribution and the projected contribution must be determined within 31 days of the event in order to determine if a reportable condition exists.

The limits of REC 12.3.2.1 are derived from 10 CFR Part 50 Appendix I.

REC 12.3.2.1 implements Technical Specification 5.5.4.d and 5.5.4.e for liquid effluents.

B 12.3 LIQUID EFFLUENTS

B 12.3.3 Liquid Radwaste Treatment Systems

BASES

The FUNCTIONALITY of the Liquid Radwaste Treatment System ensures that this system will be available for use whenever liquid effluents require treatment prior to release to the environment. The requirement that the appropriate portions of this system be used when specified provides assurance that the releases of radioactive materials in liquid effluents will be kept "as low as is reasonably achievable." This control implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objective given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the Liquid Radwaste Treatment System were specified as a suitable fraction of the dose design objectives set forth in Section II.A of Appendix I, 10 CFR Part 50 for liquid effluents.

REC 12.3.3 applies to the release of radioactive materials in liquid effluents from each unit at the site. For units with shared Radwaste Systems, the liquid effluents from the shared system are to be proportioned among the units sharing that system.

For the purposes of this REC, the Liquid Radwaste Treatment System is any equipment designed and installed to reduce radioactive liquid effluents and can include permanent or portable treatment equipment. Further information on the Liquid Radwaste Systems is contained in section II-2.1.1.

REC 12.3.3 implements Technical Specification 5.5.4.f for liquid effluent treatment systems.

B 12.4 GASEOUS EFFLUENTS

B 12.4.1 Gaseous Effluent Dose Rates

BASES

REC 12.4.1 provides reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of a MEMBER OF THE PUBLIC in an Unrestricted Area, either at or beyond the SITE BOUNDARY in excess of the design objectives of Appendix I to 10 CFR part 50. This specification is provided to ensure that gaseous effluents from all units on the site will be appropriately controlled. It provides operational flexibility for releasing gaseous effluents to satisfy the Section II.A and II.C design objectives of Appendix I to 10 CFR part 50. For MEMBERS OF THE PUBLIC who may at times be within the SITE BOUNDARY, the occupancy of the MEMBER OF THE PUBLIC will usually be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the SITE BOUNDARY. Examples of calculations for such MEMBERS OF THE PUBLIC, with appropriate occupancy factors, shall be given in the ODCM. The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to a MEMBER OF THE PUBLIC at or beyond the SITE BOUNDARY to less than or equal to 500 mrem/year to the total body or to less than or equal to 3000 mrem/year to the skin. These release rate limits also restrict, at all times, the corresponding thyroid dose rate above background to a child via the inhalation pathway to less than or equal to a dose rate of 1500 mrem/year. LCM 6/21

REC 12.4.1 applies to the release of radioactive materials in gaseous effluents from all units at the site.

The required detection capabilities for radioactive materials in liquid waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD, and other detection limits can be found in Currie, L. A., "Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements," NUREG/CR-4007 (September 1984), and in the HASL Procedures Manual, HASL-300.

For purposes of calculating doses resulting from airborne releases, the Unit 1 Main Chimney and the Units 2/3 Main Chimney are considered to be elevated release points, and the Unit 1 Chemical Cleaning Building Stack and the Units 2/3 Reactor Building Ventilation Stack are considered to be mixed mode release points.

REC 12.4.1 implements Technical Specification 5.5.4.c for gaseous effluents and 5.5.4.g.

B 12.4 GASEOUS EFFLUENTS

B 12.4.2 Dose from Noble Gases

BASES

REC 12.4.2 is provided to implement the requirements of Sections II.B, III.A and IV.A of Appendix I, 10 CFR Part 50. The REC implements the guides set forth in Section II.B of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in gaseous effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." The Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The dose calculation methodology and parameters established in the ODCM for calculating the doses due to the actual release rates of radioactive noble gases in gaseous effluents are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, "Revision 1, October 1977 and Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water Cooled Reactors," Revision 1, July 1977. NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," October 1978 provides methods for dose calculations consistent with Regulatory Guides 1.109 and 1.111. The ODCM equations provided for determining the air doses at and beyond the SITE BOUNDARY are based upon the historical average atmospheric conditions.

REC 12.4.2 applies to the release of radioactive materials in gaseous effluents from each unit at the site. For units with shared Radwaste Treatment Systems, the gaseous effluents from the shared system are proportioned among the units sharing that system.

In an event there is a release that exceeds or is projected to exceed the limits specified in REC 12.4.2, 12.4.3, or 12.4.5, a special report is required to be submitted to the NRC within 30 days. If there is an unexpected release and doses are unknown, a dose calculation and projection should be performed to ensure that public doses are maintained below the specified limits and As Low As Reasonably Achievable. The cumulative dose contribution and the projected contribution must be determined within 31 days of the event in order to determine if a reportable condition exists.

The limits of REC 12.4.2 are derived from 10 CFR Part 50 Appendix I.

REC 12.4.2 implements Technical Specification 5.5.4.e for radioactive noble gas effluents and 5.5.4.h.

B 12.4 GASEOUS EFFLUENTS

B 12.4.3 Dose from Iodine-131, Iodine-133, Tritium, and Radioactive Materials in Particulate Form

BASES

REC 12.4.3 is provided to implement the requirements of Sections II.C, III.A and IV.A of Appendix I, 10 CFR Part 50. The controls are the guides set forth in Section II.C of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive materials in gaseous effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." The ODCM calculational methods specified in the Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The ODCM calculational methodology and parameters for calculating the doses due to the actual release rates of the subject materials are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, "Revision 1, October 1977 and Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, July 1977. NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," October 1978 provides methods for dose calculations consistent with Regulatory Guides 1.109 and 1.111. These equations also provide for determining the actual doses based upon the historical average atmospheric conditions. The release rate controls for I-131, I-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days are dependent upon the existing radionuclide pathways to man in the areas at or beyond the SITE BOUNDARY. The pathways which were examined in the development of these calculations were: 1) individual inhalation of airborne radionuclides, 2) deposition of radionuclides onto green leafy vegetation with subsequent consumption by man, 3) deposition onto grassy areas where milk animals and meat producing animals graze with consumption of the milk and meat by man, and 4) deposition on the ground with subsequent exposure of man.

REC 12.4.3 applies to the release of radioactive materials in gaseous effluents from each unit at the site. For units with shared Radwaste Treatment Systems, the gaseous effluents from the shared system are proportioned among the units sharing that system.

In the event there is a release that exceeds or is projected to exceed the limits specified in REC 12.4.2, 12.4.3, or 12.4.5, a special report is required to be submitted to the NRC within 30 days. If there is an unexpected release and doses are unknown, a dose calculation and projection should be performed to ensure that public doses are maintained below the specified limits and As Low As Reasonably Achievable. The cumulative dose contribution and the projected contribution must be determined within 31 days of the event in order to determine if a reportable condition exists.

The limits of REC 12.4.3 are derived from 10 CFR Part 50 Appendix I.

REC 12.4.3 implements Technical Specification 5.5.4.e for I-131, I-133, H-3, and radioactive material in particulate form in gaseous effluents and 5.5.4.i.

B 12.4 GASEOUS EFFLUENTS

B 12.4.4 Gaseous Radwaste Treatment System

BASES

The FUNCTIONALITY of the GASEOUS RADWASTE TREATMENT SYSTEM, which reduces the amounts or concentrations of radioactive materials, ensures that the system will be available for use whenever gaseous effluents require treatment prior to release to the environment. The requirement that the appropriate portions of these systems be used, when specified, provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable." This control implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50, and the design objectives given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the systems were specified as a suitable fraction of the dose design objectives set forth in Sections II.B and II.C of Appendix I, 10 CFR Part 50, for gaseous effluents.

The GASEOUS RADWASTE TREATMENT SYSTEM is defined in section I-1.1 and consists of charcoal adsorbers and a hold up volume used to reduce the activity released from the offgas system. Further information on the GASEOUS RADWASTE TREATMENT SYSTEM is contained in section II-2.2.

REC 12.4.4 applies to the release of radioactive materials in gaseous effluents from each unit at the site. For units with shared Radwaste Treatment Systems, the gaseous effluents from the shared system are proportioned among the units sharing that system.

Technical Specification 5.5.8, Explosive Gas and Storage Tank Radioactivity Monitoring Program, and the Technical Requirements Manual (TRM) contain requirements for the operation of the offgas recombiner. The Recombiner and dryer add an additional 28 minutes of delay and should be in service when the reactor is operating at a pressure greater than 900 psig. Technical Specification 3.7.6, Main Condenser Offgas contains requirements for activity measured at the air ejector outlet.

REC 12.4.4 implements Technical Specification 5.5.4.f for gaseous effluent treatment systems.

B 12.4 GASEOUS EFFLUENTS AND TOTAL DOSE

B 12.4.5 Ventilation Exhaust Treatment Systems

BASES

The FUNCTIONALITY of the VENTILATION EXHAUST TREATMENT SYSTEMS ensures that the system will be available for use whenever gaseous effluents require treatment prior to release to the environment. The requirement that the appropriate portions of these systems be used, when specified, provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable." This specification implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50, and the design objectives given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the systems were specified as a suitable fraction of the dose design objectives set forth in Sections II.B and II.C of Appendix I, 10 CFR Part 50, for gaseous effluents.

VENTILATION EXHAUST TREATMENT SYSTEMS are defined in section I-1.1 and consists of charcoal adsorbers and/or HEPA filters used to reduce the iodine or particulate activity released from gaseous exhaust streams. Further information on VENTILATION EXHAUST TREATMENT SYSTEMS is contained in section II-2.2.

REC 12.4.5 implements Technical Specification 5.5.4.f for gaseous effluent treatment systems.

B 12.4 GASEOUS EFFLUENTS

B 12.4.6 Mark I Containment

BASES

REC 12.4.6 provides reasonable assurance that releases from drywell purging operations will not exceed the annual dose limits of 10 CFR Part 20 and Appendix I, 10 CFR 50 for UNRESTRICTED AREAS.

The concentration limits in the REC are based on 0.15 mrem/year per unit (1% of the limit for organ dose of Appendix I, 10 CFR Part 50), under the following assumptions:

1. 180 purges per year per unit (Units 2 and 3 only)
2. The entire volume of the drywell is purged
3. All the air in the drywell has the same concentration
4. Radioiodines and particulates contribute an equal fraction of the total calculated offsite dose.

Reference: Dresden Evaluation 97-EFF-001 / Dresden RP Memo #97-020, Drywell Venting Threshold Values, March 1997.

B 12.5 TOTAL DOSE

B 12.5.1 40CFR190 Dose Limits for Members of the Public

BASES

REC 12.5.1 is provided to meet the dose limitations of 40 CFR Part 190 that have been incorporated into 10 CFR Part 20 by 46 FR 18525 as well as the dose limitations specific to Independent Spent Fuel Storage Installation (ISFSI) operations in accordance with 10 CFR 72.104. ISFSI dose contribution dose contribution is in the form of direct radiation as no liquid or gas releases are expected to occur.

The control requires the preparation and submittal of a Special Report whenever the calculated doses due to releases of radioactivity and due to radiation from uranium fuel cycle sources exceed 25 mrem to the total body or any organ except the thyroid, which shall be limited to less than or equal to 75 mrem. For sites containing up to 4 reactors, it is highly unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40 CFR Part 190 if the individual reactors remain within twice the dose design objectives of Appendix I, and if direct radiation doses from the units (including outside storage tanks, etc.) are kept small. The Special Report will describe a course of action that should result in the limitation of dose to a MEMBER OF THE PUBLIC to within the 40 CFR Part 190 limits. For the purpose of the Special Report, it may be assumed that the dose commitment to the MEMBER OF THE PUBLIC from other uranium fuel cycle sources is negligible, with the exception that dose contributions from other nuclear fuel cycle facilities at the same site or within a radius of 8 km must be considered. If the dose to any member of the public is estimated to exceed the requirements of 40 CFR Part 190, the Special Report with a request for a variance (provided the release conditions resulting in violation of 40 CFR Part 190 have not already been corrected), in accordance with the provisions of 40 CFR 190.11 and 10 CFR 20.2203, is considered to be a timely request and fulfills the requirements of 40 CFR Part 190 until NRC staff action is completed. The variance only relates to the limits of 40 CFR Part 190, and does not apply in any way to the other requirements for dose limitation of 10 CFR Part 20, as addressed in RECs 12.3.1 and 12.4.1. An individual is not considered a MEMBER OF THE PUBLIC during any period in which he/she is engaged in carrying out any operation that is part of the nuclear fuel cycle.

In an event there is a release that exceeds or is projected to exceed the limits specified in REC 12.5.1, a special report is required to be submitted to the NRC within 30 days. If there is an unexpected release and doses are unknown, a dose calculation and projection should be performed to ensure that public doses are maintained below the specified limits and As Low As Reasonably Achievable. The cumulative dose contribution and the projected contribution must be determined within 31 days of the event in order to determine if a reportable condition exists.

REC 12.5.1 implements Technical Specification 5.5.4.j.

B 12.5 TOTAL DOSE

B 12.5.2 10CFR20 Dose Limits for Members of the Public

BASES

REC 12.5.2 is provided to meet the dose and dose rate limitations of 10 CFR 20.

This control applies to direct exposure of radioactive materials as well as radioactive materials released in gaseous and liquid effluents. 10 CFR 20.1301 sets forth the 100 mrem/year dose limit to members of the public; 2 mrem in any one-hour limit in the unrestricted area; and reiterates that the licensee is also required to meet the 40 CFR 190 standards. 10 CFR 20.1302 provides options to determine compliance to 10 CFR 20.1301. Compliance to the above requirement is based on 10 CFR 20 and 40 CFR 190. The Radioactive Effluent Controls shall implement monitoring, sampling, and analysis of radioactive liquid and gaseous effluents in accordance with 10 CFR 20.1302 and with the methodology and parameters of the ODCM.

In the event there is a release that exceeds or is projected to exceed the limits specified in REC 12.5.2, a special report is required to be submitted to the NRC within 30 days. If there is an unexpected release and doses are unknown, a dose calculation and projection should be performed to ensure that public doses are maintained below the specified limits and As Low As Reasonably Achievable. The cumulative dose contribution and the projected contribution must be determined within 31 days of the event in order to determine if a reportable condition exists.

REC 12.5.2 implements Technical Specification 5.5.4.c.

B 12.6 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

B 12.6.1 Radiological Environmental Monitoring Program

BASES

The Radiological Environmental Monitoring Program required by REC 12.6.1 provides representative measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposures of MEMBERS OF THE PUBLIC resulting from the plant operation. This monitoring program implements Section IV.B.2 of Appendix I to 10 CFR Part 50 and thereby supplements the Radiological Effluent Monitoring Program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and the modeling of the environmental exposure pathways. Guidance for this monitoring program is provided by the Radiological Assessment Branch Technical Position on Environmental Monitoring, Revision 1, November 1979 and NUREG-1302, "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Boiling Water Reactors," April 1991. The initially specified monitoring program will be effective for at least the first 3 years of commercial operation. Following this period, program changes may be initiated based on operational experience.

The required detection capabilities for environmental sample analyses are tabulated in terms of the lower limits of detection (LLDs). The LLDs required by Table 12.6-3 are considered optimum for routine environmental measurements in industrial laboratories. It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

Detailed discussion of the LLD, and other detection limits, can be found in Currie, L. A., "Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements," NUREG/CR-4007 (September 1984), and in the HASL Procedures Manual, HASL-300.

Table 12.6-1 requires "one sample of each community drinking water supply downstream of the plant within 10 kilometers." Drinking water supply is defined as water taken from rivers, lakes, or reservoirs (not well water) that is used for drinking.

Table 12.6-2 and Table 12.6-3 contain specific requirements if a drinking water pathway exists. For the purposes of these tables, drinking water pathway is defined as being supplied via a community water system as defined in 40 CFR Part 141, meaning a public water system which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

B 12.6 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

B 12.6.2 Land Use Census

BASES

REC 12.6.2 is provided to ensure that changes in the use of areas at and beyond the SITE BOUNDARY are identified and that modifications to the Radiological Environmental Monitoring Program given in the ODCM are made if required by the results of this census. The best information from the door-to-door survey, from aerial survey, or from consulting with local agricultural authorities should be used. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10 CFR Part 50. An annual garden census will not be required since the licensee will assume that there is a garden at the nearest residence in each sector for dose calculations.

A census identifying all gardens and all milk animals in all sectors within 5 km (3 miles) is not performed. With an elevated stack, the potential exists for the highest D/Q for a given sector to exist beyond the RESTRICTED AREA / SITE BOUNDARY. As seen in Tables 4.3 and 4.4, the highest D/Qs in each sector are at the RESTRICTED AREA BOUNDARY with the exception of the SW and WSW sectors, where the highest D/Qs are 6 meters and 60 meters, respectively, beyond the RESTRICTED AREA BOUNDARY but well within the SITE BOUNDARY. Therefore, using the RESTRICTED AREA / SITE BOUNDARY D/Q values for dose calculations involving ground deposition is a conservative and acceptable practice.

B 12.6 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

B 12.6.3 Interlaboratory Comparison Program

BASES

The requirement for participation in an Interlaboratory Comparison Program is provided to ensure that independent checks on the precision and accuracy of the measurements of radioactive material in environmental samples matrices are performed as part of the quality assurance program for environmental monitoring in order to demonstrate that the results are valid for the purposes of Section IV.B.2 of Appendix I to 10 CFR Part 50.

Due to the unconventional nature of some media sampled for the REMP (e.g., fish), interlaboratory comparisons can be satisfactorily performed using samples in equivalent media. For example, the fish media is equivalent to water after processing for analysis.

B 12.7 METEOROLOGICAL MONITORING PROGRAM (Not Applicable)

B 12.7.1 Meteorological Monitoring Program (Not Applicable)

B 12.8 ON-SITE GROUNDWATER AND STORM SEWER MONITORING

B 12.8.1 On-Site Groundwater and Storm Sewer Monitoring

BASES

This REC institutionalizes groundwater and storm sewer monitoring at the station. Monitoring is performed primarily to identify underground leaks of radioactive systems.

OFFSITE DOSE CALCULATION MANUAL

Part II, METHODOLOGY AND PARAMETERS

DRESDEN STATION

UNITS 1, 2, 3

1.0 INTRODUCTION - ODCM General Information

The Offsite Dose Calculation Manual (ODCM) contains the following:

- The basic concepts applied in calculating offsite doses from plant effluents.
- The regulations and requirements for the ODCM and related programs.
- The methodology and parameters for the offsite dose calculations to assess impact on the public and compliance with regulations.

The methodology detailed in this manual is intended for the calculation of radiation doses above background during routine (i.e., non-accident) conditions. The calculations are normally performed using a computer program. Manual calculations may be performed in lieu of the computer program.

The dose effects of airborne radioactivity releases predominately depend on meteorological conditions (wind speed, wind direction, and atmospheric stability). For airborne effluents, the dose calculations prescribed in this manual are based on historical average atmospheric conditions. This methodology is appropriate for estimating annual average dose effects and is stipulated in the Bases Section of the Radioactive Effluent Controls.

1.1 Structure of the ODCM

Part I of the ODCM is the Radioactive Effluents Controls (RECs), and contains the monitoring requirements and surveillances used to comply with Technical Specifications and regulatory requirements.

Part II of the ODCM is the Methodology and Parameters, and contains methods, equations, assumptions, and parameters for calculation of radiation doses from plant effluents.

1.2 Regulations

Note: Any information provided in the ODCM concerning specific regulations are not a substitute for the regulations as found in the Code of Federal Regulations (CFR) or Technical Specifications.

1.2.1 Code of Federal Regulations

Various sections of the Code of Federal Regulations (CFR) require nuclear power stations to be designed and operated in a manner that limits the radiation exposure to members of the public. These sections specify limits on offsite radiation doses, dose rates, and effluent radioactivity concentrations above background and they also require releases of radioactivity to be "As Low As Reasonably Achievable." These requirements are contained in 10CFR20, 10CFR50, and 40CFR190. In addition, 40CFR141 imposes limits on the concentration of radioactivity in drinking water provided by the operators of public water systems.

- <u>10CFR20, Standards for Protection Against Radiation</u>
  10CFR20 dose limits are summarized in Table 1-1.

- ALARA Provisions (Appendix I to 10CFR50)

  Sections 50.34a and 50.36a of 10CFR50 require that the nuclear plant design and the station RECs have provisions to keep levels of radioactive materials in effluents to unrestricted areas "As Low As Reasonably Achievable" (ALARA). Although 10CFR50 does not impose specific limits on releases, it does provide numerical design objectives and suggested limiting conditions for operation. According to Section I of Appendix I of 10CFR50, conforming to the guidelines of Appendix I "shall be deemed a conclusive showing of compliance with the "As Low As Reasonably Achievable" requirements of 10CFR50.34a and 50.36a."

  An applicant must use calculations to demonstrate conformance with the design objective dose limits of Appendix I. The calculations are to be based on models and data such that the actual radiation exposure of an individual is "unlikely to be substantially underestimated" (see 10CFR50 Appendix I, Section III.A.1).

  The guidelines in Appendix I call for an investigation, corrective action and a report to the NRC whenever the calculated dose due to the radioactivity released in a calendar quarter exceeds one-half of an annual design objective. The guidelines also require a surveillance program to monitor releases, monitor the environment, and identify changes in land use.

- 40CFR190, Environmental Radiation Protection Standards for Nuclear Power Operations

  Under an agreement between the NRC and the EPA, the NRC stipulated to its licensees in Generic Letter 79-041 that "Compliance with Radiological Effluent Technical Specifications (RETS), NUREG-0473 (Rev.2) for BWR's, implements the LWR provisions to meet 40CFR190." (See References 103 and 49.)

  The regulations of 40CFR190 limit radiation doses received by members of the public as a result of operations that are part of the uranium fuel cycle. Operations must be conducted in such a manner as to provide reasonable assurance that the annual dose equivalent to any member of the public due to radiation and to planned discharges of radioactive materials does not exceed the following limits:
    - 25 mrem to the total body
    - 75 mrem to the thyroid
    - 25 mrem to any other organ

  An important difference between the design objectives of 10CFR50 and the limits of 40CFR190 is that 10CFR50 addresses only doses due to radioactive effluents. 40CFR190 limits doses due to effluents and to radiation sources maintained on site. See Section 1.2.3 for further discussion of the differences between the requirements of 10CFR50 Appendix I and 40CFR190.

- 10CFR72, Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste

  10CFR72.104 states that annual dose to any real individual located beyond the controlled area must not exceed the following:
  - 25 mrem to the total body
  - 75 mrem to the thyroid
  - 25 mrem to any other critical organ

  as a result of planned discharges of radioactive material to the environment, direct radiation from ISFSI operation, and other radiation from uranium fuel cycle operation (40CFR190).

  These requirements are consistent with the requirements of 40CFR190.

- 40CFR141, National Primary Drinking Water Regulations

  The following radioactivity limits for community water systems were established in the July, 1976 Edition of 40CFR141:
  - Combined Ra-226 and Ra-228: $\leq$ 5 pCi/L.
  - Gross alpha (particle activity including Ra-226 but excluding radon and uranium): $\leq$ 15 pCi/L.
  - The average annual concentration of beta particle and photon radioactivity from man-made radionuclides in drinking water shall not produce an annual dose equivalent to the total body or any internal organ greater than 4 mrem/yr (e.g., 20,000 pCi/L ^{3}H).

  The regulations specify procedures for determining the values of annual average radionuclide concentration that produce an annual dose equivalent of 4 mrem. The responsibility for monitoring radioactivity in a community water system falls on the supplier of the water. The Dresden Station has requirements related to 40CFR141 in the RECs.

1.2.2 Offsite Dose Calculation Manual

The NRC in Generic Letter 89-01 defines the ODCM as follows (not verbatim) (see Reference 90):

> The Offsite Dose Calculation Manual (ODCM) shall contain the methodology and parameters used in the calculation of offsite doses resulting from radioactive gaseous and liquid effluents, in the calculation of gaseous and liquid effluent monitoring Alarm/Trip Setpoints, and in the conduct of the Radiological Environmental Monitoring Program. The ODCM shall also contain (1) the Radioactive Effluent Controls and Radiological Environmental Monitoring Programs and (2) descriptions of the Information that should be included in the Annual Radiological Environmental Operating and Annual Radioactive Effluent Release Reports.

Additional requirements for the content of the ODCM are contained throughout the text of the RECs.

1.2.3 Overlapping Requirements

In 10CFR20, 10CFR50, and 40CFR190, there are overlapping requirements regarding offsite radiation dose and dose commitment to the total body. In 10CFR20.1301, the total effective dose equivalent (TEDE) to a member of the public is limited to 100 mrem per calendar year. In addition, Appendix I to 10CFR50 establishes design objectives on annual total body dose or dose commitment of 3 mrem per reactor for liquid effluents and 5 mrem per reactor for gaseous effluents (see 10CFR50 Appendix I, Sections II.A and II.B.2(a)). Finally, 40CFR190 limits annual total body dose or dose commitment to a member of the public to 25 mrem due to all uranium fuel cycle operations.

While these dose limits/design objectives appear to overlap, they are different and each is addressed separately by the RECs. Calculations are made and reports are generated to demonstrate compliance to all regulations. Refer to Tables 1-1, 1-2, and 1-3 for additional information regarding instantaneous effluent limits, design objectives, and regulatory compliance.

1.2.4 Dose Receiver Methodology

Table 1-2 lists the location of the dose recipient and occupancy factors, if applicable. Dose is assessed at the locations in the unrestricted area where the combination of existing pathways and receptor age groups indicates the maximum potential exposures. The dose calculation methodology is consistent with the methodology of Regulatory Guide 1.109 (Reference 6) and NUREG 0133 (Reference 14). Dose is therefore calculated to a maximum individual. The maximum individual is characterized as "maximum" with regard to food consumption, occupancy, and other usage of the area in the vicinity of the plant site. Such a "maximum individual" represents reasonable deviation from the average for the population in general. In all physiological and metabolic respects, the maximum individual is assumed to have those characteristics that represent averages for their corresponding age group. Thus, the dose calculated is very conservative compared to the "average" (or typical) dose recipient who does not go out of the way to maximize radioactivity uptakes and exposure.

Table 1-3 relates the dose component (or pathway) to specific ODCM equations and the appropriate regulation.

In the event received dose approaches or exceeds regulatory guidelines or limits, further study should be conducted to develop a more accurate model of the receiver(s) and the dose(s) received.

1.2.5 Exposure Pathways

1.2.5.1 Introduction

Figure 1-1 illustrates some of the potential radiation exposure pathways to humans due to routine operation of a nuclear power station. These exposure pathways may be grouped into three categories:

- Airborne Releases
  Exposures resulting from radioactive materials released with gaseous effluents to the atmosphere.
- Liquid Releases
  Exposures resulting from radioactive materials released with liquid discharges to bodies of water.
- Radiation from Contained Sources
  Exposures to radiation from contained radioactive sources.

When performing radiation dose calculations, only exposure pathways that significantly contribute (≥ 10%) to the total dose of interest need to be evaluated. The radiation dose from air and water exposure pathways are routinely evaluated. (See Regulatory Guide 1.109, Reference 6.)

1.2.5.2 Airborne Releases

For airborne releases of radioactivity (Figure 1-1), the NRC considers the following pathways of radiation exposure of persons:

- External radiation from radioactivity airborne in the effluent plume.
- External radiation from radioactivity deposited by the plume on the ground.
- Ingestion of radioactivity on, or in, edible vegetation (from direct plume deposition or from the transfer of radioactivity deposited on the soil).
- Ingestion of radioactivity that entered an animal food product (milk or meat) because the animal ingested contaminated feed, with the contamination due either to direct deposition on foliage or to uptake from the soil.
- Inhalation of radioactivity in the plume.

Dresden considers these same pathways with the exception that the transfer of radioactivity from soil to vegetation is omitted. This pathway was determined to be of minimal significance in relation to the other airborne exposure pathways.

1.2.5.3 Liquid Releases

For liquid releases of radioactivity (Figure 1-1), the NRC considers the following pathways of radiation exposure of persons:

- Direct exposure to radioactivity in water while engaging in recreational activities such as swimming and boating.
- Exposure to radiation from shoreline sediments contaminated by water containing radioactivity from station liquid discharges.
- Ingestion of edible vegetation contaminated by irrigation with water containing radioactivity from station liquid discharges.
- Ingestion of radioactivity from animal food products (milk or meat) resulting from the animal either drinking water contaminated by radioactive liquid effluents or from the animal eating feed or vegetation contaminated by irrigation with such water.
- Ingestion of aquatic food (e.g., fish) obtained from the body of water to which radioactive station effluents are discharged.
- Ingestion (drinking) of potable water contaminated by radioactive liquid effluents discharged from the station.

Dresden considers the latter two of these pathways as significant. For the aquatic food pathway, only fish is considered since it is the only significant locally produced aquatic food consumed by humans.

The station omits the pathways involving irrigation and animal consumption of contaminated water because these pathways were determined to be insignificant. The stations also omit the pathway of radiation exposure from shoreline sediment because this pathway was also found to be insignificant.

The station has also verified that the dose contribution to people participating in water recreational activities (swimming and boating) is negligible. This pathway was not addressed explicitly in Regulatory Guide 1.109. Thus, the station also omits dose assessments for the water recreational activities pathway.

Periodically the Illinois Army Corps of Engineers dredges silt and debris from the riverbeds downstream of Dresden station. As a part of the land use census, Dresden will determine if the Corps performed dredging within one mile of the discharge point. If so, Dresden will obtain spoils samples, through it's REMP vendor, for analysis. The impact to the offsite dose will be evaluated on a case-by-case basis and added to the station annex of the ODCM when applicable.

1.2.5.4 Radiation from Contained Sources

Radiation from contained sources is discussed in Part II, Section 5.

Table 1-1
Regulatory Dose Limit Matrix

REGULATION	DOSE TYPE	DOSE LIMIT(s)		ODCM Section
Airborne Releases:		(quarterly)	(annual)	
10CFR50 App. I[3]	Gamma Dose to Air due to Noble Gas Radionuclides (per reactor unit)	5 mrad	10 mrad	4.2.2.1
	Beta Dose to Air Due to Noble Gas Radionuclides (per reactor unit)	10 mrad	20 mrad	4.2.2.2
	Organ Dose Due to Specified Non-Noble Gas Radionuclides (per reactor unit)	7.5 mrem	15 mrem	4.2.3
	Total Body Dose (per reactor unit)	2.5 mrem	5 mrem	4.2.2.3
	Skin Dose (per reactor unit)	7.5 mrem	15 mrem	4.2.2.4
Technical Specifications	Total Body Dose Rate Due to Noble Gas Radionuclides (instantaneous limit, per site)	500 mrem/yr		4.2.1.2
	Skin Dose Rate Due to Noble Gas Radionuclides (instantaneous limit, per site)	3,000 mrem/yr		4.2.1.3
	Organ Dose Rate Due to Specified Non-Noble Gas Radionuclides (instantaneous limit, per site)	1,500 mrem/yr		4.2.1.4
Liquid Releases:		(quarterly)	(annual)	
10CFR50 App. I[3]	Total Body Dose (per reactor unit)	1.5 mrem	3 mrem	3.4.1
	Organ Dose (per reactor unit)	5 mrem	10 mrem	3.4.1
Technical Specifications	The concentration of radioactivity in liquid effluents released to unrestricted areas	Ten times the values listed in 10CFR20 Appendix B; Table 2, Column 2		3.2
Total Doses [1]:				
10CFR20.1301(a)(1)	Total Effective Dose Equivalent [4]	100 mrem/yr		5.4.3
10CFR72 and 40CFR190	Total Body Dose	25 mrem/yr		5.4.1
	Thyroid Dose	75 mrem/yr		5.4.2
	Other Organ Dose	25 mrem/yr		5.4.2
Other Limits:				
40CFR141[2]	Total Body Dose Due to Drinking Water From Public Water Systems	4 mrem/yr		3.4
	Organ Dose Due to Drinking Water From Public Water Systems	4 mrem/yr		3.4

1 These doses are calculated considering all sources of radiation and radioactivity in effluents.
2 40CFR141 limits are not directly applicable to nuclear power stations. They are applicable to the owners or operators of public water systems. However, the Dresden RECs require assessment of compliance with these limits.
3 Note that 10CFR50 provides design objectives, not limits.
4 Compliance with 10CFR20.1301(a)(1) is demonstrated by compliance with 40CFR190.

Table 1-2
Dose Assessment Receivers

Dose Component or Pathway	Location; Occupancy if Different than 100%
"Instantaneous" dose rates from airborne radioactivity	Unrestricted area boundary location that results in the maximum dose rate
"Instantaneous" concentration limits in liquid effluents	Point where liquid effluents enter the unrestricted area
Annual average concentration limits for liquid effluents	Point where liquid effluents enter the unrestricted area
Direct dose from contained sources	Receiver spends part of this time in the controlled area and the remainder at his residence or fishing nearby; occupancy factor is considered and is site-specific. See Table 5-1 for occupancy factors.
Direct dose from airborne plume	Receiver is at the location at or beyond the site area boundary that results in the maximum dose
Dose due to radioiodines, tritium, and particulates with half-lives greater than 8 days for inhalation, ingestion of vegetation, milk and meat, and ground plane exposure pathways.	Receiver is at the location in the unrestricted area where the combination of existing pathways and receptor age groups indicates the highest potential exposures.
Ingestion dose from drinking water	The drinking water pathway is considered as an additive dose component in this assessment only if the public water supply serves the community immediately adjacent to the plant.
Ingestion dose from eating fish	The receiver eats fish from the receiving body of water
Total Organ Doses	Summation of ingestion/inhalation doses
Total Dose	Summation of above data

Table 1-3
Dose Component/Regulation Matrix

		Regulation in which dose component is utilized		
Dose Component or Pathway	**Reference equation; Comments**	**10CFR20**	**40CFR190**	**10CFR50 App I**
"Instantaneous" dose rates from airborne radioactivity (RECs requirement only)	4-1: Total Body 4-2: Skin 4-3: Organ	X(1)		
"Instantaneous" concentration limits in liquid effluents	3-2: Ten times the limits of 10CFR20, Appendix B, Table 2, Col. 2, and $2x10^{-4}$ µCi/ml total gaseous activity.	X(1)		
Direct dose from contained sources	5-1	X	X	
Direct dose from airborne plume	4-9: Gamma air dose 4-10: Beta air dose 4-11: Total body dose 4-12: Skin dose	X	X	X X X X
Direct dose from radioactivity deposited on the ground	4-13 and 4-15	X	X	X
Inhalation dose from airborne effluents	4-13 and 4-14	X	X	X
Ingestion dose from vegetables	4-13, 4-22, 4-23, and 4-24	X	X	X
Ingestion dose from milk	4-13, 4-16, 4-17, and 4-18	X	X	X
Ingestion dose from meat	4-13, 4-19, 4-20, and 4-21	X	X	X
Ingestion dose from drinking water and eating fish	3-3	X	X	X
Total Organ Doses	5-3		X	X
Total Dose	5-4	X	X	X

1 Technical Specifications have been revised to allow 10 times the 10CFR20 value.

Table 1-4 (Page 1 of 2)
Simplified Chart of Offsite Dose Calculations[2]

Category	Radionuclides	Pathway	Text Section	Receptor	Code and Limits	Frequency of Calculation[1]
Airborne Releases:						
	Noble Gases:	Plume γ^a	2.2.4 4.2.1.2	Total Body	RECs: 500 mrem/yr Instantaneous	As required by station procedure
		Plume γ^a and β^b	2.2.4 4.2.1.3	Skin	RECs: 3000 mrem/yr Instantaneous	
		Plume γ^a	4.2.2.1	Air[4]	10CFR50[3]: 5 mrad/qtr, 10 mrad/yr	Monthly
		Plume β^b	4.2.2.2		10CFR50[3]: 10 mrad/qtr, 20 mrad/yr	
	Non-Noble Gases:	Inhalation[b] Ground Deposition[c] Food[d]	4.2.1.4	Total Body Any Organ	RECs: 1500 mrem/yr Instantaneous	As required by station procedure
		Ground Deposition[c] Inhalation[b] Vegetation[c] Milk[d] Meat[d]	4.2.3	Total Body Any Organ	10CFR50[3]: 7.5 mrem/qtr, 15 mrem/yr	Monthly and Annually
Liquid Releases:						
	All	Water	3.2		RECs, 10 times 10CFR20 Appendix B, Table 2, Col. 2; $2x10^{-4}$ total Noble Gases	As required by station procedure
	Non-Noble Gases	Water[e] and Fish[f]	3.4.1	Total Body	10CFR50[3]: 1.5 mrem/qtr, 3 mrem/yr	Monthly
				Any Organ	10CFR50[3]: 5 mrem/qtr, 10 mrem/yr	
		Water[e]		Total Body and All Organs	40CFR141: 4 mrem/yr	As required by RECs
Uranium Fuel Cycle:						
	All	All releases plus direct radiation from contained sources	5.4.1	Total Body	40CFR190: 25 mrem/yr	Annually
			5.4.2	Thyroid	40CFR190: 75 mrem/yr	
				All Other Organs	40CFR190: 25 mrem/yr	
TEDE:	All	External + Internal	5.4.3	Total Body and All Organs	10CFR20: 100 mrem/yr	Annually

Table 1-4 (Page 2 of 2)

Notes for Table 1-4:

1. See RECs for exact requirements.

2. In addition to the calculations shown in this figure, monthly projections of doses due to radioactive materials are required for gaseous and liquid effluents. Projections of drinking water doses are required at least once per 92 days. See RECs.

3. 10 CFR 50 prescribes design objectives, not limits.

4. If the air dose is exceeded, doses to the total body and skin are calculated. Total body objectives are 2.5 mrem/qtr and 5.0 mrem/year; the skin dose objectives are 7.5 mrem/qtr and 15 mrem/year.

a. Evaluated at the site area boundary.

b. Evaluated at the location of maximum offsite χ/Q.

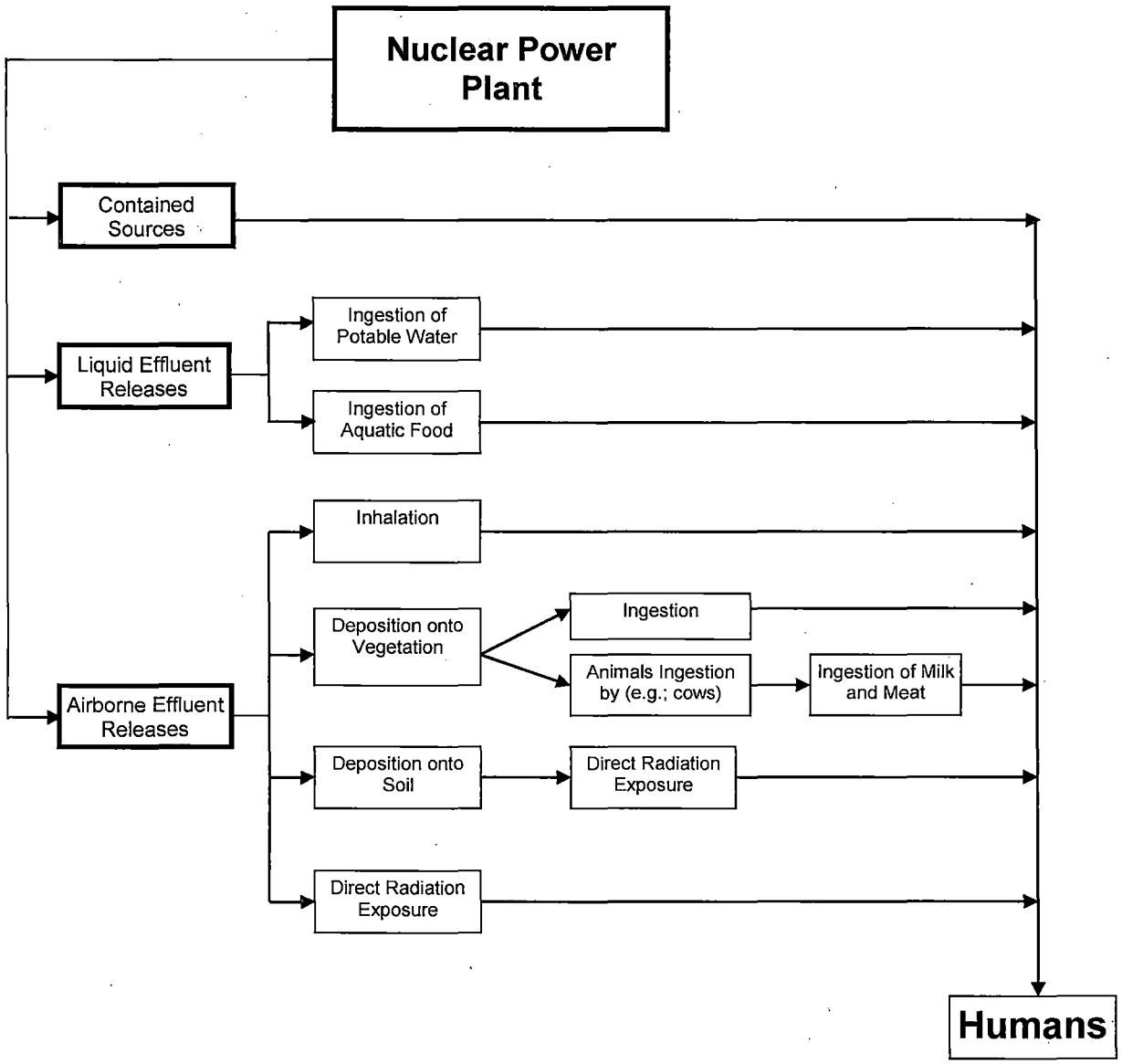
c. Ground plane and inhalation pathways are considered to be present at all offsite locations.

d. Evaluated at the location in the unrestricted area where the combination of existing pathways and receptor age groups indicates the maximum potential exposures.

e. Evaluated for the nearest downstream community water supply. The flow and dilution factors specified in Table 3-2 are used.

f. Evaluated for fish caught in the near-field region downstream of plant using the flow and dilution factors specified in Table 3-2.

Figure 1 - 1
Radiation Exposure Pathways to Humans



1.3 Offsite Dose Calculation Parameters

This section contains offsite dose calculation parameter factors, or values not specific only to one of the gas, liquid, or total dose chapters. Additional parameters are provided in the Sections 3, 4, and 5 of the ODCM.

1.3.1 Dose Factors

Dose factors are contained in Tables 1-7 through 1-15. The dose factors are obtained from NUREG/CR-1276 (reference 105) except for values that were updated by NUREG/CR-4013 (reference 107).

1.3.2 TEDE Dose Commitment Factors

Dose factors for 10CFR20 related calculations are available in Federal Guidance Report No. 11 (Reference 93). The following table lists the parameters and the corresponding data tables in the FGR:

PATHWAY	AVERAGE INDIVIDUAL
Inhalation	FGR#11: Table 2.1
Ingestion	FGR#11: Table 2.2

The factors used in offsite dose calculations are for the seven organs (Gonad, Breast, Lung, R. Marrow, B. Surface, Thyroid, and Remainder organs) but do not include the Effective (weighted) values. The factors in FGR#11 have units of Seiverts/Becquerel (Sv/Bq). To convert to traditional units of mrem/pCi multiply the factors by 3.7E+3.

1.4 References

The references listed below were transferred from the previous ODCM revision that was common to all former Commonwealth Edison nuclear stations. The references not applicable to Dresden have been deleted, however the numbering has been preserved for ease of reference management throughout the ODCM document; therefore, reference numbering is not sequential.

3. U.S. Nuclear Regulatory Commission, Standard Radiological Effluent Technical Specifications for Boiling Water Reactors, NUREG-0473, Rev. 3, Draft, September 1982 (frequently revised).

4. U.S. Nuclear Regulatory Commission, Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants, Regulatory Guide 1.21. Revision 1, June 1974.

5. U.S. Nuclear Regulatory Commission, Onsite Meteorological Programs, Regulatory Guide 1.23, Safety Guide 23, February 17, 1972.

6. U.S. Nuclear Regulatory Commission, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50 Appendix I, Regulatory Guide 1.109, Rev. 1, October 1977.

7. U.S. Nuclear Regulatory Commission, Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors, Regulatory Guide 1.111, Rev. 1, July 1977.

8. U.S. Nuclear Regulatory Commission, Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors, Regulatory Guide 1.112, Rev. 0-R, April 1976; reissued May 1977.

9. U.S. Nuclear Regulatory Commission, Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I, Regulatory Guide 1.113, Rev. 1, April 1977.

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Table 1-5
Miscellaneous Dose Assessment Factors: Consumption Parameters

Type	Variable	Infant	Child	Teenager	Adult
Air	BR_a (m^3/yr)	1400	3700	8000	8000
Milk	U_a^C (L/yr)	330	330	400	310
Stored Vegetation	U_a^S (kg/yr)	0	520	630	520
Fresh Leafy Vegetation	U_a^L (kg/yr)	0	26	42	64
Meat	U_a^M (kg/yr)	0	41	65	110
Water	U_a^W [L/yr]	330	510	510	730
Fish	U_a^F [kg/yr]	0	6.9	16	21

Source: Regulatory Guide 1.109 (Reference 6) Table E-5.

Table 1-6
Radiological Decay Constants (sec^{-1})

Isotope	λ_i	Isotope	λ_i	Isotope	λ_i
H-3	1.79E-09	Tc-101	8.14E-04	Ce-143	5.83E-06
C-14	3.83E-12	Ru-103	2.04E-07	Pr-143	5.92E-07
Na-22	8.44E-09	Ru-105	4.34E-05	Ce-144	2.82E-08
Na-24	1.28E-05	Rh-105	5.45E-06	Pr-144	6.69E-04
P-32	5.61E-07	Ru-106	2.18E-08	Nd-147	7.31E-07
Ca-41	2.13E-13	Pd-107	3.38E-15	Pm-147	8.37E-09
Sc-46	9.57E-08	Pd-109	1.43E-05	Pm-148m	1.94E-07
Cr-51	2.90E-07	Ag-110m	3.21E-08	Pm-148	1.49E-06
Mn-54	2.57E-08	Ag-111	1.08E-06	Pm-149	3.63E-06
Fe-55	8.14E-09	Cd-113m	1.60E-09	Pm-151	6.78E-06
Mn-56	7.47E-05	Cd-115m	1.80E-07	Sm-151	2.44E-10
Co-57	2.96E-08	Sn-123	6.21E-08	Sm-153	4.12E-06
Co-58	1.13E-07	Sn-125	8.32E-07	Eu-152	1.62E-09
Fe-59	1.80E-07	Sn-126	2.20E-13	Eu-154	2.50E-09
Co-60	4.17E-09	Sb-124	1.33E-07	Eu-155	4.43E-09
Ni-59	2.93E-13	Sb-125	7.93E-09	Eu-156	5.28E-07
Ni-63	2.19E-10	Sb-126	6.47E-07	Tb-160	1.11E-07
Cu-64	1.52E-05	Sb-127	2.08E-06	Ho-166m	1.83E-11
Ni-65	7.64E-05	Te-125m	1.38E-07	W-181	6.63E-08
Zn-65	3.28E-08	Te-127m	7.36E-08	W-185	1.07E-07
Zn-69m	1.40E-05	Te-127	2.06E-05	W-187	8.08E-06
Zn-69	2.08E-04	Te-129m	2.39E-07	Np-239	3.41E-06
Se-79	3.38E-13	Te-129	1.66E-04	U-232	3.05E-10
Br-82	5.45E-06	Te-133m	2.09E-04	U-233	1.38E-13
Br-83	8.06E-05	Te-134	2.76E-04	U-234	8.98E-14
Br-84	3.63E-04	I-129	1.40E-15	U-235	3.12E-17
Br-85	4.03E-03	I-130	1.56E-05	U-236	9.38E-16
Rb-86	4.30E-07	I-131	9.98E-07	U-237	1.19E-06
Rb-87	4.64E-19	Te-131m	6.42E-06	U-238	4.92E-18
Rb-88	6.49E-04	Te-131	4.62E-04	Np-237	1.03E-14
Rb-89	7.48E-04	I-132	8.37E-05	Np-238	3.79E-06
Sr-89	1.59E-07	Te-132	2.46E-06	Pu-238	2.50E-10
Sr-90	7.68E-10	I-133	9.26E-06	Pu-239	9.10E-13
Y-90	3.00E-06	Cs-134m	6.64E-05	Pu-240	3.34E-12
Sr-91	2.03E-05	Cs-134	1.07E-08	Pu-241	1.53E-09
Y-91m	2.32E-04	I-134	2.20E-04	Pu-242	5.84E-14
Y-91	1.37E-07	I-135	2.91E-05	Pu-244	2.66E-16
Sr-92	7.10E-05	Cs-135	9.55E-15	Am-241	5.08E-11
Y-92	5.44E-05	Cs-136	6.10E-07	Am-242m	1.45E-10
Y-93	1.91E-05	Cs-137	7.28E-10	Am-243	2.98E-12
Nb-93m	1.50E-09	Cs-138	3.59E-04	Cm-242	4.92E-08
Nb-95	2.29E-07	Cs-139	1.23E-03	Cm-243	7.71E-10
Nb-97	1.60E-04	Ba-139	1.39E-04	Cm-244	1.21E-09
Zr-93	1.44E-14	Ba-140	6.27E-07	Cm-245	2.58E-12
Zr-95	1.25E-07	La-140	4.79E-06	Cm-246	4.62E-12
Zr-97	1.14E-05	Ba-141	6.32E-04	Cm-247	1.41E-15
Mo-93	6.28E-12	La-141	4.89E-05	Cm-248	6.48E-14
Mo-99	2.92E-06	Ce-141	2.47E-07	Cf-252	8.32E-09
Tc-99	1.03E-13	Ba-142	1.08E-03		
Tc-99m	3.20E-05	La-142	1.21E-04		

λ_i= ln(2) / half life
Source: DOE/TIC-11026 (Reference 70)

Table 1-7 (Page 1 of 3)
External Dose Factors for Standing on Contaminated Ground (DFG_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI	Skin
H-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na-22	1.60E-08	1.60E-08	1.60E-08	1.60E-08	1.60E-08	1.60E-08	1.60E-08	1.80E-08
Na-24	2.50E-08	2.50E-08	2.50E-08	2.50E-08	2.50E-08	2.50E-08	2.50E-08	2.90E-08
P-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ca-41	3.41E-09	3.41E-09	3.41E-09	3.41E-09	3.41E-09	3.41E-09	3.41E-09	4.01E-09
Sc-46	1.30E-08	1.30E-08	1.30E-08	1.30E-08	1.30E-08	1.30E-08	1.30E-08	1.50E-08
Cr-51	2.20E-10	2.20E-10	2.20E-10	2.20E-10	2.20E-10	2.20E-10	2.20E-10	2.60E-10
Mn-54	5.80E-09	5.80E-09	5.80E-09	5.80E-09	5.80E-09	5.80E-09	5.80E-09	6.80E-09
Fe-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mn-56	1.10E-08	1.10E-08	1.10E-08	1.10E-08	1.10E-08	1.10E-08	1.10E-08	1.30E-08
Co-57	9.10E-10	9.10E-10	9.10E-10	9.10E-10	9.10E-10	9.10E-10	9.10E-10	1.00E-09
Co-58	7.00E-09	7.00E-09	7.00E-09	7.00E-09	7.00E-09	7.00E-09	7.00E-09	8.20E-09
Fe-59	8.00E-09	8.00E-09	8.00E-09	8.00E-09	8.00E-09	8.00E-09	8.00E-09	9.40E-09
Co-60	1.70E-08	1.70E-08	1.70E-08	1.70E-08	1.70E-08	1.70E-08	1.70E-08	2.00E-08
Ni-59	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cu-64	1.50E-09	1.50E-09	1.50E-09	1.50E-09	1.50E-09	1.50E-09	1.50E-09	1.70E-09
Ni-65	3.70E-09	3.70E-09	3.70E-09	3.70E-09	3.70E-09	3.70E-09	3.70E-09	4.30E-09
Zn-65	4.00E-09	4.00E-09	4.00E-09	4.00E-09	4.00E-09	4.00E-09	4.00E-09	4.60E-09
Zn-69m	2.90E-09	2.90E-09	2.90E-09	2.90E-09	2.90E-09	2.90E-09	2.90E-09	3.40E-09
Zn-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Se-79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-82	1.90E-08	1.90E-08	1.90E-08	1.90E-08	1.90E-08	1.90E-08	1.90E-08	2.20E-08
Br-83	6.40E-11	6.40E-11	6.40E-11	6.40E-11	6.40E-11	6.40E-11	6.40E-11	9.30E-11
Br-84	1.20E-08	1.20E-08	1.20E-08	1.20E-08	1.20E-08	1.20E-08	1.20E-08	1.40E-08
Br-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	6.30E-10	6.30E-10	6.30E-10	6.30E-10	6.30E-10	6.30E-10	6.30E-10	7.20E-10
Rb-87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-88	3.50E-09	3.50E-09	3.50E-09	3.50E-09	3.50E-09	3.50E-09	3.50E-09	4.00E-09
Rb-89	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.80E-08
Sr-89	5.60E-13	5.60E-13	5.60E-13	5.60E-13	5.60E-13	5.60E-13	5.60E-13	6.50E-13
Sr-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-90	2.20E-12	2.20E-12	2.20E-12	2.20E-12	2.20E-12	2.20E-12	2.20E-12	2.60E-12
Sr-91	7.10E-09	7.10E-09	7.10E-09	7.10E-09	7.10E-09	7.10E-09	7.10E-09	8.30E-09
Y-91m	4.40E-09	4.40E-09	4.40E-09	4.40E-09	4.40E-09	4.40E-09	4.40E-09	3.80E-09
Y-91	2.40E-11	2.40E-11	2.40E-11	2.40E-11	2.40E-11	2.40E-11	2.40E-11	2.70E-11
Sr-92	9.00E-09	9.00E-09	9.00E-09	9.00E-09	9.00E-09	9.00E-09	9.00E-09	1.00E-08
Y-92	1.60E-09	1.60E-09	1.60E-09	1.60E-09	1.60E-09	1.60E-09	1.60E-09	1.90E-09
Y-93	5.70E-10	5.70E-10	5.70E-10	5.70E-10	5.70E-10	5.70E-10	5.70E-10	7.80E-10
Nb-93m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	6.00E-09	6.00E-09	6.00E-09	6.00E-09	6.00E-09	6.00E-09	6.00E-09	5.10E-09
Nb-97	4.60E-09	4.60E-09	4.60E-09	4.60E-09	4.60E-09	4.60E-09	4.60E-09	5.40E-09
Zr-93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	5.00E-09	5.00E-09	5.00E-09	5.00E-09	5.00E-09	5.00E-09	5.00E-09	5.80E-09
Zr-97	5.50E-09	5.50E-09	5.50E-09	5.50E-09	5.50E-09	5.50E-09	5.50E-09	6.40E-09
Mo-93	2.29E-11	2.29E-11	2.29E-11	2.29E-11	2.29E-11	2.29E-11	2.29E-11	9.32E-10
Mo-99	2.20E-09	2.20E-09	2.20E-09	2.20E-09	2.20E-09	2.20E-09	2.20E-09	1.90E-09
Tc-99	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tc-99m	9.60E-10	9.60E-10	9.60E-10	9.60E-10	9.60E-10	9.60E-10	9.60E-10	1.10E-09
Tc-101	2.70E-09	2.70E-09	2.70E-09	2.70E-09	2.70E-09	2.70E-09	2.70E-09	3.00E-09
Ru-103	4.20E-09	4.20E-09	4.20E-09	4.20E-09	4.20E-09	4.20E-09	4.20E-09	3.60E-09
Ru-105	4.50E-09	4.50E-09	4.50E-09	4.50E-09	4.50E-09	4.50E-09	4.50E-09	5.10E-09
Rh-105	6.60E-10	6.60E-10	6.60E-10	6.60E-10	6.60E-10	6.60E-10	6.60E-10	7.70E-10
Ru-106	1.80E-09	1.80E-09	1.80E-09	1.80E-09	1.80E-09	1.80E-09	1.80E-09	1.50E-09
Pd-107	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 1-7 (Page 2 of 3)
External Dose Factors for Standing on Contaminated Ground (DFG_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI	Skin
Pd-109	3.50E-11	3.50E-11	3.50E-11	3.50E-11	3.50E-11	3.50E-11	3.50E-11	4.00E-11
Ag-110m	1.80E-08	1.80E-08	1.80E-08	1.80E-08	1.80E-08	1.80E-08	1.80E-08	2.10E-08
Ag-111	1.80E-10	1.80E-10	1.80E-10	1.80E-10	1.80E-10	1.80E-10	1.80E-10	2.10E-10
Cd-113m	2.30E-12	2.30E-12	2.30E-12	2.30E-12	2.30E-12	2.30E-12	2.30E-12	2.60E-12
Cd-115m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-123	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.46E-08
Sn-125	5.70E-10	5.70E-10	5.70E-10	5.70E-10	5.70E-10	5.70E-10	5.70E-10	6.60E-10
Sn-126	9.00E-09	9.00E-09	9.00E-09	9.00E-09	9.00E-09	9.00E-09	9.00E-09	1.00E-08
Sb-124	1.30E-08	1.30E-08	1.30E-08	1.30E-08	1.30E-08	1.30E-08	1.30E-08	1.50E-08
Sb-125	3.10E-09	3.10E-09	3.10E-09	3.10E-09	3.10E-09	3.10E-09	3.10E-09	3.50E-09
Sb-126	8.90E-09	8.90E-09	8.90E-09	8.90E-09	8.90E-09	8.90E-09	8.90E-09	1.00E-08
Sb-127	5.70E-09	5.70E-09	5.70E-09	5.70E-09	5.70E-09	5.70E-09	5.70E-09	6.60E-09
Te-125m	3.50E-11	3.50E-11	3.50E-11	3.50E-11	3.50E-11	3.50E-11	3.50E-11	4.80E-11
Te-127m	1.10E-12	1.10E-12	1.10E-12	1.10E-12	1.10E-12	1.10E-12	1.10E-12	1.30E-12
Te-127	1.00E-11	1.00E-11	1.00E-11	1.00E-11	1.00E-11	1.00E-11	1.00E-11	1.10E-11
Te-129m	7.70E-10	7.70E-10	7.70E-10	7.70E-10	7.70E-10	7.70E-10	7.70E-10	9.00E-10
Te-129	7.10E-10	7.10E-10	7.10E-10	7.10E-10	7.10E-10	7.10E-10	7.10E-10	8.40E-10
Te-133m	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.70E-08
Te-134	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.20E-09
I-129	4.50E-10	4.50E-10	4.50E-10	4.50E-10	4.50E-10	4.50E-10	4.50E-10	7.50E-10
I-130	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.70E-08
I-131	2.80E-09	2.80E-09	2.80E-09	2.80E-09	2.80E-09	2.80E-09	2.80E-09	3.40E-09
Te-131m	8.40E-09	8.40E-09	8.40E-09	8.40E-09	8.40E-09	8.40E-09	8.40E-09	9.90E-09
Te-131	2.20E-09	2.20E-09	2.20E-09	2.20E-09	2.20E-09	2.20E-09	2.20E-09	2.60E-06
I-132	2.00E-08	2.00E-08	2.00E-08	2.00E-08	2.00E-08	2.00E-08	2.00E-08	1.70E-08
Te-132	1.70E-09	1.70E-09	1.70E-09	1.70E-09	1.70E-09	1.70E-09	1.70E-09	2.00E-09
I-133	3.70E-09	3.70E-09	3.70E-09	3.70E-09	3.70E-09	3.70E-09	3.70E-09	4.50E-09
Cs-134m	6.20E-10	6.20E-10	6.20E-10	6.20E-10	6.20E-10	6.20E-10	6.20E-10	7.30E-10
Cs-134	1.20E-08	1.20E-08	1.20E-08	1.20E-08	1.20E-08	1.20E-08	1.20E-08	1.40E-08
I-134	1.60E-08	1.60E-08	1.60E-08	1.60E-08	1.60E-08	1.60E-08	1.60E-08	1.90E-08
I-135	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.20E-08
Cs-135	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-136	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.70E-08
Cs-137	4.20E-09	4.20E-09	4.20E-09	4.20E-09	4.20E-09	4.20E-09	4.20E-09	4.90E-09
Cs-138	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.10E-08	2.40E-08
Cs-139	6.30E-09	6.30E-09	6.30E-09	6.30E-09	6.30E-09	6.30E-09	6.30E-09	7.20E-09
Ba-139	2.40E-09	2.40E-09	2.40E-09	2.40E-09	2.40E-09	2.40E-09	2.40E-09	2.70E-09
Ba-140	2.10E-09	2.10E-09	2.10E-09	2.10E-09	2.10E-09	2.10E-09	2.10E-09	2.40E-09
La-140	1.70E-08	1.70E-08	1.70E-08	1.70E-08	1.70E-08	1.70E-08	1.70E-08	1.50E-08
Ba-141	4.30E-09	4.30E-09	4.30E-09	4.30E-09	4.30E-09	4.30E-09	4.30E-09	4.90E-09
La-141	2.50E-10	2.50E-10	2.50E-10	2.50E-10	2.50E-10	2.50E-10	2.50E-10	2.80E-10
Ce-141	5.50E-10	5.50E-10	5.50E-10	5.50E-10	5.50E-10	5.50E-10	5.50E-10	6.20E-10
Ba-142	7.90E-09	7.90E-09	7.90E-09	7.90E-09	7.90E-09	7.90E-09	7.90E-09	9.00E-09
La-142	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.50E-08	1.80E-08
Ce-143	2.20E-09	2.20E-09	2.20E-09	2.20E-09	2.20E-09	2.20E-09	2.20E-09	2.50E-09
Pr-143	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ce-144	3.20E-10	3.20E-10	3.20E-10	3.20E-10	3.20E-10	3.20E-10	3.20E-10	3.70E-10
Pr-144	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.00E-10	2.30E-10
Nd-147	1.20E-09	1.20E-09	1.20E-09	1.20E-09	1.20E-09	1.20E-09	1.20E-09	1.00E-09
Pm-147	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pm-148m	1.41E-08	1.41E-08	1.41E-08	1.41E-08	1.41E-08	1.41E-08	1.41E-08	8.16E-08
Pm-148	4.60E-09	4.60E-09	4.60E-09	4.60E-09	4.60E-09	4.60E-09	4.60E-09	5.30E-09
Pm-149	2.50E-11	2.50E-11	2.50E-11	2.50E-11	2.50E-11	2.50E-11	2.50E-11	2.90E-11
Pm-151	2.20E-09	2.20E-09	2.20E-09	2.20E-09	2.20E-09	2.20E-09	2.20E-09	2.30E-09
Sm-151	4.80E-11	4.80E-11	4.80E-11	4.80E-11	4.80E-11	4.80E-11	4.80E-11	2.10E-10
Sm-153	2.70E-10	2.70E-10	2.70E-10	2.70E-10	2.70E-10	2.70E-10	2.70E-10	3.00E-10

Table 1-7 (Page 3 of 3)
External Dose Factors for Standing on Contaminated Ground (DFG_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI	Skin
Eu-152	7.37E-09	7.37E-09	7.37E-09	7.37E-09	7.37E-09	7.37E-09	7.37E-09	8.53E-09
Eu-154	7.80E-09	7.80E-09	7.80E-09	7.80E-09	7.80E-09	7.80E-09	7.80E-09	9.00E-09
Eu-155	3.81E-10	3.81E-10	3.81E-10	3.81E-10	3.81E-10	3.81E-10	3.81E-10	4.33E-10
Eu-156	7.60E-09	7.60E-09	7.60E-09	7.60E-09	7.60E-09	7.60E-09	7.60E-09	8.70E-09
Tb-160	5.60E-09	5.60E-09	5.60E-09	5.60E-09	5.60E-09	5.60E-09	5.60E-09	1.00E-08
Ho-166m	8.90E-09	8.90E-09	8.90E-09	8.90E-09	8.90E-09	8.90E-09	8.90E-09	1.00E-08
W-181	2.10E-12	2.10E-12	2.10E-12	2.10E-12	2.10E-12	2.10E-12	2.10E-12	2.30E-12
W-185	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W-187	3.10E-09	3.10E-09	3.10E-09	3.10E-09	3.10E-09	3.10E-09	3.10E-09	3.60E-09
Np-239	9.50E-10	9.50E-10	9.50E-10	9.50E-10	9.50E-10	9.50E-10	9.50E-10	1.10E-09
U-232	2.59E-12	2.59E-12	2.59E-12	2.59E-12	2.59E-12	2.59E-12	2.59E-12	2.69E-11
U-233	2.30E-09	2.30E-09	2.30E-09	2.30E-09	2.30E-09	2.30E-09	2.30E-09	2.80E-09
U-234	6.32E-13	6.32E-13	6.32E-13	6.32E-13	6.32E-13	6.32E-13	6.32E-13	1.59E-10
U-235	3.20E-09	3.20E-09	3.20E-09	3.20E-09	3.20E-09	3.20E-09	3.20E-09	4.00E-09
U-236	2.10E-14	2.10E-14	2.10E-14	2.10E-14	2.10E-14	2.10E-14	2.10E-14	1.80E-11
U-237	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.00E-09	1.30E-09
U-238	1.10E-10	1.10E-10	1.10E-10	1.10E-10	1.10E-10	1.10E-10	1.10E-10	1.50E-10
Np-237	1.40E-09	1.40E-09	1.40E-09	1.40E-09	1.40E-09	1.40E-09	1.40E-09	1.60E-09
Np-238	2.80E-09	2.80E-09	2.80E-09	2.80E-09	2.80E-09	2.80E-09	2.80E-09	3.20E-09
Pu-238	1.80E-11	1.80E-11	1.80E-11	1.80E-11	1.80E-11	1.80E-11	1.80E-11	1.30E-12
Pu-239	7.70E-12	7.70E-12	7.70E-12	7.70E-12	7.70E-12	7.70E-12	7.70E-12	7.90E-13
Pu-240	1.80E-11	1.80E-11	1.80E-11	1.80E-11	1.80E-11	1.80E-11	1.80E-11	1.30E-12
Pu-241	6.80E-12	6.80E-12	6.80E-12	6.80E-12	6.80E-12	6.80E-12	6.80E-12	4.60E-12
Pu-242	1.10E-12	1.10E-12	1.10E-12	1.10E-12	1.10E-12	1.10E-12	1.10E-12	1.60E-11
Pu-244	8.95E-10	8.95E-10	8.95E-10	8.95E-10	8.95E-10	8.95E-10	8.95E-10	9.62E-10
Am-241	1.80E-10	1.80E-10	1.80E-10	1.80E-10	1.80E-10	1.80E-10	1.80E-10	2.60E-10
Am-242m	2.60E-11	2.60E-11	2.60E-11	2.60E-11	2.60E-11	2.60E-11	2.60E-11	1.80E-10
Am-243	1.30E-09	1.30E-09	1.30E-09	1.30E-09	1.30E-09	1.30E-09	1.30E-09	1.50E-09
Cm-242	5.50E-12	5.50E-12	5.50E-12	5.50E-12	5.50E-12	5.50E-12	5.50E-12	2.30E-11
Cm-243	2.30E-09	2.30E-09	2.30E-09	2.30E-09	2.30E-09	2.30E-09	2.30E-09	2.90E-09
Cm-244	2.90E-12	2.90E-12	2.90E-12	2.90E-12	2.90E-12	2.90E-12	2.90E-12	1.80E-11
Cm-245	9.50E-10	9.50E-10	9.50E-10	9.50E-10	9.50E-10	9.50E-10	9.50E-10	1.20E-09
Cm-246	1.00E-12	1.00E-12	1.00E-12	1.00E-12	1.00E-12	1.00E-12	1.00E-12	1.50E-11
Cm-247	2.20E-09	2.20E-09	2.20E-09	2.20E-09	2.20E-09	2.20E-09	2.20E-09	2.60E-09
Cm-248	6.81E-09	6.81E-09	6.81E-09	6.81E-09	6.81E-09	6.81E-09	6.81E-09	5.23E-09
Cf-252	6.60E-08	6.60E-08	6.60E-08	6.60E-08	6.60E-08	6.60E-08	6.60E-08	7.20E-08

Units of mrem/hr per pCi/m^2
Source: NUREG/CR-1276 (Reference 105), Appendix C, DF Table 1
Used for all age groups

Table 1-8 (Page 1 of 3)
Inhalation Dose Factors for Adult (DFA_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07
C-14	2.27E-06	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07
Na-22	1.30E-05	1.30E-05	1.30E-05	1.30E-05	1.30E-05	1.30E-05	1.30E-05
Na-24	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06
P-32	1.65E-04	9.64E-06	6.26E-06	0.00E+00	0.00E+00	0.00E+00	1.08E-05
Ca-41	3.83E-05	0.00E+00	4.13E-06	0.00E+00	0.00E+00	3.83E-06	2.86E-07
Sc-46	5.51E-05	1.07E-04	3.11E-05	0.00E+00	9.99E-05	0.00E+00	3.23E-05
Cr-51	0.00E+00	0.00E+00	1.25E-08	7.44E-09	2.85E-09	1.80E-06	4.15E-07
Mn-54	0.00E+00	4.95E-06	7.87E-07	0.00E+00	1.23E-06	1.75E-04	9.67E-06
Fe-55	3.07E-06	2.12E-06	4.93E-07	0.00E+00	0.00E+00	9.01E-06	7.54E-07
Mn-56	0.00E+00	1.55E-10	2.29E-11	0.00E+00	1.63E-10	1.18E-06	2.53E-06
Co-57	0.00E+00	8.65E-08	8.39E-08	0.00E+00	0.00E+00	4.62E-05	3.93E-06
Co-58	0.00E+00	1.98E-07	2.59E-07	0.00E+00	0.00E+00	1.16E-04	1.33E-05
Fe-59	1.47E-06	3.47E-06	1.32E-06	0.00E+00	0.00E+00	1.27E-04	2.35E-05
Co-60	0.00E+00	1.44E-06	1.85E-06	0.00E+00	0.00E+00	7.46E-04	3.56E-05
Ni-59	4.06E-06	1.46E-06	6.77E-07	0.00E+00	0.00E+00	8.20E-06	6.11E-07
Ni-63	5.40E-05	3.93E-06	1.81E-06	0.00E+00	0.00E+00	2.23E-05	1.67E-06
Cu-64	0.00E+00	1.83E-10	7.69E-11	0.00E+00	5.78E-10	8.48E-07	6.12E-06
Ni-65	1.92E-10	2.62E-11	1.14E-11	0.00E+00	0.00E+00	7.00E-07	1.54E-06
Zn-65	4.05E-06	1.29E-05	5.82E-06	0.00E+00	8.62E-06	1.08E-04	6.68E-06
Zn-69m	1.02E-09	2.45E-09	2.24E-10	0.00E+00	1.48E-09	2.38E-06	1.71E-05
Zn-69	4.23E-12	8.14E-12	5.65E-13	0.00E+00	5.27E-12	1.15E-07	2.04E-09
Se-79	0.00E+00	3.83E-07	6.09E-08	0.00E+00	5.69E-07	4.47E-05	3.33E-06
Br-82	0.00E+00	0.00E+00	1.69E-06	0.00E+00	0.00E+00	0.00E+00	1.30E-06
Br-83	0.00E+00	0.00E+00	3.01E-08	0.00E+00	0.00E+00	0.00E+00	2.90E-08
Br-84	0.00E+00	0.00E+00	3.91E-08	0.00E+00	0.00E+00	0.00E+00	2.05E-13
Br-85	0.00E+00	0.00E+00	1.60E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.69E-05	7.37E-06	0.00E+00	0.00E+00	0.00E+00	2.08E-06
Rb-87	0.00E+00	9.86E-06	3.21E-06	0.00E+00	0.00E+00	0.00E+00	2.88E-07
Rb-88	0.00E+00	4.84E-08	2.41E-08	0.00E+00	0.00E+00	0.00E+00	4.18E-19
Rb-89	0.00E+00	3.20E-08	2.12E-08	0.00E+00	0.00E+00	0.00E+00	1.16E-21
Sr-89	3.80E-05	0.00E+00	1.09E-06	0.00E+00	0.00E+00	1.75E-04	4.37E-05
Sr-90	6.33E-03	0.00E+00	4.24E-04	0.00E+00	0.00E+00	1.20E-03	9.02E-05
Y-90	2.61E-07	0.00E+00	7.01E-09	0.00E+00	0.00E+00	2.12E-05	6.32E-05
Sr-91	7.74E-09	0.00E+00	3.13E-10	0.00E+00	0.00E+00	4.56E-06	2.39E-05
Y-91m	3.26E-11	0.00E+00	1.27E-12	0.00E+00	0.00E+00	2.40E-07	1.66E-10
Y-91	5.78E-05	0.00E+00	1.55E-06	0.00E+00	0.00E+00	2.13E-04	4.81E-05
Sr-92	8.43E-10	0.00E+00	3.64E-11	0.00E+00	0.00E+00	2.06E-06	5.38E-06
Y-92	1.29E-09	0.00E+00	3.77E-11	0.00E+00	0.00E+00	1.96E-06	9.19E-06
Y-93	1.18E-08	0.00E+00	3.26E-10	0.00E+00	0.00E+00	6.06E-06	5.27E-05
Nb-93m	3.10E-05	1.01E-05	2.49E-06	0.00E+00	1.16E-05	3.11E-05	2.38E-06
Nb-95	1.76E-06	9.77E-07	5.26E-07	0.00E+00	9.67E-07	6.31E-05	1.30E-05
Nb-97	2.78E-11	7.03E-12	2.56E-12	0.00E+00	8.18E-12	3.00E-07	3.02E-08
Zr-93	5.22E-05	2.92E-06	1.37E-06	0.00E+00	1.11E-05	2.13E-05	1.51E-06
Zr-95	1.34E-05	4.30E-06	2.91E-06	0.00E+00	6.77E-06	2.21E-04	1.88E-05
Zr-97	1.21E-08	2.45E-09	1.13E-09	0.00E+00	3.71E-09	9.84E-06	6.54E-05
Mo-93	0.00E+00	1.17E-06	3.17E-08	0.00E+00	3.55E-07	5.11E-05	3.79E-06
Mo-99	0.00E+00	1.51E-08	2.87E-09	0.00E+00	3.64E-08	1.14E-05	3.10E-05
Tc-99	3.13E-08	4.64E-08	1.25E-08	0.00E+00	5.85E-07	1.01E-04	7.54E-06
Tc-99m	1.29E-13	3.64E-13	4.63E-12	0.00E+00	5.52E-12	9.55E-08	5.20E-07
Tc-101	5.22E-15	7.52E-15	7.38E-14	0.00E+00	1.35E-13	4.99E-08	1.36E-21
Ru-103	1.91E-07	0.00E+00	8.23E-08	0.00E+00	7.29E-07	6.31E-05	1.38E-05
Ru-105	9.88E-11	0.00E+00	3.89E-11	0.00E+00	1.27E-10	1.37E-06	6.02E-06
Rh-105	9.24E-10	6.73E-10	4.43E-10	0.00E+00	2.86E-09	2.41E-06	1.09E-05
Ru-106	8.64E-06	0.00E+00	1.09E-06	0.00E+00	1.67E-05	1.17E-03	1.14E-04
Pd-107	0.00E+00	8.27E-08	5.87E-09	0.00E+00	6.57E-07	9.47E-06	7.06E-07

Table 1-8 (Page 2 of 3)
Inhalation Dose Factors for Adult (DFA_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	4.63E-10	1.16E-10	0.00E+00	2.35E-09	1.85E-06	1.52E-05
Ag-110m	1.35E-06	1.25E-06	7.43E-07	0.00E+00	2.46E-06	5.79E-04	3.78E-05
Ag-111	4.25E-08	1.78E-08	8.87E-09	0.00E+00	5.74E-08	2.33E-05	2.79E-05
Cd-113m	0.00E+00	1.54E-04	4.97E-06	0.00E+00	1.71E-04	2.08E-04	1.59E-05
Cd-115m	0.00E+00	2.46E-05	7.95E-07	0.00E+00	1.98E-05	1.76E-04	4.80E-05
Sn-123	3.02E-05	6.67E-07	9.82E-07	5.67E-07	0.00E+00	2.88E-04	3.92E-05
Sn-125	1.16E-06	3.12E-08	7.03E-08	2.59E-08	0.00E+00	7.37E-05	6.81E-05
Sn-126	1.58E-04	4.18E-06	6.00E-06	1.23E-06	0.00E+00	1.17E-03	1.59E-05
Sb-124	3.90E-06	7.36E-08	1.55E-06	9.44E-09	0.00E+00	3.10E-04	5.08E-05
Sb-125	6.67E-06	7.44E-08	1.58E-06	6.75E-09	0.00E+00	2.18E-04	1.26E-05
Sb-126	4.50E-07	9.13E-09	1.62E-07	2.75E-09	0.00E+00	9.57E-05	6.01E-05
Sb-127	3.30E-08	7.22E-10	1.27E-08	3.97E-10	0.00E+00	2.05E-05	3.77E-05
Te-125m	4.27E-07	1.98E-07	5.84E-08	1.31E-07	1.55E-06	3.92E-05	8.83E-06
Te-127m	1.58E-06	7.21E-07	1.96E-07	4.11E-07	5.72E-06	1.20E-04	1.87E-05
Te-127	1.75E-10	8.03E-11	3.87E-11	1.32E-10	6.37E-10	8.14E-07	7.17E-06
Te-129m	1.22E-06	5.84E-07	1.98E-07	4.30E-07	4.57E-06	1.45E-04	4.79E-05
Te-129	6.22E-12	2.99E-12	1.55E-12	4.87E-12	2.34E-11	2.42E-07	1.96E-08
Te-133m	7.24E-12	5.40E-12	4.17E-12	6.27E-12	3.74E-11	5.51E-07	5.49E-08
Te-134	3.84E-12	3.22E-12	1.57E-12	3.44E-12	2.18E-11	4.34E-07	2.97E-11
I-129	2.48E-06	2.11E-06	6.91E-06	5.54E-03	4.53E-06	0.00E+00	2.22E-07
I-130	5.72E-07	1.68E-06	6.60E-07	1.42E-04	2.61E-06	0.00E+00	9.61E-07
I-131	3.15E-06	4.47E-06	2.56E-06	1.49E-03	7.66E-06	0.00E+00	7.85E-07
Te-131m	8.74E-09	5.45E-09	3.63E-09	6.88E-09	3.86E-08	1.82E-05	6.95E-05
Te-131	1.39E-12	7.44E-13	4.49E-13	1.17E-12	5.46E-12	1.74E-07	2.30E-09
I-132	1.45E-07	4.07E-07	1.45E-07	1.43E-05	6.48E-07	0.00E+00	5.08E-08
Te-132	3.25E-08	2.69E-08	2.02E-08	2.37E-08	1.82E-07	3.60E-05	6.37E-05
I-133	1.08E-06	1.85E-06	5.65E-07	2.69E-04	3.23E-06	0.00E+00	1.11E-06
Cs-134m	1.59E-08	3.20E-08	1.72E-08	0.00E+00	1.83E-08	2.93E-09	7.92E-09
Cs-134	4.66E-05	1.06E-04	9.10E-05	0.00E+00	3.59E-05	1.22E-05	1.30E-06
I-134	8.05E-08	2.16E-07	7.69E-08	3.73E-06	3.44E-07	0.00E+00	1.26E-10
I-135	3.35E-07	8.73E-07	3.21E-07	5.60E-05	1.39E-06	0.00E+00	6.56E-07
Cs-135	1.46E-05	1.29E-05	5.99E-06	0.00E+00	5.11E-06	1.57E-06	2.11E-07
Cs-136	4.88E-06	1.83E-05	1.38E-05	0.00E+00	1.07E-05	1.50E-06	1.46E-06
Cs-137	5.98E-05	7.76E-05	5.35E-05	0.00E+00	2.78E-05	9.40E-06	1.05E-06
Cs-138	4.14E-08	7.76E-08	4.05E-08	0.00E+00	6.00E-08	6.07E-09	2.33E-13
Cs-139	2.56E-08	3.63E-08	1.39E-08	0.00E+00	3.05E-08	2.84E-09	5.49E-31
Ba-139	1.17E-10	8.32E-14	3.42E-12	0.00E+00	7.78E-14	4.70E-07	1.12E-07
Ba-140	4.88E-06	6.13E-09	3.21E-07	0.00E+00	2.09E-09	1.59E-04	2.73E-05
La-140	4.30E-08	2.17E-08	5.73E-09	0.00E+00	0.00E+00	1.70E-05	5.73E-05
Ba-141	1.25E-11	9.41E-15	4.20E-13	0.00E+00	8.75E-15	2.42E-07	1.45E-17
La-141	5.34E-10	1.66E-10	2.71E-11	0.00E+00	0.00E+00	1.35E-06	7.31E-06
Ce-141	2.49E-06	1.69E-06	1.91E-07	0.00E+00	7.83E-07	4.52E-05	1.50E-05
Ba-142	3.29E-12	3.38E-15	2.07E-13	0.00E+00	2.86E-15	1.49E-07	1.96E-26
La-142	8.54E-11	3.88E-11	9.65E-12	0.00E+00	0.00E+00	7.91E-07	2.64E-07
Ce-143	2.33E-08	1.72E-08	1.91E-09	0.00E+00	7.60E-09	9.97E-06	2.83E-05
Pr-143	1.17E-06	4.69E-07	5.80E-08	0.00E+00	2.70E-07	3.51E-05	2.50E-05
Ce-144	4.29E-04	1.79E-04	2.30E-05	0.00E+00	1.06E-04	9.72E-04	1.02E-04
Pr-144	3.76E-12	1.56E-12	1.91E-13	0.00E+00	8.81E-13	1.27E-07	2.69E-18
Nd-147	6.59E-07	7.62E-07	4.56E-08	0.00E+00	4.45E-07	2.76E-05	2.16E-05
Pm-147	8.37E-05	7.87E-06	3.19E-06	0.00E+00	1.49E-05	6.60E-05	5.54E-06
Pm-148m	9.82E-06	2.54E-06	1.94E-06	0.00E+00	3.85E-06	2.14E-04	4.18E-05
Pm-148	3.84E-07	6.37E-08	3.20E-08	0.00E+00	1.20E-07	3.91E-05	5.80E-05
Pm-149	3.44E-08	4.87E-09	1.99E-09	0.00E+00	9.19E-09	7.21E-06	2.50E-05
Pm-151	8.50E-09	1.42E-09	7.21E-10	0.00E+00	2.55E-09	3.94E-06	2.00E-05
Sm-151	8.59E-05	1.48E-05	3.55E-06	0.00E+00	1.66E-05	4.45E-05	3.25E-06
Sm-153	1.70E-08	1.42E-08	1.04E-09	0.00E+00	4.59E-09	4.14E-06	1.58E-05

Table 1-8 (Page 3 of 3)
Inhalation Dose Factors for Adult (DFA_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	2.38E-04	5.41E-05	4.76E-05	0.00E+00	3.35E-04	3.43E-04	1.59E-05
Eu-154	7.40E-04	9.10E-05	6.48E-05	0.00E+00	4.36E-04	5.84E-04	3.40E-05
Eu-155	1.01E-04	1.43E-05	9.21E-06	0.00E+00	6.59E-05	9.46E-05	5.95E-06
Eu-156	1.93E-06	1.48E-06	2.40E-07	0.00E+00	9.95E-07	8.56E-05	4.50E-05
Tb-160	2.21E-05	0.00E+00	2.75E-06	0.00E+00	9.10E-06	1.92E-04	2.68E-05
Ho-166m	3.37E-04	1.05E-04	8.00E-05	0.00E+00	1.57E-04	3.94E-04	1.59E-05
W-181	6.23E-09	2.03E-09	2.17E-10	0.00E+00	0.00E+00	1.71E-06	2.53E-07
W-185	1.95E-07	6.47E-08	6.81E-09	0.00E+00	0.00E+00	5.57E-05	1.07E-05
W-187	1.06E-09	8.85E-10	3.10E-10	0.00E+00	0.00E+00	3.63E-06	1.94E-05
Np-239	2.87E-08	2.82E-09	1.55E-09	0.00E+00	8.75E-09	4.70E-06	1.49E-05
U-232	5.14E-02	0.00E+00	3.66E-03	0.00E+00	5.56E-03	2.22E-01	4.21E-05
U-233	1.09E-02	0.00E+00	6.60E-04	0.00E+00	2.54E-03	5.32E-02	3.89E-05
U-234	1.04E-02	0.00E+00	6.46E-04	0.00E+00	2.49E-03	5.22E-02	3.81E-05
U-235	1.00E-02	0.00E+00	6.07E-04	0.00E+00	2.34E-03	4.90E-02	4.84E-05
U-236	1.00E-02	0.00E+00	6.20E-04	0.00E+00	2.39E-03	5.00E-02	3.57E-05
U-237	3.67E-08	0.00E+00	9.77E-09	0.00E+00	1.51E-07	1.02E-05	1.20E-05
U-238	9.58E-03	0.00E+00	5.67E-04	0.00E+00	2.18E-03	4.58E-02	3.41E-05
Np-237	1.56E+00	1.00E+00	6.87E-02	0.00E+00	5.10E-01	5.22E-02	4.92E-05
Np-238	2.96E-07	7.20E-08	4.61E-09	0.00E+00	2.72E-08	1.02E-05	2.13E-05
Pu-238	1.43E+00	9.71E-01	6.90E-02	0.00E+00	2.96E-01	1.82E-01	4.52E-05
Pu-239	1.66E+00	1.07E+00	7.75E-02	0.00E+00	3.30E-01	1.72E-01	4.13E-05
Pu-240	1.65E+00	1.07E+00	7.73E-02	0.00E+00	3.29E-01	1.72E-01	4.21E-05
Pu-241	3.42E-02	8.69E-03	1.29E-03	0.00E+00	5.93E-03	1.52E-04	8.65E-07
Pu-242	1.53E+00	1.03E+00	7.46E-02	0.00E+00	3.17E-01	1.65E-01	4.05E-05
Pu-244	1.79E+00	1.18E+00	8.54E-02	0.00E+00	3.64E-01	1.89E-01	6.03E-05
Am-241	1.68E+00	1.13E+00	6.71E-02	0.00E+00	5.04E-01	6.06E-02	4.60E-05
Am-242m	1.70E+00	1.06E+00	6.73E-02	0.00E+00	5.01E-01	2.44E-02	5.79E-05
Am-243	1.68E+00	1.10E+00	6.57E-02	0.00E+00	4.95E-01	5.75E-02	5.40E-05
Cm-242	2.22E-02	1.77E-02	9.84E-04	0.00E+00	4.48E-03	3.92E-02	4.91E-05
Cm-243	1.10E+00	7.61E-01	4.61E-02	0.00E+00	2.15E-01	6.31E-02	4.84E-05
Cm-244	8.37E-01	5.88E-01	3.51E-02	0.00E+00	1.64E-01	6.06E-02	4.68E-05
Cm-245	1.74E+00	1.14E+00	7.14E-02	0.00E+00	3.33E-01	5.85E-02	4.36E-05
Cm-246	1.73E+00	1.14E+00	7.13E-02	0.00E+00	3.33E-01	5.96E-02	4.29E-05
Cm-247	1.68E+00	1.12E+00	7.03E-02	0.00E+00	3.28E-01	5.85E-02	5.63E-05
Cm-248	1.40E+01	9.26E+00	5.79E-01	0.00E+00	2.70E+00	4.82E-01	9.09E-04
Cf-252	5.43E-01	0.00E+00	2.33E-02	0.00E+00	0.00E+00	1.99E-01	1.78E-04

Units of mrem per pCi inhaled
Source: NUREG/CR-1276 (Reference 105), Appendix C, DF Table 2

Table 1-9 (Page 1 of 3)
Inhalation Dose Factors for Teenager (DFA_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07
C-14	3.25E-06	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07
Na-22	1.76E-05	1.76E-05	1.76E-05	1.76E-05	1.76E-05	1.76E-05	1.76E-05
Na-24	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06
P-32	2.36E-04	1.37E-05	8.95E-06	0.00E+00	0.00E+00	0.00E+00	1.16E-05
Ca-41	4.05E-05	0.00E+00	4.38E-06	0.00E+00	0.00E+00	1.01E-01	3.03E-07
Sc-46	7.24E-05	1.41E-04	4.18E-05	0.00E+00	1.35E-04	0.00E+00	2.98E-05
Cr-51	0.00E+00	0.00E+00	1.69E-08	9.37E-09	3.84E-09	2.62E-06	3.75E-07
Mn-54	0.00E+00	6.39E-06	1.05E-06	0.00E+00	1.59E-06	2.48E-04	8.35E-06
Fe-55	4.18E-06	2.98E-06	6.93E-07	0.00E+00	0.00E+00	1.55E-05	7.99E-07
Mn-56	0.00E+00	2.12E-10	3.15E-11	0.00E+00	2.24E-10	1.90E-06	7.18E-06
Co-57	0.00E+00	1.18E-07	1.15E-07	0.00E+00	0.00E+00	7.33E-05	3.93E-06
Co-58	0.00E+00	2.59E-07	3.47E-07	0.00E+00	0.00E+00	1.68E-04	1.19E-05
Fe-59	1.99E-06	4.62E-06	1.79E-06	0.00E+00	0.00E+00	1.91E-04	2.23E-05
Co-60	0.00E+00	1.89E-06	2.48E-06	0.00E+00	0.00E+00	1.09E-03	3.24E-05
Ni-59	5.44E-06	2.02E-06	9.24E-07	0.00E+00	0.00E+00	1.41E-05	6.48E-07
Ni-63	7.25E-05	5.43E-06	2.47E-06	0.00E+00	0.00E+00	3.84E-05	1.77E-06
Cu-64	0.00E+00	2.54E-10	1.06E-10	0.00E+00	8.01E-10	1.39E-06	7.68E-06
Ni-65	2.73E-10	3.66E-11	1.59E-11	0.00E+00	0.00E+00	1.17E-06	4.59E-06
Zn-65	4.82E-06	1.67E-05	7.80E-06	0.00E+00	1.08E-05	1.55E-04	5.83E-06
Zn-69m	1.44E-09	3.39E-09	3.11E-10	0.00E+00	2.06E-09	3.92E-06	2.14E-05
Zn-69	6.04E-12	1.15E-11	8.07E-13	0.00E+00	7.53E-12	1.98E-07	3.56E-08
Se-79	0.00E+00	5.43E-07	8.71E-08	0.00E+00	8.13E-07	7.71E-05	3.53E-06
Br-82	0.00E+00	0.00E+00	2.28E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	4.30E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	5.41E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	2.29E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	2.38E-05	1.05E-05	0.00E+00	0.00E+00	0.00E+00	2.21E-06
Rb-87	0.00E+00	1.40E-05	4.58E-06	0.00E+00	0.00E+00	0.00E+00	3.05E-07
Rb-88	0.00E+00	6.82E-08	3.40E-08	0.00E+00	0.00E+00	0.00E+00	3.65E-15
Rb-89	0.00E+00	4.40E-08	2.91E-08	0.00E+00	0.00E+00	0.00E+00	4.22E-17
Sr-89	5.43E-05	0.00E+00	1.56E-06	0.00E+00	0.00E+00	3.02E-04	4.64E-05
Sr-90	7.30E-02	0.00E+00	4.90E-04	0.00E+00	0.00E+00	2.06E-03	9.56E-05
Y-90	3.73E-07	0.00E+00	1.00E-08	0.00E+00	0.00E+00	3.66E-05	6.99E-05
Sr-91	1.10E-08	0.00E+00	4.39E-10	0.00E+00	0.00E+00	7.59E-06	3.24E-05
Y-91m	4.63E-11	0.00E+00	1.77E-12	0.00E+00	0.00E+00	4.00E-07	3.77E-09
Y-91	8.26E-05	0.00E+00	2.21E-06	0.00E+00	0.00E+00	3.67E-04	5.11E-05
Sr-92	1.19E-09	0.00E+00	5.08E-11	0.00E+00	0.00E+00	3.43E-06	1.49E-05
Y-92	1.84E-09	0.00E+00	5.36E-11	0.00E+00	0.00E+00	3.35E-06	2.06E-05
Y-93	1.69E-08	0.00E+00	4.65E-10	0.00E+00	0.00E+00	1.04E-05	7.24E-05
Nb-93m	4.14E-05	1.36E-05	3.41E-06	0.00E+00	1.59E-05	5.36E-05	2.52E-06
Nb-95	2.32E-06	1.29E-06	7.08E-07	0.00E+00	1.25E-06	9.39E-05	1.21E-05
Nb-97	3.92E-11	9.72E-12	3.55E-12	0.00E+00	1.14E-11	4.91E-07	2.71E-07
Zr-93	6.83E-05	3.38E-05	1.84E-05	0.00E+00	1.16E-04	3.67E-04	1.60E-05
Zr-95	1.82E-05	5.73E-06	3.94E-06	0.00E+00	8.42E-06	3.36E-04	1.86E-05
Zr-97	1.72E-08	3.40E-09	1.57E-09	0.00E+00	5.15E-09	1.62E-05	7.88E-05
Mo-93	0.00E+00	1.66E-06	4.52E-08	0.00E+00	5.06E-07	8.81E-05	3.99E-06
Mo-99	0.00E+00	2.11E-08	4.03E-09	0.00E+00	5.14E-08	1.92E-05	3.36E-05
Tc-99	4.48E-08	6.58E-08	1.79E-08	0.00E+00	8.35E-07	1.74E-04	7.99E-06
Tc-99m	1.73E-13	4.83E-13	6.24E-12	0.00E+00	7.20E-12	1.44E-07	7.66E-07
Tc-101	7.40E-15	1.05E-14	1.03E-13	0.00E+00	1.90E-13	8.34E-08	1.09E-16
Ru-103	2.63E-07	0.00E+00	1.12E-07	0.00E+00	9.29E-07	9.79E-05	1.36E-05
Ru-105	1.40E-10	0.00E+00	5.42E-11	0.00E+00	1.76E-10	2.27E-06	1.13E-05
Rh-105	1.32E-09	9.48E-10	6.24E-10	0.00E+00	4.04E-09	4.09E-06	1.23E-05
Ru-106	1.23E-05	0.00E+00	1.55E-06	0.00E+00	2.38E-05	2.01E-03	1.20E-04
Pd-107	0.00E+00	1.17E-07	8.39E-09	0.00E+00	9.39E-07	1.63E-05	7.49E-07

Table 1-9 (Page 2 of 3)
Inhalation Dose Factors for Teenager (DFA_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	6.56E-10	1.66E-10	0.00E+00	3.36E-09	3.19E-06	1.96E-05
Ag-110m	1.73E-06	1.64E-06	9.99E-07	0.00E+00	3.13E-06	8.44E-04	3.41E-05
Ag-111	6.07E-08	2.52E-08	1.26E-08	0.00E+00	8.17E-08	4.00E-05	3.00E-05
Cd-113m	0.00E+00	2.17E-04	7.10E-06	0.00E+00	2.43E-04	3.59E-04	1.68E-05
Cd-115m	0.00E+00	3.48E-05	1.14E-06	0.00E+00	2.82E-05	3.03E-04	5.10E-05
Sn-123	4.31E-05	9.44E-07	1.40E-06	7.55E-07	0.00E+00	4.96E-04	4.16E-05
Sn-125	1.66E-06	4.42E-08	9.99E-08	3.45E-08	0.00E+00	1.26E-04	7.29E-05
Sn-126	2.18E-04	5.39E-06	8.24E-06	1.42E-06	0.00E+00	1.72E-03	1.68E-05
Sb-124	5.38E-06	9.92E-08	2.10E-06	1.22E-08	0.00E+00	4.81E-04	4.98E-05
Sb-125	9.23E-06	1.01E-07	2.15E-06	8.80E-09	0.00E+00	3.42E-04	1.24E-05
Sb-126	6.19E-07	1.27E-08	2.23E-07	3.50E-09	0.00E+00	1.55E-04	6.01E-05
Sb-127	4.64E-08	9.92E-10	1.75E-08	5.21E-10	0.00E+00	3.31E-05	3.94E-05
Te-125m	6.10E-07	2.80E-07	8.34E-08	1.75E-07	0.00E+00	6.70E-05	9.38E-06
Te-127m	2.25E-06	1.02E-06	2.73E-07	5.48E-07	8.17E-06	2.07E-04	1.99E-05
Te-127	2.51E-10	1.14E-10	5.52E-11	1.77E-10	9.10E-10	1.40E-06	1.01E-05
Te-129m	1.74E-06	8.23E-07	2.81E-07	5.72E-07	6.49E-06	2.47E-04	5.06E-05
Te-129	8.87E-12	4.22E-12	2.20E-12	6.48E-12	3.32E-11	4.12E-07	2.02E-07
Te-133m	1.01E-11	7.33E-12	5.71E-12	8.18E-12	5.07E-11	8.71E-07	1.23E-07
Te-134	5.31E-12	4.35E-12	3.64E-12	4.46E-12	2.91E-11	6.75E-07	1.37E-09
I-129	3.53E-06	2.94E-06	4.90E-06	3.66E-03	5.26E-06	0.00E+00	2.29E-07
I-130	7.80E-07	2.24E-06	8.96E-07	1.86E-04	3.44E-06	0.00E+00	1.14E-06
I-131	4.43E-06	6.14E-06	3.30E-06	1.83E-03	1.05E-05	0.00E+00	8.11E-07
Te-131m	1.23E-08	7.51E-09	5.03E-09	9.06E-09	5.49E-08	2.97E-05	7.76E-05
Te-131	1.97E-12	1.04E-12	6.30E-13	1.55E-12	7.72E-12	2.92E-07	1.89E-09
I-132	1.99E-07	5.47E-07	1.97E-07	1.89E-05	8.65E-07	0.00E+00	1.59E-07
Te-132	4.50E-08	3.63E-08	2.74E-08	3.07E-08	2.44E-07	5.61E-05	5.79E-05
I-133	1.52E-06	2.56E-06	7.78E-07	3.65E-04	4.49E-06	0.00E+00	1.29E-06
Cs-134m	2.20E-08	4.35E-08	2.35E-08	0.00E+00	2.54E-08	4.56E-09	2.02E-08
Cs-134	6.28E-05	1.41E-04	6.86E-05	0.00E+00	4.69E-05	1.83E-05	1.22E-06
I-134	1.11E-07	2.90E-07	1.05E-07	4.94E-06	4.58E-07	0.00E+00	2.55E-09
I-135	4.62E-07	1.18E-06	4.36E-07	7.76E-05	1.86E-06	0.00E+00	8.69E-07
Cs-135	2.08E-05	1.82E-05	4.47E-06	0.00E+00	7.30E-06	2.70E-06	2.23E-07
Cs-136	6.44E-06	2.42E-05	1.71E-05	0.00E+00	1.38E-05	2.22E-06	1.36E-06
Cs-137	8.38E-05	1.06E-04	3.89E-05	0.00E+00	3.80E-05	1.51E-05	1.06E-06
Cs-138	5.82E-08	1.07E-07	5.58E-08	0.00E+00	8.28E-08	9.84E-09	3.38E-11
Cs-139	3.65E-08	5.12E-08	1.97E-08	0.00E+00	4.34E-08	4.86E-09	1.66E-23
Ba-139	1.67E-10	1.18E-13	4.87E-12	0.00E+00	1.11E-13	8.08E-07	8.06E-07
Ba-140	6.84E-06	8.38E-09	4.40E-07	0.00E+00	2.85E-09	2.54E-04	2.86E-05
La-140	5.99E-08	2.95E-08	7.82E-09	0.00E+00	0.00E+00	2.68E-05	6.09E-05
Ba-141	1.78E-11	1.32E-14	5.93E-13	0.00E+00	1.23E-14	4.11E-07	9.33E-14
La-141	7.63E-10	2.35E-10	3.87E-11	0.00E+00	0.00E+00	2.31E-06	1.54E-05
Ce-141	3.55E-06	2.37E-06	2.71E-07	0.00E+00	1.11E-06	7.67E-05	1.58E-05
Ba-142	4.62E-12	4.63E-15	2.84E-13	0.00E+00	3.92E-15	2.39E-07	5.99E-20
La-142	1.20E-10	5.31E-11	1.32E-11	0.00E+00	0.00E+00	1.27E-06	1.50E-06
Ce-143	3.32E-08	2.42E-08	2.70E-09	0.00E+00	1.08E-08	1.63E-05	3.19E-05
Pr-143	1.67E-06	6.64E-07	8.28E-08	0.00E+00	3.86E-07	6.04E-05	2.67E-05
Ce-144	6.11E-04	2.53E-04	3.28E-05	0.00E+00	1.51E-04	1.67E-03	1.08E-04
Pr-144	5.37E-12	2.20E-12	2.72E-13	0.00E+00	1.26E-12	2.19E-07	2.94E-14
Nd-147	9.83E-07	1.07E-06	6.41E-08	0.00E+00	6.28E-07	4.65E-05	2.28E-05
Pm-147	1.15E-04	1.10E-05	4.50E-06	0.00E+00	2.10E-05	1.14E-04	5.87E-06
Pm-148m	1.32E-05	3.35E-06	2.62E-06	0.00E+00	5.07E-06	3.20E-04	4.10E-05
Pm-148	5.44E-07	8.88E-08	4.48E-08	0.00E+00	1.60E-07	6.52E-05	6.14E-05
Pm-149	4.91E-08	6.89E-09	2.84E-09	0.00E+00	1.31E-08	1.24E-05	2.79E-05
Pm-151	1.20E-08	1.99E-09	1.01E-09	0.00E+00	3.57E-09	6.56E-06	2.27E-05
Sm-151	1.07E-04	2.10E-05	4.86E-06	0.00E+00	2.27E-05	7.68E-05	3.53E-06
Sm-153	2.43E-08	2.01E-08	1.47E-09	0.00E+00	6.56E-09	7.11E-06	1.77E-05

Table 1-9 (Page 3 of 3)
Inhalation Dose Factors for Teenager (DFA_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	2.96E-04	7.19E-05	6.30E-05	0.00E+00	3.34E-04	5.01E-04	1.35E-05
Eu-154	9.43E-04	1.23E-04	8.60E-05	0.00E+00	5.44E-04	9.12E-04	3.34E-05
Eu-155	2.00E-04	1.96E-05	1.21E-05	0.00E+00	7.65E-05	1.51E-03	5.97E-05
Eu-156	2.70E-06	2.03E-06	3.30E-07	0.00E+00	1.36E-06	1.37E-04	4.56E-05
Tb-160	3.04E-05	0.00E+00	3.79E-06	0.00E+00	1.20E-05	2.97E-04	2.60E-05
Ho-166m	4.40E-04	1.36E-04	9.87E-05	0.00E+00	2.00E-04	6.24E-04	1.68E-05
W-181	8.90E-09	2.88E-09	3.01E-10	0.00E+00	0.00E+00	2.95E-06	2.69E-07
W-185	2.78E-07	9.17E-08	9.73E-09	0.00E+00	0.00E+00	9.60E-05	1.14E-05
W-187	1.50E-09	1.22E-09	4.29E-10	0.00E+00	0.00E+00	5.92E-06	2.21E-05
Np-239	4.23E-08	3.99E-09	2.21E-09	0.00E+00	1.25E-08	8.11E-06	1.65E-05
U-232	7.31E-02	0.00E+00	5.23E-03	0.00E+00	7.94E-03	3.84E-01	4.46E-05
U-233	1.55E-02	0.00E+00	9.42E-04	0.00E+00	3.63E-03	9.18E-02	4.12E-05
U-234	1.48E-02	0.00E+00	9.23E-04	0.00E+00	3.55E-03	8.99E-02	4.04E-05
U-235	1.42E-02	0.00E+00	8.67E-04	0.00E+00	3.34E-03	8.44E-02	5.13E-05
U-236	1.42E-02	0.00E+00	8.86E-04	0.00E+00	3.41E-03	8.62E-02	3.79E-05
U-237	5.25E-08	0.00E+00	1.40E-08	0.00E+00	2.16E-07	1.76E-05	1.29E-05
U-238	1.36E-02	0.00E+00	8.10E-04	0.00E+00	3.12E-03	7.89E-02	3.62E-05
Np-237	1.64E+00	1.06E+00	7.21E-02	0.00E+00	5.35E-01	8.99E-02	5.22E-05
Np-238	4.23E-07	1.02E-07	6.59E-09	0.00E+00	3.88E-08	1.75E-05	2.38E-05
Pu-238	1.50E+00	1.03E+00	7.22E-02	0.00E+00	3.10E-01	3.12E-01	4.79E-05
Pu-239	1.73E+00	1.12E+00	8.05E-02	0.00E+00	3.44E-01	2.93E-01	4.37E-05
Pu-240	1.72E+00	1.12E+00	8.04E-02	0.00E+00	3.43E-01	2.93E-01	4.46E-05
Pu-241	3.74E-02	9.56E-03	1.40E-03	0.00E+00	6.47E-03	2.60E-04	9.17E-07
Pu-242	1.60E+00	1.08E+00	7.75E-02	0.00E+00	3.31E-01	2.82E-01	4.29E-05
Pu-244	1.87E+00	1.24E+00	8.88E-02	0.00E+00	3.79E-01	3.23E-01	6.39E-05
Am-241	1.77E+00	1.20E+00	7.10E-02	0.00E+00	5.32E-01	1.05E-01	4.88E-05
Am-242m	1.79E+00	1.13E+00	7.15E-02	0.00E+00	5.30E-01	4.21E-02	6.14E-05
Am-243	1.77E+00	1.17E+00	6.95E-02	0.00E+00	5.21E-01	9.91E-02	5.72E-05
Cm-242	3.17E-02	2.51E-02	1.41E-03	0.00E+00	6.40E-03	6.76E-02	5.21E-05
Cm-243	1.19E+00	8.30E-01	5.00E-02	0.00E+00	2.34E-01	1.09E-01	5.13E-05
Cm-244	9.19E-01	6.53E-01	3.88E-02	0.00E+00	1.81E-01	1.05E-01	4.96E-05
Cm-245	1.83E+00	1.22E+00	7.53E-02	0.00E+00	3.52E-01	1.01E-01	4.63E-05
Cm-246	1.81E+00	1.22E+00	7.52E-02	0.00E+00	3.51E-01	1.03E-01	4.54E-05
Cm-247	1.77E+00	1.19E+00	7.41E-02	0.00E+00	3.46E-01	1.01E-01	5.97E-05
Cm-248	1.47E+01	9.83E+00	6.11E-01	0.00E+00	2.85E+00	8.32E-01	9.63E-04
Cf-252	7.16E-01	0.00E+00	3.07E-02	0.00E+00	0.00E+00	3.43E-01	1.89E-04

Units of mrem per pCi inhaled
Source: NUREG/CR-1276 (Reference 105), Appendix C, DF Table 3

Table 1-10 (Page 1 of 3)
Inhalation Dose Factors for Child (DFA_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07
C-14	9.70E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06
Na-22	4.41E-05	4.41E-05	4.41E-05	4.41E-05	4.41E-05	4.41E-05	4.41E-05
Na-24	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06
P-32	7.04E-04	3.09E-05	2.67E-05	0.00E+00	0.00E+00	0.00E+00	1.14E-05
Ca-41	7.06E-05	0.00E+00	7.70E-06	0.00E+00	0.00E+00	7.21E-02	2.94E-07
Sc-46	1.97E-04	2.70E-04	1.04E-04	0.00E+00	2.39E-04	0.00E+00	2.45E-05
Cr-51	0.00E+00	0.00E+00	4.17E-08	2.31E-08	6.57E-09	4.59E-06	2.93E-07
Mn-54	0.00E+00	1.16E-05	2.57E-06	0.00E+00	2.71E-06	4.26E-04	6.19E-06
Fe-55	1.28E-05	6.80E-06	2.10E-06	0.00E+00	0.00E+00	3.00E-05	7.75E-07
Mn-56	0.00E+00	4.48E-10	8.43E-11	0.00E+00	4.52E-10	3.55E-06	3.33E-05
Co-57	0.00E+00	2.44E-07	2.88E-07	0.00E+00	0.00E+00	1.37E-04	3.58E-06
Co-58	0.00E+00	4.79E-07	8.55E-07	0.00E+00	0.00E+00	2.99E-04	9.29E-06
Fe-59	5.59E-06	9.04E-06	4.51E-06	0.00E+00	0.00E+00	3.43E-04	1.91E-05
Co-60	0.00E+00	3.55E-06	6.12E-06	0.00E+00	0.00E+00	1.91E-03	2.60E-05
Ni-59	1.66E-05	4.67E-06	2.83E-06	0.00E+00	0.00E+00	2.73E-05	6.29E-07
Ni-63	2.22E-04	1.25E-05	7.56E-06	0.00E+00	0.00E+00	7.43E-05	1.71E-06
Cu-64	0.00E+00	5.39E-10	2.90E-10	0.00E+00	1.63E-09	2.59E-06	9.92E-06
Ni-65	8.08E-10	7.99E-11	4.44E-11	0.00E+00	0.00E+00	2.21E-06	2.27E-05
Zn-65	1.15E-05	3.06E-05	1.90E-05	0.00E+00	1.93E-05	2.69E-04	4.41E-06
Zn-69m	4.26E-09	7.28E-09	8.59E-10	0.00E+00	4.22E-09	7.36E-06	2.71E-05
Zn-69	1.81E-11	2.61E-11	2.41E-12	0.00E+00	1.58E-11	3.84E-07	2.75E-06
Se-79	0.00E+00	1.23E-06	2.60E-07	0.00E+00	1.71E-06	1.49E-04	3.43E-06
Br-82	0.00E+00	0.00E+00	5.66E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	1.28E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	1.48E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	6.84E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	5.36E-05	3.09E-05	0.00E+00	0.00E+00	0.00E+00	2.16E-06
Rb-87	0.00E+00	3.16E-05	1.37E-05	0.00E+00	0.00E+00	0.00E+00	2.96E-07
Rb-88	0.00E+00	1.52E-07	9.90E-08	0.00E+00	0.00E+00	0.00E+00	4.66E-09
Rb-89	0.00E+00	9.33E-08	7.83E-08	0.00E+00	0.00E+00	0.00E+00	5.11E-10
Sr-89	1.62E-04	0.00E+00	4.66E-06	0.00E+00	0.00E+00	5.83E-04	4.52E-05
Sr-90	1.83E-02	0.00E+00	1.22E-03	0.00E+00	0.00E+00	3.99E-03	9.28E-05
Y-90	1.11E-06	0.00E+00	2.99E-08	0.00E+00	0.00E+00	7.07E-05	7.24E-05
Sr-91	3.28E-08	0.00E+00	1.24E-09	0.00E+00	0.00E+00	1.44E-05	4.70E-05
Y-91m	1.37E-10	0.00E+00	4.98E-12	0.00E+00	0.00E+00	7.60E-07	4.64E-07
Y-91	2.47E-04	0.00E+00	6.59E-06	0.00E+00	0.00E+00	7.10E-04	4.97E-05
Sr-92	3.54E-09	0.00E+00	1.42E-10	0.00E+00	0.00E+00	6.49E-06	6.55E-05
Y-92	5.50E-09	0.00E+00	1.57E-10	0.00E+00	0.00E+00	6.46E-06	6.46E-05
Y-93	5.04E-08	0.00E+00	1.38E-09	0.00E+00	0.00E+00	2.01E-05	1.05E-04
Nb-93m	1.27E-04	3.17E-05	1.04E-05	0.00E+00	3.44E-05	1.04E-04	2.45E-06
Nb-95	6.35E-06	2.48E-06	1.77E-06	0.00E+00	2.33E-06	1.66E-04	1.00E-05
Nb-97	1.16E-10	2.08E-11	9.74E-12	0.00E+00	2.31E-11	9.23E-07	7.52E-06
Zr-93	2.07E-04	7.80E-05	5.55E-05	0.00E+00	3.00E-04	7.10E-04	1.47E-05
Zr-95	5.13E-05	1.13E-05	1.00E-05	0.00E+00	1.61E-05	6.03E-04	1.65E-05
Zr-97	5.07E-08	7.34E-09	4.32E-09	0.00E+00	1.05E-08	3.06E-05	9.49E-05
Mo-93	0.00E+00	3.76E-06	1.35E-07	0.00E+00	1.06E-06	1.70E-04	3.78E-06
Mo-99	0.00E+00	4.66E-08	1.15E-08	0.00E+00	1.06E-07	3.66E-05	3.42E-05
Tc-99	1.34E-07	1.49E-07	5.35E-08	0.00E+00	1.75E-06	3.37E-04	7.75E-06
Tc-99m	4.81E-13	9.41E-13	1.56E-11	0.00E+00	1.37E-11	2.57E-07	1.30E-06
Tc-101	2.19E-14	2.30E-14	2.91E-13	0.00E+00	3.92E-13	1.58E-07	4.41E-09
Ru-103	7.55E-07	0.00E+00	2.90E-07	0.00E+00	1.90E-06	1.79E-04	1.21E-05
Ru-105	4.13E-10	0.00E+00	1.50E-10	0.00E+00	3.63E-10	4.30E-06	2.69E-05
Rh-105	3.91E-09	2.10E-09	1.79E-09	0.00E+00	8.39E-09	7.82E-06	1.33E-05
Ru-106	3.68E-05	0.00E+00	4.57E-06	0.00E+00	4.97E-05	3.87E-03	1.16E-04
Pd-107	0.00E+00	2.65E-07	2.51E-08	0.00E+00	1.97E-06	3.16E-05	7.26E-07

Table 1-10 (Page 2 of 3)
Inhalation Dose Factors for Child (DFA_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	1.48E-09	4.95E-10	0.00E+00	7.06E-09	6.16E-06	2.59E-05
Ag-110m	4.56E-06	3.08E-06	2.47E-06	0.00E+00	5.74E-06	1.48E-03	2.71E-05
Ag-111	1.81E-07	5.68E-08	3.75E-08	0.00E+00	1.71E-07	7.73E-05	2.98E-05
Cd-113m	0.00E+00	4.93E-04	2.12E-05	0.00E+00	5.13E-04	6.94E-04	1.63E-05
Cd-115m	0.00E+00	7.88E-05	3.39E-06	0.00E+00	5.93E-05	5.86E-04	4.97E-05
Sn-123	1.29E-04	2.14E-06	4.19E-06	2.27E-06	0.00E+00	9.59E-04	4.05E-05
Sn-125	4.95E-06	9.94E-08	2.95E-07	1.03E-07	0.00E+00	2.43E-04	7.17E-05
Sn-126	6.23E-04	1.04E-05	2.36E-05	2.84E-06	0.00E+00	3.02E-03	1.63E-05
Sb-124	1.55E-05	2.00E-07	5.41E-06	3.41E-08	0.00E+00	8.76E-04	4.43E-05
Sb-125	2.66E-05	2.05E-07	5.59E-06	2.46E-08	0.00E+00	6.27E-04	1.09E-05
Sb-126	1.72E-06	2.62E-08	6.16E-07	1.00E-08	0.00E+00	2.86E-04	5.67E-05
Sb-127	1.36E-07	2.09E-09	4.70E-08	1.51E-09	0.00E+00	6.17E-05	3.82E-05
Te-125m	1.82E-06	6.29E-07	2.47E-07	5.20E-07	0.00E+00	1.29E-04	9.13E-06
Te-127m	6.72E-06	2.31E-06	8.16E-07	1.64E-06	1.72E-05	4.00E-04	1.93E-05
Te-127	7.49E-10	2.57E-10	1.65E-10	5.30E-10	1.91E-09	2.71E-06	1.52E-05
Te-129m	5.19E-06	1.85E-06	8.22E-07	1.71E-06	1.36E-05	4.76E-04	4.91E-05
Te-129	2.64E-11	9.45E-12	6.44E-12	1.93E-11	6.94E-11	7.93E-07	6.89E-06
Te-133m	2.93E-11	1.51E-11	1.50E-11	2.32E-11	1.01E-10	1.60E-06	4.77E-06
Te-134	1.53E-11	8.81E-12	9.40E-12	1.24E-11	5.71E-11	1.23E-06	4.87E-07
I-129	1.05E-05	6.40E-06	5.71E-06	4.28E-03	1.08E-05	0.00E+00	2.15E-07
I-130	2.21E-06	4.43E-06	2.28E-06	4.99E-04	6.61E-06	0.00E+00	1.38E-06
I-131	1.30E-05	1.30E-05	7.37E-06	4.39E-03	2.13E-05	0.00E+00	7.68E-07
Te-131m	3.63E-08	1.60E-08	1.37E-08	2.64E-08	1.08E-07	5.56E-05	8.32E-05
Te-131	5.87E-12	2.28E-12	1.78E-12	4.59E-12	1.59E-11	5.55E-07	3.60E-07
I-132	5.72E-07	1.10E-06	5.07E-07	5.23E-05	1.69E-06	0.00E+00	8.65E-07
Te-132	1.30E-07	7.36E-08	7.12E-08	8.58E-08	4.79E-07	1.02E-04	3.72E-05
I-133	4.48E-06	5.49E-06	2.08E-06	1.04E-03	9.13E-06	0.00E+00	1.48E-06
Cs-134m	6.33E-08	8.92E-08	6.12E-08	0.00E+00	4.94E-08	8.35E-09	7.92E-08
Cs-134	1.76E-04	2.74E-04	6.07E-05	0.00E+00	8.93E-05	3.27E-05	1.04E-06
I-134	3.17E-07	5.84E-07	2.69E-07	1.37E-05	8.92E-07	0.00E+00	2.58E-07
I-135	1.33E-06	2.36E-06	1.12E-06	2.14E-04	3.62E-06	0.00E+00	1.20E-06
Cs-135	6.23E-05	4.13E-05	4.45E-06	0.00E+00	1.53E-05	5.22E-06	2.17E-07
Cs-136	1.76E-05	4.62E-05	3.14E-05	0.00E+00	2.58E-05	3.93E-06	1.13E-06
Cs-137	2.45E-04	2.23E-04	3.47E-05	0.00E+00	7.63E-05	2.81E-05	9.78E-07
Cs-138	1.71E-07	2.27E-07	1.50E-07	0.00E+00	1.68E-07	1.84E-08	7.29E-08
Cs-139	1.09E-07	1.15E-07	5.80E-08	0.00E+00	9.08E-08	9.36E-09	7.23E-12
Ba-139	4.98E-10	2.66E-13	1.45E-11	0.00E+00	2.33E-13	1.56E-06	1.56E-05
Ba-140	2.00E-05	1.75E-08	1.17E-06	0.00E+00	5.71E-09	4.71E-04	2.75E-05
La-140	1.74E-07	6.08E-08	2.04E-08	0.00E+00	0.00E+00	4.94E-05	6.10E-05
Ba-141	5.29E-11	2.95E-14	1.72E-12	0.00E+00	2.56E-14	7.89E-07	7.44E-08
La-141	2.28E-09	5.31E-10	1.15E-10	0.00E+00	0.00E+00	4.48E-06	4.37E-05
Ce-141	1.06E-05	5.28E-06	7.83E-07	0.00E+00	2.31E-06	1.47E-04	1.53E-05
Ba-142	1.35E-11	9.73E-15	7.54E-13	0.00E+00	7.87E-15	4.44E-07	7.41E-10
La-142	3.50E-10	1.11E-10	3.49E-11	0.00E+00	0.00E+00	2.35E-06	2.05E-05
Ce-143	9.89E-08	5.37E-08	7.77E-09	0.00E+00	2.26E-08	3.12E-05	3.44E-05
Pr-143	4.99E-06	1.50E-06	2.47E-07	0.00E+00	8.11E-07	1.17E-04	2.63E-05
Ce-144	1.83E-03	5.72E-04	9.77E-05	0.00E+00	3.17E-04	3.23E-03	1.05E-04
Pr-144	1.61E-11	4.99E-12	8.10E-13	0.00E+00	2.64E-12	4.23E-07	5.32E-08
Nd-147	2.92E-06	2.36E-06	1.84E-07	0.00E+00	1.30E-06	8.87E-05	2.22E-05
Pm-147	3.52E-04	2.52E-05	1.36E-05	0.00E+00	4.45E-05	2.20E-04	5.70E-06
Pm-148m	3.31E-05	6.55E-06	6.55E-06	0.00E+00	9.74E-06	5.72E-04	3.58E-05
Pm-148	1.61E-06	1.94E-07	1.25E-07	0.00E+00	3.30E-07	1.24E-04	6.01E-05
Pm-149	1.47E-07	1.56E-08	8.45E-09	0.00E+00	2.75E-08	2.40E-05	2.92E-05
Pm-151	3.57E-08	4.33E-09	2.82E-09	0.00E+00	7.35E-09	1.24E-05	2.50E-05
Sm-151	3.14E-04	4.75E-05	1.49E-05	0.00E+00	4.89E-05	1.48E-04	3.43E-06
Sm-153	7.24E-08	4.51E-08	4.35E-09	0.00E+00	1.37E-08	1.37E-05	1.87E-05

Table 1-10 (Page 3 of 3)
Inhalation Dose Factors for Child (DFA_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	7.42E-04	1.37E-04	1.61E-04	0.00E+00	5.73E-04	9.00E-04	1.14E-05
Eu-154	2.74E-03	2.49E-04	2.27E-04	0.00E+00	1.09E-03	1.66E-03	2.98E-05
Eu-155	5.60E-04	4.05E-05	3.18E-05	0.00E+00	1.51E-04	2.79E-04	5.39E-05
Eu-156	7.89E-06	4.23E-06	8.75E-07	0.00E+00	2.72E-06	2.54E-04	4.24E-05
Tb-160	7.79E-05	0.00E+00	9.67E-06	0.00E+00	2.32E-05	5.34E-04	2.28E-05
Ho-166m	1.34E-03	2.81E-04	2.37E-04	0.00E+00	4.01E-04	1.13E-03	1.63E-05
W-181	2.66E-08	6.52E-09	8.99E-10	0.00E+00	0.00E+00	5.71E-06	2.61E-07
W-185	8.31E-07	2.08E-07	2.91E-08	0.00E+00	0.00E+00	1.86E-04	1.11E-05
W-187	4.41E-09	2.61E-09	1.17E-09	0.00E+00	0.00E+00	1.11E-05	2.46E-05
Np-239	1.26E-07	9.04E-09	6.35E-09	0.00E+00	2.63E-08	1.57E-05	1.73E-05
U-232	2.19E-01	0.00E+00	1.56E-02	0.00E+00	1.67E-02	7.42E-01	4.33E-05
U-233	4.64E-02	0.00E+00	2.82E-03	0.00E+00	7.62E-03	1.77E-01	4.00E-05
U-234	4.46E-02	0.00E+00	2.76E-03	0.00E+00	7.47E-03	1.74E-01	3.92E-05
U-235	4.27E-02	0.00E+00	2.59E-03	0.00E+00	7.01E-03	1.63E-01	4.98E-05
U-236	4.27E-02	0.00E+00	2.65E-03	0.00E+00	7.16E-03	1.67E-01	3.67E-05
U-237	1.57E-07	0.00E+00	4.17E-08	0.00E+00	4.53E-07	3.40E-05	1.29E-05
U-238	4.09E-02	0.00E+00	2.42E-03	0.00E+00	6.55E-03	1.53E-01	3.51E-05
Np-237	2.72E+00	1.62E+00	1.19E-01	0.00E+00	7.41E-01	1.74E-01	5.06E-05
Np-238	1.26E-06	2.30E-07	1.97E-08	0.00E+00	8.16E-08	3.39E-05	2.50E-05
Pu-238	2.55E+00	1.60E+00	1.21E-01	0.00E+00	4.47E-01	6.08E-01	4.65E-05
Pu-239	2.79E+00	1.68E+00	1.28E-01	0.00E+00	4.78E-01	5.72E-01	4.24E-05
Pu-240	2.79E+00	1.68E+00	1.27E-01	0.00E+00	4.77E-01	5.71E-01	4.33E-05
Pu-241	7.94E-02	1.75E-02	2.93E-03	0.00E+00	1.10E-02	5.06E-04	8.90E-07
Pu-242	2.59E+00	1.62E+00	1.23E-01	0.00E+00	4.60E-01	5.50E-01	4.16E-05
Pu-244	3.02E+00	1.85E+00	1.41E-01	0.00E+00	5.27E-01	6.30E-01	6.20E-05
Am-241	2.97E+00	1.84E+00	1.24E-01	0.00E+00	7.63E-01	2.02E-01	4.73E-05
Am-242m	3.07E+00	1.76E+00	1.27E-01	0.00E+00	7.71E-01	8.14E-02	5.96E-05
Am-243	2.94E+00	1.78E+00	1.20E-01	0.00E+00	7.42E-01	1.92E-01	5.55E-05
Cm-242	9.48E-02	5.68E-02	4.20E-03	0.00E+00	1.34E-02	1.31E-01	5.06E-05
Cm-243	2.32E+00	1.42E+00	9.95E-02	0.00E+00	3.74E-01	2.10E-01	4.98E-05
Cm-244	1.94E+00	1.18E+00	8.31E-02	0.00E+00	3.06E-01	2.02E-01	4.82E-05
Cm-245	3.05E+00	1.84E+00	1.28E-01	0.00E+00	5.03E-01	1.95E-01	4.49E-05
Cm-246	3.02E+00	1.84E+00	1.28E-01	0.00E+00	5.03E-01	1.99E-01	4.41E-05
Cm-247	2.94E+00	1.82E+00	1.26E-01	0.00E+00	4.95E-01	1.95E-01	5.80E-05
Cm-248	2.45E+01	1.50E+01	1.04E+00	0.00E+00	4.08E+00	1.61E+00	9.35E-04
Cf-252	2.18E+00	0.00E+00	9.33E-02	0.00E+00	0.00E+00	6.62E-01	1.84E-04

Units of mrem per pCi inhaled
Source: NUREG/CR-1276 (Reference 105), Appendix C, DF Table 4

Table 1-11 (Page 1 of 3)
Inhalation Dose Factors for Infant (DFA_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07
C-14	1.89E-05	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06
Na-22	7.37E-05	7.37E-05	7.37E-05	7.37E-05	7.37E-05	7.37E-05	7.37E-05
Na-24	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06
P-32	1.45E-03	8.03E-05	5.53E-05	0.00E+00	0.00E+00	0.00E+00	1.15E-05
Ca-41	7.48E-05	0.00E+00	8.16E-06	0.00E+00	0.00E+00	6.94E-02	2.96E-07
Sc-46	3.75E-04	5.41E-04	1.69E-04	0.00E+00	3.56E-04	0.00E+00	2.19E-05
Cr-51	0.00E+00	0.00E+00	6.39E-08	4.11E-08	9.45E-09	9.17E-06	2.55E-07
Mn-54	0.00E+00	1.81E-05	3.56E-06	0.00E+00	3.56E-06	7.14E-04	5.04E-06
Fe-55	1.41E-05	8.39E-06	2.38E-06	0.00E+00	0.00E+00	6.21E-05	7.82E-07
Mn-56	0.00E+00	1.10E-09	1.58E-10	0.00E+00	7.86E-10	8.95E-06	5.12E-05
Co-57	0.00E+00	4.65E-07	4.58E-07	0.00E+00	0.00E+00	2.71E-04	3.47E-06
Co-58	0.00E+00	8.71E-07	1.30E-06	0.00E+00	0.00E+00	5.55E-04	7.95E-06
Fe-59	9.69E-06	1.68E-05	6.77E-06	0.00E+00	0.00E+00	7.25E-04	1.77E-05
Co-60	0.00E+00	5.73E-06	8.41E-06	0.00E+00	0.00E+00	3.22E-03	2.28E-05
Ni-59	1.81E-05	5.44E-06	3.10E-06	0.00E+00	0.00E+00	5.48E-05	6.34E-07
Ni-63	2.42E-04	1.46E-05	8.29E-06	0.00E+00	0.00E+00	1.49E-04	1.73E-06
Cu-64	0.00E+00	1.34E-09	5.53E-10	0.00E+00	2.84E-09	6.64E-06	1.07E-05
Ni-65	1.71E-09	2.03E-10	8.79E-11	0.00E+00	0.00E+00	5.80E-06	3.58E-05
Zn-65	1.38E-05	4.47E-05	2.22E-05	0.00E+00	2.32E-05	4.62E-04	3.67E-05
Zn-69m	8.98E-09	1.84E-08	1.67E-09	0.00E+00	7.45E-09	1.91E-05	2.92E-05
Zn-69	3.85E-11	6.91E-11	5.13E-12	0.00E+00	2.87E-11	1.05E-06	9.44E-06
Se-79	0.00E+00	2.25E-06	4.20E-07	0.00E+00	2.47E-06	2.99E-04	3.46E-06
Br-82	0.00E+00	0.00E+00	9.49E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	2.72E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	2.86E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	1.46E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.36E-04	6.30E-05	0.00E+00	0.00E+00	0.00E+00	2.17E-06
Rb-87	0.00E+00	8.88E-05	3.52E-05	0.00E+00	0.00E+00	0.00E+00	5.98E-07
Rb-88	0.00E+00	3.98E-07	2.05E-07	0.00E+00	0.00E+00	0.00E+00	2.42E-07
Rb-89	0.00E+00	2.29E-07	1.47E-07	0.00E+00	0.00E+00	0.00E+00	4.87E-08
Sr-89	2.84E-04	0.00E+00	8.15E-06	0.00E+00	0.00E+00	1.45E-03	4.57E-05
Sr-90	2.92E-02	0.00E+00	1.31E-03	0.00E+00	0.00E+00	8.03E-03	9.36E-05
Y-90	2.35E-06	0.00E+00	6.30E-08	0.00E+00	0.00E+00	1.92E-04	7.43E-05
Sr-91	6.83E-08	0.00E+00	2.47E-09	0.00E+00	0.00E+00	3.76E-05	5.24E-05
Y-91m	2.91E-10	0.00E+00	9.90E-12	0.00E+00	0.00E+00	1.99E-06	1.68E-06
Y-91	4.20E-04	0.00E+00	1.12E-05	0.00E+00	0.00E+00	1.75E-03	5.02E-05
Sr-92	7.50E-09	0.00E+00	2.79E-10	0.00E+00	0.00E+00	1.70E-05	1.00E-04
Y-92	1.17E-08	0.00E+00	3.29E-10	0.00E+00	0.00E+00	1.75E-05	9.04E-05
Y-93	1.07E-07	0.00E+00	2.91E-09	0.00E+00	0.00E+00	5.46E-05	1.19E-04
Nb-93m	1.38E-04	3.59E-05	1.15E-05	0.00E+00	3.68E-05	2.09E-04	2.47E-06
Nb-95	1.12E-05	4.59E-06	2.70E-06	0.00E+00	3.37E-06	3.42E-04	9.05E-06
Nb-97	2.44E-10	5.21E-11	1.88E-11	0.00E+00	4.07E-11	2.37E-06	1.92E-05
Zr-93	2.24E-04	9.51E-05	6.18E-05	0.00E+00	3.19E-04	1.37E-03	1.48E-05
Zr-95	8.24E-05	1.99E-05	1.45E-05	0.00E+00	2.22E-05	1.25E-03	1.55E-05
Zr-97	1.07E-07	1.83E-08	8.36E-09	0.00E+00	1.85E-08	7.88E-05	1.00E-04
Mo-93	0.00E+00	6.46E-06	2.22E-07	0.00E+00	1.54E-06	3.40E-04	3.76E-06
Mo-99	0.00E+00	1.18E-07	2.31E-08	0.00E+00	1.89E-07	9.63E-05	3.48E-05
Tc-99	2.09E-07	2.68E-07	8.85E-08	0.00E+00	2.49E-06	6.77E-04	7.82E-06
Tc-99m	9.98E-13	2.06E-12	2.66E-11	0.00E+00	2.22E-11	5.79E-07	1.45E-06
Tc-101	4.65E-14	5.88E-14	5.80E-13	0.00E+00	6.99E-13	4.17E-07	6.03E-07
Ru-103	1.44E-06	0.00E+00	4.85E-07	0.00E+00	3.03E-06	3.94E-04	1.15E-05
Ru-105	8.74E-10	0.00E+00	2.93E-10	0.00E+00	6.42E-10	1.12E-05	3.46E-05
Rh-105	8.26E-09	5.41E-09	3.63E-09	0.00E+00	1.50E-08	2.08E-05	1.37E-05
Ru-106	6.20E-05	0.00E+00	7.77E-06	0.00E+00	7.61E-05	8.26E-03	1.17E-04
Pd-107	0.00E+00	4.92E-07	4.11E-08	0.00E+00	2.75E-06	6.34E-05	7.33E-07

Table 1-11 (Page 2 of 3)
Inhalation Dose Factors for Infant (DFA_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	3.92E-09	1.05E-09	0.00E+00	1.28E-08	1.68E-05	2.85E-05
Ag-110m	7.13E-06	5.16E-06	3.57E-06	0.00E+00	7.80E-06	2.62E-03	2.36E-05
Ag-111	3.75E-07	1.45E-07	7.75E-08	0.00E+00	3.05E-07	2.06E-04	3.02E-05
Cd-113m	0.00E+00	6.67E-04	2.64E-05	0.00E+00	5.80E-04	1.40E-03	1.65E-05
Cd-115m	0.00E+00	1.73E-04	6.19E-06	0.00E+00	9.41E-05	1.47E-03	5.02E-05
Sn-123	2.09E-04	4.21E-06	7.28E-06	4.27E-06	0.00E+00	2.22E-03	4.08E-05
Sn-125	1.01E-05	2.51E-07	6.00E-07	2.47E-07	0.00E+00	6.43E-04	7.26E-05
Sn-126	8.30E-04	1.44E-05	3.52E-05	3.84E-06	0.00E+00	4.93E-03	1.65E-05
Sb-124	2.71E-05	3.97E-07	8.56E-06	7.18E-08	0.00E+00	1.89E-03	4.22E-05
Sb-125	3.69E-05	3.41E-07	7.78E-06	4.45E-08	0.00E+00	1.17E-03	1.05E-05
Sb-126	3.08E-06	6.01E-08	1.11E-06	2.35E-08	0.00E+00	6.88E-04	5.33E-05
Sb-127	2.82E-07	5.04E-09	8.76E-08	3.60E-09	0.00E+00	1.54E-04	3.78E-05
Te-125m	3.40E-06	1.42E-06	4.70E-07	1.16E-06	0.00E+00	3.19E-04	9.22E-06
Te-127m	1.19E-05	4.93E-06	1.48E-06	3.48E-06	2.68E-05	9.37E-04	1.95E-05
Te-127	1.59E-09	6.81E-10	3.49E-10	1.32E-09	3.47E-09	7.39E-06	1.74E-05
Te-129m	1.01E-05	4.35E-06	1.59E-06	3.91E-06	2.27E-05	1.20E-03	4.93E-05
Te-129	5.63E-11	2.48E-11	1.34E-11	4.82E-11	1.25E-10	2.14E-06	1.88E-05
Te-133m	6.13E-11	3.59E-11	2.74E-11	5.52E-11	1.72E-10	3.92E-06	1.59E-05
Te-134	3.18E-11	2.04E-11	1.68E-11	2.91E-11	9.59E-11	2.93E-06	2.53E-06
I-129	2.16E-05	1.59E-05	1.16E-05	1.04E-02	1.88E-05	0.00E+00	2.12E-07
I-130	4.54E-06	9.91E-06	3.98E-06	1.14E-03	1.09E-05	0.00E+00	1.42E-06
I-131	2.71E-05	3.17E-05	1.40E-05	1.06E-02	3.70E-05	0.00E+00	7.56E-07
Te-131m	7.62E-08	3.93E-08	2.59E-08	6.38E-08	1.89E-07	1.42E-04	8.51E-05
Te-131	1.24E-11	5.87E-12	3.57E-12	1.13E-11	2.85E-11	1.47E-06	5.87E-06
I-132	1.21E-06	2.53E-06	8.99E-07	1.21E-04	2.82E-06	0.00E+00	1.36E-06
Te-132	2.66E-07	1.69E-07	1.26E-07	1.99E-07	7.39E-07	2.43E-04	3.15E-05
I-133	9.46E-06	1.37E-05	4.00E-06	2.54E-03	1.60E-05	0.00E+00	1.54E-06
Cs-134m	1.32E-07	2.10E-07	1.11E-07	0.00E+00	8.50E-08	2.00E-08	1.16E-07
Cs-134	2.83E-04	5.02E-04	5.32E-05	0.00E+00	1.36E-04	5.69E-05	9.53E-07
I-134	6.58E-07	1.34E-06	4.75E-07	3.18E-05	1.49E-06	0.00E+00	9.21E-07
I-135	2.76E-06	5.43E-06	1.98E-06	4.97E-04	6.05E-06	0.00E+00	1.31E-06
Cs-135	1.00E-04	8.66E-05	4.73E-06	0.00E+00	2.58E-05	1.01E-05	2.18E-07
Cs-136	3.45E-05	9.61E-05	3.78E-05	0.00E+00	4.03E-05	8.40E-06	1.02E-06
Cs-137	3.92E-04	4.37E-04	3.25E-05	0.00E+00	1.23E-04	5.09E-05	9.53E-07
Cs-138	3.61E-07	5.58E-07	2.84E-07	0.00E+00	2.93E-07	4.67E-08	6.26E-07
Cs-139	2.32E-07	3.03E-07	1.22E-07	0.00E+00	1.65E-07	2.53E-08	1.33E-08
Ba-139	1.06E-09	7.03E-13	3.07E-11	0.00E+00	4.23E-13	4.25E-06	3.64E-05
Ba-140	4.00E-05	4.00E-08	2.07E-06	0.00E+00	9.59E-09	1.14E-03	2.74E-05
La-140	3.61E-07	1.43E-07	3.68E-08	0.00E+00	0.00E+00	1.20E-04	6.06E-05
Ba-141	1.12E-10	7.70E-14	3.55E-12	0.00E+00	4.64E-14	2.12E-06	3.39E-06
La-141	4.85E-09	1.40E-09	2.45E-10	0.00E+00	0.00E+00	1.22E-05	5.96E-05
Ce-141	1.98E-05	1.19E-05	1.42E-06	0.00E+00	3.75E-06	3.69E-04	1.54E-05
Ba-142	2.84E-11	2.36E-14	1.40E-12	0.00E+00	1.36E-14	1.11E-06	4.95E-07
La-142	7.36E-10	2.69E-10	6.46E-11	0.00E+00	0.00E+00	5.87E-06	4.25E-05
Ce-143	2.09E-07	1.38E-07	1.58E-08	0.00E+00	4.03E-08	8.30E-05	3.55E-05
Pr-143	1.00E-05	3.74E-06	4.99E-07	0.00E+00	1.41E-06	3.09E-04	2.66E-05
Ce-144	2.28E-03	8.65E-04	1.26E-04	0.00E+00	3.84E-04	7.03E-03	1.06E-04
Pr-144	3.42E-11	1.32E-11	1.72E-12	0.00E+00	4.80E-12	1.15E-06	3.06E-06
Nd-147	5.67E-06	5.81E-06	3.57E-07	0.00E+00	2.25E-06	2.30E-04	2.23E-05
Pm-147	3.91E-04	3.07E-05	1.56E-05	0.00E+00	4.93E-05	4.55E-04	5.75E-06
Pm-148m	5.00E-05	1.24E-05	9.94E-06	0.00E+00	1.45E-05	1.22E-03	3.37E-05
Pm-148	3.34E-06	4.82E-07	2.44E-07	0.00E+00	5.76E-07	3.20E-04	6.04E-05
Pm-149	3.10E-07	4.08E-08	1.78E-08	0.00E+00	4.96E-08	6.50E-05	3.01E-05
Pm-151	7.52E-08	1.10E-08	5.55E-09	0.00E+00	1.30E-08	3.25E-05	2.58E-05
Sm-151	3.38E-04	6.45E-05	1.63E-05	0.00E+00	5.24E-05	2.98E-04	3.46E-06
Sm-153	1.53E-07	1.18E-07	9.06E-09	0.00E+00	2.47E-08	3.70E-05	1.93E-05

Table 1-11 (Page 3 of 3)
Inhalation Dose Factors for Infant (DFA_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	7.83E-04	1.77E-04	1.72E-04	0.00E+00	5.94E-04	1.48E-03	9.88E-06
Eu-154	2.96E-03	3.46E-04	2.45E-04	0.00E+00	1.14E-03	3.05E-03	2.84E-05
Eu-155	5.97E-04	5.72E-05	3.46E-05	0.00E+00	1.58E-04	5.20E-04	5.19E-05
Eu-156	1.56E-05	9.59E-06	1.54E-06	0.00E+00	4.48E-06	6.12E-04	4.14E-05
Tb-160	1.12E-04	0.00E+00	1.40E-05	0.00E+00	3.20E-05	1.11E-03	2.14E-05
Ho-166m	1.45E-03	3.07E-04	2.51E-04	0.00E+00	4.22E-04	2.05E-03	1.65E-05
W-181	4.86E-08	1.46E-08	1.67E-09	0.00E+00	0.00E+00	1.33E-05	2.63E-07
W-185	1.57E-06	4.83E-07	5.58E-08	0.00E+00	0.00E+00	4.48E-04	1.12E-05
W-187	9.26E-09	6.44E-09	2.23E-09	0.00E+00	0.00E+00	2.83E-05	2.54E-05
Np-239	2.65E-07	2.37E-08	1.34E-08	0.00E+00	4.73E-08	4.25E-05	1.78E-05
U-232	2.57E-01	0.00E+00	2.13E-02	0.00E+00	2.40E-02	1.49E+00	4.36E-05
U-233	5.44E-02	0.00E+00	3.83E-03	0.00E+00	1.09E-02	3.56E-01	4.03E-05
U-234	5.22E-02	0.00E+00	3.75E-03	0.00E+00	1.07E-02	3.49E-01	3.95E-05
U-235	5.01E-02	0.00E+00	3.52E-03	0.00E+00	1.01E-02	3.28E-01	5.02E-05
U-236	5.01E-02	0.00E+00	3.60E-03	0.00E+00	1.03E-02	3.35E-01	3.71E-05
U-237	3.25E-07	0.00E+00	8.65E-08	0.00E+00	8.08E-07	9.13E-05	1.31E-05
U-238	4.79E-02	0.00E+00	3.29E-03	0.00E+00	9.40E-03	3.06E-01	3.54E-05
Np-237	2.88E+00	1.71E+00	1.26E-01	0.00E+00	7.69E-01	3.49E-01	5.10E-05
Np-238	2.67E-06	6.05E-07	4.16E-08	0.00E+00	1.47E-07	9.19E-05	2.58E-05
Pu-238	2.69E+00	1.68E+00	1.27E-01	0.00E+00	4.64E-01	9.03E-01	4.69E-05
Pu-239	2.93E+00	1.76E+00	1.34E-01	0.00E+00	4.95E-01	8.47E-01	4.28E-05
Pu-240	2.93E+00	1.75E+00	1.34E-01	0.00E+00	4.94E-01	8.47E-01	4.36E-05
Pu-241	8.43E-02	1.85E-02	3.11E-03	0.00E+00	1.15E-02	7.62E-04	8.97E-07
Pu-242	2.72E+00	1.69E+00	1.29E-01	0.00E+00	4.77E-01	8.15E-01	4.20E-05
Pu-244	3.17E+00	1.94E+00	1.48E-01	0.00E+00	5.46E-01	9.33E-01	6.26E-05
Am-241	3.15E+00	1.95E+00	1.31E-01	0.00E+00	7.94E-01	4.06E-01	4.78E-05
Am-242m	3.25E+00	1.86E+00	1.35E-01	0.00E+00	8.03E-01	1.64E-01	6.01E-05
Am-243	3.10E+00	1.88E+00	1.27E-01	0.00E+00	7.72E-01	3.85E-01	5.60E-05
Cm-242	1.28E-01	8.65E-02	5.70E-03	0.00E+00	1.69E-02	2.97E-01	5.10E-05
Cm-243	2.47E+00	1.52E+00	1.06E-01	0.00E+00	3.91E-01	4.24E-01	5.02E-05
Cm-244	2.07E+00	1.27E+00	8.89E-02	0.00E+00	3.21E-01	4.08E-01	4.86E-05
Cm-245	3.22E+00	1.96E+00	1.36E-01	0.00E+00	5.23E-01	3.92E-01	4.53E-05
Cm-246	3.20E+00	1.96E+00	1.36E-01	0.00E+00	5.23E-01	3.99E-01	4.45E-05
Cm-247	3.11E+00	1.93E+00	1.33E-01	0.00E+00	5.15E-01	3.92E-01	5.85E-05
Cm-248	2.58E+01	1.59E+01	1.10E+00	0.00E+00	4.24E+00	3.23E+00	9.43E-04
Cf-252	2.37E+00	0.00E+00	1.01E-01	0.00E+00	0.00E+00	1.37E+00	1.85E-04

Units of mrem per pCi inhaled
Source: NUREG/CR-1276 (Reference 105), Appendix C, DF Table 5

Table 1-12 (Page 1 of 3)
Ingestion Dose Factors for Adult (DFL_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	5.99E-08	5.99E-08	5.99E-08	5.99E-08	5.99E-08	5.99E-08
C-14	2.84E-06	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07
Na-22	1.74E-05	1.74E-05	1.74E-05	1.74E-05	1.74E-05	1.74E-05	1.74E-05
Na-24	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06
P-32	1.93E-04	1.20E-05	7.46E-06	0.00E+00	0.00E+00	0.00E+00	2.17E-05
Ca-41	1.85E-04	0.00E+00	2.00E-05	0.00E+00	0.00E+00	0.00E+00	1.84E-07
Sc-46	5.51E-09	1.07E-08	3.11E-09	0.00E+00	9.99E-09	0.00E+00	5.21E-05
Cr-51	0.00E+00	0.00E+00	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
Mn-54	0.00E+00	4.57E-06	8.72E-07	0.00E+00	1.36E-06	0.00E+00	1.40E-05
Fe-55	2.75E-06	1.90E-06	4.43E-07	0.00E+00	0.00E+00	1.06E-06	1.09E-06
Mn-56	0.00E+00	1.15E-07	2.04E-08	0.00E+00	1.46E-07	0.00E+00	3.67E-06
Co-57	0.00E+00	1.75E-07	2.91E-07	0.00E+00	0.00E+00	0.00E+00	4.44E-06
Co-58	0.00E+00	7.45E-07	1.67E-06	0.00E+00	0.00E+00	0.00E+00	1.51E-05
Fe-59	4.34E-06	1.02E-05	3.91E-06	0.00E+00	0.00E+00	2.85E-06	3.40E-05
Co-60	0.00E+00	2.14E-06	4.72E-06	0.00E+00	0.00E+00	0.00E+00	4.02E-05
Ni-59	9.76E-06	3.35E-06	1.63E-06	0.00E+00	0.00E+00	0.00E+00	6.90E-07
Ni-63	1.30E-04	9.01E-06	4.36E-06	0.00E+00	0.00E+00	0.00E+00	1.88E-06
Cu-64	0.00E+00	8.33E-08	3.91E-08	0.00E+00	2.10E-07	0.00E+00	7.10E-06
Ni-65	5.28E-07	6.86E-08	3.13E-08	0.00E+00	0.00E+00	0.00E+00	1.74E-06
Zn-65	4.84E-06	1.54E-05	6.96E-06	0.00E+00	1.03E-05	0.00E+00	9.70E-06
Zn-69m	1.70E-07	4.08E-07	3.73E-08	0.00E+00	2.47E-07	0.00E+00	2.49E-05
Zn-69	1.03E-08	1.97E-08	1.37E-09	0.00E+00	1.28E-08	0.00E+00	2.96E-09
Se-79	0.00E+00	2.63E-06	4.39E-07	0.00E+00	4.55E-06	0.00E+00	5.38E-07
Br-82	0.00E+00	0.00E+00	2.26E-06	0.00E+00	0.00E+00	0.00E+00	2.59E-06
Br-83	0.00E+00	0.00E+00	4.02E-08	0.00E+00	0.00E+00	0.00E+00	5.79E-08
Br-84	0.00E+00	0.00E+00	5.21E-08	0.00E+00	0.00E+00	0.00E+00	4.09E-13
Br-85	0.00E+00	0.00E+00	2.14E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	2.11E-05	9.83E-06	0.00E+00	0.00E+00	0.00E+00	4.16E-06
Rb-87	0.00E+00	1.23E-05	4.28E-06	0.00E+00	0.00E+00	0.00E+00	5.76E-07
Rb-88	0.00E+00	6.05E-08	3.21E-08	0.00E+00	0.00E+00	0.00E+00	8.36E-19
Rb-89	0.00E+00	4.01E-08	2.82E-08	0.00E+00	0.00E+00	0.00E+00	2.33E-21
Sr-89	3.08E-04	0.00E+00	8.84E-06	0.00E+00	0.00E+00	0.00E+00	4.94E-05
Sr-90	8.71E-03	0.00E+00	1.75E-04	0.00E+00	0.00E+00	0.00E+00	2.19E-04
Y-90	9.62E-09	0.00E+00	2.58E-10	0.00E+00	0.00E+00	0.00E+00	1.02E-04
Sr-91	5.67E-06	0.00E+00	2.29E-07	0.00E+00	0.00E+00	0.00E+00	2.70E-05
Y-91m	9.09E-11	0.00E+00	3.52E-12	0.00E+00	0.00E+00	0.00E+00	2.67E-10
Y-91	1.41E-07	0.00E+00	3.77E-09	0.00E+00	0.00E+00	0.00E+00	7.76E-05
Sr-92	2.15E-06	0.00E+00	9.30E-08	0.00E+00	0.00E+00	0.00E+00	4.26E-05
Y-92	8.45E-10	0.00E+00	2.47E-11	0.00E+00	0.00E+00	0.00E+00	1.48E-05
Y-93	2.68E-09	0.00E+00	7.40E-11	0.00E+00	0.00E+00	0.00E+00	8.50E-05
Nb-93m	2.55E-08	8.32E-09	2.05E-09	0.00E+00	9.57E-09	0.00E+00	3.84E-06
Nb-95	6.22E-09	3.46E-09	1.86E-09	0.00E+00	3.42E-09	0.00E+00	2.10E-05
Nb-97	5.22E-11	1.32E-11	4.82E-12	0.00E+00	1.54E-11	0.00E+00	4.87E-08
Zr-93	4.18E-08	2.34E-09	1.09E-09	0.00E+00	8.87E-09	0.00E+00	2.43E-06
Zr-95	3.04E-08	9.75E-09	6.60E-09	0.00E+00	1.53E-08	0.00E+00	3.09E-05
Zr-97	1.68E-09	3.39E-10	1.55E-10	0.00E+00	5.12E-10	0.00E+00	1.05E-04
Mo-93	0.00E+00	7.51E-06	2.03E-07	0.00E+00	2.13E-06	0.00E+00	1.22E-06
Mo-99	0.00E+00	4.31E-06	8.20E-07	0.00E+00	9.76E-06	0.00E+00	9.99E-06
Tc-99	1.25E-07	1.86E-07	5.02E-08	0.00E+00	2.34E-06	1.58E-08	6.08E-06
Tc-99m	2.47E-10	6.98E-10	8.89E-09	0.00E+00	1.06E-08	3.42E-10	4.13E-07
Tc-101	2.54E-10	3.66E-10	3.59E-09	0.00E+00	6.59E-09	1.87E-10	1.10E-21
Ru-103	1.85E-07	0.00E+00	7.97E-08	0.00E+00	7.06E-07	0.00E+00	2.16E-05
Ru-105	1.54E-08	0.00E+00	6.08E-09	0.00E+00	1.99E-07	0.00E+00	9.42E-06
Rh-105	1.21E-07	8.85E-08	5.83E-08	0.00E+00	3.76E-07	0.00E+00	1.41E-05
Ru-106	2.75E-06	0.00E+00	3.48E-07	0.00E+00	5.31E-06	0.00E+00	1.78E-04
Pd-107	0.00E+00	1.47E-07	9.40E-09	0.00E+00	1.32E-06	0.00E+00	9.11E-07

Table 1-12 (Page 2 of 3)
Ingestion Dose Factors for Adult (DFL_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	1.77E-07	3.99E-08	0.00E+00	1.01E-06	0.00E+00	1.96E-05
Ag-110m	1.60E-07	1.48E-07	8.79E-08	0.00E+00	2.91E-07	0.00E+00	6.04E-05
Ag-111	5.81E-08	2.43E-08	1.21E-08	0.00E+00	7.84E-08	0.00E+00	4.46E-05
Cd-113m	0.00E+00	3.18E-06	1.02E-07	0.00E+00	3.50E-06	0.00E+00	2.56E-05
Cd-115m	0.00E+00	1.84E-06	5.87E-08	0.00E+00	1.46E-06	0.00E+00	7.74E-05
Sn-123	3.11E-05	5.15E-07	7.59E-07	4.38E-07	0.00E+00	0.00E+00	6.33E-05
Sn-125	8.33E-06	1.68E-07	3.78E-07	1.39E-07	0.00E+00	0.00E+00	1.04E-04
Sn-126	8.45E-05	1.67E-06	2.40E-06	4.92E-07	0.00E+00	0.00E+00	2.43E-05
Sb-124	2.80E-06	5.29E-08	1.11E-06	6.79E-09	0.00E+00	2.18E-06	7.95E-05
Sb-125	1.79E-06	2.00E-08	4.26E-07	1.82E-09	0.00E+00	1.38E-06	1.97E-05
Sb-126	1.15E-06	2.34E-08	4.15E-07	7.04E-09	0.00E+00	7.05E-07	9.40E-05
Sb-127	2.58E-07	5.65E-09	9.90E-08	3.10E-09	0.00E+00	1.53E-07	5.90E-05
Te-125m	2.68E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	0.00E+00	1.07E-05
Te-127m	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	0.00E+00	2.27E-05
Te-127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	0.00E+00	8.68E-06
Te-129m	1.15E-05	4.29E-06	1.82E-06	3.95E-06	4.80E-05	0.00E+00	5.79E-05
Te-129	3.14E-08	1.18E-08	7.65E-09	2.41E-08	1.32E-07	0.00E+00	2.37E-08
Te-133m	4.62E-08	2.70E-08	2.60E-08	3.91E-08	2.67E-07	0.00E+00	9.26E-09
Te-134	3.24E-08	2.12E-08	1.30E-08	2.83E-08	2.05E-07	0.00E+00	3.59E-11
I-129	3.27E-06	2.81E-06	9.21E-06	7.23E-03	6.04E-06	0.00E+00	4.44E-07
I-130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	0.00E+00	1.92E-06
I-131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	0.00E+00	1.57E-06
Te-131m	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	0.00E+00	8.40E-05
Te-131	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	0.00E+00	2.79E-09
I-132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	0.00E+00	1.02E-07
Te-132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	0.00E+00	7.71E-05
I-133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	0.00E+00	2.22E-06
Cs-134m	2.13E-08	4.48E-08	2.29E-08	0.00E+00	2.43E-08	3.83E-09	1.58E-08
Cs-134	6.22E-05	1.48E-04	1.21E-04	0.00E+00	4.79E-05	1.59E-05	2.59E-06
I-134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	0.00E+00	2.51E-10
I-135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	0.00E+00	1.31E-06
Cs-135	1.95E-05	1.80E-05	7.99E-06	0.00E+00	6.81E-06	2.04E-06	4.21E-07
Cs-136	6.51E-06	2.57E-05	1.85E-05	0.00E+00	1.43E-05	1.96E-06	2.92E-06
Cs-137	7.97E-05	1.09E-04	7.14E-05	0.00E+00	3.70E-05	1.23E-05	2.11E-06
Cs-138	5.52E-08	1.09E-07	5.40E-08	0.00E+00	8.01E-08	7.91E-09	4.65E-13
Cs-139	3.41E-08	5.08E-08	1.85E-08	0.00E+00	4.07E-08	3.70E-09	1.10E-30
Ba-139	9.70E-08	6.91E-11	2.84E-09	0.00E+00	6.46E-11	3.92E-11	1.72E-07
Ba-140	2.03E-05	2.55E-08	1.33E-06	0.00E+00	8.67E-09	1.46E-08	4.18E-05
La-140	2.50E-09	1.26E-09	3.33E-10	0.00E+00	0.00E+00	0.00E+00	9.25E-05
Ba-141	4.71E-08	3.56E-11	1.59E-09	0.00E+00	3.31E-11	2.02E-11	2.22E-17
La-141	3.19E-10	9.90E-11	1.62E-11	0.00E+00	0.00E+00	0.00E+00	1.18E-05
Ce-141	9.36E-09	6.33E-09	7.18E-10	0.00E+00	2.94E-09	0.00E+00	2.42E-05
Ba-142	2.13E-08	2.19E-11	1.34E-09	0.00E+00	1.85E-11	1.24E-11	3.00E-26
La-142	1.28E-10	5.82E-11	1.45E-11	0.00E+00	0.00E+00	0.00E+00	4.25E-07
Ce-143	1.65E-09	1.22E-06	1.35E-10	0.00E+00	5.37E-10	0.00E+00	4.56E-05
Pr-143	9.20E-09	3.69E-09	4.56E-10	0.00E+00	2.13E-09	0.00E+00	4.03E-05
Ce-144	4.88E-07	2.04E-07	2.62E-08	0.00E+00	1.21E-07	0.00E+00	1.65E-04
Pr-144	3.01E-11	1.25E-11	1.53E-12	0.00E+00	7.05E-12	0.00E+00	4.33E-18
Nd-147	6.29E-09	7.27E-09	4.35E-10	0.00E+00	4.25E-09	0.00E+00	3.49E-05
Pm-147	7.54E-08	7.09E-09	2.87E-09	0.00E+00	1.34E-08	0.00E+00	8.93E-06
Pm-148m	3.07E-08	7.95E-09	6.08E-09	0.00E+00	1.20E-08	0.00E+00	6.74E-05
Pm-148	7.17E-09	1.19E-09	5.99E-10	0.00E+00	2.25E-09	0.00E+00	9.35E-05
Pm-149	1.52E-09	2.15E-10	8.78E-11	0.00E+00	4.06E-10	0.00E+00	4.03E-05
Pm-151	6.97E-10	1.17E-10	5.91E-11	0.00E+00	2.09E-10	0.00E+00	3.22E-05
Sm-151	6.90E-08	1.19E-08	2.85E-09	0.00E+00	1.33E-08	0.00E+00	5.25E-06
Sm-153	8.57E-10	7.15E-10	5.22E-11	0.00E+00	2.31E-10	0.00E+00	2.55E-05

Table 1-12 (Page 3 of 3)
Ingestion Dose Factors for Adult (DFL_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	1.95E-07	4.44E-08	3.90E-08	0.00E+00	2.75E-07	0.00E+00	2.56E-05
Eu-154	6.15E-07	7.56E-08	5.38E-08	0.00E+00	3.62E-07	0.00E+00	5.48E-05
Eu-155	8.60E-08	1.22E-08	7.87E-09	0.00E+00	5.63E-08	0.00E+00	9.60E-06
Eu-156	1.37E-08	1.06E-08	1.71E-09	0.00E+00	7.08E-09	0.00E+00	7.26E-05
Tb-160	4.70E-08	0.00E+00	5.86E-09	0.00E+00	1.94E-08	0.00E+00	4.33E-05
Ho-166m	2.70E-07	8.43E-08	6.40E-08	0.00E+00	1.26E-07	0.00E+00	2.56E-05
W-181	9.91E-09	3.23E-09	3.46E-10	0.00E+00	0.00E+00	0.00E+00	3.68E-07
W-185	4.05E-07	1.35E-07	1.42E-08	0.00E+00	0.00E+00	0.00E+00	1.56E-05
W-187	1.03E-07	8.61E-08	3.01E-08	0.00E+00	0.00E+00	0.00E+00	2.82E-05
Np-239	1.19E-09	1.17E-10	6.45E-11	0.00E+00	3.65E-10	0.00E+00	2.40E-05
U-232	4.13E-03	0.00E+00	2.95E-04	0.00E+00	4.47E-04	0.00E+00	6.78E-05
U-233	8.71E-04	0.00E+00	5.28E-05	0.00E+00	2.03E-04	0.00E+00	6.27E-05
U-234	8.36E-04	0.00E+00	5.17E-05	0.00E+00	1.99E-04	0.00E+00	6.14E-05
U-235	8.01E-04	0.00E+00	4.86E-05	0.00E+00	1.87E-04	0.00E+00	7.81E-05
U-236	8.01E-04	0.00E+00	4.96E-05	0.00E+00	1.91E-04	0.00E+00	5.76E-05
U-237	5.52E-08	0.00E+00	1.47E-08	0.00E+00	2.27E-07	0.00E+00	1.94E-05
U-238	7.67E-04	0.00E+00	4.54E-05	0.00E+00	1.75E-04	0.00E+00	5.50E-05
Np-237	1.26E-03	8.96E-05	5.54E-05	0.00E+00	4.12E-04	0.00E+00	7.94E-05
Np-238	1.37E-08	3.69E-10	2.13E-10	0.00E+00	1.25E-09	0.00E+00	3.43E-05
Pu-238	6.30E-04	7.98E-05	1.71E-05	0.00E+00	7.32E-05	0.00E+00	7.30E-05
Pu-239	7.25E-04	8.71E-05	1.91E-05	0.00E+00	8.11E-05	0.00E+00	6.66E-05
Pu-240	7.24E-04	8.70E-05	1.91E-05	0.00E+00	8.10E-05	0.00E+00	6.78E-05
Pu-241	1.57E-05	7.45E-07	3.32E-07	0.00E+00	1.53E-06	0.00E+00	1.40E-06
Pu-242	6.72E-04	8.39E-05	1.84E-05	0.00E+00	7.81E-05	0.00E+00	6.53E-05
Pu-244	7.84E-04	9.61E-05	2.11E-05	0.00E+00	8.95E-05	0.00E+00	9.73E-05
Am-241	7.55E-04	7.05E-04	5.41E-05	0.00E+00	4.07E-04	0.00E+00	7.42E-05
Am-242m	7.61E-04	6.63E-04	5.43E-05	0.00E+00	4.05E-04	0.00E+00	9.34E-05
Am-243	7.54E-04	6.90E-04	5.30E-05	0.00E+00	3.99E-04	0.00E+00	8.70E-05
Cm-242	2.06E-05	2.19E-05	1.37E-06	0.00E+00	6.22E-06	0.00E+00	7.92E-05
Cm-243	5.99E-04	5.49E-04	3.75E-05	0.00E+00	1.75E-04	0.00E+00	7.81E-05
Cm-244	4.56E-04	4.27E-04	2.87E-05	0.00E+00	1.34E-04	0.00E+00	7.55E-05
Cm-245	9.38E-04	8.17E-04	5.76E-05	0.00E+00	2.69E-04	0.00E+00	7.04E-05
Cm-246	9.30E-04	8.16E-04	5.75E-05	0.00E+00	2.68E-04	0.00E+00	6.91E-05
Cm-247	9.07E-04	8.04E-04	5.67E-05	0.00E+00	2.64E-04	0.00E+00	9.09E-05
Cm-248	7.54E-03	6.63E-03	4.67E-04	0.00E+00	2.18E-03	0.00E+00	1.47E-03
Cf-252	2.61E-04	0.00E+00	6.29E-06	0.00E+00	0.00E+00	0.00E+00	2.88E-04

Units of mrem per pCi ingested
Source: NUREG/CR-4013 (Reference 107), Table 3.8 when available and NUREG/CR-1276 (Reference 105), Appendix C, DF Table 6

Table 1-13 (Page 1 of 3)
Ingestion Dose Factors for Teenager (DFL_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	6.04E-08	6.04E-08	6.04E-08	6.04E-08	6.04E-08	6.04E-08
C-14	4.06E-06	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07
Na-22	2.34E-05	2.34E-05	2.34E-05	2.34E-05	2.34E-05	2.34E-05	2.34E-05
Na-24	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06
P-32	2.76E-04	1.71E-05	1.07E-05	0.00E+00	0.00E+00	0.00E+00	2.32E-05
Ca-41	1.97E-04	0.00E+00	2.13E-05	0.00E+00	0.00E+00	0.00E+00	1.95E-07
Sc-46	7.24E-09	1.41E-08	4.18E-09	0.00E+00	1.35E-08	0.00E+00	4.80E-05
Cr-51	0.00E+00	0.00E+00	3.60E-09	2.00E-09	7.89E-10	5.14E-09	6.05E-07
Mn-54	0.00E+00	5.90E-06	1.17E-06	0.00E+00	1.76E-06	0.00E+00	1.21E-05
Fe-55	3.78E-06	2.68E-06	6.25E-07	0.00E+00	0.00E+00	1.70E-06	1.16E-06
Mn-56	0.00E+00	1.58E-07	2.81E-08	0.00E+00	2.00E-07	0.00E+00	1.04E-05
Co-57	0.00E+00	2.38E-07	3.99E-07	0.00E+00	0.00E+00	0.00E+00	4.44E-06
Co-58	0.00E+00	9.72E-07	2.24E-06	0.00E+00	0.00E+00	0.00E+00	1.34E-05
Fe-59	5.87E-06	1.37E-05	5.29E-06	0.00E+00	0.00E+00	4.32E-06	3.24E-05
Co-60	0.00E+00	2.81E-06	6.33E-06	0.00E+00	0.00E+00	0.00E+00	3.66E-05
Ni-59	1.32E-05	4.66E-06	2.24E-06	0.00E+00	0.00E+00	0.00E+00	7.31E-07
Ni-63	1.77E-04	1.25E-05	6.00E-06	0.00E+00	0.00E+00	0.00E+00	1.99E-06
Cu-64	0.00E+00	1.15E-07	5.41E-08	0.00E+00	2.91E-07	0.00E+00	8.92E-06
Ni-65	7.49E-07	9.57E-08	4.36E-08	0.00E+00	0.00E+00	0.00E+00	5.19E-06
Zn-65	5.76E-06	2.00E-05	9.33E-06	0.00E+00	1.28E-05	0.00E+00	8.47E-06
Zn-69m	2.40E-07	5.66E-07	5.19E-08	0.00E+00	3.44E-07	0.00E+00	3.11E-05
Zn-69	1.47E-08	2.80E-08	1.96E-09	0.00E+00	1.83E-08	0.00E+00	5.16E-08
Se-79	0.00E+00	3.73E-06	6.27E-07	0.00E+00	6.50E-06	0.00E+00	5.70E-07
Br-82	0.00E+00	0.00E+00	3.04E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	5.74E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	7.22E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	3.05E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	2.98E-05	1.40E-05	0.00E+00	0.00E+00	0.00E+00	4.41E-06
Rb-87	0.00E+00	1.75E-05	6.11E-06	0.00E+00	0.00E+00	0.00E+00	6.11E-07
Rb-88	0.00E+00	8.52E-08	4.54E-08	0.00E+00	0.00E+00	0.00E+00	7.30E-15
Rb-89	0.00E+00	5.50E-08	3.89E-08	0.00E+00	0.00E+00	0.00E+00	8.43E-17
Sr-89	4.40E-04	0.00E+00	1.26E-05	0.00E+00	0.00E+00	0.00E+00	5.24E-05
Sr-90	1.02E-02	0.00E+00	2.04E-04	0.00E+00	0.00E+00	0.00E+00	2.33E-04
Y-90	1.37E-08	0.00E+00	3.69E-10	0.00E+00	0.00E+00	0.00E+00	1.13E-04
Sr-91	8.07E-06	0.00E+00	3.21E-07	0.00E+00	0.00E+00	0.00E+00	3.66E-05
Y-91m	1.29E-10	0.00E+00	4.93E-12	0.00E+00	0.00E+00	0.00E+00	6.09E-09
Y-91	2.01E-07	0.00E+00	5.39E-09	0.00E+00	0.00E+00	0.00E+00	8.24E-05
Sr-92	3.05E-06	0.00E+00	1.30E-07	0.00E+00	0.00E+00	0.00E+00	7.77E-05
Y-92	1.21E-09	0.00E+00	3.50E-11	0.00E+00	0.00E+00	0.00E+00	3.32E-05
Y-93	3.83E-09	0.00E+00	1.05E-10	0.00E+00	0.00E+00	0.00E+00	1.17E-04
Nb-93m	3.44E-08	1.13E-08	2.83E-09	0.00E+00	1.32E-08	0.00E+00	4.07E-06
Nb-95	8.22E-09	4.56E-09	2.51E-09	0.00E+00	4.42E-09	0.00E+00	1.95E-05
Nb-97	7.37E-11	1.83E-11	6.68E-12	0.00E+00	2.14E-11	0.00E+00	4.37E-07
Zr-93	5.53E-08	2.73E-08	1.49E-08	0.00E+00	9.65E-08	0.00E+00	2.58E-05
Zr-95	4.12E-08	1.30E-08	8.94E-09	0.00E+00	1.91E-08	0.00E+00	3.00E-05
Zr-97	2.37E-09	4.69E-10	2.16E-10	0.00E+00	7.11E-10	0.00E+00	1.27E-04
Mo-93	0.00E+00	1.06E-05	2.90E-07	0.00E+00	3.04E-06	0.00E+00	1.29E-06
Mo-99	0.00E+00	6.03E-06	1.15E-06	0.00E+00	1.38E-05	0.00E+00	1.08E-05
Tc-99	1.79E-07	2.63E-07	7.17E-08	0.00E+00	3.34E-06	2.72E-08	6.44E-06
Tc-99m	3.32E-10	9.26E-10	1.20E-08	0.00E+00	1.38E-08	5.14E-10	6.08E-07
Tc-101	3.60E-10	5.12E-10	5.03E-09	0.00E+00	9.26E-09	3.12E-10	8.75E-17
Ru-103	2.55E-07	0.00E+00	1.09E-07	0.00E+00	8.99E-07	0.00E+00	2.13E-05
Ru-105	2.18E-08	0.00E+00	8.46E-09	0.00E+00	2.75E-07	0.00E+00	1.76E-05
Rh-105	1.73E-07	1.25E-07	8.20E-08	0.00E+00	5.31E-07	0.00E+00	1.59E-05
Ru-106	3.92E-06	0.00E+00	4.94E-07	0.00E+00	7.56E-06	0.00E+00	1.88E-04
Pd-107	0.00E+00	2.08E-07	1.34E-08	0.00E+00	1.88E-06	0.00E+00	9.66E-07

Table 1-13 (Page 2 of 3)
Ingestion Dose Factors for Teenager (DFL_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	2.51E-07	5.70E-08	0.00E+00	1.45E-06	0.00E+00	2.53E-05
Ag-110m	2.05E-07	1.94E-07	1.18E-07	0.00E+00	3.70E-07	0.00E+00	5.45E-05
Ag-111	8.29E-08	3.44E-08	1.73E-08	0.00E+00	1.12E-07	0.00E+00	4.80E-05
Cd-113m	0.00E+00	4.51E-06	1.45E-07	0.00E+00	4.99E-06	0.00E+00	2.71E-05
Cd-115m	0.00E+00	2.60E-06	8.39E-08	0.00E+00	2.08E-06	0.00E+00	8.23E-05
Sn-123	4.44E-05	7.29E-07	1.08E-06	5.84E-07	0.00E+00	0.00E+00	6.71E-05
Sn-125	1.19E-05	2.37E-07	5.37E-07	1.86E-07	0.00E+00	0.00E+00	1.12E-04
Sn-126	1.16E-04	2.16E-06	3.30E-06	5.69E-07	0.00E+00	0.00E+00	2.58E-05
Sb-124	3.87E-06	7.13E-08	1.51E-06	8.78E-09	0.00E+00	3.38E-06	7.80E-05
Sb-125	2.48E-06	2.71E-08	5.80E-07	2.37E-09	0.00E+00	2.18E-06	1.93E-05
Sb-126	1.59E-06	3.25E-08	5.71E-07	8.99E-09	0.00E+00	1.14E-06	9.41E-05
Sb-127	3.63E-07	7.76E-09	1.37E-07	4.08E-09	0.00E+00	2.47E-07	6.16E-05
Te-125m	3.83E-06	1.38E-06	5.12E-07	1.07E-06	0.00E+00	0.00E+00	1.13E-05
Te-127m	9.67E-06	3.43E-06	1.15E-06	2.30E-06	3.92E-05	0.00E+00	2.41E-05
Te-127	1.58E-07	5.60E-08	3.40E-08	1.09E-07	6.40E-07	0.00E+00	1.22E-05
Te-129m	1.63E-05	6.05E-06	2.58E-06	5.26E-06	6.82E-05	0.00E+00	6.12E-05
Te-129	4.48E-08	1.67E-08	1.09E-08	3.20E-08	1.88E-07	0.00E+00	2.45E-07
Te-133m	6.44E-08	3.66E-08	3.56E-08	5.11E-08	3.62E-07	0.00E+00	1.48E-07
Te-134	4.47E-08	2.87E-08	3.00E-08	3.67E-08	2.74E-07	0.00E+00	1.66E-09
I-129	4.66E-06	3.92E-06	6.54E-06	4.77E-03	7.01E-06	0.00E+00	4.57E-07
I-130	1.03E-06	2.98E-06	1.19E-06	2.43E-04	4.59E-06	0.00E+00	2.29E-06
I-131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	0.00E+00	1.62E-06
Te-131m	2.44E-06	1.17E-06	9.76E-07	1.76E-06	1.22E-05	0.00E+00	9.39E-05
Te-131	2.79E-08	1.15E-08	8.72E-09	2.15E-08	1.22E-07	0.00E+00	2.29E-09
I-132	2.79E-07	7.30E-07	2.62E-07	2.46E-05	1.15E-06	0.00E+00	3.18E-07
Te-132	3.49E-06	2.21E-06	2.08E-06	2.33E-06	2.12E-05	0.00E+00	7.00E-05
I-133	2.01E-06	3.41E-06	1.04E-06	4.76E-04	5.98E-06	0.00E+00	2.58E-06
Cs-134m	2.94E-08	6.09E-08	3.13E-08	0.00E+00	3.39E-08	5.95E-09	4.05E-08
Cs-134	8.37E-05	1.97E-04	9.14E-05	0.00E+00	6.26E-05	2.39E-05	2.45E-06
I-134	1.46E-07	3.87E-07	1.39E-07	6.45E-06	6.10E-07	0.00E+00	5.10E-09
I-135	6.10E-07	1.57E-06	5.82E-07	1.01E-04	2.48E-06	0.00E+00	1.74E-06
Cs-135	2.78E-05	2.55E-05	5.96E-06	0.00E+00	9.73E-06	3.52E-06	4.46E-07
Cs-136	8.59E-06	3.38E-05	2.27E-05	0.00E+00	1.84E-05	2.90E-06	2.72E-06
Cs-137	1.12E-04	1.49E-04	5.19E-05	0.00E+00	5.07E-05	1.97E-05	2.12E-06
Cs-138	7.76E-08	1.49E-07	7.45E-08	0.00E+00	1.10E-07	1.28E-08	6.76E-11
Cs-139	4.87E-08	7.17E-08	2.63E-08	0.00E+00	5.79E-08	6.34E-09	3.33E-23
Ba-139	1.39E-07	9.78E-11	4.05E-09	0.00E+00	9.22E-11	6.74E-11	1.24E-06
Ba-140	2.84E-05	3.48E-08	1.83E-06	0.00E+00	1.18E-08	2.34E-08	4.38E-05
La-140	3.48E-09	1.71E-09	4.55E-10	0.00E+00	0.00E+00	0.00E+00	9.82E-05
Ba-141	6.71E-08	5.01E-11	2.24E-09	0.00E+00	4.65E-11	3.43E-11	1.43E-13
La-141	4.55E-10	1.40E-10	2.31E-11	0.00E+00	0.00E+00	0.00E+00	2.48E-05
Ce-141	1.33E-08	8.88E-09	1.02E-09	0.00E+00	4.18E-09	0.00E+00	2.54E-05
Ba-142	2.99E-08	2.99E-11	1.84E-09	0.00E+00	2.53E-11	1.99E-11	9.18E-20
La-142	1.79E-10	7.95E-11	1.98E-11	0.00E+00	0.00E+00	0.00E+00	2.42E-06
Ce-143	2.35E-09	1.71E-06	1.91E-10	0.00E+00	7.67E-10	0.00E+00	5.14E-05
Pr-143	1.31E-08	5.23E-09	6.52E-10	0.00E+00	3.04E-09	0.00E+00	4.31E-05
Ce-144	6.96E-07	2.88E-07	3.74E-08	0.00E+00	1.72E-07	0.00E+00	1.75E-04
Pr-144	4.30E-11	1.76E-11	2.18E-12	0.00E+00	1.01E-11	0.00E+00	4.74E-14
Nd-147	9.38E-09	1.02E-08	6.11E-10	0.00E+00	5.99E-09	0.00E+00	3.68E-05
Pm-147	1.05E-07	9.96E-09	4.06E-09	0.00E+00	1.90E-08	0.00E+00	9.47E-06
Pm-148m	4.14E-08	1.05E-08	8.21E-09	0.00E+00	1.59E-08	0.00E+00	6.61E-05
Pm-148	1.02E-08	1.66E-09	8.36E-10	0.00E+00	3.00E-09	0.00E+00	9.90E-05
Pm-149	2.17E-09	3.05E-10	1.25E-10	0.00E+00	5.81E-10	0.00E+00	4.49E-05
Pm-151	9.87E-10	1.63E-10	8.25E-11	0.00E+00	2.93E-10	0.00E+00	3.66E-05
Sm-151	8.73E-08	1.68E-08	3.94E-09	0.00E+00	1.84E-08	0.00E+00	5.70E-06
Sm-153	1.22E-09	1.01E-09	7.43E-11	0.00E+00	3.30E-10	0.00E+00	2.85E-05

Table 1-13 (Page 3 of 3)
Ingestion Dose Factors for Teenager (DFL_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	2.45E-07	5.90E-08	5.20E-08	0.00E+00	2.74E-07	0.00E+00	2.17E-05
Eu-154	7.91E-07	1.02E-07	7.19E-08	0.00E+00	4.56E-07	0.00E+00	5.39E-05
Eu-155	1.74E-07	1.68E-08	1.04E-08	0.00E+00	6.57E-08	0.00E+00	9.63E-05
Eu-156	1.92E-08	1.44E-08	2.35E-09	0.00E+00	9.69E-09	0.00E+00	7.36E-05
Tb-160	6.47E-08	0.00E+00	8.07E-09	0.00E+00	2.56E-08	0.00E+00	4.19E-05
Ho-166m	3.57E-07	1.10E-07	7.96E-08	0.00E+00	1.61E-07	0.00E+00	2.71E-05
W-181	1.42E-08	4.58E-09	4.79E-10	0.00E+00	0.00E+00	0.00E+00	3.90E-07
W-185	5.79E-07	1.91E-07	2.02E-08	0.00E+00	0.00E+00	0.00E+00	1.65E-05
W-187	1.46E-07	1.19E-07	4.17E-08	0.00E+00	0.00E+00	0.00E+00	3.22E-05
Np-239	1.76E-09	1.66E-10	9.22E-11	0.00E+00	5.21E-10	0.00E+00	2.67E-05
U-232	5.89E-03	0.00E+00	4.21E-04	0.00E+00	6.38E-04	0.00E+00	7.19E-05
U-233	1.24E-03	0.00E+00	7.54E-05	0.00E+00	2.90E-04	0.00E+00	6.65E-05
U-234	1.19E-03	0.00E+00	7.39E-05	0.00E+00	2.85E-04	0.00E+00	6.51E-05
U-235	1.14E-03	0.00E+00	6.94E-05	0.00E+00	2.67E-04	0.00E+00	8.28E-05
U-236	1.14E-03	0.00E+00	7.09E-05	0.00E+00	2.73E-04	0.00E+00	6.11E-05
U-237	7.89E-08	0.00E+00	2.10E-08	0.00E+00	3.24E-07	0.00E+00	2.09E-05
U-238	1.09E-03	0.00E+00	6.49E-05	0.00E+00	2.50E-04	0.00E+00	5.83E-05
Np-237	1.33E-03	9.55E-05	5.85E-05	0.00E+00	4.33E-04	0.00E+00	8.41E-05
Np-238	1.95E-08	5.22E-10	3.04E-10	0.00E+00	1.79E-09	0.00E+00	3.83E-05
Pu-238	6.70E-04	8.58E-05	1.82E-05	0.00E+00	7.80E-05	0.00E+00	7.73E-05
Pu-239	7.65E-04	9.29E-05	2.01E-05	0.00E+00	8.57E-05	0.00E+00	7.06E-05
Pu-240	7.64E-04	9.27E-05	2.01E-05	0.00E+00	8.56E-05	0.00E+00	7.19E-05
Pu-241	1.75E-05	8.40E-07	3.69E-07	0.00E+00	1.71E-06	0.00E+00	1.48E-06
Pu-242	7.09E-04	8.94E-05	1.94E-05	0.00E+00	8.25E-05	0.00E+00	6.92E-05
Pu-244	8.28E-04	1.02E-04	2.22E-05	0.00E+00	9.45E-05	0.00E+00	1.03E-04
Am-241	7.98E-04	7.53E-04	5.75E-05	0.00E+00	4.31E-04	0.00E+00	7.87E-05
Am-242m	8.07E-04	7.11E-04	5.80E-05	0.00E+00	4.30E-04	0.00E+00	9.90E-05
Am-243	7.96E-04	7.35E-04	5.62E-05	0.00E+00	4.22E-04	0.00E+00	9.23E-05
Cm-242	2.94E-05	3.10E-05	1.95E-06	0.00E+00	8.89E-06	0.00E+00	8.40E-05
Cm-243	6.50E-04	6.03E-04	4.09E-05	0.00E+00	1.91E-04	0.00E+00	8.28E-05
Cm-244	5.04E-04	4.77E-04	3.19E-05	0.00E+00	1.49E-04	0.00E+00	8.00E-05
Cm-245	9.90E-04	8.71E-04	6.10E-05	0.00E+00	2.85E-04	0.00E+00	7.46E-05
Cm-246	9.82E-04	8.70E-04	6.09E-05	0.00E+00	2.84E-04	0.00E+00	7.33E-05
Cm-247	9.57E-04	8.57E-04	6.00E-05	0.00E+00	2.80E-04	0.00E+00	9.63E-05
Cm-248	7.95E-03	7.06E-03	4.95E-04	0.00E+00	2.31E-03	0.00E+00	1.55E-03
Cf-252	3.47E-04	0.00E+00	8.37E-06	0.00E+00	0.00E+00	0.00E+00	3.05E-04

Units of mrem per pCi ingested
Source: NUREG/CR-4013 (Reference 107), Table 3.8 when available and NUREG/CR-1276 (Reference 105), Appendix C, DF Table 7

Table 1-14 (Page 1 of 3)
Ingestion Dose Factors for Child (DFL_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.16E-07	1.16E-07	1.16E-07	1.16E-07	1.16E-07	1.16E-07
C-14	1.21E-05	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06
Na-22	5.88E-05	5.88E-05	5.88E-05	5.88E-05	5.88E-05	5.88E-05	5.88E-05
Na-24	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06
P-32	8.25E-04	3.86E-05	3.18E-05	0.00E+00	0.00E+00	0.00E+00	2.28E-05
Ca-41	3.47E-04	0.00E+00	3.79E-05	0.00E+00	0.00E+00	0.00E+00	1.90E-07
Sc-46	1.97E-08	2.70E-08	1.04E-08	0.00E+00	2.39E-08	0.00E+00	3.95E-05
Cr-51	0.00E+00	0.00E+00	8.90E-09	4.94E-09	1.35E-09	9.02E-09	4.72E-07
Mn-54	0.00E+00	1.07E-05	2.85E-06	0.00E+00	3.00E-06	0.00E+00	8.98E-06
Fe-55	1.15E-05	6.10E-06	1.89E-06	0.00E+00	0.00E+00	3.45E-06	1.13E-06
Mn-56	0.00E+00	3.34E-07	7.54E-08	0.00E+00	4.04E-07	0.00E+00	4.84E-05
Co-57	0.00E+00	4.93E-07	9.98E-07	0.00E+00	0.00E+00	0.00E+00	4.04E-06
Co-58	0.00E+00	1.80E-06	5.51E-06	0.00E+00	0.00E+00	0.00E+00	1.05E-05
Fe-59	1.65E-05	2.67E-05	1.33E-05	0.00E+00	0.00E+00	7.74E-06	2.78E-05
Co-60	0.00E+00	5.29E-06	1.56E-05	0.00E+00	0.00E+00	0.00E+00	2.93E-05
Ni-59	4.02E-05	1.07E-05	6.82E-06	0.00E+00	0.00E+00	0.00E+00	7.10E-07
Ni-63	5.38E-04	2.88E-05	1.83E-05	0.00E+00	0.00E+00	0.00E+00	1.94E-06
Cu-64	0.00E+00	2.45E-07	1.48E-07	0.00E+00	5.92E-07	0.00E+00	1.15E-05
Ni-65	2.22E-06	2.09E-07	1.22E-07	0.00E+00	0.00E+00	0.00E+00	2.56E-05
Zn-65	1.37E-05	3.65E-05	2.27E-05	0.00E+00	2.30E-05	0.00E+00	6.41E-06
Zn-69m	7.10E-07	1.21E-06	1.43E-07	0.00E+00	7.03E-07	0.00E+00	3.94E-05
Zn-69	4.38E-08	6.33E-08	5.85E-09	0.00E+00	3.84E-08	0.00E+00	3.99E-06
Se-79	0.00E+00	8.43E-06	1.87E-06	0.00E+00	1.37E-05	0.00E+00	5.53E-07
Br-82	0.00E+00	0.00E+00	7.55E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	1.71E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	1.98E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	9.12E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	6.70E-05	4.12E-05	0.00E+00	0.00E+00	0.00E+00	4.31E-06
Rb-87	0.00E+00	3.95E-05	1.83E-05	0.00E+00	0.00E+00	0.00E+00	5.92E-07
Rb-88	0.00E+00	1.90E-07	1.32E-07	0.00E+00	0.00E+00	0.00E+00	9.32E-09
Rb-89	0.00E+00	1.17E-07	1.04E-07	0.00E+00	0.00E+00	0.00E+00	1.02E-09
Sr-89	1.32E-03	0.00E+00	3.77E-05	0.00E+00	0.00E+00	0.00E+00	5.11E-05
Sr-90	2.56E-02	0.00E+00	5.15E-04	0.00E+00	0.00E+00	0.00E+00	2.29E-04
Y-90	4.11E-08	0.00E+00	1.10E-09	0.00E+00	0.00E+00	0.00E+00	1.17E-04
Sr-91	2.40E-05	0.00E+00	9.06E-07	0.00E+00	0.00E+00	0.00E+00	5.30E-05
Y-91m	3.82E-10	0.00E+00	1.39E-11	0.00E+00	0.00E+00	0.00E+00	7.48E-07
Y-91	6.02E-07	0.00E+00	1.61E-08	0.00E+00	0.00E+00	0.00E+00	8.02E-05
Sr-92	9.03E-06	0.00E+00	3.62E-07	0.00E+00	0.00E+00	0.00E+00	1.71E-04
Y-92	3.60E-09	0.00E+00	1.03E-10	0.00E+00	0.00E+00	0.00E+00	1.04E-04
Y-93	1.14E-08	0.00E+00	3.13E-10	0.00E+00	0.00E+00	0.00E+00	1.70E-04
Nb-93m	1.05E-07	2.62E-08	8.61E-09	0.00E+00	2.83E-08	0.00E+00	3.95E-06
Nb-95	2.25E-08	8.76E-09	6.26E-09	0.00E+00	8.23E-09	0.00E+00	1.62E-05
Nb-97	2.17E-10	3.92E-11	1.83E-11	0.00E+00	4.35E-11	0.00E+00	1.21E-05
Zr-93	1.67E-07	6.25E-08	4.45E-08	0.00E+00	2.42E-07	0.00E+00	2.37E-05
Zr-95	1.16E-07	2.55E-08	2.27E-08	0.00E+00	3.65E-08	0.00E+00	2.66E-05
Zr-97	6.99E-09	1.01E-09	5.96E-10	0.00E+00	1.45E-09	0.00E+00	1.53E-04
Mo-93	0.00E+00	2.41E-05	8.65E-07	0.00E+00	6.35E-06	0.00E+00	1.22E-06
Mo-99	0.00E+00	1.33E-05	3.29E-06	0.00E+00	2.84E-05	0.00E+00	1.10E-05
Tc-99	5.35E-07	5.96E-07	2.14E-07	0.00E+00	7.02E-06	5.27E-08	6.25E-06
Tc-99m	9.23E-10	1.81E-09	3.00E-08	0.00E+00	2.63E-08	9.19E-10	1.03E-06
Tc-101	1.07E-09	1.12E-09	1.42E-08	0.00E+00	1.91E-08	5.92E-10	3.56E-09
Ru-103	7.31E-07	0.00E+00	2.81E-07	0.00E+00	1.84E-06	0.00E+00	1.89E-05
Ru-105	6.45E-08	0.00E+00	2.34E-08	0.00E+00	5.67E-07	0.00E+00	4.21E-05
Rh-105	5.14E-07	2.76E-07	2.36E-07	0.00E+00	1.10E-06	0.00E+00	1.71E-05
Ru-106	1.17E-05	0.00E+00	1.46E-06	0.00E+00	1.58E-05	0.00E+00	1.82E-04
Pd-107	0.00E+00	4.72E-07	4.01E-08	0.00E+00	3.95E-06	0.00E+00	9.37E-07

Table 1-14 (Page 2 of 3)
Ingestion Dose Factors for Child (DFL_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	5.67E-07	1.70E-07	0.00E+00	3.04E-06	0.00E+00	3.35E-05
Ag-110m	5.39E-07	3.64E-07	2.91E-07	0.00E+00	6.78E-07	0.00E+00	4.33E-05
Ag-111	2.48E-07	7.76E-08	5.12E-08	0.00E+00	2.34E-07	0.00E+00	4.75E-05
Cd-113m	0.00E+00	1.02E-05	4.34E-07	0.00E+00	1.05E-05	0.00E+00	2.63E-05
Cd-115m	0.00E+00	5.89E-06	2.51E-07	0.00E+00	4.38E-06	0.00E+00	8.01E-05
Sn-123	1.33E-04	1.65E-06	3.24E-06	1.75E-06	0.00E+00	0.00E+00	6.52E-05
Sn-125	3.55E-05	5.35E-07	1.59E-06	5.55E-07	0.00E+00	0.00E+00	1.10E-04
Sn-126	3.33E-04	4.15E-06	9.46E-06	1.14E-06	0.00E+00	0.00E+00	2.50E-05
Sb-124	1.11E-05	1.44E-07	3.89E-06	2.45E-08	0.00E+00	6.16E-06	6.94E-05
Sb-125	7.16E-06	5.52E-08	1.50E-06	6.63E-09	0.00E+00	3.99E-06	1.71E-05
Sb-126	4.40E-06	6.73E-08	1.58E-06	2.58E-08	0.00E+00	2.10E-06	8.87E-05
Sb-127	1.06E-06	1.64E-08	3.68E-07	1.18E-08	0.00E+00	4.60E-07	5.97E-05
Te-125m	1.14E-05	3.09E-06	1.52E-06	3.20E-06	0.00E+00	0.00E+00	1.10E-05
Te-127m	2.89E-05	7.78E-06	3.43E-06	6.91E-06	8.24E-05	0.00E+00	2.34E-05
Te-127	4.71E-07	1.27E-07	1.01E-07	3.26E-07	1.34E-06	0.00E+00	1.84E-05
Te-129m	4.87E-05	1.36E-05	7.56E-06	1.57E-05	1.43E-04	0.00E+00	5.94E-05
Te-129	1.34E-07	3.74E-08	3.18E-08	9.56E-08	3.92E-07	0.00E+00	8.34E-06
Te-133m	1.87E-07	7.56E-08	9.37E-08	1.45E-07	7.18E-07	0.00E+00	5.77E-06
Te-134	1.29E-07	5.80E-08	7.74E-08	1.02E-07	5.37E-07	0.00E+00	5.89E-07
I-129	1.39E-05	8.53E-06	7.62E-06	5.58E-03	1.44E-05	0.00E+00	4.29E-07
I-130	2.92E-06	5.90E-06	3.04E-06	6.50E-04	8.82E-06	0.00E+00	2.76E-06
I-131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	0.00E+00	1.54E-06
Te-131m	7.20E-06	2.49E-06	2.65E-06	5.12E-06	2.41E-05	0.00E+00	1.01E-04
Te-131	8.30E-08	2.53E-08	2.47E-08	6.35E-08	2.51E-07	0.00E+00	4.36E-07
I-132	8.00E-07	1.47E-06	6.76E-07	6.82E-05	2.25E-06	0.00E+00	1.73E-06
Te-132	1.01E-05	4.47E-06	5.40E-06	6.51E-06	4.15E-05	0.00E+00	4.50E-05
I-133	5.92E-06	7.32E-06	2.77E-06	1.36E-03	1.22E-05	0.00E+00	2.95E-06
Cs-134m	8.44E-08	1.25E-07	8.16E-08	0.00E+00	6.59E-08	1.09E-08	1.58E-07
Cs-134	2.34E-04	3.84E-04	8.10E-05	0.00E+00	1.19E-04	4.27E-05	2.07E-06
I-134	4.19E-07	7.78E-07	3.58E-07	1.79E-05	1.19E-06	0.00E+00	5.16E-07
I-135	1.75E-06	3.15E-06	1.49E-06	2.79E-04	4.83E-06	0.00E+00	2.40E-06
Cs-135	8.30E-05	5.78E-05	5.93E-06	0.00E+00	2.04E-05	6.81E-06	4.33E-07
Cs-136	2.35E-05	6.46E-05	4.18E-05	0.00E+00	3.44E-05	5.13E-06	2.27E-06
Cs-137	3.27E-04	3.13E-04	4.62E-05	0.00E+00	1.02E-04	3.67E-05	1.96E-06
Cs-138	2.28E-07	3.17E-07	2.01E-07	0.00E+00	2.23E-07	2.40E-08	1.46E-07
Cs-139	1.45E-07	1.61E-07	7.74E-08	0.00E+00	1.21E-07	1.22E-08	1.45E-11
Ba-139	4.14E-07	2.21E-10	1.20E-08	0.00E+00	1.93E-10	1.30E-10	2.39E-05
Ba-140	8.31E-05	7.28E-08	4.85E-06	0.00E+00	2.37E-08	4.34E-08	4.21E-05
La-140	1.01E-08	3.53E-09	1.19E-09	0.00E+00	0.00E+00	0.00E+00	9.84E-05
Ba-141	2.00E-07	1.12E-10	6.51E-09	0.00E+00	9.69E-11	6.58E-10	1.14E-07
La-141	1.36E-09	3.17E-10	6.88E-11	0.00E+00	0.00E+00	0.00E+00	7.05E-05
Ce-141	3.97E-08	1.98E-08	2.94E-09	0.00E+00	8.68E-09	0.00E+00	2.47E-05
Ba-142	8.74E-08	6.29E-11	4.88E-09	0.00E+00	5.09E-11	3.70E-11	1.14E-09
La-142	5.24E-10	1.67E-10	5.23E-11	0.00E+00	0.00E+00	0.00E+00	3.31E-05
Ce-143	6.99E-09	3.79E-06	5.49E-10	0.00E+00	1.59E-09	0.00E+00	5.55E-05
Pr-143	3.93E-08	1.18E-08	1.95E-09	0.00E+00	6.39E-09	0.00E+00	4.24E-05
Ce-144	2.08E-06	6.52E-07	1.11E-07	0.00E+00	3.61E-07	0.00E+00	1.70E-04
Pr-144	1.29E-10	3.99E-11	6.49E-12	0.00E+00	2.11E-11	0.00E+00	8.59E-08
Nd-147	2.79E-08	2.26E-08	1.75E-09	0.00E+00	1.24E-08	0.00E+00	3.58E-05
Pm-147	3.18E-07	2.27E-08	1.22E-08	0.00E+00	4.01E-08	0.00E+00	9.19E-06
Pm-148m	1.03E-07	2.05E-08	2.05E-08	0.00E+00	3.04E-08	0.00E+00	5.78E-05
Pm-148	3.02E-08	3.63E-09	2.35E-09	0.00E+00	6.17E-09	0.00E+00	9.70E-05
Pm-149	6.49E-09	6.90E-10	3.74E-10	0.00E+00	1.22E-09	0.00E+00	4.71E-05
Pm-151	2.92E-09	3.55E-10	2.31E-10	0.00E+00	6.02E-10	0.00E+00	4.03E-05
Sm-151	2.56E-07	3.81E-08	1.20E-08	0.00E+00	3.94E-08	0.00E+00	5.53E-06
Sm-153	3.65E-09	2.27E-09	2.19E-10	0.00E+00	6.91E-10	0.00E+00	3.02E-05

Table 1-14 (Page 3 of 3)
Ingestion Dose Factors for Child (DFL_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	6.15E-07	1.12E-07	1.33E-07	0.00E+00	4.73E-07	0.00E+00	1.84E-05
Eu-154	2.30E-06	2.07E-07	1.89E-07	0.00E+00	9.09E-07	0.00E+00	4.81E-05
Eu-155	4.82E-07	3.47E-08	2.72E-08	0.00E+00	1.30E-07	0.00E+00	8.69E-05
Eu-156	5.62E-08	3.01E-08	6.23E-09	0.00E+00	1.94E-08	0.00E+00	6.83E-05
Tb-160	1.66E-07	0.00E+00	2.06E-08	0.00E+00	4.94E-08	0.00E+00	3.68E-05
Ho-166m	1.08E-06	2.26E-07	1.91E-07	0.00E+00	3.22E-07	0.00E+00	2.63E-05
W-181	4.23E-08	1.04E-08	1.43E-09	0.00E+00	0.00E+00	0.00E+00	3.79E-07
W-185	1.73E-06	4.32E-07	6.05E-08	0.00E+00	0.00E+00	0.00E+00	1.61E-05
W-187	4.29E-07	2.54E-07	1.14E-07	0.00E+00	0.00E+00	0.00E+00	3.57E-05
Np-239	5.25E-09	3.77E-10	2.65E-10	0.00E+00	1.09E-09	0.00E+00	2.79E-05
U-232	1.76E-02	0.00E+00	1.26E-03	0.00E+00	1.34E-03	0.00E+00	6.98E-05
U-233	3.72E-03	0.00E+00	2.25E-04	0.00E+00	6.10E-04	0.00E+00	6.45E-05
U-234	3.57E-03	0.00E+00	2.21E-04	0.00E+00	5.98E-04	0.00E+00	6.32E-05
U-235	3.42E-03	0.00E+00	2.07E-04	0.00E+00	5.61E-04	0.00E+00	8.03E-05
U-236	3.42E-03	0.00E+00	2.12E-04	0.00E+00	5.73E-04	0.00E+00	5.92E-05
U-237	2.36E-07	0.00E+00	6.27E-08	0.00E+00	6.81E-07	0.00E+00	2.08E-05
U-238	3.27E-03	0.00E+00	1.94E-04	0.00E+00	5.24E-04	0.00E+00	5.66E-05
Np-237	2.23E-03	1.47E-04	9.79E-05	0.00E+00	6.05E-04	0.00E+00	8.16E-05
Np-238	5.83E-08	1.18E-09	9.08E-10	0.00E+00	3.76E-09	0.00E+00	4.04E-05
Pu-238	1.19E-03	1.38E-04	3.16E-05	0.00E+00	1.15E-04	0.00E+00	7.50E-05
Pu-239	1.29E-03	1.38E-04	3.31E-05	0.00E+00	1.22E-04	0.00E+00	6.85E-05
Pu-240	1.28E-03	1.43E-04	3.31E-05	0.00E+00	1.22E-04	0.00E+00	6.98E-05
Pu-241	3.87E-05	1.58E-06	8.04E-07	0.00E+00	2.96E-06	0.00E+00	1.44E-06
Pu-242	1.19E-03	1.38E-04	3.19E-05	0.00E+00	1.17E-04	0.00E+00	6.71E-05
Pu-244	1.39E-03	1.58E-03	3.65E-05	0.00E+00	1.35E-04	0.00E+00	1.00E-04
Am-241	1.36E-03	1.17E-03	1.02E-04	0.00E+00	6.23E-04	0.00E+00	7.64E-05
Am-242m	1.40E-03	1.12E-03	1.04E-04	0.00E+00	6.30E-04	0.00E+00	9.61E-05
Am-243	1.34E-03	1.13E-03	9.83E-05	0.00E+00	6.06E-04	0.00E+00	8.95E-05
Cm-242	8.78E-05	7.01E-05	5.84E-06	0.00E+00	1.87E-05	0.00E+00	8.16E-05
Cm-243	1.28E-03	1.04E-03	8.24E-05	0.00E+00	3.08E-04	0.00E+00	8.03E-05
Cm-244	1.08E-03	8.74E-04	6.93E-05	0.00E+00	2.54E-04	0.00E+00	7.77E-05
Cm-245	1.67E-03	1.34E-03	1.05E-04	0.00E+00	4.11E-04	0.00E+00	7.24E-05
Cm-246	1.65E-03	1.34E-03	1.05E-04	0.00E+00	4.10E-04	0.00E+00	7.11E-05
Cm-247	1.61E-03	1.32E-03	1.03E-04	0.00E+00	4.04E-04	0.00E+00	9.35E-05
Cm-248	1.34E-02	1.09E-02	8.52E-04	0.00E+00	3.33E-03	0.00E+00	1.51E-03
Cf-252	1.05E-03	0.00E+00	2.54E-05	0.00E+00	0.00E+00	0.00E+00	2.96E-04

Units of mrem per pCi ingested
Source: NUREG/CR-4013 (Reference 107), Table 3.8 when available and NUREG/CR-1276 (Reference 105), Appendix C, DF Table 8

Table 1-15 (Page 1 of 3)
Ingestion Dose Factors for Infant (DFL_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.76E-07	1.76E-07	1.76E-07	1.76E-07	1.76E-07	1.76E-07
C-14	2.37E-05	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06
Na-22	9.83E-05	9.83E-05	9.83E-05	9.83E-05	9.83E-05	9.83E-05	9.83E-05
Na-24	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05
P-32	1.70E-03	1.00E-04	6.59E-05	0.00E+00	0.00E+00	0.00E+00	2.30E-05
Ca-41	3.74E-04	0.00E+00	4.08E-05	0.00E+00	0.00E+00	0.00E+00	1.91E-07
Sc-46	3.75E-08	5.41E-08	1.69E-08	0.00E+00	3.56E-08	0.00E+00	3.53E-05
Cr-51	0.00E+00	0.00E+00	1.41E-08	9.20E-09	2.01E-09	1.79E-08	4.11E-07
Mn-54	0.00E+00	1.99E-05	4.51E-06	0.00E+00	4.41E-06	0.00E+00	7.31E-06
Fe-55	1.39E-05	8.98E-06	2.40E-06	0.00E+00	0.00E+00	4.39E-06	1.14E-06
Mn-56	0.00E+00	8.18E-07	1.41E-07	0.00E+00	7.03E-07	0.00E+00	7.43E-05
Co-57	0.00E+00	1.15E-06	1.87E-06	0.00E+00	0.00E+00	0.00E+00	3.92E-06
Co-58	0.00E+00	3.60E-06	8.98E-06	0.00E+00	0.00E+00	0.00E+00	8.97E-06
Fe-59	3.08E-05	5.38E-05	2.12E-05	0.00E+00	0.00E+00	1.59E-05	2.57E-05
Co-60	0.00E+00	1.08E-05	2.55E-05	0.00E+00	0.00E+00	0.00E+00	2.57E-05
Ni-59	4.73E-05	1.45E-05	8.17E-06	0.00E+00	0.00E+00	0.00E+00	7.16E-07
Ni-63	6.34E-04	3.92E-05	2.20E-05	0.00E+00	0.00E+00	0.00E+00	1.95E-06
Cu-64	0.00E+00	6.09E-07	2.82E-07	0.00E+00	1.03E-06	0.00E+00	1.25E-05
Ni-65	4.70E-06	5.32E-07	2.42E-07	0.00E+00	0.00E+00	0.00E+00	4.05E-05
Zn-65	1.84E-05	6.31E-05	2.91E-05	0.00E+00	3.06E-05	0.00E+00	5.33E-05
Zn-69m	1.50E-06	3.06E-06	2.79E-07	0.00E+00	1.24E-06	0.00E+00	4.24E-05
Zn-69	9.33E-08	1.68E-07	1.25E-08	0.00E+00	6.98E-08	0.00E+00	1.37E-05
Se-79	0.00E+00	2.10E-05	3.90E-06	0.00E+00	2.43E-05	0.00E+00	5.58E-07
Br-82	0.00E+00	0.00E+00	1.27E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	3.63E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	3.82E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	1.94E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.70E-04	8.40E-05	0.00E+00	0.00E+00	0.00E+00	4.35E-06
Rb-87	0.00E+00	8.88E-05	3.52E-05	0.00E+00	0.00E+00	0.00E+00	5.98E-07
Rb-88	0.00E+00	4.98E-07	2.73E-07	0.00E+00	0.00E+00	0.00E+00	4.85E-07
Rb-89	0.00E+00	2.86E-07	1.97E-07	0.00E+00	0.00E+00	0.00E+00	9.74E-08
Sr-89	2.51E-03	0.00E+00	7.20E-05	0.00E+00	0.00E+00	0.00E+00	5.16E-05
Sr-90	2.83E-02	0.00E+00	5.74E-04	0.00E+00	0.00E+00	0.00E+00	2.31E-04
Y-90	8.69E-08	0.00E+00	2.33E-09	0.00E+00	0.00E+00	0.00E+00	1.20E-04
Sr-91	5.00E-05	0.00E+00	1.81E-06	0.00E+00	0.00E+00	0.00E+00	5.92E-05
Y-91m	8.10E-10	0.00E+00	2.76E-11	0.00E+00	0.00E+00	0.00E+00	2.70E-06
Y-91	1.13E-06	0.00E+00	3.01E-08	0.00E+00	0.00E+00	0.00E+00	8.10E-05
Sr-92	1.92E-05	0.00E+00	7.13E-07	0.00E+00	0.00E+00	0.00E+00	2.07E-04
Y-92	7.65E-09	0.00E+00	2.15E-10	0.00E+00	0.00E+00	0.00E+00	1.46E-04
Y-93	2.43E-08	0.00E+00	6.62E-10	0.00E+00	0.00E+00	0.00E+00	1.92E-04
Nb-93m	1.23E-07	3.33E-08	1.04E-08	0.00E+00	3.25E-08	0.00E+00	3.98E-06
Nb-95	4.20E-08	1.73E-08	1.00E-08	0.00E+00	1.24E-08	0.00E+00	1.46E-05
Nb-97	4.59E-10	9.79E-11	3.53E-11	0.00E+00	7.65E-11	0.00E+00	3.09E-05
Zr-93	1.93E-07	9.18E-08	5.54E-08	0.00E+00	2.71E-07	0.00E+00	2.39E-05
Zr-95	2.06E-07	5.02E-08	3.56E-08	0.00E+00	5.41E-08	0.00E+00	2.50E-05
Zr-97	1.48E-08	2.54E-09	1.16E-09	0.00E+00	2.56E-09	0.00E+00	1.62E-04
Mo-93	0.00E+00	5.65E-05	1.82E-06	0.00E+00	1.13E-05	0.00E+00	1.21E-06
Mo-99	0.00E+00	3.40E-05	6.63E-06	0.00E+00	5.08E-05	0.00E+00	1.12E-05
Tc-99	1.08E-06	1.46E-06	4.55E-07	0.00E+00	1.23E-05	1.42E-07	6.31E-06
Tc-99m	1.92E-09	3.96E-09	5.10E-08	0.00E+00	4.26E-08	2.07E-09	1.15E-06
Tc-101	2.27E-09	2.86E-09	2.83E-08	0.00E+00	3.40E-08	1.56E-09	4.86E-07
Ru-103	1.48E-06	0.00E+00	4.95E-07	0.00E+00	3.08E-06	0.00E+00	1.80E-05
Ru-105	1.36E-07	0.00E+00	4.58E-08	0.00E+00	1.00E-06	0.00E+00	5.41E-05
Rh-105	1.09E-06	7.13E-07	4.79E-07	0.00E+00	1.98E-06	0.00E+00	1.77E-05
Ru-106	2.41E-05	0.00E+00	3.01E-06	0.00E+00	2.85E-05	0.00E+00	1.83E-04
Pd-107	0.00E+00	1.19E-06	8.45E-08	0.00E+00	6.79E-06	0.00E+00	9.46E-07

Table 1-15 (Page 2 of 3)
Ingestion Dose Factors for Infant (DFL_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	1.50E-06	3.62E-07	0.00E+00	5.51E-06	0.00E+00	3.68E-05
Ag-110m	9.96E-07	7.27E-07	4.81E-07	0.00E+00	1.04E-06	0.00E+00	3.77E-05
Ag-111	5.20E-07	2.02E-07	1.07E-07	0.00E+00	4.22E-07	0.00E+00	4.82E-05
Cd-113m	0.00E+00	1.77E-05	6.52E-07	0.00E+00	1.34E-05	0.00E+00	2.66E-05
Cd-115m	0.00E+00	1.42E-05	4.93E-07	0.00E+00	7.41E-06	0.00E+00	8.09E-05
Sn-123	2.49E-04	3.89E-06	6.50E-06	3.91E-06	0.00E+00	0.00E+00	6.58E-05
Sn-125	7.41E-05	1.38E-06	3.29E-06	1.36E-06	0.00E+00	0.00E+00	1.11E-04
Sn-126	5.53E-04	7.26E-06	1.80E-05	1.91E-06	0.00E+00	0.00E+00	2.52E-05
Sb-124	2.14E-05	3.15E-07	6.63E-06	5.68E-08	0.00E+00	1.34E-05	6.60E-05
Sb-125	1.23E-05	1.19E-07	2.53E-06	1.54E-08	0.00E+00	7.12E-06	1.64E-05
Sb-126	8.06E-06	1.58E-07	2.91E-06	6.19E-08	0.00E+00	5.07E-06	8.35E-05
Sb-127	2.23E-06	3.98E-08	6.90E-07	2.84E-08	0.00E+00	1.15E-06	5.91E-05
Te-125m	2.33E-05	7.79E-06	3.15E-06	7.84E-06	0.00E+00	0.00E+00	1.11E-05
Te-127m	5.85E-05	1.94E-05	7.08E-06	1.69E-05	1.44E-04	0.00E+00	2.36E-05
Te-127	1.00E-06	3.35E-07	2.15E-07	8.14E-07	2.44E-06	0.00E+00	2.10E-05
Te-129m	1.00E-04	3.43E-05	1.54E-05	3.84E-05	2.50E-04	0.00E+00	5.97E-05
Te-129	2.84E-07	9.79E-08	6.63E-08	2.38E-07	7.07E-07	0.00E+00	2.27E-05
Te-133m	3.91E-07	1.79E-07	1.71E-07	3.45E-07	1.22E-06	0.00E+00	1.93E-05
Te-134	2.67E-07	1.34E-07	1.38E-07	2.39E-07	9.03E-07	0.00E+00	3.06E-06
I-129	2.86E-05	2.12E-05	1.55E-05	1.36E-02	2.51E-05	0.00E+00	4.24E-07
I-130	6.00E-06	1.32E-05	5.30E-06	1.48E-03	1.45E-05	0.00E+00	2.83E-06
I-131	3.59E-05	4.23E-05	1.86E-05	1.39E-02	4.94E-05	0.00E+00	1.51E-06
Te-131m	1.52E-05	6.12E-06	5.05E-06	1.24E-05	4.21E-05	0.00E+00	1.03E-04
Te-131	1.76E-07	6.50E-08	4.94E-08	1.57E-07	4.50E-07	0.00E+00	7.11E-06
I-132	1.66E-06	3.37E-06	1.20E-06	1.58E-04	3.76E-06	0.00E+00	2.73E-06
Te-132	2.08E-05	1.03E-05	9.61E-06	1.52E-05	6.44E-05	0.00E+00	3.81E-05
I-133	1.25E-05	1.82E-05	5.33E-06	3.31E-03	2.14E-05	0.00E+00	3.08E-06
Cs-134m	1.76E-07	2.93E-07	1.48E-07	0.00E+00	1.13E-07	2.60E-08	2.32E-07
Cs-134	3.77E-04	7.03E-04	7.10E-05	0.00E+00	1.81E-04	7.42E-05	1.91E-06
I-134	8.69E-07	1.78E-06	6.33E-07	4.15E-05	1.99E-06	0.00E+00	1.84E-06
I-135	3.64E-06	7.24E-06	2.64E-06	6.49E-04	8.07E-06	0.00E+00	2.62E-06
Cs-135	1.33E-04	1.21E-04	6.30E-06	0.00E+00	3.44E-05	1.31E-05	4.37E-07
Cs-136	4.59E-05	1.35E-04	5.04E-05	0.00E+00	5.38E-05	1.10E-05	2.05E-06
Cs-137	5.22E-04	6.11E-04	4.33E-05	0.00E+00	1.64E-04	6.64E-05	1.91E-06
Cs-138	4.81E-07	7.82E-07	3.79E-07	0.00E+00	3.90E-07	6.09E-08	1.25E-06
Cs-139	3.10E-07	4.24E-07	1.62E-07	0.00E+00	2.19E-07	3.30E-08	2.66E-08
Ba-139	8.81E-07	5.84E-10	2.55E-08	0.00E+00	3.51E-10	3.54E-10	5.58E-05
Ba-140	1.71E-04	1.71E-07	8.81E-06	0.00E+00	4.06E-08	1.05E-07	4.20E-05
La-140	2.11E-08	8.32E-09	2.14E-09	0.00E+00	0.00E+00	0.00E+00	9.77E-05
Ba-141	4.25E-07	2.91E-10	1.34E-08	0.00E+00	1.75E-10	1.77E-10	5.19E-06
La-141	2.89E-09	8.38E-10	1.46E-10	0.00E+00	0.00E+00	0.00E+00	9.61E-05
Ce-141	7.87E-08	4.80E-08	5.65E-09	0.00E+00	1.48E-08	0.00E+00	2.48E-05
Ba-142	1.84E-07	1.53E-10	9.06E-09	0.00E+00	8.81E-11	9.26E-11	7.59E-07
La-142	1.10E-09	4.04E-10	9.67E-11	0.00E+00	0.00E+00	0.00E+00	6.86E-05
Ce-143	1.48E-08	9.82E-06	1.12E-09	0.00E+00	2.86E-09	0.00E+00	5.73E-05
Pr-143	8.13E-08	3.04E-08	4.03E-09	0.00E+00	1.13E-08	0.00E+00	4.29E-05
Ce-144	2.98E-06	1.22E-06	1.67E-07	0.00E+00	4.93E-07	0.00E+00	1.71E-04
Pr-144	2.74E-10	1.06E-10	1.38E-11	0.00E+00	3.84E-11	0.00E+00	4.93E-06
Nd-147	5.53E-08	5.68E-08	3.48E-09	0.00E+00	2.19E-08	0.00E+00	3.60E-05
Pm-147	3.88E-07	3.27E-08	1.59E-08	0.00E+00	4.88E-08	0.00E+00	9.27E-06
Pm-148m	1.65E-07	4.18E-08	3.28E-08	0.00E+00	4.80E-08	0.00E+00	5.44E-05
Pm-148	6.32E-08	9.13E-09	4.60E-09	0.00E+00	1.09E-08	0.00E+00	9.74E-05
Pm-149	1.38E-08	1.81E-09	7.90E-10	0.00E+00	2.20E-09	0.00E+00	4.86E-05
Pm-151	6.18E-09	9.01E-10	4.56E-10	0.00E+00	1.07E-09	0.00E+00	4.17E-05
Sm-151	2.90E-07	6.67E-08	1.44E-08	0.00E+00	4.53E-08	0.00E+00	5.58E-06
Sm-153	7.72E-09	5.97E-09	4.58E-10	0.00E+00	1.25E-09	0.00E+00	3.12E-05

Table 1-15 (Page 3 of 3)
Ingestion Dose Factors for Infant (DFL_i)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	6.74E-07	1.79E-07	1.51E-07	0.00E+00	5.02E-07	0.00E+00	1.59E-05
Eu-154	2.64E-06	3.67E-07	2.20E-07	0.00E+00	9.95E-07	0.00E+00	4.58E-05
Eu-155	5.42E-07	6.25E-08	3.23E-08	0.00E+00	1.40E-07	0.00E+00	8.37E-05
Eu-156	1.14E-07	7.06E-08	1.12E-08	0.00E+00	3.26E-08	0.00E+00	6.67E-05
Tb-160	2.59E-07	0.00E+00	3.24E-08	0.00E+00	7.37E-08	0.00E+00	3.45E-05
Ho-166m	1.25E-06	2.69E-07	2.13E-07	0.00E+00	3.57E-07	0.00E+00	2.66E-05
W-181	8.85E-08	2.72E-08	3.04E-09	0.00E+00	0.00E+00	0.00E+00	3.82E-07
W-185	3.62E-06	1.13E-06	1.29E-07	0.00E+00	0.00E+00	0.00E+00	1.62E-05
W-187	9.03E-07	6.28E-07	2.17E-07	0.00E+00	0.00E+00	0.00E+00	3.69E-05
Np-239	1.11E-08	9.93E-10	5.61E-10	0.00E+00	1.98E-09	0.00E+00	2.87E-05
U-232	2.42E-02	0.00E+00	2.16E-03	0.00E+00	2.37E-03	0.00E+00	7.04E-05
U-233	5.08E-03	0.00E+00	3.87E-04	0.00E+00	1.08E-03	0.00E+00	6.51E-05
U-234	4.88E-03	0.00E+00	3.80E-04	0.00E+00	1.06E-03	0.00E+00	6.37E-05
U-235	4.67E-03	0.00E+00	3.56E-04	0.00E+00	9.93E-04	0.00E+00	8.10E-05
U-236	4.67E-03	0.00E+00	3.64E-04	0.00E+00	1.01E-03	0.00E+00	5.98E-05
U-237	4.95E-07	0.00E+00	1.32E-07	0.00E+00	1.23E-06	0.00E+00	2.11E-05
U-238	4.47E-03	0.00E+00	3.33E-04	0.00E+00	9.28E-04	0.00E+00	5.71E-05
Np-237	2.40E-03	1.59E-04	1.05E-04	0.00E+00	6.34E-04	0.00E+00	8.23E-05
Np-238	1.24E-07	3.12E-09	1.92E-09	0.00E+00	6.81E-09	0.00E+00	4.17E-05
Pu-238	1.28E-03	1.50E-04	3.40E-05	0.00E+00	1.21E-04	0.00E+00	7.57E-05
Pu-239	1.38E-03	1.55E-04	3.54E-05	0.00E+00	1.28E-04	0.00E+00	6.91E-05
Pu-240	1.38E-03	1.55E-04	3.54E-05	0.00E+00	1.28E-04	0.00E+00	7.04E-05
Pu-241	4.25E-05	1.76E-06	8.82E-07	0.00E+00	3.17E-06	0.00E+00	1.45E-06
Pu-242	1.28E-03	1.49E-04	3.41E-05	0.00E+00	1.23E-04	0.00E+00	6.77E-05
Pu-244	1.49E-03	1.71E-04	3.91E-05	0.00E+00	1.41E-04	0.00E+00	1.01E-04
Am-241	1.46E-03	1.27E-03	1.09E-04	0.00E+00	6.55E-04	0.00E+00	7.70E-05
Am-242m	1.51E-03	1.22E-03	1.13E-04	0.00E+00	6.64E-04	0.00E+00	9.69E-05
Am-243	1.44E-03	1.23E-03	1.06E-04	0.00E+00	6.36E-04	0.00E+00	9.03E-05
Cm-242	1.37E-04	1.27E-04	9.10E-06	0.00E+00	2.62E-05	0.00E+00	8.23E-05
Cm-243	1.40E-03	1.15E-03	8.98E-05	0.00E+00	3.27E-04	0.00E+00	8.10E-05
Cm-244	1.18E-03	9.70E-04	7.59E-05	0.00E+00	2.71E-04	0.00E+00	7.84E-05
Cm-245	1.79E-03	1.45E-03	1.13E-04	0.00E+00	4.32E-04	0.00E+00	7.30E-05
Cm-246	1.77E-03	1.45E-03	1.13E-04	0.00E+00	4.31E-04	0.00E+00	7.17E-05
Cm-247	1.73E-03	1.43E-03	1.11E-04	0.00E+00	4.24E-04	0.00E+00	9.43E-05
Cm-248	1.43E-02	1.18E-02	9.16E-04	0.00E+00	3.50E-03	0.00E+00	1.52E-03
Cf-252	1.22E-03	0.00E+00	2.95E-05	0.00E+00	0.00E+00	0.00E+00	2.99E-04

Units of mrem per pCi ingested
Source: NUREG/CR-4013 (Reference 107), Table 3.8 when available and NUREG/CR-1276 (Reference 105), Appendix C, DF Table 9

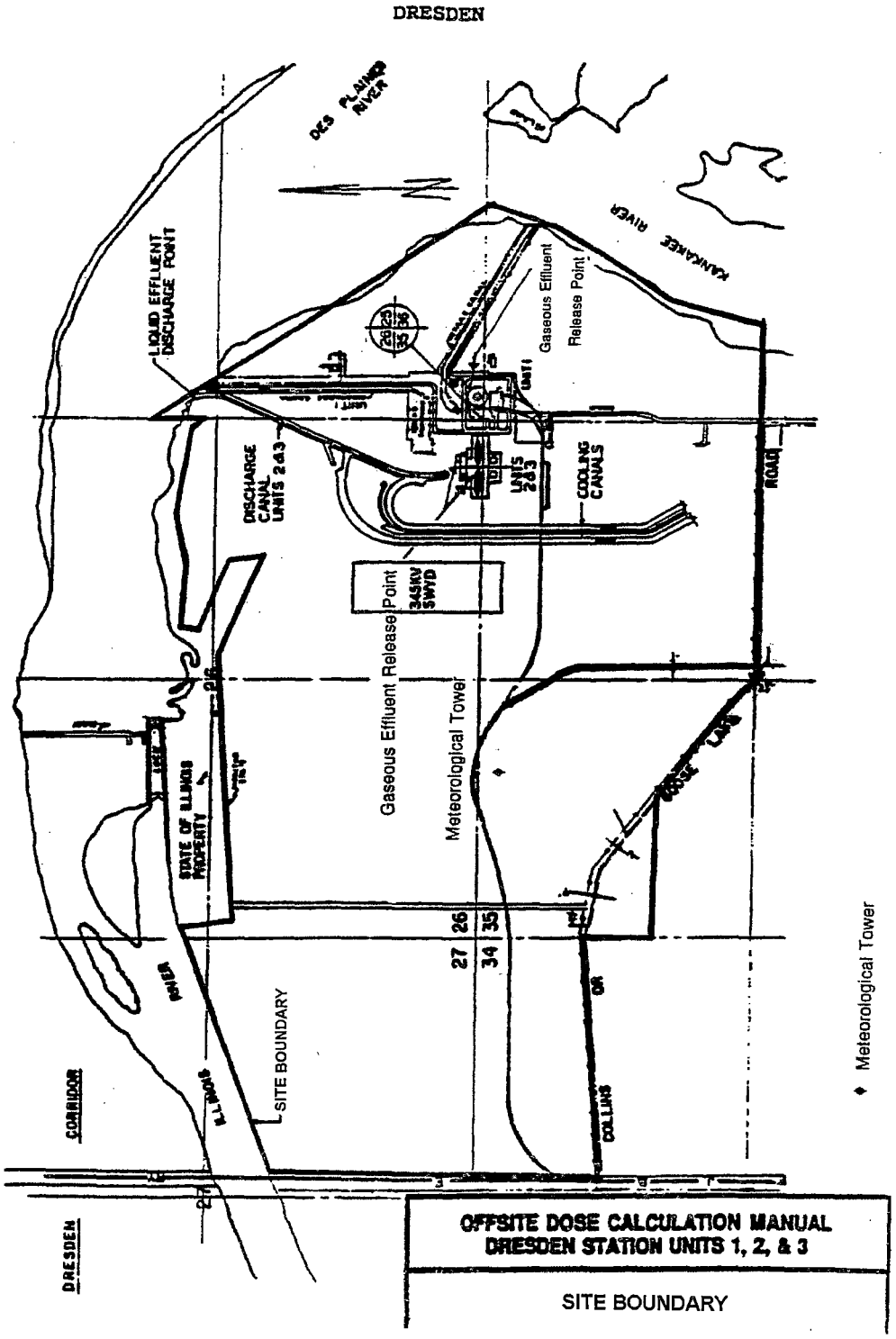
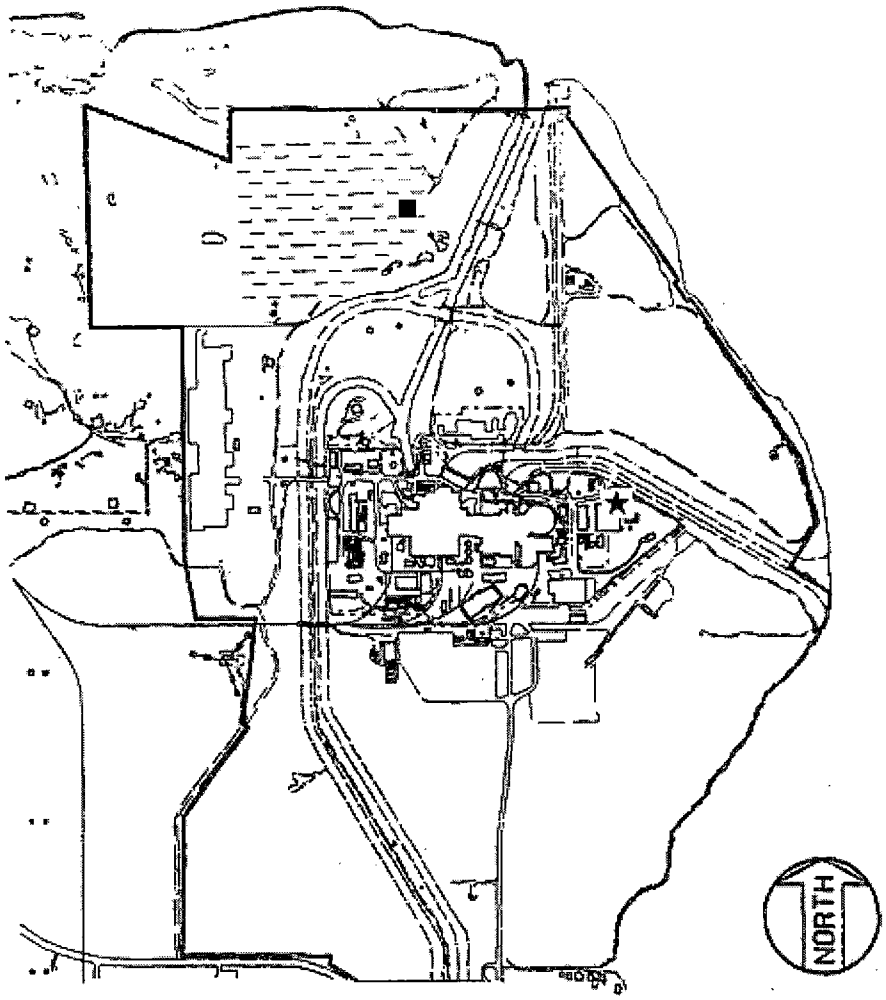


Figure 1-2
Site Boundary



★ Interim Radwaste Storage Facility

■ Steam Dryer Storage Building

Radwaste Storage Area (this area may include 48-packs, DAW, and other types of storage)

500 0 500 1000 FEET

GRAPHIC SCALE

OFFSITE DOSE CALCULATION MANUAL
DRESDEN STATION

RESTRICTED AREA BOUNDARY

Figure 1-3
Restricted / Unrestricted Area Boundary

2.0 INSTRUMENTATION AND SYSTEMS

2.1 Liquid Effluents

2.1.1 Liquid Radwaste System Description

A simplified liquid radwaste and liquid effluent flow diagram is provided in Figure 2-1. The liquid radwaste treatment system is designed and installed to reduce radioactive liquid effluents by collecting the liquids, providing for retention or holdup, and providing for treatment by evaporator, demineralizer, filter, and further vendor processing systems for the purpose of reducing the total radioactivity prior to reuse or release to the environment. The system is described in the Dresden UFSAR Section 11.2.

2.1.1.1 Unit 1 Storage Tanks

Liquid radioactive effluents are not released from Unit 1 Storage tanks directly to the environment but are processed through the Units 2/3 Radwaste system.

2.1.1.2 Units 2/3 Waste Sample Tanks

There are three waste sample tanks (33,000 gallons each) that receive water from the liquid waste treatment system. These tanks are transferred to the waste surge tank for discharge to the Illinois River via the discharge canal.

2.1.1.3 Units 2/3 Floor Drain Sample Tanks

There are two floor drain sample tanks (22,000 gallons each) that receive liquid waste from the floor drain treatment system. These tanks are transferred to the waste surge tank or discharged to the Illinois River via the discharge canal.

2.1.1.4 Units 2/3 Waste Surge Tank

The waste surge tank (77,000 gallons) normally receives processed water from the waste sample tanks and floor drain sample tanks. The waste surge tank may also receive water from portable waste treatment system tanks. This tank discharges to the Illinois River via the discharge canal.

2.1.2 Radiation Monitors

Pertinent information on the monitor and associated control devices is provided in the Dresden UFSAR Section 11.5.

2.1.2.1 Units 2 & 3 Service Water Effluent Monitors

The monitors continuously monitor the service water effluent of each unit. No automatic isolation or trip functions are associated with the monitors.

2.1.2.2 Liquid Radwaste Effluent Monitor

The monitor is used to monitor releases from the waste surge tank, floor drain sample tanks or portable waste treatment system tanks. On high alarm, a grab sample of the effluent is automatically taken from the discharge side of the sample chamber after a 0 to 60 second delay determined by a locally mounted timer. The release is terminated manually by initiating closure of the low flow or high flow discharge line valves.

2.1.3 Liquid Radiation Effluent Monitors Alarm And Trip Setpoints

Alarm setpoints of liquid effluent monitors at the principal release points are established to ensure that the limits of 10CFR20 are not exceeded in the unrestricted area. The liquid effluent monitors do not have trip functions.

2.1.3.1 Liquid Radwaste Effluent Monitor

The monitor alarm setpoint is determined by solving equation 2-1 or set at 450,000 counts per minute; whichever is lower. The monitor detects only gamma-emitting radionuclides, so only gamma-emitting radionuclides are used in the setpoint calculation.

$$P \leq K \times \frac{\sum_i c_{i\gamma}}{\sum_i \left(c_{i\gamma}/ECL_{i\gamma}\right)} \times \frac{F+f}{f} \qquad (2-1)$$

where:		(units)
P	Effluent monitor setpoint	[cpm]
K	Effluent monitor calibration constant	[cpm/(µCi/ml)]
$c_{i\gamma}$	Concentration of gamma emitting radionuclide i in the release tank	[µCi/ml]
$ECL_{i\gamma}$	Effluent Concentration Limit (ECL) for gamma-emitting radionuclide i. Also called Derived Water Concentration (DWC) or Maximum Permissible Concentration (MPC). Derived from 10CFR20, Appendix B, Table 2, Column 2. Ten (10) times the value of 10CFR20, Appendix B, Table 2, Column 2 for radionuclide i may be used per site Technical Specifications and REC 12.3.1.	[µCi/ml]
F	Dilution flow rate. The minimum dilution flow rate of 40,000 is used for setpoint calculations.	[gpm]
f	Flow rate from the radwaste discharge tank. The maximum pump discharge rate of 250 gpm is used for setpoint calculations.	[gpm]

2.1.3.2 Units 2 & Unit 3 Service Water Effluent Monitors

The monitor setpoint is established at two times the background radiation value.

2.1.4 Discharge Flow Rates

Prior to each batch release, a grab sample is obtained. All detected and estimated (in the case of difficult to measure) nuclides are considered. The results of the sample analysis are used to determine the maximum permitted discharge rate of each batch as follows:

$$f_{max} = 0.2 \times \frac{F}{\sum_i (c_i / ECL_i)} \qquad (2 - 2)$$

where:		(units)
f_{max}	Maximum discharge flow rate from the radwaste discharge tank. Releases are not permitted if the calculated discharge rate is less than 250 gpm.	[gpm]
0.2	Reduction factor for conservatism. See 2.1.5.	
F	Dilution flow rate. The minimum dilution flow rate of 40,000 is used for this calculation.	[gpm]
c_i	Concentration of radionuclide i in the release tank based on measurements of a sample drawn from the tank and estimates of difficult-to-measure nuclide concentrations.	[µCi/ml]
ECL_i	Effluent Concentration Limit (ECL) for radionuclide i. Also called Derived Water Concentration (DWC) or Maximum Permissible Concentration (MPC). Derived from 10CFR20, Appendix B, Table 2, Column 2. Ten (10) times 10CFR20, Appendix B, Table 2, Column 2 values may be used per site Technical Specifications and REC 12.3.1.	[µCi/ml]

2.1.5 Release Limits

Release limits are determined from 10CFR20. Calculated maximum permissible discharge rates are divided by 5 to ensure that applicable effluent concentration limits are not exceeded.

2.1.5.1 Release Mixture

For the liquid radwaste effluent monitor, the release mixture used for the setpoint determination is the radionuclide mix identified in the grab sample gamma isotopic analysis.

For all other liquid effluent monitors, no release mixture is used because the setpoint is established at two times background.

2.1.5.2 Liquid Dilution Flow Rate

The dilution flow rate is determined using the installed flowmeter in the discharge canal.

2.1.5.3 Conversion Factors

The liquid radwaste effluent monitor and the Units 2 and 3 service water effluent monitors are standardized to a Cobalt-60 source to determine the calibration constant.

The readout for the liquid radwaste effluent monitor is in CPM.

The readouts for the Units 2 & 3 service water effluent monitors are in µCi/ml.

2.1.6 Allocation of Effluents from Common Release Points

Radioactive liquid effluents released from the release tanks are comprised of contributions from all three units. Under normal operating conditions, it is difficult to apportion the radioactivity between the units. Consequently, allocation is normally made evenly between Units 2 and 3.

2.1.7 Projected Doses for Releases

Doses due to liquid effluents are calculated in accordance with the RECs.

2.2 Airborne Releases

2.2.1 System Description

A simplified gaseous radwaste and gaseous effluent flow diagram is provided for Dresden Unit 1 in Figure 2-2 and for Dresden Units 2 and 3 in Figure 2-3. Dresden 1 is no longer operational and all spent fuel is removed, but monitoring of potentially radioactive releases from the plant chimney continues.

Each airborne release point is classified as stack, vent, or ground level in accordance with the definitions in Section 4.1.4 and the results in Table 1.1-1 in Part I. The principal release points for potentially radioactive airborne effluents and their classifications are as follows:

- For Dresden 1:
  --The Unit 1 Main Chimney (a stack release point).
  --The Chemical Cleaning Building Ventilation (a vent release point)

- For Dresden 2/3:
  --The 2/3 Main Chimney (a stack release point).
  --The 2/3 Reactor Building Ventilation (a vent release point).

2.2.1.1 Condenser Offgas Treatment System

The condenser offgas treatment system is designed and installed to reduce radioactive gaseous effluents by collecting non-condensable off-gases from the condenser and providing for holdup to reduce the total radioactivity by decay prior to release to the environment. Charcoal and HEPA filters retain the daughter products. The system is described in Section 11.3 of the Dresden UFSAR.

2.2.1.2 Ventilation Exhaust Treatment System

Ventilation exhaust treatment systems are designed and installed to reduce gaseous radioiodine or radioactive material in particulate form in selected effluent streams by passing ventilation or vent exhaust gases through charcoal absorbers and/or HEPA filters prior to release to the environment. Such a system is not considered to have any effect on noble gas effluents. The ventilation exhaust treatment systems are shown in Figure 2-2 and Figure 2-3.

Engineered safety features atmospheric cleanup systems are not considered to be ventilation exhaust treatment system components.

2.2.2 Radiation Monitors

2.2.2.1 Unit 1 Chimney Sampler

Effluent from the chimney is sampled via an isokinetic probe. The sampler provides for continuous particulate and iodine sampling of the Unit 1 Chimney effluent.

This sampler performs no automatic isolation or control functions.

2.2.2.2 Units 2/3 Chimney Monitor

The 2/3 Chimney SPING continuously monitors the final effluent from the Units 2/3 Chimney.

Effluent from the chimney is sampled via an isokinetic probe. The monitor has continuous gaseous monitoring, continuous particulate and iodine sampling, and post accident sampling capability. A tap is available for obtaining other samples via the isokinetic probe, which is used for tritium sample collection or gaseous grab sample collection. There is a backup system, the Units 2/3 Chimney (GE) Radiation Monitor, consisting of two additional noble gas detectors and continuous particulate and iodine collection capability.

In normal operation the two lower SPING noble gas channels (low and mid-range) and the backup noble gas channels are on line and active. The high range noble gas channel flow is bypassed and this channel is in standby. At a predetermined threshold the low and mid-range noble gas channels are bypassed and only the high range noble gas channel remains active.

This monitor performs no automatic isolation or control functions. Further information is provided in Dresden UFSAR Section 11.5.

2.2.2.3 Reactor Building Ventilation Effluent Monitor

The 2/3 Reactor Building Vent SPING continuously monitors the final effluent from the 2/3 Reactor Building Vent stack.

Effluent from the chimney is sampled via an isokinetic probe. The monitor has continuous gaseous monitoring and continuous particulate and iodine sampling. A tap is available for obtaining other samples via the isokinetic probe, which is used for tritium sample collection or gaseous grab sample collection. Backup noble gas monitoring is performed using the Reactor Building Ventilation Duct Radiation Monitors, described below. Backup capability for continuous particulate and iodine sampling is available on both the Unit 2 and Unit 3 ventilation ducting.

All channels are normally on line and active. This monitor performs no automatic isolation or control functions.

2.2.2.4 Reactor Building Ventilation Duct Radiation Monitors

Each monitor (located in the ventilation exhaust duct) monitors the effluent from the Unit 2 and Unit 3 reactor building ventilation. On high alarm, the monitors automatically initiate isolation of the Unit 2(3) reactor building ventilation, and initiate startup of the Unit 2/3 Standby Gas Treatment System.

Further information is provided in Dresden UFSAR Section 11.5.

2.2.2.5 Condenser Air Ejector Monitors

The monitors continuously monitor gross gamma activity downstream of the Unit 2 and Unit 3 steam jet air ejector prior to release to the 2/3 Main Chimney.

At the trip setpoint the monitors automatically activate an interval timer that in turn initiates closure of an air-operated valve, thus terminating the release.

Further information is provided in Dresden UFSAR Section 11.5.

2.2.2.6 Isolation Condenser Vent Monitor

The monitor continuously monitors radioactivity in the effluent from the isolation condenser vent to provide indication of a tube leak. This monitor initiates no control device.

Further information is provided in Dresden UFSAR Section 11.5.

2.2.2.7 Chemical Cleaning Building Ventilation Sampler

The sampler provides for continuous particulate and iodine sampling of the Chemical Cleaning Building effluent.

This monitor performs no automatic isolation, control functions or alarm functions.

2.2.3 Gaseous Radiation Effluent Monitors Alarm and Trip Setpoints

2.2.3.1 Reactor Building Vent (Duct) Monitors

The alarm setpoint for the Reactor Building Vent monitors is set at ≤10 mr/hr.

2.2.3.2 Condenser Air Ejector Monitors

The high-high trip limit is established at ≤ 100 µCi/sec per MWt (252,700 µCi/sec). The high alarm is set at 1.5 times the normal full power background with hydrogen addition to satisfy licensing commitments associated with the main steam line monitor Technical Specification amendments.

2.2.3.3 Units 2/3 Chimney (GE) Radiation Monitor

The setpoint is established at a count rate corresponding to no greater than 105,000 µCi/sec.

2.2.4 Release Limits

Alarm and trip setpoints of gaseous effluent monitors are established to ensure that the release rate limits of RECs are not exceeded. The release rate limit requirements are met when Equations 2-3 and 2-4 are satisfied:

$$\sum_i \left[f_i \left(V_i \dot{Q}_{ts} + K_i \left(\left(\overline{\chi/Q} \right)_v \dot{Q}_{tv} \right) \right) \right] < 500 \text{ mrem / yr} \qquad (2\text{-}3)$$

$$\sum_i \left[f_i \left(\left(L_i \left(\overline{\chi/Q} \right)_s + 1.1 B_i \right) \dot{Q}_{ts} + \left(L_i + 1.1 M_i \right) \left(\left(\overline{\chi/Q} \right)_v \right) \dot{Q}_{tv} \right) \right] < 3000 \text{ mrem / yr} \qquad (2\text{-}4)$$

where: (units)

1.1 Conversion factor to rem in tissue from rads in air. [mrem/mrad]

f_i Fractional Radionuclide Composition. The release rate of noble gas radionuclide i divided by the total release rate of all noble gas radionuclides, dimensionless.

$\dot{Q}_{ts}$ Total allowed Release Rate, Stack Release. The total allowed release rate of all noble gas radionuclides released as stack releases. [µCi/sec]

$\dot{Q}_{tv}$ Total Allowed Release Rate, Vent Release. The total allowed release rate of all noble gas radionuclides released as vent releases. Limited by the Unit 2 and Unit 3 Reactor Building Duct Radiation Monitors' setpoint (≤10 mrem). [µCi/sec]

Remaining terms are defined in Section II, Part 4.

Equation 2-3 is based on Equation 4-1 and the RECs restriction on total body dose rate (500 mrem/yr) due to noble gases released in gaseous effluents (see Section 4.2.1.2). Equation 2-4 is based on Equation 4-2 and the RECs restriction on skin dose rate (3000 mrem/yr) due to noble gases released in gaseous effluents (see Section 4.2.1.3).

Calibration methods and surveillance frequency for the monitors are conducted as specified in the RECs.

2.2.4.1 Release Mixture

In the determination of alarm and trip setpoints the radioactivity mixture in the exhaust air is assumed to have the following compositions.

- Reactor Building Vent (Duct) Monitors

The mixture used for the duct monitors is taken from a representative isotopic analysis of the vent stack noble gas released since the last calibration, or based on nominal response of detector. The "mixture" used for the SPING is assumed to be a single pseudo-noble gas radionuclide.

- Condenser Air Ejector Monitors

  The mixture used for this monitor is taken from a representative isotopic analysis of noble gases collected at the recombiner outlet during plant operation, since the last alarm setpoint calculation.

- Units 2/3 Chimney Monitors

  The mixture used for the GE monitors is taken from the most recent isotopic analysis of noble gases collected from the chimney monitor that corresponds to an above background recorder reading. The "mixture" used for the SPING is assumed to be a single pseudo-noble gas radionuclide.

2.2.4.2 Conversion Factors

The conversion factors used to establish gaseous effluent monitor setpoints are obtained as follows.

- Reactor building vent effluent monitors

  For the duct monitors, the isotopic analysis in Section 2.2.4.1 and the monitor reading (in mR/hr) at the time of the analysis are used to establish the conversion factor in mR/hr per µCi/cc or µCi/ft^3 or nominal response of the detector (7200 mR/hr per µCi/sec at design flow rate) is used. For the SPING the conversion factor is based on the 0.8 MeV gamma of the pseudo-noble gas radionuclide.

- Condenser air ejector monitor

  The isotopic analysis in Section 2.2.4.1 and the flow and monitor reading (in mR/hr) at the time of the analysis are used to establish the conversion factor in mR/hr per µCi/cc or µCi/ft^3.

- Units 2/3 plant chimney monitors

  For the GE monitors or, the isotopic analysis in Section 2.2.4.1 and flow and monitor reading (in cps) at the time of the analysis are used to establish the conversion factor in cps per µCi/cc or µCi/ft^3. For the SPING the conversion factor is based on the 0.8 MeV gamma of the pseudo-noble gas radionuclide.

2.2.4.3 HVAC Flow Rates to determine release limits

The HVAC exhaust flow rates are obtained from either the Units 2/3 process computers, the SPING control station. For the 2/3 Chimney, additional process flow rates must be added to obtain the total chimney flow (see Figure 2-3). Unit operation may affect actual flow rates, which therefore may differ

from values listed. If the actual flows are not available, the following default values based on design flow can be used:

Units 2/3 Chimney Air Flow	1.25E10 cc/min
Unit 2 and Unit 3 Reactor Building Vent (each)	3.11E9 cc/min
Units 2/3 Combined Reactor Building Vent	6.23E9 cc/min
Unit 1 Chimney Air Flow	8.41E8 cc/min
Unit 1 Chemical Cleaning Chimney Air Flow	1.61E9 cc/min

2.2.5 Allocation of Effluents from Common Release Points

Radioactive particulates and iodine released from the Unit 1 Chemical Cleaning Chimney originate from the Chemical Cleaning Building and Interim Radwaste Storage Facility.

Radioactive gases, particulates, and iodines released from the Unit 1 Chimney originate from Unit 1 only. However, radioactive gaseous effluents released from Units 2/3 are comprised of contributions from both units. Estimates of noble gas contributions from Units 2 and 3 are allocated considering appropriate operating conditions and measured SJAE off-gas activities. Allocation of radioiodine and radioactive particulate releases to Units 2 or 3 specifically is not as practical and is influenced greatly by in-plant leakage. Under normal operating conditions, allocation is made using reactor coolant iodine activities. During unit shutdowns or periods of known major in-plant leakage, the apportionment is adjusted accordingly. The allocation of effluents is estimated on a monthly basis.

2.2.6 Dose Projections

Because radioactive gaseous releases are continuous, dose estimates and projections are routinely calculated in accordance with the RECs.

2.3 Solidification of Waste/Process Control Program

The process control program (PCP) contains the sampling, analysis, and formulation determination by which solidification of radioactive wastes from liquid systems is ensured.

Figure 2-4 is a simplified diagram of solid radwaste processing.

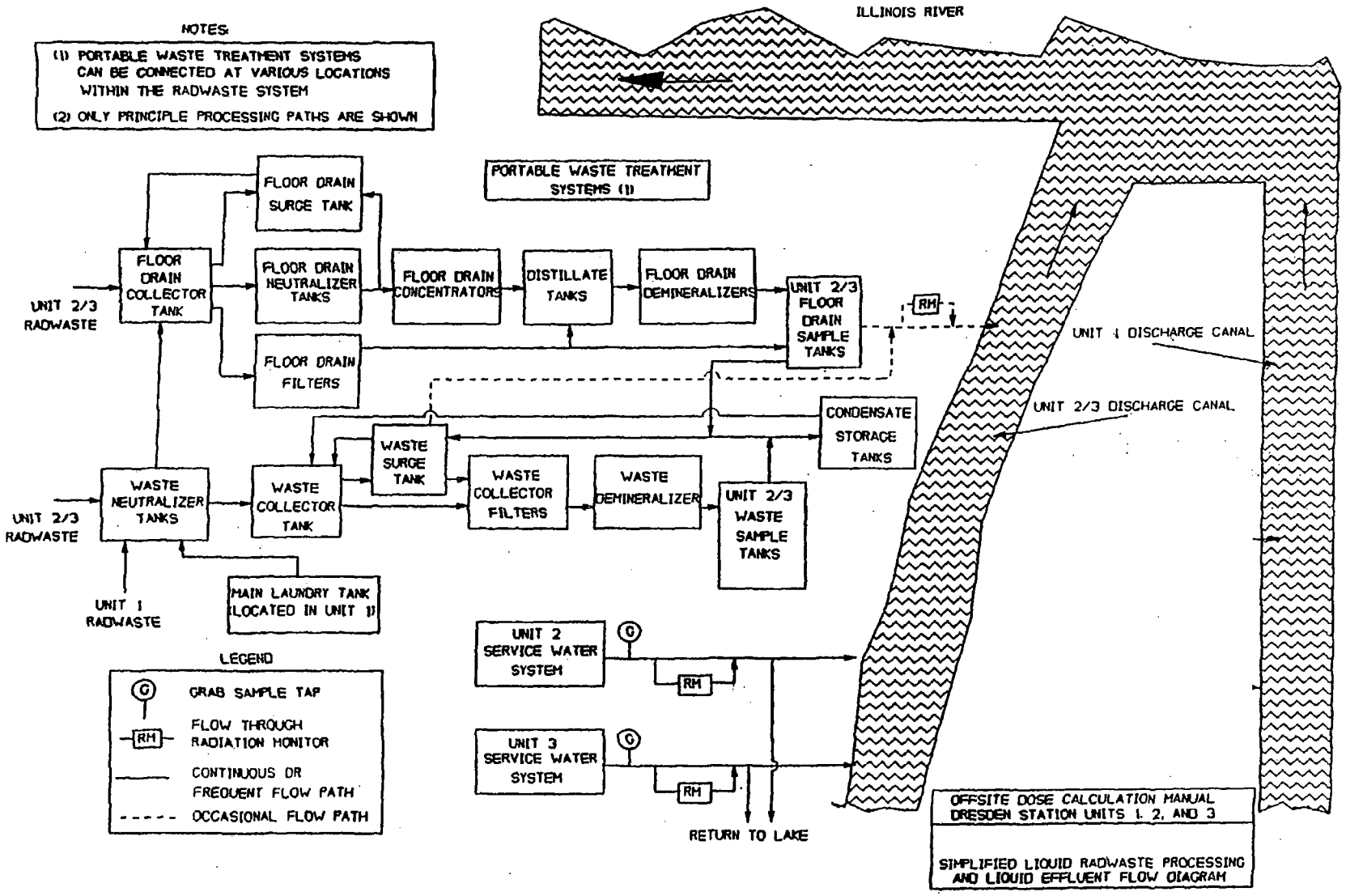
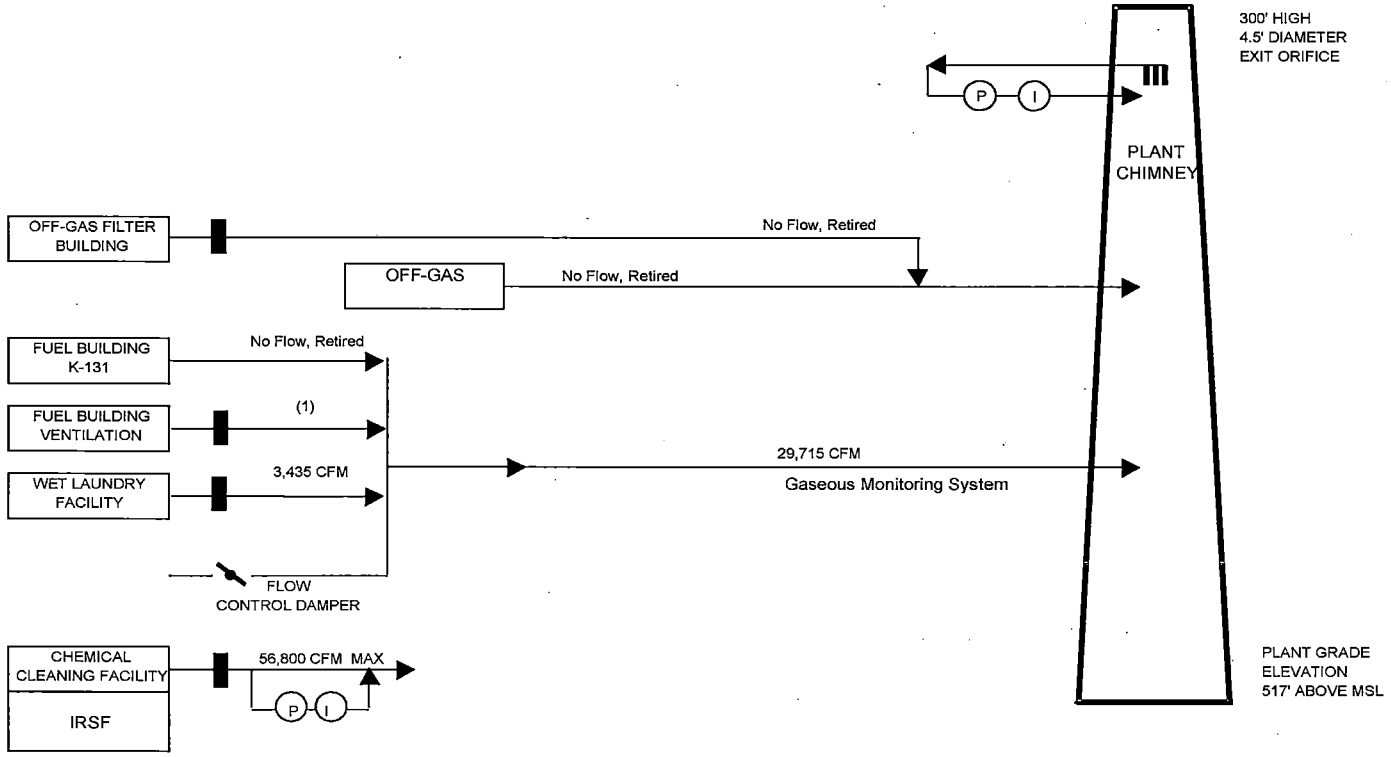

NOTES:
(1) PORTABLE WASTE TREATMENT SYSTEMS CAN BE CONNECTED AT VARIOUS LOCATIONS WITHIN THE RADWASTE SYSTEM
(2) ONLY PRINCIPLE PROCESSING PATHS ARE SHOWN
ILLINOIS RIVER
PORTABLE WASTE TREATMENT SYSTEMS (1)
FLOOR DRAIN SURGE TANK
FLOOR DRAIN COLLECTOR TANK
FLOOR DRAIN NEUTRALIZER TANKS
FLOOR DRAIN CONCENTRATORS
DISTILLATE TANKS
FLOOR DRAIN DEMINERALIZERS
UNIT 2/3 FLOOR DRAIN SAMPLE TANKS
FLOOR DRAIN FILTERS
UNIT 2/3 RADWASTE
RM
UNIT 1 DISCHARGE CANAL
UNIT 2/3 DISCHARGE CANAL
CONDENSATE STORAGE TANKS
WASTE SURGE TANK
WASTE NEUTRALIZER TANKS
WASTE COLLECTOR TANK
WASTE COLLECTOR FILTERS
WASTE DEMINERALIZER
UNIT 2/3 WASTE SAMPLE TANKS
UNIT 2/3 RADWASTE
UNIT 1 RADWASTE
MAIN LAUNDRY TANK (LOCATED IN UNIT 1)
UNIT 2 SERVICE WATER SYSTEM
UNIT 3 SERVICE WATER SYSTEM
G
RM
RETURN TO LAKE
LEGEND
GRAB SAMPLE TAP
FLOW THROUGH RADIATION MONITOR
CONTINUOUS OR FREQUENT FLOW PATH
OCCASIONAL FLOW PATH
OFFSITE DOSE CALCULATION MANUAL
DRESDEN STATION UNITS 1, 2, AND 3
SIMPLIFIED LIQUID RADWASTE PROCESSING AND LIQUID EFFLUENT FLOW DIAGRAM

Figure 2-1



(1) 8,000 CFM summer
4,000 CFM winter

LEGEND AND NOTES

HEPA FILTER

PARTICULATE SAMPLE

IODINE SAMPLE

NOTES:
1. UNIT 1 IS NOT OPERATIONAL
2. ALL FLOW RATES ARE DESIGN FLOW RATES, NOT ACTUAL

OFFSITE DOSE CALCULATION MANUAL
DRESDEN STATION UNIT 1

SIMPLIFIED GASEOUS RADWASTE AND GASEOUS EFFLUENT FLOW DIAGRAM

Figure 2-2

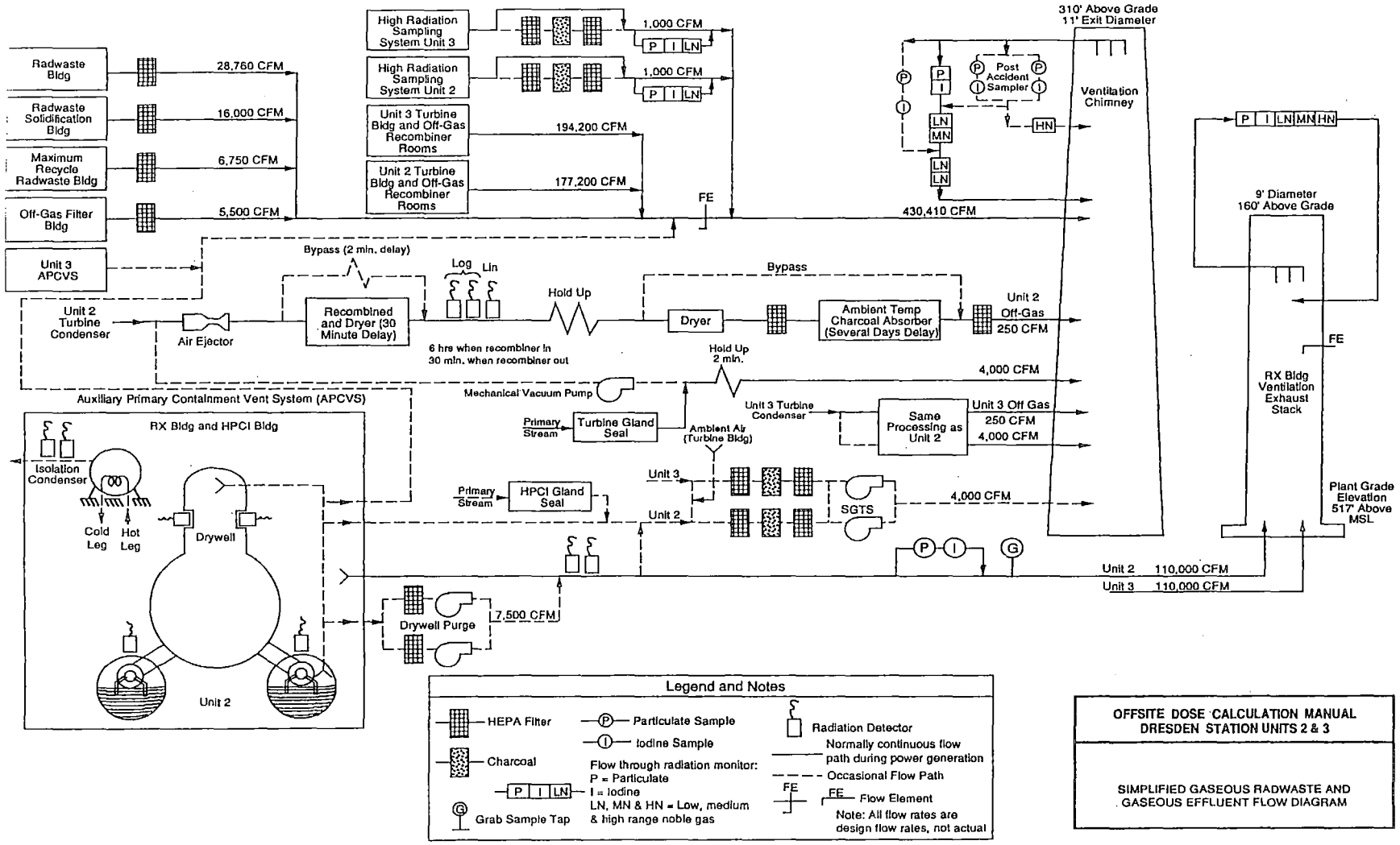

Radwaste Bldg
28,760 CFM
Radwaste Solidification Bldg
16,000 CFM
Maximum Recycle Radwaste Bldg
6,750 CFM
Off-Gas Filter Bldg
5,500 CFM
Unit 3 APCVS
High Radiation Sampling System Unit 3
1,000 CFM
High Radiation Sampling System Unit 2
1,000 CFM
Unit 3 Turbine Bldg and Off-Gas Recombiner Rooms
194,200 CFM
Unit 2 Turbine Bldg and Off-Gas Recombiner Rooms
177,200 CFM
FE
430,410 CFM
310' Above Grade
11' Exit Diameter
Post Accident Sampler
Ventilation Chimney
9' Diameter
160' Above Grade
Bypass (2 min. delay)
Log
Lin
Hold Up
Bypass
Unit 2 Turbine Condenser
Air Ejector
Recombined and Dryer (30 Minute Delay)
6 hrs when recombiner in
30 min. when recombiner out
Dryer
Ambient Temp Charcoal Absorber (Several Days Delay)
Unit 2 Off-Gas
250 CFM
Hold Up
2 min.
4,000 CFM
Mechanical Vacuum Pump
Auxiliary Primary Containment Vent System (APCVS)
RX Bldg and HPCI Bldg
Isolation Condenser
Cold Leg
Hot Leg
Drywell
Unit 2
Primary Stream
Turbine Gland Seal
Ambient Air (Turbine Bldg)
Unit 3 Turbine Condenser
Same Processing as Unit 2
Unit 3 Off Gas
250 CFM
4,000 CFM
Primary Stream
HPCI Gland Seal
Unit 3
Unit 2
SGTS
4,000 CFM
Unit 2 110,000 CFM
Unit 3 110,000 CFM
Drywell Purge
7,500 CFM
RX Bldg Ventilation Exhaust Stack
Plant Grade Elevation 517' Above MSL
Legend and Notes
HEPA Filter
Charcoal
Grab Sample Tap
Particulate Sample
Iodine Sample
Flow through radiation monitor:
P = Particulate
I = Iodine
LN, MN & HN = Low, medium & high range noble gas
Radiation Detector
Normally continuous flow path during power generation
Occasional Flow Path
Flow Element
Note: All flow rates are design flow rates, not actual
OFFSITE DOSE CALCULATION MANUAL
DRESDEN STATION UNITS 2 & 3
SIMPLIFIED GASEOUS RADWASTE AND GASEOUS EFFLUENT FLOW DIAGRAM

Figure 2-3

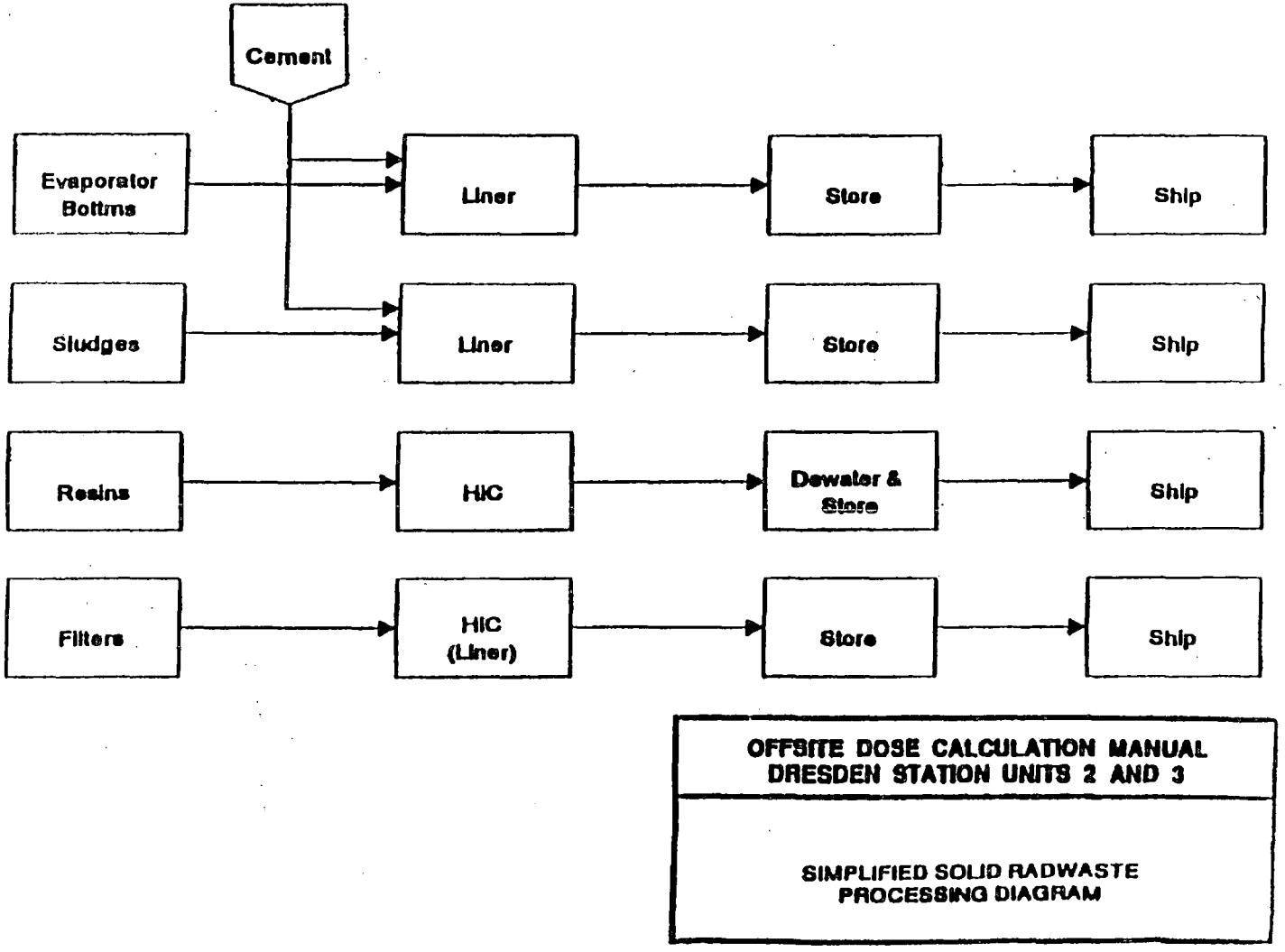

Cement
Evaporator Bottms
Liner
Store
Ship
Sludges
Liner
Store
Ship
Resins
HIC
Dewater & Store
Ship
Filters
HIC (Liner)
Store
Ship
OFFSITE DOSE CALCULATION MANUAL
DRESDEN STATION UNITS 2 AND 3
SIMPLIFIED SOLID RADWASTE PROCESSING DIAGRAM

Figure 2-4

3.0 LIQUID EFFLUENTS

3.1 Liquid Effluent Releases – General Information

3.1.1 The design objectives of 10CFR50, Appendix I and RECS provide the following limits on the dose or dose commitment to a member of the public from radioactive materials in liquid effluents released from each reactor unit to restricted area boundaries:

- During any calendar quarter, less than or equal to 1.5 mrem to the total body and less than or equal to 5 mrem to any organ.
- During any calendar year, less than or equal to 3 mrem to the total body and less than or equal to 10 mrem to any organ.

3.1.2 The organ doses due to radioactivity in liquid effluents are also used as part of the 40CFR190 compliance and are included in the combination of doses to determine the total dose used to demonstrate 10CFR20 compliance. (See Section 5.0, Total Dose)

3.1.3 Dose assessments are made for four age groups (adult, teenager, child, infant) using NUREG/CR-1276 (Reference 105) and NUREG/CR-4013 (Reference 107) dose conversion factors.

3.1.4 To limit the consequences of tank overflow, the Technical Specifications / Technical Requirements Manual (TRM) limits the quantity of radioactivity that may be stored in unprotected outdoor tanks. Unprotected tanks are tanks that are not surrounded by liners, dikes, or walls capable of holding the tank contents and that do not have tank overflows and surrounding area drains connected to the liquid radwaste treatment system. The specific objective is to provide assurance that in the event of an uncontrolled release of a tank's contents, the resulting radioactivity concentrations beyond the unrestricted area boundary, at the nearest potable water supply and at the nearest surface water supply, will be less than the limits of 10CFR20 Appendix B, Table 2; Column 2.

3.1.5 Cases in which normally non-radioactive liquid streams (such as the Service Water) are found to contain radioactive material are non-routine will be treated on a case specific basis if and when this occurs. Since the station has sufficient capacity to delay a liquid release for reasonable periods of time, it is expected that planned releases will not take place under these circumstances. Therefore, the liquid release setpoint calculations need not and do not contain provisions for treating multiple simultaneous release pathways.

3.2 Liquid Effluent Concentrations

3.2.1 As a means of assuring that annual concentration limits will not be exceeded, and as a matter of policy assuring that doses by the liquid pathway will be ALARA, RECS provides the following restriction:

> "The maximum concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS (see Part II Figure 1-3) shall be limited to 10 times the concentration specified in 10 CFR 20 Appendix B, Table 2, Column 2 for radionuclides other than dissolved or entrained noble gases and 2 x 10^{-4} microCurie/ml total activity for all dissolved or entrained noble gases."

3.2.2 An alternate method of demonstrating compliance to the requirements of 10CFR20.1301 is to demonstrate that the annual average concentrations of radioactive material released in gaseous and liquid effluents do not exceed the values specified in 10CFR20 Appendix B, Table 2, Column 2. (See 10CFR 20.1302(b)(2).) However, as noted in Section 5.5.1, this alternate method of 10CFR20.1301 compliance is not used.

3.2.3 Liquid effluents concentrations are controlled as described in Part II, Section 2.1.

3.2.4 When radioactivity is released to the unrestricted area with liquid discharge from a tank (e.g., a radwaste discharge tank), the concentration of a radionuclide in the effluent at the unrestricted area boundary is calculated as follows:

$$C_i = c_i \frac{f}{F + f} \qquad (3\text{-}1)$$

where:		(units)
C_i	Concentration of radionuclide i in liquid released to the unrestricted area (after initial dilution).	[μCi/ml]
c_i	Concentration of radionuclide i in the discharge tank (undiluted).	[μCi/ml]
f	Flow rate, tank discharge. See Table 3-2	[gpm]
F	Flow rate, initial dilution stream. See Table 3-2	[gpm]

3.2.5 When a radionuclide mix of known composition is released, the concentrations released to the unrestricted area must be such that:

$$\sum_i \left(\frac{C_i}{ECL_i} \right) \leq 1 \qquad (3\text{-}2)$$

where: (units)

C_i	Concentration of radionuclide i in liquid released to the unrestricted area (after initial dilution).	[μCi/ml]
ECL_i	Effluent Concentration Limit (ECL) for radionuclide i. Also called Derived Water Concentration (DWC) or Maximum Permissible Concentration (MPC). Derived from 10CFR20, Appendix B, Table 2, Column 2. Ten (10) times 10CFR20, Appendix B, Table 2, Column 2 values may be used per site Technical Specifications and REC 12.3.1.	[μCi/ml]

If either the identity or concentration of any radionuclide in the mixture is not known, special rules apply. These are given in the footnotes in 10CFR20 Appendix B, Table 2, Column 2.

3.2.6 The RECs and Technical Specifications require a specified sampling and analysis program to assure that liquid radioactivity concentrations at the point of release are maintained within the required limits. To comply with this provision, samples are analyzed in accordance with the Radioactive Liquid Waste Sampling and Analysis Program in Section 12.3.1 of Part I, RECs.

3.3 Liquid Effluent Dose Calculation Requirements

3.3.1 RECs require determination of cumulative and projected dose contributions from liquid effluents at least once per 31 days. (See Section 12.3.2 of Part I, RECS.)

3.3.2 Radioactive liquid effluents released from the release tanks are comprised of contributions primarily from Units 2 and 3. Contributions from Unit 1 are negligible. Under normal operating conditions, it is difficult to apportion the radioactivity between the units. Consequently, allocation is normally made evenly between Units 2 and 3.

3.3.3 Functionality and Use of the Liquid Radwaste Treatment System

The design objectives of 10CFR50, Appendix I and RECs/Technical Specifications require that the liquid radwaste treatment system be FUNCTIONAL and that appropriate portions be used to reduce releases of radioactivity when projected doses due to the liquid effluent from each reactor unit to unrestricted areas exceed either of the following (see Section 12.3.3 of Part I, RECS):

- 0.06 mrem to the total body in a 31-day period.
- 0.2 mrem to any organ in a 31-day period.

3.4 Dose Methodology

3.4.1 Liquid Effluent Dose Method: General

The dose from radioactive materials in liquid effluents is calculated for the four age groups considering only the two principle pathways for radiation exposure. The maximum dose to each organ and to the total body is obtained as the sum of contributions from consumption of drinking water and fish:

$$D_{\tau}^{LIQ} = \sum_{i} \left(A_{i\tau}^{liq} \Delta t \, C_i \, F_{\lambda} \right) \tag{3-3}$$

And drinking water dose is calculated using only the drinking water pathway:

$$D_{\tau}^{water} = \sum_{i} \left(A_{i\tau}^{water} \Delta t \, C_i \, F_{\lambda} \right) \tag{3-4}$$

where:

$$A_{i\tau}^{liq} = k_o \left(\frac{U_a^w}{D_w} + U_a^F BF_i \right) DFL_i \tag{3-5}$$

$$A_{i\tau}^{water} = k_o \left(\frac{U_a^w}{D_w} \right) DFL_i \tag{3-6}$$

and:

		(units)
D_{τ}^{LIQ}	Cumulative dose commitment to the total body or any organ τ due to radioactivity in liquid effluents from consuming water and fish.	[mrem]
D_{τ}^{water}	Cumulative dose commitment to the total body or any organ τ due to radioactivity in liquid effluents from consuming water.	[mrem]
$A_{i\tau}$	Ingestion Dose Commitment Factor to the total body or any organ τ from the drinking water and fish ingestion pathways (^{liq}) or drinking water only (^{water}) for each principle gamma emitter and beta emitter. See Tables 3-4 through 3-11.	[mrem/hr per µCi/ml]
Δt	Duration of radioactive liquid release.	[hr]
C_i	Average concentration of radionuclide i in undiluted liquid effluent.	[µCi/ml]
F_{ℓ}	Near field average dilution factor for C_i during liquid effluent release. Defined as the ratio of the maximum undiluted liquid waste flow during release to the average flow of receiving waters, dimensionless. See Table 3-2.	
k_o	Conversion constant to pCi from µCi, to ml from kg, and to hours from years. 1.14E+05=10^6 pCi/µCi x 10^3 ÷ 8760 hr/yr	$\left[\frac{pCi\,ml\,yr}{\mu Ci\,kg\,hr}\right]$
U_a^w, U_a^F	Usage Factor. Consumption rate of water (^{w}) or fish (^{F}). See Table 1-5.	[L/hr(^{w}) or kg/hr(^{F})]
D_w	Dilution factor from the near field area within one quarter mile of the release point to the potable water intake for drinking water consumption, dimensionless. See Table 3-2.	

BF_i	Bioaccumulation Factor. Equilibrium ratio of the concentration of radionuclide i in fish (pCi/kg) to its concentration in water (pCi/L). See Table 3-3.	[L/kg]
DFL_i	Ingestion Dose Factor. Dose commitment to selected organ τ and total body of an individual in per unit of radionuclide i ingested. See Tables 1-12 – 1-15.	[mrem/pCi]

Offsite doses due to projected releases of radioactive materials in liquid effluents are calculated using Equation 3-3. Projected radionuclide release concentrations are used in place of measured concentrations, C_i.

3.4.2 Dose due to Drinking Water (40CFR141)

The National Primary Drinking Water Regulations, 40CFR141, contain the requirements of the Environmental Protection Agency applicable to public water systems. Included are limits on radioactivity concentration. Although these regulations are directed at the owners and operators of public water systems, Dresden has requirements in the RECs related to 40CFR141. Peoria, located 106 miles downriver of the station, is nearest community water system that can be affected by station liquid effluents.

3.4.2.1 40CFR141 Restrictions on Manmade Radionuclides

Section 141.66 states the following:

(a) The average annual concentration of beta particle and photon radioactivity from man-made radionuclides in drinking water shall not produce an annual dose equivalent to the total body or any internal organ greater than 4 millirem/year.

(b) Except for the radionuclides listed in Table 3-1, the concentration of man-made radionuclides causing 4 mrem total body or organ dose equivalents shall be calculated on the basis of drinking 2 liter of water per day (using the 168 hour data listed in "Maximum Permissible Body Burdens and Maximum Permissible Concentration of Radionuclides in Air or Water for Occupational Exposure," NBS Handbook 69 as amended August 1963, U.S. Department of Commerce). If two or more radionuclides are present, the sum of their annual dose equivalents to the total body or any organ shall not exceed 4 millirem/year.

Table 3-1
Average Annual Concentrations Assumed to Produce a Total Body or Organ Dose of 4 mrem/yr

Radionuclide	Critical Organ	pCi/liter
Tritium	Total body	20,000
Strontium-90	Bone marrow	8

3.4.2.2 Application

The projection or calculation of dose due to the drinking water pathway is made using Equation 3-4. Projections are made using projected radionuclides releases in place of measured releases C_i. Doses calculated using Equation 3-4 may differ from doses determined by the methodology prescribed in 40CFR141.66.

When required, Dresden prepares a special report on radiological impact at the nearest community water system. The report should include the following:

- The doses calculated by Equation 3-4.
- A statement identifying the dose calculation methodology (e.g., a reference to this manual).
- A statement that the doses calculated by the ODCM methodology are not necessarily the same as doses calculated by the methodology prescribed in 40CFR141.66.
- The data used to calculate the doses. This information includes the amounts of radioactivity released and the flow rate and dilution values used (see Table 3-2). This information is provided to assist the operator of the community water system in performing its own dose assessment.

3.5 Aquatic Environmental Dose Parameters, General Information

3.5.1 This information is based on Figure 2.2.6-1 of the Dresden UFSAR (update through Rev. 5, June 1987), Section 2.4.1.1 and Figure 2.4-2 of the LaSalle Environmental Report, and the Dresden SAR, Section 2.5, Dresden Station Water Flow Schematic, and Braidwood and LaSalle Stations' collective data.

3.5.2 The station liquid discharge flows into the Illinois River. The nearest public potable water intake is at Peoria, 106 miles downstream of the station.

3.5.3 There is no irrigation occurring on the Illinois River downstream of the station.

3.5.4 Recreation includes one or more of the following: boating, water-skiing, swimming, and sport fishing.

3.5.5 Downstream dams on the Illinois River within 50 miles of the station are located at:

- Dresden Island
- Marseilles
- Starved Rock

3.5.6 Information on radioactivity limits in unprotected outdoor tanks can be found in the Units 2 and 3 Technical Specifications, Section 5.5.8.

Table 3-2
Miscellaneous Dose Assessment Factors: Water and Fish Ingestion Parameters

Parameter	Value	Description	Units
D_w	1.78	Dilution factor from the near field area within one quarter mile of the release point to the potable water intake for drinking water consumption. Derived by dividing average Illinois River flow at Peoria (1.85E+04 cfs) by average Illinois River flow at Dresden (1.04E+04 cfs). Dimensionless.	
f	250	Flow rate, tank discharge. Maximum undiluted discharge rate.	[gpm]
F	4.67E+06	Flow rate, initial dilution stream. Average Illinois River flow rate (1.04E+04 cfs converted to gpm).	[gpm]
F_ℓ	5.35E-05	Near field average dilution factor for C_i during liquid effluent release. Defined as the ratio of the maximum undiluted liquid waste flow during release (250 gpm) to the average flow of receiving waters (4.67E+06 gpm). A factor for the mixing effect of the discharge structure is not used. Dimensionless.	

Table 3-3
Bioaccumulation Factors for Freshwater Fish (BF_i)

Element	BF_i	Element	BF_i
H	9.0E-01	Ag	2.3E+00
C	4.6E+03	Cd	2.0E+02
Na	1.0E+02	Sn	3.0E+03
P	1.0E+05	Sb	1.0E+00
Ca	4.0E+01	Te	4.0E+02
Sc	2.0E+00	I	1.5E+01
Cr	2.0E+02	Cs	2.0E+03
Mn	4.0E+02	Ba	4.0E+00
Fe	1.0E+02	La	2.5E+01
Co	5.0E+01	Ce	1.0E+00
Ni	1.0E+02	Pr	2.5E+01
Cu	5.0E+01	Nd	2.5E+01
Zn	2.0E+03	Pm	2.5E+01
Se	1.7E+02	Sm	2.5E+01
Br	4.2E+02	Eu	2.5E+01
Rb	2.0E+03	Tb	2.5E+01
Sr	3.0E+01	Ho	2.5E+01
Y	2.5E+01	W	1.2E+03
Zr	3.3E+00	U	2.0E+00
Nb	3.0E+04	Np	1.0E+01
Mo	1.0E+01	Pu	3.5E+00
Tc	1.5E+01	Am	2.5E+01
Ru	1.0E+01	Cm	2.5E+01
Rh	1.0E+01	Cf	2.5E+01
Pd	1.0E+01		

Units of pCi/kg per pCi/L
Source: NUREG/CR-4013 (Reference 107) Table 3.1

Table 3-4 (Page 1 of 3)
Liquid Ingestion Dose Commitment Factor for Adult $\left(A_{i\tau}^{liq}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	2.93E+00	2.93E+00	2.93E+00	2.93E+00	2.93E+00	2.93E+00
C-14	3.15E+04	6.29E+03	6.29E+03	6.29E+03	6.29E+03	6.29E+03	6.29E+03
Na-22	4.99E+03	4.99E+03	4.99E+03	4.99E+03	4.99E+03	4.99E+03	4.99E+03
Na-24	4.87E+02	4.87E+02	4.87E+02	4.87E+02	4.87E+02	4.87E+02	4.87E+02
P-32	4.63E+07	2.88E+06	1.79E+06	0.00E+00	0.00E+00	0.00E+00	5.20E+06
Ca-41	2.64E+04	0.00E+00	2.85E+03	0.00E+00	0.00E+00	0.00E+00	2.63E+01
Sc-46	2.84E-01	5.52E-01	1.61E-01	0.00E+00	5.16E-01	0.00E+00	2.69E+03
Cr-51	0.00E+00	0.00E+00	1.40E+00	8.37E-01	3.08E-01	1.86E+00	3.52E+02
Mn-54	0.00E+00	4.60E+03	8.77E+02	0.00E+00	1.37E+03	0.00E+00	1.41E+04
Fe-55	7.88E+02	5.44E+02	1.27E+02	0.00E+00	0.00E+00	3.04E+02	3.12E+02
Mn-56	0.00E+00	1.16E+02	2.05E+01	0.00E+00	1.47E+02	0.00E+00	3.69E+03
Co-57	0.00E+00	2.92E+01	4.85E+01	0.00E+00	0.00E+00	0.00E+00	7.40E+02
Co-58	0.00E+00	1.24E+02	2.78E+02	0.00E+00	0.00E+00	0.00E+00	2.52E+03
Fe-59	1.24E+03	2.92E+03	1.12E+03	0.00E+00	0.00E+00	8.17E+02	9.74E+03
Co-60	0.00E+00	3.57E+02	7.87E+02	0.00E+00	0.00E+00	0.00E+00	6.70E+03
Ni-59	2.80E+03	9.60E+02	4.67E+02	0.00E+00	0.00E+00	0.00E+00	1.98E+02
Ni-63	3.73E+04	2.58E+03	1.25E+03	0.00E+00	0.00E+00	0.00E+00	5.39E+02
Cu-64	0.00E+00	1.39E+01	6.52E+00	0.00E+00	3.50E+01	0.00E+00	1.18E+03
Ni-65	1.51E+02	1.97E+01	8.97E+00	0.00E+00	0.00E+00	0.00E+00	4.99E+02
Zn-65	2.34E+04	7.46E+04	3.37E+04	0.00E+00	4.99E+04	0.00E+00	4.70E+04
Zn-69m	8.23E+02	1.98E+03	1.81E+02	0.00E+00	1.20E+03	0.00E+00	1.21E+05
Zn-69	4.99E+01	9.54E+01	6.63E+00	0.00E+00	6.20E+01	0.00E+00	1.43E+01
Se-79	0.00E+00	1.19E+03	1.99E+02	0.00E+00	2.07E+03	0.00E+00	2.44E+02
Br-82	0.00E+00	0.00E+00	2.38E+03	0.00E+00	0.00E+00	0.00E+00	2.73E+03
Br-83	0.00E+00	0.00E+00	4.24E+01	0.00E+00	0.00E+00	0.00E+00	6.10E+01
Br-84	0.00E+00	0.00E+00	5.49E+01	0.00E+00	0.00E+00	0.00E+00	4.31E-04
Br-85	0.00E+00	0.00E+00	2.25E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.02E+05	4.76E+04	0.00E+00	0.00E+00	0.00E+00	2.01E+04
Rb-87	0.00E+00	5.95E+04	2.07E+04	0.00E+00	0.00E+00	0.00E+00	2.79E+03
Rb-88	0.00E+00	2.93E+02	1.55E+02	0.00E+00	0.00E+00	0.00E+00	4.05E-09
Rb-89	0.00E+00	1.94E+02	1.37E+02	0.00E+00	0.00E+00	0.00E+00	1.13E-11
Sr-89	3.66E+04	0.00E+00	1.05E+03	0.00E+00	0.00E+00	0.00E+00	5.87E+03
Sr-90	1.03E+06	0.00E+00	2.08E+04	0.00E+00	0.00E+00	0.00E+00	2.60E+04
Y-90	1.03E+00	0.00E+00	2.75E-02	0.00E+00	0.00E+00	0.00E+00	1.09E+04
Sr-91	6.73E+02	0.00E+00	2.72E+01	0.00E+00	0.00E+00	0.00E+00	3.21E+03
Y-91m	9.70E-03	0.00E+00	3.76E-04	0.00E+00	0.00E+00	0.00E+00	2.85E-02
Y-91	1.51E+01	0.00E+00	4.02E-01	0.00E+00	0.00E+00	0.00E+00	8.28E+03
Sr-92	2.55E+02	0.00E+00	1.10E+01	0.00E+00	0.00E+00	0.00E+00	5.06E+03
Y-92	9.02E-02	0.00E+00	2.64E-03	0.00E+00	0.00E+00	0.00E+00	1.58E+03
Y-93	2.86E-01	0.00E+00	7.90E-03	0.00E+00	0.00E+00	0.00E+00	9.07E+03
Nb-93m	1.84E+03	5.99E+02	1.48E+02	0.00E+00	6.89E+02	0.00E+00	2.76E+05
Nb-95	4.48E+02	2.49E+02	1.34E+02	0.00E+00	2.46E+02	0.00E+00	1.51E+06
Nb-97	3.76E+00	9.50E-01	3.47E-01	0.00E+00	1.11E+00	0.00E+00	3.50E+03
Zr-93	2.29E+00	1.28E-01	5.97E-02	0.00E+00	4.85E-01	0.00E+00	1.33E+02
Zr-95	1.66E+00	5.34E-01	3.61E-01	0.00E+00	8.37E-01	0.00E+00	1.69E+03
Zr-97	9.19E-02	1.86E-02	8.48E-03	0.00E+00	2.80E-02	0.00E+00	5.75E+03
Mo-93	0.00E+00	5.32E+02	1.44E+01	0.00E+00	1.51E+02	0.00E+00	8.64E+01
Mo-99	0.00E+00	3.05E+02	5.80E+01	0.00E+00	6.91E+02	0.00E+00	7.07E+02
Tc-99	1.03E+01	1.54E+01	4.16E+00	0.00E+00	1.94E+02	1.31E+00	5.03E+02
Tc-99m	2.04E-02	5.78E-02	7.36E-01	0.00E+00	8.77E-01	2.83E-02	3.42E+01
Tc-101	2.10E-02	3.03E-02	2.97E-01	0.00E+00	5.45E-01	1.55E-02	9.11E-14
Ru-103	1.31E+01	0.00E+00	5.64E+00	0.00E+00	5.00E+01	0.00E+00	1.53E+03
Ru-105	1.09E+00	0.00E+00	4.30E-01	0.00E+00	1.41E+01	0.00E+00	6.67E+02
Rh-105	8.57E+00	6.26E+00	4.13E+00	0.00E+00	2.66E+01	0.00E+00	9.98E+02
Ru-106	1.95E+02	0.00E+00	2.46E+01	0.00E+00	3.76E+02	0.00E+00	1.26E+04
Pd-107	0.00E+00	1.04E+01	6.65E-01	0.00E+00	9.34E+01	0.00E+00	6.45E+01

Table 3-4 (Page 2 of 3)
Liquid Ingestion Dose Commitment Factor for Adult $\left(A_{i\tau}^{liq}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	1.25E+01	2.82E+00	0.00E+00	7.15E+01	0.00E+00	1.39E+03
Ag-110m	8.37E+00	7.74E+00	4.60E+00	0.00E+00	1.52E+01	0.00E+00	3.16E+03
Ag-111	3.04E+00	1.27E+00	6.33E-01	0.00E+00	4.10E+00	0.00E+00	2.33E+03
Cd-113m	0.00E+00	1.67E+03	5.37E+01	0.00E+00	1.84E+03	0.00E+00	1.35E+04
Cd-115m	0.00E+00	9.68E+02	3.09E+01	0.00E+00	7.68E+02	0.00E+00	4.07E+04
Sn-123	2.25E+05	3.73E+03	5.49E+03	3.17E+03	0.00E+00	0.00E+00	4.58E+05
Sn-125	6.03E+04	1.22E+03	2.74E+03	1.01E+03	0.00E+00	0.00E+00	7.53E+05
Sn-126	6.12E+05	1.21E+04	1.74E+04	3.56E+03	0.00E+00	0.00E+00	1.76E+05
Sb-124	1.38E+02	2.60E+00	5.46E+01	3.34E-01	0.00E+00	1.07E+02	3.91E+03
Sb-125	8.81E+01	9.84E-01	2.10E+01	8.96E-02	0.00E+00	6.79E+01	9.70E+02
Sb-126	5.66E+01	1.15E+00	2.04E+01	3.46E-01	0.00E+00	3.47E+01	4.63E+03
Sb-127	1.27E+01	2.78E-01	4.87E+00	1.53E-01	0.00E+00	7.53E+00	2.90E+03
Te-125m	2.70E+03	9.77E+02	3.61E+02	8.11E+02	1.10E+04	0.00E+00	1.08E+04
Te-127m	6.81E+03	2.43E+03	8.30E+02	1.74E+03	2.77E+04	0.00E+00	2.28E+04
Te-127	1.11E+02	3.97E+01	2.39E+01	8.20E+01	4.51E+02	0.00E+00	8.73E+03
Te-129m	1.16E+04	4.31E+03	1.83E+03	3.97E+03	4.83E+04	0.00E+00	5.82E+04
Te-129	3.16E+01	1.19E+01	7.69E+00	2.42E+01	1.33E+02	0.00E+00	2.38E+01
Te-133m	4.65E+01	2.72E+01	2.61E+01	3.93E+01	2.69E+02	0.00E+00	9.31E+00
Te-134	3.26E+01	2.13E+01	1.31E+01	2.85E+01	2.06E+02	0.00E+00	3.61E-02
I-129	2.71E+02	2.33E+02	7.62E+02	5.98E+05	5.00E+02	0.00E+00	3.68E+01
I-130	6.26E+01	1.85E+02	7.28E+01	1.56E+04	2.88E+02	0.00E+00	1.59E+02
I-131	3.44E+02	4.93E+02	2.82E+02	1.61E+05	8.44E+02	0.00E+00	1.30E+02
Te-131m	1.74E+03	8.51E+02	7.09E+02	1.35E+03	8.62E+03	0.00E+00	8.45E+04
Te-131	1.98E+01	8.28E+00	6.26E+00	1.63E+01	8.68E+01	0.00E+00	2.81E+00
I-132	1.68E+01	4.49E+01	1.57E+01	1.57E+03	7.16E+01	0.00E+00	8.44E+00
Te-132	2.53E+03	1.64E+03	1.54E+03	1.81E+03	1.58E+04	0.00E+00	7.75E+04
I-133	1.18E+02	2.04E+02	6.23E+01	3.00E+04	3.57E+02	0.00E+00	1.84E+02
Cs-134m	1.03E+02	2.17E+02	1.11E+02	0.00E+00	1.18E+02	1.85E+01	7.65E+01
Cs-134	3.01E+05	7.17E+05	5.86E+05	0.00E+00	2.32E+05	7.70E+04	1.25E+04
I-134	8.77E+00	2.38E+01	8.53E+00	4.13E+02	3.79E+01	0.00E+00	2.08E-02
I-135	3.67E+01	9.60E+01	3.54E+01	6.33E+03	1.54E+02	0.00E+00	1.08E+02
Cs-135	9.44E+04	8.71E+04	3.87E+04	0.00E+00	3.30E+04	9.88E+03	2.04E+03
Cs-136	3.15E+04	1.24E+05	8.96E+04	0.00E+00	6.92E+04	9.49E+03	1.41E+04
Cs-137	3.86E+05	5.28E+05	3.46E+05	0.00E+00	1.79E+05	5.95E+04	1.02E+04
Cs-138	2.67E+02	5.28E+02	2.61E+02	0.00E+00	3.88E+02	3.83E+01	2.25E-03
Cs-139	1.65E+02	2.46E+02	8.96E+01	0.00E+00	1.97E+02	1.79E+01	5.33E-21
Ba-139	5.47E+00	3.90E-03	1.60E-01	0.00E+00	3.64E-03	2.21E-03	9.70E+00
Ba-140	1.15E+03	1.44E+00	7.50E+01	0.00E+00	4.89E-01	8.24E-01	2.36E+03
La-140	2.67E-01	1.35E-01	3.55E-02	0.00E+00	0.00E+00	0.00E+00	9.87E+03
Ba-141	2.66E+00	2.01E-03	8.97E-02	0.00E+00	1.87E-03	1.14E-03	1.25E-09
La-141	3.41E-02	1.06E-02	1.73E-03	0.00E+00	0.00E+00	0.00E+00	1.26E+03
Ce-141	4.61E-01	3.12E-01	3.53E-02	0.00E+00	1.45E-01	0.00E+00	1.19E+03
Ba-142	1.20E+00	1.24E-03	7.56E-02	0.00E+00	1.04E-03	6.99E-04	1.69E-18
La-142	1.37E-02	6.21E-03	1.55E-03	0.00E+00	0.00E+00	0.00E+00	4.54E+01
Ce-143	8.12E-02	6.00E+01	6.64E-03	0.00E+00	2.64E-02	0.00E+00	2.24E+03
Pr-143	9.82E-01	3.94E-01	4.87E-02	0.00E+00	2.27E-01	0.00E+00	4.30E+03
Ce-144	2.40E+01	1.00E+01	1.29E+00	0.00E+00	5.95E+00	0.00E+00	8.12E+03
Pr-144	3.21E-03	1.33E-03	1.63E-04	0.00E+00	7.53E-04	0.00E+00	4.62E-10
Nd-147	6.71E-01	7.76E-01	4.64E-02	0.00E+00	4.54E-01	0.00E+00	3.73E+03
Pm-147	8.05E+00	7.57E-01	3.06E-01	0.00E+00	1.43E+00	0.00E+00	9.53E+02
Pm-148m	3.28E+00	8.49E-01	6.49E-01	0.00E+00	1.28E+00	0.00E+00	7.19E+03
Pm-148	7.65E-01	1.27E-01	6.39E-02	0.00E+00	2.40E-01	0.00E+00	9.98E+03
Pm-149	1.62E-01	2.30E-02	9.37E-03	0.00E+00	4.33E-02	0.00E+00	4.30E+03
Pm-151	7.44E-02	1.25E-02	6.31E-03	0.00E+00	2.23E-02	0.00E+00	3.44E+03
Sm-151	7.37E+00	1.27E+00	3.04E-01	0.00E+00	1.42E+00	0.00E+00	5.60E+02
Sm-153	9.15E-02	7.63E-02	5.57E-03	0.00E+00	2.47E-02	0.00E+00	2.72E+03

Table 3-4 (Page 3 of 3)
Liquid Ingestion Dose Commitment Factor for Adult $\left(A_{i\tau}^{liq}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	2.08E+01	4.74E+00	4.16E+00	0.00E+00	2.94E+01	0.00E+00	2.73E+03
Eu-154	6.57E+01	8.07E+00	5.74E+00	0.00E+00	3.86E+01	0.00E+00	5.85E+03
Eu-155	9.18E+00	1.30E+00	8.40E-01	0.00E+00	6.01E+00	0.00E+00	1.02E+03
Eu-156	1.46E+00	1.13E+00	1.83E-01	0.00E+00	7.56E-01	0.00E+00	7.75E+03
Tb-160	5.02E+00	0.00E+00	6.26E-01	0.00E+00	2.07E+00	0.00E+00	4.62E+03
Ho-166m	2.88E+01	9.00E+00	6.83E+00	0.00E+00	1.35E+01	0.00E+00	2.73E+03
W-181	2.90E+01	9.44E+00	1.01E+00	0.00E+00	0.00E+00	0.00E+00	1.08E+03
W-185	1.18E+03	3.95E+02	4.15E+01	0.00E+00	0.00E+00	0.00E+00	4.56E+04
W-187	3.01E+02	2.52E+02	8.80E+01	0.00E+00	0.00E+00	0.00E+00	8.24E+04
Np-239	8.42E-02	8.28E-03	4.57E-03	0.00E+00	2.58E-02	0.00E+00	1.70E+03
U-232	2.13E+05	0.00E+00	1.52E+04	0.00E+00	2.31E+04	0.00E+00	3.50E+03
U-233	4.50E+04	0.00E+00	2.73E+03	0.00E+00	1.05E+04	0.00E+00	3.24E+03
U-234	4.31E+04	0.00E+00	2.67E+03	0.00E+00	1.03E+04	0.00E+00	3.17E+03
U-235	4.13E+04	0.00E+00	2.51E+03	0.00E+00	9.65E+03	0.00E+00	4.03E+03
U-236	4.13E+04	0.00E+00	2.56E+03	0.00E+00	9.86E+03	0.00E+00	2.97E+03
U-237	2.85E+00	0.00E+00	7.59E-01	0.00E+00	1.17E+01	0.00E+00	1.00E+03
U-238	3.96E+04	0.00E+00	2.34E+03	0.00E+00	9.03E+03	0.00E+00	2.84E+03
Np-237	8.92E+04	6.34E+03	3.92E+03	0.00E+00	2.92E+04	0.00E+00	5.62E+03
Np-238	9.70E-01	2.61E-02	1.51E-02	0.00E+00	8.85E-02	0.00E+00	2.43E+03
Pu-238	3.48E+04	4.41E+03	9.44E+02	0.00E+00	4.04E+03	0.00E+00	4.03E+03
Pu-239	4.00E+04	4.81E+03	1.05E+03	0.00E+00	4.48E+03	0.00E+00	3.68E+03
Pu-240	4.00E+04	4.80E+03	1.05E+03	0.00E+00	4.47E+03	0.00E+00	3.74E+03
Pu-241	8.67E+02	4.11E+01	1.83E+01	0.00E+00	8.45E+01	0.00E+00	7.73E+01
Pu-242	3.71E+04	4.63E+03	1.02E+03	0.00E+00	4.31E+03	0.00E+00	3.61E+03
Pu-244	4.33E+04	5.31E+03	1.16E+03	0.00E+00	4.94E+03	0.00E+00	5.37E+03
Am-241	8.06E+04	7.53E+04	5.78E+03	0.00E+00	4.34E+04	0.00E+00	7.92E+03
Am-242m	8.12E+04	7.08E+04	5.80E+03	0.00E+00	4.32E+04	0.00E+00	9.97E+03
Am-243	8.05E+04	7.37E+04	5.66E+03	0.00E+00	4.26E+04	0.00E+00	9.29E+03
Cm-242	2.20E+03	2.34E+03	1.46E+02	0.00E+00	6.64E+02	0.00E+00	8.45E+03
Cm-243	6.39E+04	5.86E+04	4.00E+03	0.00E+00	1.87E+04	0.00E+00	8.34E+03
Cm-244	4.87E+04	4.56E+04	3.06E+03	0.00E+00	1.43E+04	0.00E+00	8.06E+03
Cm-245	1.00E+05	8.72E+04	6.15E+03	0.00E+00	2.87E+04	0.00E+00	7.52E+03
Cm-246	9.93E+04	8.71E+04	6.14E+03	0.00E+00	2.86E+04	0.00E+00	7.38E+03
Cm-247	9.68E+04	8.58E+04	6.05E+03	0.00E+00	2.82E+04	0.00E+00	9.70E+03
Cm-248	8.05E+05	7.08E+05	4.99E+04	0.00E+00	2.33E+05	0.00E+00	1.57E+05
Cf-252	2.79E+04	0.00E+00	6.71E+02	0.00E+00	0.00E+00	0.00E+00	3.07E+04

Units of mrem/hr per µCi/ml

Table 3-5 (Page 1 of 3)
Liquid Ingestion Dose Commitment Factor for Teenager $\left(A_{i\tau}^{liq}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	2.07E+00	2.07E+00	2.07E+00	2.07E+00	2.07E+00	2.07E+00
C-14	3.42E+04	6.85E+03	6.85E+03	6.85E+03	6.85E+03	6.85E+03	6.85E+03
Na-22	5.04E+03	5.04E+03	5.04E+03	5.04E+03	5.04E+03	5.04E+03	5.04E+03
Na-24	4.95E+02	4.95E+02	4.95E+02	4.95E+02	4.95E+02	4.95E+02	4.95E+02
P-32	5.04E+07	3.12E+06	1.95E+06	0.00E+00	0.00E+00	0.00E+00	4.24E+06
Ca-41	2.08E+04	0.00E+00	2.25E+03	0.00E+00	0.00E+00	0.00E+00	2.06E+01
Sc-46	2.63E-01	5.13E-01	1.52E-01	0.00E+00	4.91E-01	0.00E+00	1.75E+03
Cr-51	0.00E+00	0.00E+00	1.43E+00	7.96E-01	3.14E-01	2.05E+00	2.41E+02
Mn-54	0.00E+00	4.50E+03	8.93E+02	0.00E+00	1.34E+03	0.00E+00	9.24E+03
Fe-55	8.14E+02	5.77E+02	1.35E+02	0.00E+00	0.00E+00	3.66E+02	2.50E+02
Mn-56	0.00E+00	1.21E+02	2.14E+01	0.00E+00	1.53E+02	0.00E+00	7.94E+03
Co-57	0.00E+00	2.95E+01	4.95E+01	0.00E+00	0.00E+00	0.00E+00	5.51E+02
Co-58	0.00E+00	1.21E+02	2.78E+02	0.00E+00	0.00E+00	0.00E+00	1.66E+03
Fe-59	1.26E+03	2.95E+03	1.14E+03	0.00E+00	0.00E+00	9.30E+02	6.98E+03
Co-60	0.00E+00	3.49E+02	7.85E+02	0.00E+00	0.00E+00	0.00E+00	4.54E+03
Ni-59	2.84E+03	1.00E+03	4.82E+02	0.00E+00	0.00E+00	0.00E+00	1.57E+02
Ni-63	3.81E+04	2.69E+03	1.29E+03	0.00E+00	0.00E+00	0.00E+00	4.29E+02
Cu-64	0.00E+00	1.43E+01	6.71E+00	0.00E+00	3.61E+01	0.00E+00	1.11E+03
Ni-65	1.61E+02	2.06E+01	9.39E+00	0.00E+00	0.00E+00	0.00E+00	1.12E+03
Zn-65	2.12E+04	7.37E+04	3.44E+04	0.00E+00	4.72E+04	0.00E+00	3.12E+04
Zn-69m	8.85E+02	2.09E+03	1.91E+02	0.00E+00	1.27E+03	0.00E+00	1.15E+05
Zn-69	5.42E+01	1.03E+02	7.22E+00	0.00E+00	6.74E+01	0.00E+00	1.90E+02
Se-79	0.00E+00	1.28E+03	2.15E+02	0.00E+00	2.23E+03	0.00E+00	1.96E+02
Br-82	0.00E+00	0.00E+00	2.43E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	4.59E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	5.77E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	2.44E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.10E+05	5.16E+04	0.00E+00	0.00E+00	0.00E+00	1.63E+04
Rb-87	0.00E+00	6.45E+04	2.25E+04	0.00E+00	0.00E+00	0.00E+00	2.25E+03
Rb-88	0.00E+00	3.14E+02	1.67E+02	0.00E+00	0.00E+00	0.00E+00	2.69E-05
Rb-89	0.00E+00	2.03E+02	1.43E+02	0.00E+00	0.00E+00	0.00E+00	3.11E-07
Sr-89	3.85E+04	0.00E+00	1.10E+03	0.00E+00	0.00E+00	0.00E+00	4.59E+03
Sr-90	8.93E+05	0.00E+00	1.79E+04	0.00E+00	0.00E+00	0.00E+00	2.04E+04
Y-90	1.07E+00	0.00E+00	2.89E-02	0.00E+00	0.00E+00	0.00E+00	8.86E+03
Sr-91	7.06E+02	0.00E+00	2.81E+01	0.00E+00	0.00E+00	0.00E+00	3.20E+03
Y-91m	1.01E-02	0.00E+00	3.86E-04	0.00E+00	0.00E+00	0.00E+00	4.77E-01
Y-91	1.58E+01	0.00E+00	4.22E-01	0.00E+00	0.00E+00	0.00E+00	6.46E+03
Sr-92	2.67E+02	0.00E+00	1.14E+01	0.00E+00	0.00E+00	0.00E+00	6.80E+03
Y-92	9.48E-02	0.00E+00	2.74E-03	0.00E+00	0.00E+00	0.00E+00	2.60E+03
Y-93	3.00E-01	0.00E+00	8.23E-03	0.00E+00	0.00E+00	0.00E+00	9.17E+03
Nb-93m	1.89E+03	6.20E+02	1.55E+02	0.00E+00	7.24E+02	0.00E+00	2.23E+05
Nb-95	4.51E+02	2.50E+02	1.38E+02	0.00E+00	2.42E+02	0.00E+00	1.07E+06
Nb-97	4.04E+00	1.00E+00	3.66E-01	0.00E+00	1.17E+00	0.00E+00	2.40E+04
Zr-93	2.14E+00	1.06E+00	5.77E-01	0.00E+00	3.74E+00	0.00E+00	9.99E+02
Zr-95	1.60E+00	5.04E-01	3.46E-01	0.00E+00	7.40E-01	0.00E+00	1.16E+03
Zr-97	9.18E-02	1.82E-02	8.37E-03	0.00E+00	2.75E-02	0.00E+00	4.92E+03
Mo-93	0.00E+00	5.40E+02	1.48E+01	0.00E+00	1.55E+02	0.00E+00	6.58E+01
Mo-99	0.00E+00	3.07E+02	5.86E+01	0.00E+00	7.03E+02	0.00E+00	5.51E+02
Tc-99	1.08E+01	1.58E+01	4.31E+00	0.00E+00	2.01E+02	1.63E+00	3.87E+02
Tc-99m	2.00E-02	5.57E-02	7.21E-01	0.00E+00	8.29E-01	3.09E-02	3.65E+01
Tc-101	2.16E-02	3.08E-02	3.02E-01	0.00E+00	5.57E-01	1.88E-02	5.26E-09
Ru-103	1.30E+01	0.00E+00	5.56E+00	0.00E+00	4.58E+01	0.00E+00	1.09E+03
Ru-105	1.11E+00	0.00E+00	4.31E-01	0.00E+00	1.40E+01	0.00E+00	8.97E+02
Rh-105	8.82E+00	6.37E+00	4.18E+00	0.00E+00	2.71E+01	0.00E+00	8.10E+02
Ru-106	2.00E+02	0.00E+00	2.52E+01	0.00E+00	3.85E+02	0.00E+00	9.58E+03
Pd-107	0.00E+00	1.06E+01	6.83E-01	0.00E+00	9.58E+01	0.00E+00	4.92E+01

Table 3-5 (Page 2 of 3)
Liquid Ingestion Dose Commitment Factor for Teenager $\left(A_{i\tau}^{liq}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	1.28E+01	2.91E+00	0.00E+00	7.39E+01	0.00E+00	1.29E+03
Ag-110m	7.57E+00	7.16E+00	4.36E+00	0.00E+00	1.37E+01	0.00E+00	2.01E+03
Ag-111	3.06E+00	1.27E+00	6.39E-01	0.00E+00	4.13E+00	0.00E+00	1.77E+03
Cd-113m	0.00E+00	1.79E+03	5.77E+01	0.00E+00	1.99E+03	0.00E+00	1.08E+04
Cd-115m	0.00E+00	1.03E+03	3.34E+01	0.00E+00	8.28E+02	0.00E+00	3.28E+04
Sn-123	2.45E+05	4.02E+03	5.95E+03	3.22E+03	0.00E+00	0.00E+00	3.70E+05
Sn-125	6.56E+04	1.31E+03	2.96E+03	1.03E+03	0.00E+00	0.00E+00	6.17E+05
Sn-126	6.39E+05	1.19E+04	1.82E+04	3.14E+03	0.00E+00	0.00E+00	1.42E+05
Sb-124	1.34E+02	2.46E+00	5.21E+01	3.03E-01	0.00E+00	1.17E+02	2.69E+03
Sb-125	8.56E+01	9.36E-01	2.00E+01	8.18E-02	0.00E+00	7.53E+01	6.67E+02
Sb-126	5.49E+01	1.12E+00	1.97E+01	3.10E-01	0.00E+00	3.94E+01	3.25E+03
Sb-127	1.25E+01	2.68E-01	4.73E+00	1.41E-01	0.00E+00	8.53E+00	2.13E+03
Te-125m	2.92E+03	1.05E+03	3.91E+02	8.17E+02	0.00E+00	0.00E+00	8.63E+03
Te-127m	7.38E+03	2.62E+03	8.78E+02	1.76E+03	2.99E+04	0.00E+00	1.84E+04
Te-127	1.21E+02	4.27E+01	2.60E+01	8.32E+01	4.89E+02	0.00E+00	9.31E+03
Te-129m	1.24E+04	4.62E+03	1.97E+03	4.01E+03	5.21E+04	0.00E+00	4.67E+04
Te-129	3.42E+01	1.27E+01	8.32E+00	2.44E+01	1.44E+02	0.00E+00	1.87E+02
Te-133m	4.92E+01	2.79E+01	2.72E+01	3.90E+01	2.76E+02	0.00E+00	1.13E+02
Te-134	3.41E+01	2.19E+01	2.29E+01	2.80E+01	2.09E+02	0.00E+00	1.27E+00
I-129	2.80E+02	2.36E+02	3.93E+02	2.87E+05	4.21E+02	0.00E+00	2.75E+01
I-130	6.19E+01	1.79E+02	7.15E+01	1.46E+04	2.76E+02	0.00E+00	1.38E+02
I-131	3.52E+02	4.92E+02	2.64E+02	1.44E+05	8.47E+02	0.00E+00	9.74E+01
Te-131m	1.86E+03	8.93E+02	7.45E+02	1.34E+03	9.31E+03	0.00E+00	7.17E+04
Te-131	2.13E+01	8.78E+00	6.66E+00	1.64E+01	9.31E+01	0.00E+00	1.75E+00
I-132	1.68E+01	4.39E+01	1.57E+01	1.48E+03	6.91E+01	0.00E+00	1.91E+01
Te-132	2.66E+03	1.69E+03	1.59E+03	1.78E+03	1.62E+04	0.00E+00	5.34E+04
I-133	1.21E+02	2.05E+02	6.25E+01	2.86E+04	3.59E+02	0.00E+00	1.55E+02
Cs-134m	1.08E+02	2.24E+02	1.15E+02	0.00E+00	1.25E+02	2.19E+01	1.49E+02
Cs-134	3.08E+05	7.26E+05	3.37E+05	0.00E+00	2.31E+05	8.81E+04	9.03E+03
I-134	8.78E+00	2.33E+01	8.35E+00	3.88E+02	3.67E+01	0.00E+00	3.07E-01
I-135	3.67E+01	9.44E+01	3.50E+01	6.07E+03	1.49E+02	0.00E+00	1.05E+02
Cs-135	1.02E+05	9.40E+04	2.20E+04	0.00E+00	3.59E+04	1.30E+04	1.64E+03
Cs-136	3.17E+04	1.25E+05	8.37E+04	0.00E+00	6.78E+04	1.07E+04	1.00E+04
Cs-137	4.13E+05	5.49E+05	1.91E+05	0.00E+00	1.87E+05	7.26E+04	7.81E+03
Cs-138	2.86E+02	5.49E+02	2.75E+02	0.00E+00	4.05E+02	4.72E+01	2.49E-01
Cs-139	1.79E+02	2.64E+02	9.69E+01	0.00E+00	2.13E+02	2.34E+01	1.23E-13
Ba-139	5.56E+00	3.91E-03	1.62E-01	0.00E+00	3.69E-03	2.70E-03	4.96E+01
Ba-140	1.14E+03	1.39E+00	7.32E+01	0.00E+00	4.72E-01	9.36E-01	1.75E+03
La-140	2.73E-01	1.34E-01	3.57E-02	0.00E+00	0.00E+00	0.00E+00	7.70E+03
Ba-141	2.68E+00	2.00E-03	8.96E-02	0.00E+00	1.86E-03	1.37E-03	5.72E-06
La-141	3.57E-02	1.10E-02	1.81E-03	0.00E+00	0.00E+00	0.00E+00	1.94E+03
Ce-141	4.59E-01	3.07E-01	3.52E-02	0.00E+00	1.44E-01	0.00E+00	8.77E+02
Ba-142	1.20E+00	1.20E-03	7.36E-02	0.00E+00	1.01E-03	7.96E-04	3.67E-12
La-142	1.40E-02	6.23E-03	1.55E-03	0.00E+00	0.00E+00	0.00E+00	1.90E+02
Ce-143	8.12E-02	5.91E+01	6.60E-03	0.00E+00	2.65E-02	0.00E+00	1.78E+03
Pr-143	1.03E+00	4.10E-01	5.11E-02	0.00E+00	2.38E-01	0.00E+00	3.38E+03
Ce-144	2.40E+01	9.95E+00	1.29E+00	0.00E+00	5.94E+00	0.00E+00	6.04E+03
Pr-144	3.37E-03	1.38E-03	1.71E-04	0.00E+00	7.92E-04	0.00E+00	3.71E-06
Nd-147	7.35E-01	7.99E-01	4.79E-02	0.00E+00	4.69E-01	0.00E+00	2.88E+03
Pm-147	8.23E+00	7.81E-01	3.18E-01	0.00E+00	1.49E+00	0.00E+00	7.42E+02
Pm-148m	3.24E+00	8.23E-01	6.43E-01	0.00E+00	1.25E+00	0.00E+00	5.18E+03
Pm-148	7.99E-01	1.30E-01	6.55E-02	0.00E+00	2.35E-01	0.00E+00	7.76E+03
Pm-149	1.70E-01	2.39E-02	9.80E-03	0.00E+00	4.55E-02	0.00E+00	3.52E+03
Pm-151	7.74E-02	1.28E-02	6.47E-03	0.00E+00	2.30E-02	0.00E+00	2.87E+03
Sm-151	6.84E+00	1.32E+00	3.09E-01	0.00E+00	1.44E+00	0.00E+00	4.47E+02
Sm-153	9.56E-02	7.92E-02	5.82E-03	0.00E+00	2.59E-02	0.00E+00	2.23E+03

Table 3-5 (Page 3 of 3)
Liquid Ingestion Dose Commitment Factor for Teenager $\left(A_{i\tau}^{liq}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	1.92E+01	4.62E+00	4.08E+00	0.00E+00	2.15E+01	0.00E+00	1.70E+03
Eu-154	6.20E+01	7.99E+00	5.63E+00	0.00E+00	3.57E+01	0.00E+00	4.22E+03
Eu-155	1.36E+01	1.32E+00	8.15E-01	0.00E+00	5.15E+00	0.00E+00	7.55E+03
Eu-156	1.50E+00	1.13E+00	1.84E-01	0.00E+00	7.59E-01	0.00E+00	5.77E+03
Tb-160	5.07E+00	0.00E+00	6.32E-01	0.00E+00	2.01E+00	0.00E+00	3.28E+03
Ho-166m	2.80E+01	8.62E+00	6.24E+00	0.00E+00	1.26E+01	0.00E+00	2.12E+03
W-181	3.16E+01	1.02E+01	1.07E+00	0.00E+00	0.00E+00	0.00E+00	8.68E+02
W-185	1.29E+03	4.25E+02	4.49E+01	0.00E+00	0.00E+00	0.00E+00	3.67E+04
W-187	3.25E+02	2.65E+02	9.28E+01	0.00E+00	0.00E+00	0.00E+00	7.16E+04
Np-239	8.97E-02	8.46E-03	4.70E-03	0.00E+00	2.66E-02	0.00E+00	1.36E+03
U-232	2.14E+05	0.00E+00	1.53E+04	0.00E+00	2.32E+04	0.00E+00	2.61E+03
U-233	4.51E+04	0.00E+00	2.74E+03	0.00E+00	1.05E+04	0.00E+00	2.42E+03
U-234	4.33E+04	0.00E+00	2.69E+03	0.00E+00	1.04E+04	0.00E+00	2.37E+03
U-235	4.15E+04	0.00E+00	2.52E+03	0.00E+00	9.71E+03	0.00E+00	3.01E+03
U-236	4.15E+04	0.00E+00	2.58E+03	0.00E+00	9.93E+03	0.00E+00	2.22E+03
U-237	2.87E+00	0.00E+00	7.64E-01	0.00E+00	1.18E+01	0.00E+00	7.60E+02
U-238	3.96E+04	0.00E+00	2.36E+03	0.00E+00	9.09E+03	0.00E+00	2.12E+03
Np-237	6.78E+04	4.87E+03	2.98E+03	0.00E+00	2.21E+04	0.00E+00	4.29E+03
Np-238	9.94E-01	2.66E-02	1.55E-02	0.00E+00	9.12E-02	0.00E+00	1.95E+03
Pu-238	2.62E+04	3.35E+03	7.12E+02	0.00E+00	3.05E+03	0.00E+00	3.02E+03
Pu-239	2.99E+04	3.63E+03	7.86E+02	0.00E+00	3.35E+03	0.00E+00	2.76E+03
Pu-240	2.99E+04	3.62E+03	7.86E+02	0.00E+00	3.35E+03	0.00E+00	2.81E+03
Pu-241	6.84E+02	3.28E+01	1.44E+01	0.00E+00	6.69E+01	0.00E+00	5.79E+01
Pu-242	2.77E+04	3.50E+03	7.59E+02	0.00E+00	3.23E+03	0.00E+00	2.71E+03
Pu-244	3.24E+04	3.99E+03	8.68E+02	0.00E+00	3.69E+03	0.00E+00	4.03E+03
Am-241	6.25E+04	5.90E+04	4.51E+03	0.00E+00	3.38E+04	0.00E+00	6.17E+03
Am-242m	6.32E+04	5.57E+04	4.55E+03	0.00E+00	3.37E+04	0.00E+00	7.76E+03
Am-243	6.24E+04	5.76E+04	4.40E+03	0.00E+00	3.31E+04	0.00E+00	7.23E+03
Cm-242	2.30E+03	2.43E+03	1.53E+02	0.00E+00	6.97E+02	0.00E+00	6.58E+03
Cm-243	5.09E+04	4.73E+04	3.21E+03	0.00E+00	1.50E+04	0.00E+00	6.49E+03
Cm-244	3.95E+04	3.74E+04	2.50E+03	0.00E+00	1.17E+04	0.00E+00	6.27E+03
Cm-245	7.76E+04	6.83E+04	4.78E+03	0.00E+00	2.23E+04	0.00E+00	5.85E+03
Cm-246	7.70E+04	6.82E+04	4.77E+03	0.00E+00	2.23E+04	0.00E+00	5.74E+03
Cm-247	7.50E+04	6.72E+04	4.70E+03	0.00E+00	2.19E+04	0.00E+00	7.55E+03
Cm-248	6.23E+05	5.53E+05	3.88E+04	0.00E+00	1.81E+05	0.00E+00	1.21E+05
Cf-252	2.72E+04	0.00E+00	6.56E+02	0.00E+00	0.00E+00	0.00E+00	2.39E+04

Units of mrem/hr per µCi/ml

Table 3-6 (Page 1 of 3)
Liquid Ingestion Dose Commitment Factor for Child $\left(A_{i\tau}^{liq}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	3.88E+00	3.88E+00	3.88E+00	3.88E+00	3.88E+00	3.88E+00
C-14	4.42E+04	8.85E+03	8.85E+03	8.85E+03	8.85E+03	8.85E+03	8.85E+03
Na-22	6.55E+03	6.55E+03	6.55E+03	6.55E+03	6.55E+03	6.55E+03	6.55E+03
Na-24	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02
P-32	6.50E+07	3.04E+06	2.51E+06	0.00E+00	0.00E+00	0.00E+00	1.80E+06
Ca-41	2.23E+04	0.00E+00	2.43E+03	0.00E+00	0.00E+00	0.00E+00	1.22E+01
Sc-46	6.75E-01	9.26E-01	3.57E-01	0.00E+00	8.19E-01	0.00E+00	1.35E+03
Cr-51	0.00E+00	0.00E+00	1.69E+00	9.40E-01	2.57E-01	1.72E+00	8.98E+01
Mn-54	0.00E+00	3.72E+03	9.91E+02	0.00E+00	1.04E+03	0.00E+00	3.12E+03
Fe-55	1.28E+03	6.80E+02	2.11E+02	0.00E+00	0.00E+00	3.85E+02	1.26E+02
Mn-56	0.00E+00	1.16E+02	2.62E+01	0.00E+00	1.41E+02	0.00E+00	1.68E+04
Co-57	0.00E+00	3.55E+01	7.19E+01	0.00E+00	0.00E+00	0.00E+00	2.91E+02
Co-58	0.00E+00	1.30E+02	3.97E+02	0.00E+00	0.00E+00	0.00E+00	7.57E+02
Fe-59	1.84E+03	2.98E+03	1.48E+03	0.00E+00	0.00E+00	8.63E+02	3.10E+03
Co-60	0.00E+00	3.81E+02	1.12E+03	0.00E+00	0.00E+00	0.00E+00	2.11E+03
Ni-59	4.48E+03	1.19E+03	7.60E+02	0.00E+00	0.00E+00	0.00E+00	7.91E+01
Ni-63	6.00E+04	3.21E+03	2.04E+03	0.00E+00	0.00E+00	0.00E+00	2.16E+02
Cu-64	0.00E+00	1.77E+01	1.07E+01	0.00E+00	4.27E+01	0.00E+00	8.29E+02
Ni-65	2.47E+02	2.33E+01	1.36E+01	0.00E+00	0.00E+00	0.00E+00	2.85E+03
Zn-65	2.20E+04	5.87E+04	3.65E+04	0.00E+00	3.70E+04	0.00E+00	1.03E+04
Zn-69m	1.14E+03	1.95E+03	2.30E+02	0.00E+00	1.13E+03	0.00E+00	6.34E+04
Zn-69	7.04E+01	1.02E+02	9.41E+00	0.00E+00	6.17E+01	0.00E+00	6.42E+03
Se-79	0.00E+00	1.40E+03	3.12E+02	0.00E+00	2.28E+03	0.00E+00	9.21E+01
Br-82	0.00E+00	0.00E+00	2.74E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	6.22E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	7.20E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	3.32E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.08E+05	6.63E+04	0.00E+00	0.00E+00	0.00E+00	6.93E+03
Rb-87	0.00E+00	6.35E+04	2.94E+04	0.00E+00	0.00E+00	0.00E+00	9.52E+02
Rb-88	0.00E+00	3.06E+02	2.12E+02	0.00E+00	0.00E+00	0.00E+00	1.50E+01
Rb-89	0.00E+00	1.88E+02	1.67E+02	0.00E+00	0.00E+00	0.00E+00	1.64E+00
Sr-89	7.44E+04	0.00E+00	2.12E+03	0.00E+00	0.00E+00	0.00E+00	2.88E+03
Sr-90	1.44E+06	0.00E+00	2.90E+04	0.00E+00	0.00E+00	0.00E+00	1.29E+04
Y-90	2.15E+00	0.00E+00	5.76E-02	0.00E+00	0.00E+00	0.00E+00	6.13E+03
Sr-91	1.35E+03	0.00E+00	5.10E+01	0.00E+00	0.00E+00	0.00E+00	2.99E+03
Y-91m	2.00E-02	0.00E+00	7.28E-04	0.00E+00	0.00E+00	0.00E+00	3.92E+01
Y-91	3.15E+01	0.00E+00	8.44E-01	0.00E+00	0.00E+00	0.00E+00	4.20E+03
Sr-92	5.09E+02	0.00E+00	2.04E+01	0.00E+00	0.00E+00	0.00E+00	9.63E+03
Y-92	1.89E-01	0.00E+00	5.40E-03	0.00E+00	0.00E+00	0.00E+00	5.45E+03
Y-93	5.97E-01	0.00E+00	1.64E-02	0.00E+00	0.00E+00	0.00E+00	8.91E+03
Nb-93m	2.48E+03	6.20E+02	2.04E+02	0.00E+00	6.70E+02	0.00E+00	9.35E+04
Nb-95	5.32E+02	2.07E+02	1.48E+02	0.00E+00	1.95E+02	0.00E+00	3.83E+05
Nb-97	5.13E+00	9.28E-01	4.33E-01	0.00E+00	1.03E+00	0.00E+00	2.86E+05
Zr-93	5.90E+00	2.21E+00	1.57E+00	0.00E+00	8.54E+00	0.00E+00	8.37E+02
Zr-95	4.10E+00	9.00E-01	8.01E-01	0.00E+00	1.29E+00	0.00E+00	9.39E+02
Zr-97	2.47E-01	3.57E-02	2.10E-02	0.00E+00	5.12E-02	0.00E+00	5.40E+03
Mo-93	0.00E+00	9.78E+02	3.51E+01	0.00E+00	2.58E+02	0.00E+00	4.95E+01
Mo-99	0.00E+00	5.40E+02	1.34E+02	0.00E+00	1.15E+03	0.00E+00	4.46E+02
Tc-99	2.38E+01	2.65E+01	9.53E+00	0.00E+00	3.13E+02	2.35E+00	2.78E+02
Tc-99m	4.11E-02	8.06E-02	1.34E+00	0.00E+00	1.17E+00	4.09E-02	4.59E+01
Tc-101	4.76E-02	4.99E-02	6.32E-01	0.00E+00	8.50E-01	2.64E-02	1.59E-01
Ru-103	2.97E+01	0.00E+00	1.14E+01	0.00E+00	7.47E+01	0.00E+00	7.67E+02
Ru-105	2.62E+00	0.00E+00	9.50E-01	0.00E+00	2.30E+01	0.00E+00	1.71E+03
Rh-105	2.09E+01	1.12E+01	9.58E+00	0.00E+00	4.46E+01	0.00E+00	6.94E+02
Ru-106	4.75E+02	0.00E+00	5.93E+01	0.00E+00	6.41E+02	0.00E+00	7.39E+03
Pd-107	0.00E+00	1.92E+01	1.63E+00	0.00E+00	1.60E+02	0.00E+00	3.80E+01

Table 3-6 (Page 2 of 3)
Liquid Ingestion Dose Commitment Factor for Child $\left(A_{i\tau}^{liq}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	2.30E+01	6.90E+00	0.00E+00	1.23E+02	0.00E+00	1.36E+03
Ag-110m	1.86E+01	1.26E+01	1.00E+01	0.00E+00	2.34E+01	0.00E+00	1.49E+03
Ag-111	8.56E+00	2.68E+00	1.77E+00	0.00E+00	8.08E+00	0.00E+00	1.64E+03
Cd-113m	0.00E+00	1.94E+03	8.26E+01	0.00E+00	2.00E+03	0.00E+00	5.00E+03
Cd-115m	0.00E+00	1.12E+03	4.78E+01	0.00E+00	8.33E+02	0.00E+00	1.52E+04
Sn-123	3.19E+05	3.95E+03	7.76E+03	4.19E+03	0.00E+00	0.00E+00	1.56E+05
Sn-125	8.50E+04	1.28E+03	3.81E+03	1.33E+03	0.00E+00	0.00E+00	2.64E+05
Sn-126	7.98E+05	9.94E+03	2.27E+04	2.73E+03	0.00E+00	0.00E+00	5.99E+04
Sb-124	3.72E+02	4.82E+00	1.30E+02	8.21E-01	0.00E+00	2.06E+02	2.32E+03
Sb-125	2.40E+02	1.85E+00	5.02E+01	2.22E-01	0.00E+00	1.34E+02	5.73E+02
Sb-126	1.47E+02	2.25E+00	5.29E+01	8.64E-01	0.00E+00	7.03E+01	2.97E+03
Sb-127	3.55E+01	5.49E-01	1.23E+01	3.95E-01	0.00E+00	1.54E+01	2.00E+03
Te-125m	3.96E+03	1.07E+03	5.29E+02	1.11E+03	0.00E+00	0.00E+00	3.83E+03
Te-127m	1.01E+04	2.71E+03	1.19E+03	2.40E+03	2.87E+04	0.00E+00	8.14E+03
Te-127	1.64E+02	4.42E+01	3.51E+01	1.13E+02	4.66E+02	0.00E+00	6.40E+03
Te-129m	1.69E+04	4.73E+03	2.63E+03	5.46E+03	4.97E+04	0.00E+00	2.07E+04
Te-129	4.66E+01	1.30E+01	1.11E+01	3.32E+01	1.36E+02	0.00E+00	2.90E+03
Te-133m	6.50E+01	2.63E+01	3.26E+01	5.04E+01	2.50E+02	0.00E+00	2.01E+03
Te-134	4.49E+01	2.02E+01	2.69E+01	3.55E+01	1.87E+02	0.00E+00	2.05E+02
I-129	6.19E+02	3.80E+02	3.39E+02	2.48E+05	6.41E+02	0.00E+00	1.91E+01
I-130	1.30E+02	2.63E+02	1.35E+02	2.89E+04	3.93E+02	0.00E+00	1.23E+02
I-131	7.66E+02	7.70E+02	4.38E+02	2.55E+05	1.26E+03	0.00E+00	6.86E+01
Te-131m	2.50E+03	8.66E+02	9.22E+02	1.78E+03	8.38E+03	0.00E+00	3.51E+04
Te-131	2.89E+01	8.80E+00	8.59E+00	2.21E+01	8.73E+01	0.00E+00	1.52E+02
I-132	3.56E+01	6.54E+01	3.01E+01	3.04E+03	1.00E+02	0.00E+00	7.70E+01
Te-132	3.51E+03	1.55E+03	1.88E+03	2.26E+03	1.44E+04	0.00E+00	1.56E+04
I-133	2.64E+02	3.26E+02	1.23E+02	6.06E+04	5.43E+02	0.00E+00	1.31E+02
Cs-134m	1.36E+02	2.01E+02	1.31E+02	0.00E+00	1.06E+02	1.75E+01	2.54E+02
Cs-134	3.76E+05	6.17E+05	1.30E+05	0.00E+00	1.91E+05	6.87E+04	3.33E+03
I-134	1.87E+01	3.46E+01	1.59E+01	7.97E+02	5.30E+01	0.00E+00	2.30E+01
I-135	7.79E+01	1.40E+02	6.63E+01	1.24E+04	2.15E+02	0.00E+00	1.07E+02
Cs-135	1.33E+05	9.29E+04	9.54E+03	0.00E+00	3.28E+04	1.10E+04	6.96E+02
Cs-136	3.78E+04	1.04E+05	6.72E+04	0.00E+00	5.53E+04	8.25E+03	3.65E+03
Cs-137	5.26E+05	5.03E+05	7.43E+04	0.00E+00	1.64E+05	5.90E+04	3.15E+03
Cs-138	3.67E+02	5.10E+02	3.23E+02	0.00E+00	3.59E+02	3.86E+01	2.35E+02
Cs-139	2.33E+02	2.59E+02	1.24E+02	0.00E+00	1.95E+02	1.96E+01	2.33E-02
Ba-139	1.48E+01	7.92E-03	4.30E-01	0.00E+00	6.92E-03	4.66E-03	8.57E+02
Ba-140	2.98E+03	2.61E+00	1.74E+02	0.00E+00	8.50E-01	1.56E+00	1.51E+03
La-140	5.29E-01	1.85E-01	6.24E-02	0.00E+00	0.00E+00	0.00E+00	5.16E+03
Ba-141	7.17E+00	4.02E-03	2.33E-01	0.00E+00	3.47E-03	2.36E-02	4.09E+00
La-141	7.13E-02	1.66E-02	3.61E-03	0.00E+00	0.00E+00	0.00E+00	3.69E+03
Ce-141	1.33E+00	6.63E-01	9.85E-02	0.00E+00	2.91E-01	0.00E+00	8.27E+02
Ba-142	3.13E+00	2.26E-03	1.75E-01	0.00E+00	1.83E-03	1.33E-03	4.09E-02
La-142	2.75E-02	8.75E-03	2.74E-03	0.00E+00	0.00E+00	0.00E+00	1.73E+03
Ce-143	2.34E-01	1.27E+02	1.84E-02	0.00E+00	5.33E-02	0.00E+00	1.86E+03
Pr-143	2.06E+00	6.18E-01	1.02E-01	0.00E+00	3.35E-01	0.00E+00	2.22E+03
Ce-144	6.97E+01	2.18E+01	3.72E+00	0.00E+00	1.21E+01	0.00E+00	5.69E+03
Pr-144	6.76E-03	2.09E-03	3.40E-04	0.00E+00	1.11E-03	0.00E+00	4.50E+00
Nd-147	1.46E+00	1.18E+00	9.17E-02	0.00E+00	6.50E-01	0.00E+00	1.88E+03
Pm-147	1.67E+01	1.19E+00	6.39E-01	0.00E+00	2.10E+00	0.00E+00	4.82E+02
Pm-148m	5.40E+00	1.07E+00	1.07E+00	0.00E+00	1.59E+00	0.00E+00	3.03E+03
Pm-148	1.58E+00	1.90E-01	1.23E-01	0.00E+00	3.23E-01	0.00E+00	5.08E+03
Pm-149	3.40E-01	3.62E-02	1.96E-02	0.00E+00	6.39E-02	0.00E+00	2.47E+03
Pm-151	1.53E-01	1.86E-02	1.21E-02	0.00E+00	3.15E-02	0.00E+00	2.11E+03
Sm-151	1.34E+01	2.00E+00	6.29E-01	0.00E+00	2.06E+00	0.00E+00	2.90E+02
Sm-153	1.91E-01	1.19E-01	1.15E-02	0.00E+00	3.62E-02	0.00E+00	1.58E+03

Table 3-6 (Page 3 of 3)
Liquid Ingestion Dose Commitment Factor for Child $\left(A_{i\tau}^{liq}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	3.22E+01	5.87E+00	6.97E+00	0.00E+00	2.48E+01	0.00E+00	9.64E+02
Eu-154	1.21E+02	1.08E+01	9.90E+00	0.00E+00	4.76E+01	0.00E+00	2.52E+03
Eu-155	2.53E+01	1.82E+00	1.43E+00	0.00E+00	6.81E+00	0.00E+00	4.55E+03
Eu-156	2.94E+00	1.58E+00	3.26E-01	0.00E+00	1.02E+00	0.00E+00	3.58E+03
Tb-160	8.70E+00	0.00E+00	1.08E+00	0.00E+00	2.59E+00	0.00E+00	1.93E+03
Ho-166m	5.66E+01	1.18E+01	1.00E+01	0.00E+00	1.69E+01	0.00E+00	1.38E+03
W-181	4.14E+01	1.02E+01	1.40E+00	0.00E+00	0.00E+00	0.00E+00	3.71E+02
W-185	1.69E+03	4.22E+02	5.92E+01	0.00E+00	0.00E+00	0.00E+00	1.57E+04
W-187	4.20E+02	2.48E+02	1.11E+02	0.00E+00	0.00E+00	0.00E+00	3.49E+04
Np-239	2.13E-01	1.53E-02	1.08E-02	0.00E+00	4.42E-02	0.00E+00	1.13E+03
U-232	6.03E+05	0.00E+00	4.32E+04	0.00E+00	4.59E+04	0.00E+00	2.39E+03
U-233	1.28E+05	0.00E+00	7.71E+03	0.00E+00	2.09E+04	0.00E+00	2.21E+03
U-234	1.22E+05	0.00E+00	7.58E+03	0.00E+00	2.05E+04	0.00E+00	2.17E+03
U-235	1.17E+05	0.00E+00	7.10E+03	0.00E+00	1.92E+04	0.00E+00	2.75E+03
U-236	1.17E+05	0.00E+00	7.27E+03	0.00E+00	1.96E+04	0.00E+00	2.03E+03
U-237	8.09E+00	0.00E+00	2.15E+00	0.00E+00	2.33E+01	0.00E+00	7.13E+02
U-238	1.12E+05	0.00E+00	6.65E+03	0.00E+00	1.80E+04	0.00E+00	1.94E+03
Np-237	9.05E+04	5.97E+03	3.97E+03	0.00E+00	2.46E+04	0.00E+00	3.31E+03
Np-238	2.37E+00	4.79E-02	3.69E-02	0.00E+00	1.53E-01	0.00E+00	1.64E+03
Pu-238	4.22E+04	4.89E+03	1.12E+03	0.00E+00	4.08E+03	0.00E+00	2.66E+03
Pu-239	4.57E+04	4.89E+03	1.17E+03	0.00E+00	4.33E+03	0.00E+00	2.43E+03
Pu-240	4.54E+04	5.07E+03	1.17E+03	0.00E+00	4.33E+03	0.00E+00	2.48E+03
Pu-241	1.37E+03	5.60E+01	2.85E+01	0.00E+00	1.05E+02	0.00E+00	5.11E+01
Pu-242	4.22E+04	4.89E+03	1.13E+03	0.00E+00	4.15E+03	0.00E+00	2.38E+03
Pu-244	4.93E+04	5.60E+04	1.29E+03	0.00E+00	4.79E+03	0.00E+00	3.55E+03
Am-241	7.13E+04	6.13E+04	5.34E+03	0.00E+00	3.26E+04	0.00E+00	4.00E+03
Am-242m	7.34E+04	5.87E+04	5.45E+03	0.00E+00	3.30E+04	0.00E+00	5.04E+03
Am-243	7.02E+04	5.92E+04	5.15E+03	0.00E+00	3.18E+04	0.00E+00	4.69E+03
Cm-242	4.60E+03	3.67E+03	3.06E+02	0.00E+00	9.80E+02	0.00E+00	4.28E+03
Cm-243	6.71E+04	5.45E+04	4.32E+03	0.00E+00	1.61E+04	0.00E+00	4.21E+03
Cm-244	5.66E+04	4.58E+04	3.63E+03	0.00E+00	1.33E+04	0.00E+00	4.07E+03
Cm-245	8.75E+04	7.02E+04	5.50E+03	0.00E+00	2.15E+04	0.00E+00	3.79E+03
Cm-246	8.65E+04	7.02E+04	5.50E+03	0.00E+00	2.15E+04	0.00E+00	3.73E+03
Cm-247	8.44E+04	6.92E+04	5.40E+03	0.00E+00	2.12E+04	0.00E+00	4.90E+03
Cm-248	7.02E+05	5.71E+05	4.46E+04	0.00E+00	1.74E+05	0.00E+00	7.91E+04
Cf-252	5.50E+04	0.00E+00	1.33E+03	0.00E+00	0.00E+00	0.00E+00	1.55E+04

Units of mrem/hr per µCi/ml

Table 3-7 (Page 1 of 3)
Liquid Ingestion Dose Commitment Factor for Infant $\left(A_{i\tau}^{liq}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	3.72E+00	3.72E+00	3.72E+00	3.72E+00	3.72E+00	3.72E+00
C-14	5.02E+02	1.07E+02	1.07E+02	1.07E+02	1.07E+02	1.07E+02	1.07E+02
Na-22	2.08E+03	2.08E+03	2.08E+03	2.08E+03	2.08E+03	2.08E+03	2.08E+03
Na-24	2.14E+02	2.14E+02	2.14E+02	2.14E+02	2.14E+02	2.14E+02	2.14E+02
P-32	3.60E+04	2.12E+03	1.39E+03	0.00E+00	0.00E+00	0.00E+00	4.87E+02
Ca-41	7.92E+03	0.00E+00	8.63E+02	0.00E+00	0.00E+00	0.00E+00	4.04E+00
Sc-46	7.94E-01	1.14E+00	3.58E-01	0.00E+00	7.53E-01	0.00E+00	7.47E+02
Cr-51	0.00E+00	0.00E+00	2.98E-01	1.95E-01	4.25E-02	3.79E-01	8.70E+00
Mn-54	0.00E+00	4.21E+02	9.54E+01	0.00E+00	9.33E+01	0.00E+00	1.55E+02
Fe-55	2.94E+02	1.90E+02	5.08E+01	0.00E+00	0.00E+00	9.29E+01	2.41E+01
Mn-56	0.00E+00	1.73E+01	2.98E+00	0.00E+00	1.49E+01	0.00E+00	1.57E+03
Co-57	0.00E+00	2.43E+01	3.96E+01	0.00E+00	0.00E+00	0.00E+00	8.30E+01
Co-58	0.00E+00	7.62E+01	1.90E+02	0.00E+00	0.00E+00	0.00E+00	1.90E+02
Fe-59	6.52E+02	1.14E+03	4.49E+02	0.00E+00	0.00E+00	3.37E+02	5.44E+02
Co-60	0.00E+00	2.29E+02	5.40E+02	0.00E+00	0.00E+00	0.00E+00	5.44E+02
Ni-59	1.00E+03	3.07E+02	1.73E+02	0.00E+00	0.00E+00	0.00E+00	1.52E+01
Ni-63	1.34E+04	8.30E+02	4.66E+02	0.00E+00	0.00E+00	0.00E+00	4.13E+01
Cu-64	0.00E+00	1.29E+01	5.97E+00	0.00E+00	2.18E+01	0.00E+00	2.65E+02
Ni-65	9.95E+01	1.13E+01	5.12E+00	0.00E+00	0.00E+00	0.00E+00	8.57E+02
Zn-65	3.89E+02	1.34E+03	6.16E+02	0.00E+00	6.48E+02	0.00E+00	1.13E+03
Zn-69m	3.17E+01	6.48E+01	5.90E+00	0.00E+00	2.62E+01	0.00E+00	8.97E+02
Zn-69	1.97E+00	3.56E+00	2.65E-01	0.00E+00	1.48E+00	0.00E+00	2.90E+02
Se-79	0.00E+00	4.44E+02	8.25E+01	0.00E+00	5.14E+02	0.00E+00	1.18E+01
Br-82	0.00E+00	0.00E+00	2.69E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	7.68E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	8.08E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	4.11E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	3.60E+03	1.78E+03	0.00E+00	0.00E+00	0.00E+00	9.21E+01
Rb-87	0.00E+00	1.88E+03	7.45E+02	0.00E+00	0.00E+00	0.00E+00	1.27E+01
Rb-88	0.00E+00	1.05E+01	5.78E+00	0.00E+00	0.00E+00	0.00E+00	1.03E+01
Rb-89	0.00E+00	6.05E+00	4.17E+00	0.00E+00	0.00E+00	0.00E+00	2.06E+00
Sr-89	5.31E+04	0.00E+00	1.52E+03	0.00E+00	0.00E+00	0.00E+00	1.09E+03
Sr-90	5.99E+05	0.00E+00	1.21E+04	0.00E+00	0.00E+00	0.00E+00	4.89E+03
Y-90	1.84E+00	0.00E+00	4.93E-02	0.00E+00	0.00E+00	0.00E+00	2.54E+03
Sr-91	1.06E+03	0.00E+00	3.83E+01	0.00E+00	0.00E+00	0.00E+00	1.25E+03
Y-91m	1.71E-02	0.00E+00	5.84E-04	0.00E+00	0.00E+00	0.00E+00	5.71E+01
Y-91	2.39E+01	0.00E+00	6.37E-01	0.00E+00	0.00E+00	0.00E+00	1.71E+03
Sr-92	4.06E+02	0.00E+00	1.51E+01	0.00E+00	0.00E+00	0.00E+00	4.38E+03
Y-92	1.62E-01	0.00E+00	4.55E-03	0.00E+00	0.00E+00	0.00E+00	3.09E+03
Y-93	5.14E-01	0.00E+00	1.40E-02	0.00E+00	0.00E+00	0.00E+00	4.06E+03
Nb-93m	2.60E+00	7.05E-01	2.20E-01	0.00E+00	6.88E-01	0.00E+00	8.42E+01
Nb-95	8.89E-01	3.66E-01	2.12E-01	0.00E+00	2.62E-01	0.00E+00	3.09E+02
Nb-97	9.71E-03	2.07E-03	7.47E-04	0.00E+00	1.62E-03	0.00E+00	6.54E+02
Zr-93	4.08E+00	1.94E+00	1.17E+00	0.00E+00	5.74E+00	0.00E+00	5.06E+02
Zr-95	4.36E+00	1.06E+00	7.53E-01	0.00E+00	1.14E+00	0.00E+00	5.29E+02
Zr-97	3.13E-01	5.38E-02	2.45E-02	0.00E+00	5.42E-02	0.00E+00	3.43E+03
Mo-93	0.00E+00	1.20E+03	3.85E+01	0.00E+00	2.39E+02	0.00E+00	2.56E+01
Mo-99	0.00E+00	7.20E+02	1.40E+02	0.00E+00	1.08E+03	0.00E+00	2.37E+02
Tc-99	2.29E+01	3.09E+01	9.63E+00	0.00E+00	2.60E+02	3.01E+00	1.34E+02
Tc-99m	4.06E-02	8.38E-02	1.08E+00	0.00E+00	9.02E-01	4.38E-02	2.43E+01
Tc-101	4.80E-02	6.05E-02	5.99E-01	0.00E+00	7.20E-01	3.30E-02	1.03E+01
Ru-103	3.13E+01	0.00E+00	1.05E+01	0.00E+00	6.52E+01	0.00E+00	3.81E+02
Ru-105	2.88E+00	0.00E+00	9.69E-01	0.00E+00	2.12E+01	0.00E+00	1.14E+03
Rh-105	2.31E+01	1.51E+01	1.01E+01	0.00E+00	4.19E+01	0.00E+00	3.75E+02
Ru-106	5.10E+02	0.00E+00	6.37E+01	0.00E+00	6.03E+02	0.00E+00	3.87E+03
Pd-107	0.00E+00	2.52E+01	1.79E+00	0.00E+00	1.44E+02	0.00E+00	2.00E+01

Table 3-7 (Page 2 of 3)
Liquid Ingestion Dose Commitment Factor for Infant $\left(A_{i\tau}^{liq}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	3.17E+01	7.66E+00	0.00E+00	1.17E+02	0.00E+00	7.79E+02
Ag-110m	2.11E+01	1.54E+01	1.02E+01	0.00E+00	2.20E+01	0.00E+00	7.98E+02
Ag-111	1.10E+01	4.28E+00	2.26E+00	0.00E+00	8.93E+00	0.00E+00	1.02E+03
Cd-113m	0.00E+00	3.75E+02	1.38E+01	0.00E+00	2.84E+02	0.00E+00	5.63E+02
Cd-115m	0.00E+00	3.01E+02	1.04E+01	0.00E+00	1.57E+02	0.00E+00	1.71E+03
Sn-123	5.27E+03	8.23E+01	1.38E+02	8.27E+01	0.00E+00	0.00E+00	1.39E+03
Sn-125	1.57E+03	2.92E+01	6.96E+01	2.88E+01	0.00E+00	0.00E+00	2.35E+03
Sn-126	1.17E+04	1.54E+02	3.81E+02	4.04E+01	0.00E+00	0.00E+00	5.33E+02
Sb-124	4.53E+02	6.67E+00	1.40E+02	1.20E+00	0.00E+00	2.84E+02	1.40E+03
Sb-125	2.60E+02	2.52E+00	5.35E+01	3.26E-01	0.00E+00	1.51E+02	3.47E+02
Sb-126	1.71E+02	3.34E+00	6.16E+01	1.31E+00	0.00E+00	1.07E+02	1.77E+03
Sb-127	4.72E+01	8.42E-01	1.46E+01	6.01E-01	0.00E+00	2.43E+01	1.25E+03
Te-125m	4.93E+02	1.65E+02	6.67E+01	1.66E+02	0.00E+00	0.00E+00	2.35E+02
Te-127m	1.24E+03	4.11E+02	1.50E+02	3.58E+02	3.05E+03	0.00E+00	4.99E+02
Te-127	2.12E+01	7.09E+00	4.55E+00	1.72E+01	5.16E+01	0.00E+00	4.44E+02
Te-129m	2.12E+03	7.26E+02	3.26E+02	8.13E+02	5.29E+03	0.00E+00	1.26E+03
Te-129	6.01E+00	2.07E+00	1.40E+00	5.04E+00	1.50E+01	0.00E+00	4.80E+02
Te-133m	8.27E+00	3.79E+00	3.62E+00	7.30E+00	2.58E+01	0.00E+00	4.08E+02
Te-134	5.65E+00	2.84E+00	2.92E+00	5.06E+00	1.91E+01	0.00E+00	6.48E+01
I-129	6.05E+02	4.49E+02	3.28E+02	2.88E+05	5.31E+02	0.00E+00	8.97E+00
I-130	1.27E+02	2.79E+02	1.12E+02	3.13E+04	3.07E+02	0.00E+00	5.99E+01
I-131	7.60E+02	8.95E+02	3.94E+02	2.94E+05	1.05E+03	0.00E+00	3.20E+01
Te-131m	3.22E+02	1.30E+02	1.07E+02	2.62E+02	8.91E+02	0.00E+00	2.18E+03
Te-131	3.72E+00	1.38E+00	1.05E+00	3.32E+00	9.52E+00	0.00E+00	1.50E+02
I-132	3.51E+01	7.13E+01	2.54E+01	3.34E+03	7.96E+01	0.00E+00	5.78E+01
Te-132	4.40E+02	2.18E+02	2.03E+02	3.22E+02	1.36E+03	0.00E+00	8.06E+02
I-133	2.65E+02	3.85E+02	1.13E+02	7.01E+04	4.53E+02	0.00E+00	6.52E+01
Cs-134m	3.72E+00	6.20E+00	3.13E+00	0.00E+00	2.39E+00	5.50E-01	4.91E+00
Cs-134	7.98E+03	1.49E+04	1.50E+03	0.00E+00	3.83E+03	1.57E+03	4.04E+01
I-134	1.84E+01	3.77E+01	1.34E+01	8.78E+02	4.21E+01	0.00E+00	3.89E+01
I-135	7.70E+01	1.53E+02	5.59E+01	1.37E+04	1.71E+02	0.00E+00	5.54E+01
Cs-135	2.81E+03	2.56E+03	1.33E+02	0.00E+00	7.28E+02	2.77E+02	9.25E+00
Cs-136	9.71E+02	2.86E+03	1.07E+03	0.00E+00	1.14E+03	2.33E+02	4.34E+01
Cs-137	1.10E+04	1.29E+04	9.16E+02	0.00E+00	3.47E+03	1.41E+03	4.04E+01
Cs-138	1.02E+01	1.65E+01	8.02E+00	0.00E+00	8.25E+00	1.29E+00	2.65E+01
Cs-139	6.56E+00	8.97E+00	3.43E+00	0.00E+00	4.63E+00	6.98E-01	5.63E-01
Ba-139	1.86E+01	1.24E-02	5.40E-01	0.00E+00	7.43E-03	7.49E-03	1.18E+03
Ba-140	3.62E+03	3.62E+00	1.86E+02	0.00E+00	8.59E-01	2.22E+00	8.89E+02
La-140	4.47E-01	1.76E-01	4.53E-02	0.00E+00	0.00E+00	0.00E+00	2.07E+03
Ba-141	8.99E+00	6.16E-03	2.84E-01	0.00E+00	3.70E-03	3.75E-03	1.10E+02
La-141	6.12E-02	1.77E-02	3.09E-03	0.00E+00	0.00E+00	0.00E+00	2.03E+03
Ce-141	1.67E+00	1.02E+00	1.20E-01	0.00E+00	3.13E-01	0.00E+00	5.25E+02
Ba-142	3.89E+00	3.24E-03	1.92E-01	0.00E+00	1.86E-03	1.96E-03	1.61E+01
La-142	2.33E-02	8.55E-03	2.05E-03	0.00E+00	0.00E+00	0.00E+00	1.45E+03
Ce-143	3.13E-01	2.08E+02	2.37E-02	0.00E+00	6.05E-02	0.00E+00	1.21E+03
Pr-143	1.72E+00	6.43E-01	8.53E-02	0.00E+00	2.39E-01	0.00E+00	9.08E+02
Ce-144	6.31E+01	2.58E+01	3.53E+00	0.00E+00	1.04E+01	0.00E+00	3.62E+03
Pr-144	5.80E-03	2.24E-03	2.92E-04	0.00E+00	8.13E-04	0.00E+00	1.04E+02
Nd-147	1.17E+00	1.20E+00	7.36E-02	0.00E+00	4.63E-01	0.00E+00	7.62E+02
Pm-147	8.21E+00	6.92E-01	3.37E-01	0.00E+00	1.03E+00	0.00E+00	1.96E+02
Pm-148m	3.49E+00	8.85E-01	6.94E-01	0.00E+00	1.02E+00	0.00E+00	1.15E+03
Pm-148	1.34E+00	1.93E-01	9.74E-02	0.00E+00	2.31E-01	0.00E+00	2.06E+03
Pm-149	2.92E-01	3.83E-02	1.67E-02	0.00E+00	4.66E-02	0.00E+00	1.03E+03
Pm-151	1.31E-01	1.91E-02	9.65E-03	0.00E+00	2.26E-02	0.00E+00	8.83E+02
Sm-151	6.14E+00	1.41E+00	3.05E-01	0.00E+00	9.59E-01	0.00E+00	1.18E+02
Sm-153	1.63E-01	1.26E-01	9.69E-03	0.00E+00	2.65E-02	0.00E+00	6.60E+02

Table 3-7 (Page 3 of 3)
Liquid Ingestion Dose Commitment Factor for Infant $\left(A_{i\tau}^{liq}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	1.43E+01	3.79E+00	3.20E+00	0.00E+00	1.06E+01	0.00E+00	3.37E+02
Eu-154	5.59E+01	7.77E+00	4.66E+00	0.00E+00	2.11E+01	0.00E+00	9.69E+02
Eu-155	1.15E+01	1.32E+00	6.84E-01	0.00E+00	2.96E+00	0.00E+00	1.77E+03
Eu-156	2.41E+00	1.49E+00	2.37E-01	0.00E+00	6.90E-01	0.00E+00	1.41E+03
Tb-160	5.48E+00	0.00E+00	6.86E-01	0.00E+00	1.56E+00	0.00E+00	7.30E+02
Ho-166m	2.65E+01	5.69E+00	4.51E+00	0.00E+00	7.56E+00	0.00E+00	5.63E+02
W-181	1.87E+00	5.76E-01	6.43E-02	0.00E+00	0.00E+00	0.00E+00	8.08E+00
W-185	7.66E+01	2.39E+01	2.73E+00	0.00E+00	0.00E+00	0.00E+00	3.43E+02
W-187	1.91E+01	1.33E+01	4.59E+00	0.00E+00	0.00E+00	0.00E+00	7.81E+02
Np-239	2.35E-01	2.10E-02	1.19E-02	0.00E+00	4.19E-02	0.00E+00	6.07E+02
U-232	5.12E+05	0.00E+00	4.57E+04	0.00E+00	5.02E+04	0.00E+00	1.49E+03
U-233	1.08E+05	0.00E+00	8.19E+03	0.00E+00	2.29E+04	0.00E+00	1.38E+03
U-234	1.03E+05	0.00E+00	8.04E+03	0.00E+00	2.24E+04	0.00E+00	1.35E+03
U-235	9.88E+04	0.00E+00	7.53E+03	0.00E+00	2.10E+04	0.00E+00	1.71E+03
U-236	9.88E+04	0.00E+00	7.70E+03	0.00E+00	2.14E+04	0.00E+00	1.27E+03
U-237	1.05E+01	0.00E+00	2.79E+00	0.00E+00	2.60E+01	0.00E+00	4.47E+02
U-238	9.46E+04	0.00E+00	7.05E+03	0.00E+00	1.96E+04	0.00E+00	1.21E+03
Np-237	5.08E+04	3.37E+03	2.22E+03	0.00E+00	1.34E+04	0.00E+00	1.74E+03
Np-238	2.62E+00	6.60E-02	4.06E-02	0.00E+00	1.44E-01	0.00E+00	8.83E+02
Pu-238	2.71E+04	3.17E+03	7.20E+02	0.00E+00	2.56E+03	0.00E+00	1.60E+03
Pu-239	2.92E+04	3.28E+03	7.49E+02	0.00E+00	2.71E+03	0.00E+00	1.46E+03
Pu-240	2.92E+04	3.28E+03	7.49E+02	0.00E+00	2.71E+03	0.00E+00	1.49E+03
Pu-241	8.99E+02	3.72E+01	1.87E+01	0.00E+00	6.71E+01	0.00E+00	3.07E+01
Pu-242	2.71E+04	3.15E+03	7.22E+02	0.00E+00	2.60E+03	0.00E+00	1.43E+03
Pu-244	3.15E+04	3.62E+03	8.27E+02	0.00E+00	2.98E+03	0.00E+00	2.14E+03
Am-241	3.09E+04	2.69E+04	2.31E+03	0.00E+00	1.39E+04	0.00E+00	1.63E+03
Am-242m	3.20E+04	2.58E+04	2.39E+03	0.00E+00	1.41E+04	0.00E+00	2.05E+03
Am-243	3.05E+04	2.60E+04	2.24E+03	0.00E+00	1.35E+04	0.00E+00	1.91E+03
Cm-242	2.90E+03	2.69E+03	1.93E+02	0.00E+00	5.54E+02	0.00E+00	1.74E+03
Cm-243	2.96E+04	2.43E+04	1.90E+03	0.00E+00	6.92E+03	0.00E+00	1.71E+03
Cm-244	2.50E+04	2.05E+04	1.61E+03	0.00E+00	5.74E+03	0.00E+00	1.66E+03
Cm-245	3.79E+04	3.07E+04	2.39E+03	0.00E+00	9.14E+03	0.00E+00	1.54E+03
Cm-246	3.75E+04	3.07E+04	2.39E+03	0.00E+00	9.12E+03	0.00E+00	1.52E+03
Cm-247	3.66E+04	3.03E+04	2.35E+03	0.00E+00	8.97E+03	0.00E+00	2.00E+03
Cm-248	3.03E+05	2.50E+05	1.94E+04	0.00E+00	7.41E+04	0.00E+00	3.22E+04
Cf-252	2.58E+04	0.00E+00	6.24E+02	0.00E+00	0.00E+00	0.00E+00	6.33E+03

Units of mrem/hr per µCi/ml

Table 3-8 (Page 1 of 3)
Drinking Water Ingestion Dose Commitment Factor for Adult $\left(A_{i\tau}^{water}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	2.80E+00	2.80E+00	2.80E+00	2.80E+00	2.80E+00	2.80E+00
C-14	1.33E+02	2.66E+01	2.66E+01	2.66E+01	2.66E+01	2.66E+01	2.66E+01
Na-22	8.15E+02	8.15E+02	8.15E+02	8.15E+02	8.15E+02	8.15E+02	8.15E+02
Na-24	7.96E+01	7.96E+01	7.96E+01	7.96E+01	7.96E+01	7.96E+01	7.96E+01
P-32	9.04E+03	5.62E+02	3.49E+02	0.00E+00	0.00E+00	0.00E+00	1.02E+03
Ca-41	8.66E+03	0.00E+00	9.36E+02	0.00E+00	0.00E+00	0.00E+00	8.61E+00
Sc-46	2.58E-01	5.01E-01	1.46E-01	0.00E+00	4.68E-01	0.00E+00	2.44E+03
Cr-51	0.00E+00	0.00E+00	1.25E-01	7.44E-02	2.74E-02	1.65E-01	3.13E+01
Mn-54	0.00E+00	2.14E+02	4.08E+01	0.00E+00	6.37E+01	0.00E+00	6.55E+02
Fe-55	1.29E+02	8.90E+01	2.07E+01	0.00E+00	0.00E+00	4.96E+01	5.10E+01
Mn-56	0.00E+00	5.38E+00	9.55E-01	0.00E+00	6.84E+00	0.00E+00	1.72E+02
Co-57	0.00E+00	8.19E+00	1.36E+01	0.00E+00	0.00E+00	0.00E+00	2.08E+02
Co-58	0.00E+00	3.49E+01	7.82E+01	0.00E+00	0.00E+00	0.00E+00	7.07E+02
Fe-59	2.03E+02	4.78E+02	1.83E+02	0.00E+00	0.00E+00	1.33E+02	1.59E+03
Co-60	0.00E+00	1.00E+02	2.21E+02	0.00E+00	0.00E+00	0.00E+00	1.88E+03
Ni-59	4.57E+02	1.57E+02	7.63E+01	0.00E+00	0.00E+00	0.00E+00	3.23E+01
Ni-63	6.09E+03	4.22E+02	2.04E+02	0.00E+00	0.00E+00	0.00E+00	8.80E+01
Cu-64	0.00E+00	3.90E+00	1.83E+00	0.00E+00	9.83E+00	0.00E+00	3.32E+02
Ni-65	2.47E+01	3.21E+00	1.47E+00	0.00E+00	0.00E+00	0.00E+00	8.15E+01
Zn-65	2.27E+02	7.21E+02	3.26E+02	0.00E+00	4.82E+02	0.00E+00	4.54E+02
Zn-69m	7.96E+00	1.91E+01	1.75E+00	0.00E+00	1.16E+01	0.00E+00	1.17E+03
Zn-69	4.82E-01	9.22E-01	6.41E-02	0.00E+00	5.99E-01	0.00E+00	1.39E-01
Se-79	0.00E+00	1.23E+02	2.06E+01	0.00E+00	2.13E+02	0.00E+00	2.52E+01
Br-82	0.00E+00	0.00E+00	1.06E+02	0.00E+00	0.00E+00	0.00E+00	1.21E+02
Br-83	0.00E+00	0.00E+00	1.88E+00	0.00E+00	0.00E+00	0.00E+00	2.71E+00
Br-84	0.00E+00	0.00E+00	2.44E+00	0.00E+00	0.00E+00	0.00E+00	1.91E-05
Br-85	0.00E+00	0.00E+00	1.00E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	9.88E+02	4.60E+02	0.00E+00	0.00E+00	0.00E+00	1.95E+02
Rb-87	0.00E+00	5.76E+02	2.00E+02	0.00E+00	0.00E+00	0.00E+00	2.70E+01
Rb-88	0.00E+00	2.83E+00	1.50E+00	0.00E+00	0.00E+00	0.00E+00	3.91E-11
Rb-89	0.00E+00	1.88E+00	1.32E+00	0.00E+00	0.00E+00	0.00E+00	1.09E-13
Sr-89	1.44E+04	0.00E+00	4.14E+02	0.00E+00	0.00E+00	0.00E+00	2.31E+03
Sr-90	4.08E+05	0.00E+00	8.19E+03	0.00E+00	0.00E+00	0.00E+00	1.03E+04
Y-90	4.50E-01	0.00E+00	1.21E-02	0.00E+00	0.00E+00	0.00E+00	4.78E+03
Sr-91	2.65E+02	0.00E+00	1.07E+01	0.00E+00	0.00E+00	0.00E+00	1.26E+03
Y-91m	4.26E-03	0.00E+00	1.65E-04	0.00E+00	0.00E+00	0.00E+00	1.25E-02
Y-91	6.60E+00	0.00E+00	1.76E-01	0.00E+00	0.00E+00	0.00E+00	3.63E+03
Sr-92	1.01E+02	0.00E+00	4.35E+00	0.00E+00	0.00E+00	0.00E+00	1.99E+03
Y-92	3.96E-02	0.00E+00	1.16E-03	0.00E+00	0.00E+00	0.00E+00	6.93E+02
Y-93	1.25E-01	0.00E+00	3.46E-03	0.00E+00	0.00E+00	0.00E+00	3.98E+03
Nb-93m	1.19E+00	3.90E-01	9.60E-02	0.00E+00	4.48E-01	0.00E+00	1.80E+02
Nb-95	2.91E-01	1.62E-01	8.71E-02	0.00E+00	1.60E-01	0.00E+00	9.83E+02
Nb-97	2.44E-03	6.18E-04	2.26E-04	0.00E+00	7.21E-04	0.00E+00	2.28E+00
Zr-93	1.96E+00	1.10E-01	5.10E-02	0.00E+00	4.15E-01	0.00E+00	1.14E+02
Zr-95	1.42E+00	4.56E-01	3.09E-01	0.00E+00	7.16E-01	0.00E+00	1.45E+03
Zr-97	7.87E-02	1.59E-02	7.26E-03	0.00E+00	2.40E-02	0.00E+00	4.92E+03
Mo-93	0.00E+00	3.52E+02	9.50E+00	0.00E+00	9.97E+01	0.00E+00	5.71E+01
Mo-99	0.00E+00	2.02E+02	3.84E+01	0.00E+00	4.57E+02	0.00E+00	4.68E+02
Tc-99	5.85E+00	8.71E+00	2.35E+00	0.00E+00	1.10E+02	7.40E-01	2.85E+02
Tc-99m	1.16E-02	3.27E-02	4.16E-01	0.00E+00	4.96E-01	1.60E-02	1.93E+01
Tc-101	1.19E-02	1.71E-02	1.68E-01	0.00E+00	3.09E-01	8.75E-03	5.15E-14
Ru-103	8.66E+00	0.00E+00	3.73E+00	0.00E+00	3.31E+01	0.00E+00	1.01E+03
Ru-105	7.21E-01	0.00E+00	2.85E-01	0.00E+00	9.32E+00	0.00E+00	4.41E+02
Rh-105	5.66E+00	4.14E+00	2.73E+00	0.00E+00	1.76E+01	0.00E+00	6.60E+02
Ru-106	1.29E+02	0.00E+00	1.63E+01	0.00E+00	2.49E+02	0.00E+00	8.33E+03
Pd-107	0.00E+00	6.88E+00	4.40E-01	0.00E+00	6.18E+01	0.00E+00	4.26E+01

Table 3-8 (Page 2 of 3)
Drinking Water Ingestion Dose Commitment Factor for Adult $\left(A_{i\tau}^{water}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	8.29E+00	1.87E+00	0.00E+00	4.73E+01	0.00E+00	9.18E+02
Ag-110m	7.49E+00	6.93E+00	4.12E+00	0.00E+00	1.36E+01	0.00E+00	2.83E+03
Ag-111	2.72E+00	1.14E+00	5.66E-01	0.00E+00	3.67E+00	0.00E+00	2.09E+03
Cd-113m	0.00E+00	1.49E+02	4.78E+00	0.00E+00	1.64E+02	0.00E+00	1.20E+03
Cd-115m	0.00E+00	8.61E+01	2.75E+00	0.00E+00	6.84E+01	0.00E+00	3.62E+03
Sn-123	1.46E+03	2.41E+01	3.55E+01	2.05E+01	0.00E+00	0.00E+00	2.96E+03
Sn-125	3.90E+02	7.87E+00	1.77E+01	6.51E+00	0.00E+00	0.00E+00	4.87E+03
Sn-126	3.96E+03	7.82E+01	1.12E+02	2.30E+01	0.00E+00	0.00E+00	1.14E+03
Sb-124	1.31E+02	2.48E+00	5.20E+01	3.18E-01	0.00E+00	1.02E+02	3.72E+03
Sb-125	8.38E+01	9.36E-01	1.99E+01	8.52E-02	0.00E+00	6.46E+01	9.22E+02
Sb-126	5.38E+01	1.10E+00	1.94E+01	3.30E-01	0.00E+00	3.30E+01	4.40E+03
Sb-127	1.21E+01	2.65E-01	4.63E+00	1.45E-01	0.00E+00	7.16E+00	2.76E+03
Te-125m	1.25E+02	4.55E+01	1.68E+01	3.77E+01	5.10E+02	0.00E+00	5.01E+02
Te-127m	3.17E+02	1.13E+02	3.86E+01	8.10E+01	1.29E+03	0.00E+00	1.06E+03
Te-127	5.15E+00	1.85E+00	1.11E+00	3.82E+00	2.10E+01	0.00E+00	4.06E+02
Te-129m	5.38E+02	2.01E+02	8.52E+01	1.85E+02	2.25E+03	0.00E+00	2.71E+03
Te-129	1.47E+00	5.52E-01	3.58E-01	1.13E+00	6.18E+00	0.00E+00	1.11E+00
Te-133m	2.16E+00	1.26E+00	1.22E+00	1.83E+00	1.25E+01	0.00E+00	4.34E-01
Te-134	1.52E+00	9.93E-01	6.09E-01	1.32E+00	9.60E+00	0.00E+00	1.68E-03
I-129	1.53E+02	1.32E+02	4.31E+02	3.38E+05	2.83E+02	0.00E+00	2.08E+01
I-130	3.54E+01	1.04E+02	4.12E+01	8.85E+03	1.63E+02	0.00E+00	8.99E+01
I-131	1.95E+02	2.79E+02	1.60E+02	9.13E+04	4.78E+02	0.00E+00	7.35E+01
Te-131m	8.10E+01	3.96E+01	3.30E+01	6.27E+01	4.01E+02	0.00E+00	3.93E+03
Te-131	9.22E-01	3.85E-01	2.91E-01	7.58E-01	4.04E+00	0.00E+00	1.31E-01
I-132	9.50E+00	2.54E+01	8.90E+00	8.90E+02	4.05E+01	0.00E+00	4.78E+00
Te-132	1.18E+02	7.63E+01	7.16E+01	8.43E+01	7.35E+02	0.00E+00	3.61E+03
I-133	6.65E+01	1.16E+02	3.53E+01	1.70E+04	2.02E+02	0.00E+00	1.04E+02
Cs-134m	9.97E-01	2.10E+00	1.07E+00	0.00E+00	1.14E+00	1.79E-01	7.40E-01
Cs-134	2.91E+03	6.93E+03	5.66E+03	0.00E+00	2.24E+03	7.44E+02	1.21E+02
I-134	4.96E+00	1.35E+01	4.82E+00	2.34E+02	2.14E+01	0.00E+00	1.18E-02
I-135	2.07E+01	5.43E+01	2.00E+01	3.58E+03	8.71E+01	0.00E+00	6.13E+01
Cs-135	9.13E+02	8.43E+02	3.74E+02	0.00E+00	3.19E+02	9.55E+01	1.97E+01
Cs-136	3.05E+02	1.20E+03	8.66E+02	0.00E+00	6.69E+02	9.18E+01	1.37E+02
Cs-137	3.73E+03	5.10E+03	3.34E+03	0.00E+00	1.73E+03	5.76E+02	9.88E+01
Cs-138	2.58E+00	5.10E+00	2.53E+00	0.00E+00	3.75E+00	3.70E-01	2.18E-05
Cs-139	1.60E+00	2.38E+00	8.66E-01	0.00E+00	1.91E+00	1.73E-01	5.15E-23
Ba-139	4.54E+00	3.24E-03	1.33E-01	0.00E+00	3.02E-03	1.84E-03	8.05E+00
Ba-140	9.50E+02	1.19E+00	6.23E+01	0.00E+00	4.06E-01	6.84E-01	1.96E+03
La-140	1.17E-01	5.90E-02	1.56E-02	0.00E+00	0.00E+00	0.00E+00	4.33E+03
Ba-141	2.21E+00	1.67E-03	7.44E-02	0.00E+00	1.55E-03	9.46E-04	1.04E-09
La-141	1.49E-02	4.63E-03	7.58E-04	0.00E+00	0.00E+00	0.00E+00	5.52E+02
Ce-141	4.38E-01	2.96E-01	3.36E-02	0.00E+00	1.38E-01	0.00E+00	1.13E+03
Ba-142	9.97E-01	1.03E-03	6.27E-02	0.00E+00	8.66E-04	5.81E-04	1.40E-18
La-142	5.99E-03	2.72E-03	6.79E-04	0.00E+00	0.00E+00	0.00E+00	1.99E+01
Ce-143	7.72E-02	5.71E+01	6.32E-03	0.00E+00	2.51E-02	0.00E+00	2.13E+03
Pr-143	4.31E-01	1.73E-01	2.13E-02	0.00E+00	9.97E-02	0.00E+00	1.89E+03
Ce-144	2.28E+01	9.55E+00	1.23E+00	0.00E+00	5.66E+00	0.00E+00	7.72E+03
Pr-144	1.41E-03	5.85E-04	7.16E-05	0.00E+00	3.30E-04	0.00E+00	2.03E-10
Nd-147	2.94E-01	3.40E-01	2.04E-02	0.00E+00	1.99E-01	0.00E+00	1.63E+03
Pm-147	3.53E+00	3.32E-01	1.34E-01	0.00E+00	6.27E-01	0.00E+00	4.18E+02
Pm-148m	1.44E+00	3.72E-01	2.85E-01	0.00E+00	5.62E-01	0.00E+00	3.16E+03
Pm-148	3.36E-01	5.57E-02	2.80E-02	0.00E+00	1.05E-01	0.00E+00	4.38E+03
Pm-149	7.12E-02	1.01E-02	4.11E-03	0.00E+00	1.90E-02	0.00E+00	1.89E+03
Pm-151	3.26E-02	5.48E-03	2.77E-03	0.00E+00	9.78E-03	0.00E+00	1.51E+03
Sm-151	3.23E+00	5.57E-01	1.33E-01	0.00E+00	6.23E-01	0.00E+00	2.46E+02
Sm-153	4.01E-02	3.35E-02	2.44E-03	0.00E+00	1.08E-02	0.00E+00	1.19E+03

Table 3-8 (Page 3 of 3)
Drinking Water Ingestion Dose Commitment Factor for Adult $\left(A_{i\tau}^{water}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	9.13E+00	2.08E+00	1.83E+00	0.00E+00	1.29E+01	0.00E+00	1.20E+03
Eu-154	2.88E+01	3.54E+00	2.52E+00	0.00E+00	1.69E+01	0.00E+00	2.57E+03
Eu-155	4.03E+00	5.71E-01	3.68E-01	0.00E+00	2.64E+00	0.00E+00	4.49E+02
Eu-156	6.41E-01	4.96E-01	8.01E-02	0.00E+00	3.31E-01	0.00E+00	3.40E+03
Tb-160	2.20E+00	0.00E+00	2.74E-01	0.00E+00	9.08E-01	0.00E+00	2.03E+03
Ho-166m	1.26E+01	3.95E+00	3.00E+00	0.00E+00	5.90E+00	0.00E+00	1.20E+03
W-181	4.64E-01	1.51E-01	1.62E-02	0.00E+00	0.00E+00	0.00E+00	1.72E+01
W-185	1.90E+01	6.32E+00	6.65E-01	0.00E+00	0.00E+00	0.00E+00	7.30E+02
W-187	4.82E+00	4.03E+00	1.41E+00	0.00E+00	0.00E+00	0.00E+00	1.32E+03
Np-239	5.57E-02	5.48E-03	3.02E-03	0.00E+00	1.71E-02	0.00E+00	1.12E+03
U-232	1.93E+05	0.00E+00	1.38E+04	0.00E+00	2.09E+04	0.00E+00	3.17E+03
U-233	4.08E+04	0.00E+00	2.47E+03	0.00E+00	9.50E+03	0.00E+00	2.94E+03
U-234	3.91E+04	0.00E+00	2.42E+03	0.00E+00	9.32E+03	0.00E+00	2.87E+03
U-235	3.75E+04	0.00E+00	2.28E+03	0.00E+00	8.75E+03	0.00E+00	3.66E+03
U-236	3.75E+04	0.00E+00	2.32E+03	0.00E+00	8.94E+03	0.00E+00	2.70E+03
U-237	2.58E+00	0.00E+00	6.88E-01	0.00E+00	1.06E+01	0.00E+00	9.08E+02
U-238	3.59E+04	0.00E+00	2.13E+03	0.00E+00	8.19E+03	0.00E+00	2.57E+03
Np-237	5.90E+04	4.19E+03	2.59E+03	0.00E+00	1.93E+04	0.00E+00	3.72E+03
Np-238	6.41E-01	1.73E-02	9.97E-03	0.00E+00	5.85E-02	0.00E+00	1.61E+03
Pu-238	2.95E+04	3.74E+03	8.01E+02	0.00E+00	3.43E+03	0.00E+00	3.42E+03
Pu-239	3.39E+04	4.08E+03	8.94E+02	0.00E+00	3.80E+03	0.00E+00	3.12E+03
Pu-240	3.39E+04	4.07E+03	8.94E+02	0.00E+00	3.79E+03	0.00E+00	3.17E+03
Pu-241	7.35E+02	3.49E+01	1.55E+01	0.00E+00	7.16E+01	0.00E+00	6.55E+01
Pu-242	3.15E+04	3.93E+03	8.61E+02	0.00E+00	3.66E+03	0.00E+00	3.06E+03
Pu-244	3.67E+04	4.50E+03	9.88E+02	0.00E+00	4.19E+03	0.00E+00	4.56E+03
Am-241	3.53E+04	3.30E+04	2.53E+03	0.00E+00	1.91E+04	0.00E+00	3.47E+03
Am-242m	3.56E+04	3.10E+04	2.54E+03	0.00E+00	1.90E+04	0.00E+00	4.37E+03
Am-243	3.53E+04	3.23E+04	2.48E+03	0.00E+00	1.87E+04	0.00E+00	4.07E+03
Cm-242	9.64E+02	1.03E+03	6.41E+01	0.00E+00	2.91E+02	0.00E+00	3.71E+03
Cm-243	2.80E+04	2.57E+04	1.76E+03	0.00E+00	8.19E+03	0.00E+00	3.66E+03
Cm-244	2.13E+04	2.00E+04	1.34E+03	0.00E+00	6.27E+03	0.00E+00	3.53E+03
Cm-245	4.39E+04	3.82E+04	2.70E+03	0.00E+00	1.26E+04	0.00E+00	3.30E+03
Cm-246	4.35E+04	3.82E+04	2.69E+03	0.00E+00	1.25E+04	0.00E+00	3.24E+03
Cm-247	4.25E+04	3.76E+04	2.65E+03	0.00E+00	1.24E+04	0.00E+00	4.26E+03
Cm-248	3.53E+05	3.10E+05	2.19E+04	0.00E+00	1.02E+05	0.00E+00	6.88E+04
Cf-252	1.22E+04	0.00E+00	2.94E+02	0.00E+00	0.00E+00	0.00E+00	1.35E+04

Units of mrem/hr per µCi/ml

Table 3-9 (Page 1 of 3)
Drinking Water Ingestion Dose Commitment Factor for Teenager $\left(A_{i\tau}^{water}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.98E+00	1.98E+00	1.98E+00	1.98E+00	1.98E+00	1.98E+00
C-14	1.33E+02	2.66E+01	2.66E+01	2.66E+01	2.66E+01	2.66E+01	2.66E+01
Na-22	7.65E+02	7.65E+02	7.65E+02	7.65E+02	7.65E+02	7.65E+02	7.65E+02
Na-24	7.52E+01	7.52E+01	7.52E+01	7.52E+01	7.52E+01	7.52E+01	7.52E+01
P-32	9.03E+03	5.59E+02	3.50E+02	0.00E+00	0.00E+00	0.00E+00	7.59E+02
Ca-41	6.44E+03	0.00E+00	6.97E+02	0.00E+00	0.00E+00	0.00E+00	6.38E+00
Sc-46	2.37E-01	4.61E-01	1.37E-01	0.00E+00	4.42E-01	0.00E+00	1.57E+03
Cr-51	0.00E+00	0.00E+00	1.18E-01	6.54E-02	2.58E-02	1.68E-01	1.98E+01
Mn-54	0.00E+00	1.93E+02	3.83E+01	0.00E+00	5.76E+01	0.00E+00	3.96E+02
Fe-55	1.24E+02	8.77E+01	2.04E+01	0.00E+00	0.00E+00	5.56E+01	3.79E+01
Mn-56	0.00E+00	5.17E+00	9.19E-01	0.00E+00	6.54E+00	0.00E+00	3.40E+02
Co-57	0.00E+00	7.78E+00	1.31E+01	0.00E+00	0.00E+00	0.00E+00	1.45E+02
Co-58	0.00E+00	3.18E+01	7.33E+01	0.00E+00	0.00E+00	0.00E+00	4.38E+02
Fe-59	1.92E+02	4.48E+02	1.73E+02	0.00E+00	0.00E+00	1.41E+02	1.06E+03
Co-60	0.00E+00	9.19E+01	2.07E+02	0.00E+00	0.00E+00	0.00E+00	1.20E+03
Ni-59	4.32E+02	1.52E+02	7.33E+01	0.00E+00	0.00E+00	0.00E+00	2.39E+01
Ni-63	5.79E+03	4.09E+02	1.96E+02	0.00E+00	0.00E+00	0.00E+00	6.51E+01
Cu-64	0.00E+00	3.76E+00	1.77E+00	0.00E+00	9.52E+00	0.00E+00	2.92E+02
Ni-65	2.45E+01	3.13E+00	1.43E+00	0.00E+00	0.00E+00	0.00E+00	1.70E+02
Zn-65	1.88E+02	6.54E+02	3.05E+02	0.00E+00	4.19E+02	0.00E+00	2.77E+02
Zn-69m	7.85E+00	1.85E+01	1.70E+00	0.00E+00	1.13E+01	0.00E+00	1.02E+03
Zn-69	4.81E-01	9.16E-01	6.41E-02	0.00E+00	5.99E-01	0.00E+00	1.69E+00
Se-79	0.00E+00	1.22E+02	2.05E+01	0.00E+00	2.13E+02	0.00E+00	1.86E+01
Br-82	0.00E+00	0.00E+00	9.94E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	1.88E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	2.36E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	9.98E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	9.75E+02	4.58E+02	0.00E+00	0.00E+00	0.00E+00	1.44E+02
Rb-87	0.00E+00	5.72E+02	2.00E+02	0.00E+00	0.00E+00	0.00E+00	2.00E+01
Rb-88	0.00E+00	2.79E+00	1.48E+00	0.00E+00	0.00E+00	0.00E+00	2.39E-07
Rb-89	0.00E+00	1.80E+00	1.27E+00	0.00E+00	0.00E+00	0.00E+00	2.76E-09
Sr-89	1.44E+04	0.00E+00	4.12E+02	0.00E+00	0.00E+00	0.00E+00	1.71E+03
Sr-90	3.34E+05	0.00E+00	6.67E+03	0.00E+00	0.00E+00	0.00E+00	7.62E+03
Y-90	4.48E-01	0.00E+00	1.21E-02	0.00E+00	0.00E+00	0.00E+00	3.70E+03
Sr-91	2.64E+02	0.00E+00	1.05E+01	0.00E+00	0.00E+00	0.00E+00	1.20E+03
Y-91m	4.22E-03	0.00E+00	1.61E-04	0.00E+00	0.00E+00	0.00E+00	1.99E-01
Y-91	6.57E+00	0.00E+00	1.76E-01	0.00E+00	0.00E+00	0.00E+00	2.70E+03
Sr-92	9.98E+01	0.00E+00	4.25E+00	0.00E+00	0.00E+00	0.00E+00	2.54E+03
Y-92	3.96E-02	0.00E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	1.09E+03
Y-93	1.25E-01	0.00E+00	3.43E-03	0.00E+00	0.00E+00	0.00E+00	3.83E+03
Nb-93m	1.13E+00	3.70E-01	9.26E-02	0.00E+00	4.32E-01	0.00E+00	1.33E+02
Nb-95	2.69E-01	1.49E-01	8.21E-02	0.00E+00	1.45E-01	0.00E+00	6.38E+02
Nb-97	2.41E-03	5.99E-04	2.18E-04	0.00E+00	7.00E-04	0.00E+00	1.43E+01
Zr-93	1.81E+00	8.93E-01	4.87E-01	0.00E+00	3.16E+00	0.00E+00	8.44E+02
Zr-95	1.35E+00	4.25E-01	2.92E-01	0.00E+00	6.25E-01	0.00E+00	9.81E+02
Zr-97	7.75E-02	1.53E-02	7.06E-03	0.00E+00	2.33E-02	0.00E+00	4.15E+03
Mo-93	0.00E+00	3.47E+02	9.49E+00	0.00E+00	9.94E+01	0.00E+00	4.22E+01
Mo-99	0.00E+00	1.97E+02	3.76E+01	0.00E+00	4.51E+02	0.00E+00	3.53E+02
Tc-99	5.85E+00	8.60E+00	2.35E+00	0.00E+00	1.09E+02	8.90E-01	2.11E+02
Tc-99m	1.09E-02	3.03E-02	3.92E-01	0.00E+00	4.51E-01	1.68E-02	1.99E+01
Tc-101	1.18E-02	1.67E-02	1.65E-01	0.00E+00	3.03E-01	1.02E-02	2.86E-09
Ru-103	8.34E+00	0.00E+00	3.57E+00	0.00E+00	2.94E+01	0.00E+00	6.97E+02
Ru-105	7.13E-01	0.00E+00	2.77E-01	0.00E+00	8.99E+00	0.00E+00	5.76E+02
Rh-105	5.66E+00	4.09E+00	2.68E+00	0.00E+00	1.74E+01	0.00E+00	5.20E+02
Ru-106	1.28E+02	0.00E+00	1.62E+01	0.00E+00	2.47E+02	0.00E+00	6.15E+03
Pd-107	0.00E+00	6.80E+00	4.38E-01	0.00E+00	6.15E+01	0.00E+00	3.16E+01

Table 3-9 (Page 2 of 3)
Drinking Water Ingestion Dose Commitment Factor for Teenager $\left(A_{i\tau}^{water}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	8.21E+00	1.86E+00	0.00E+00	4.74E+01	0.00E+00	8.27E+02
Ag-110m	6.71E+00	6.35E+00	3.86E+00	0.00E+00	1.21E+01	0.00E+00	1.78E+03
Ag-111	2.71E+00	1.13E+00	5.66E-01	0.00E+00	3.66E+00	0.00E+00	1.57E+03
Cd-113m	0.00E+00	1.48E+02	4.74E+00	0.00E+00	1.63E+02	0.00E+00	8.86E+02
Cd-115m	0.00E+00	8.50E+01	2.74E+00	0.00E+00	6.80E+01	0.00E+00	2.69E+03
Sn-123	1.45E+03	2.38E+01	3.53E+01	1.91E+01	0.00E+00	0.00E+00	2.19E+03
Sn-125	3.89E+02	7.75E+00	1.76E+01	6.08E+00	0.00E+00	0.00E+00	3.66E+03
Sn-126	3.79E+03	7.06E+01	1.08E+02	1.86E+01	0.00E+00	0.00E+00	8.44E+02
Sb-124	1.27E+02	2.33E+00	4.94E+01	2.87E-01	0.00E+00	1.11E+02	2.55E+03
Sb-125	8.11E+01	8.86E-01	1.90E+01	7.75E-02	0.00E+00	7.13E+01	6.31E+02
Sb-126	5.20E+01	1.06E+00	1.87E+01	2.94E-01	0.00E+00	3.73E+01	3.08E+03
Sb-127	1.19E+01	2.54E-01	4.48E+00	1.33E-01	0.00E+00	8.08E+00	2.01E+03
Te-125m	1.25E+02	4.51E+01	1.67E+01	3.50E+01	0.00E+00	0.00E+00	3.70E+02
Te-127m	3.16E+02	1.12E+02	3.76E+01	7.52E+01	1.28E+03	0.00E+00	7.88E+02
Te-127	5.17E+00	1.83E+00	1.11E+00	3.57E+00	2.09E+01	0.00E+00	3.99E+02
Te-129m	5.33E+02	1.98E+02	8.44E+01	1.72E+02	2.23E+03	0.00E+00	2.00E+03
Te-129	1.47E+00	5.46E-01	3.57E-01	1.05E+00	6.15E+00	0.00E+00	8.01E+00
Te-133m	2.11E+00	1.20E+00	1.16E+00	1.67E+00	1.18E+01	0.00E+00	4.84E+00
Te-134	1.46E+00	9.39E-01	9.81E-01	1.20E+00	8.96E+00	0.00E+00	5.43E-02
I-129	1.52E+02	1.28E+02	2.14E+02	1.56E+05	2.29E+02	0.00E+00	1.49E+01
I-130	3.37E+01	9.75E+01	3.89E+01	7.95E+03	1.50E+02	0.00E+00	7.49E+01
I-131	1.91E+02	2.68E+02	1.44E+02	7.82E+04	4.61E+02	0.00E+00	5.30E+01
Te-131m	7.98E+01	3.83E+01	3.19E+01	5.76E+01	3.99E+02	0.00E+00	3.07E+03
Te-131	9.13E-01	3.76E-01	2.85E-01	7.03E-01	3.99E+00	0.00E+00	7.49E-02
I-132	9.13E+00	2.39E+01	8.57E+00	8.05E+02	3.76E+01	0.00E+00	1.04E+01
Te-132	1.14E+02	7.23E+01	6.80E+01	7.62E+01	6.93E+02	0.00E+00	2.29E+03
I-133	6.57E+01	1.12E+02	3.40E+01	1.56E+04	1.96E+02	0.00E+00	8.44E+01
Cs-134m	9.62E-01	1.99E+00	1.02E+00	0.00E+00	1.11E+00	1.95E-01	1.32E+00
Cs-134	2.74E+03	6.44E+03	2.99E+03	0.00E+00	2.05E+03	7.82E+02	8.01E+01
I-134	4.78E+00	1.27E+01	4.55E+00	2.11E+02	2.00E+01	0.00E+00	1.67E-01
I-135	2.00E+01	5.14E+01	1.90E+01	3.30E+03	8.11E+01	0.00E+00	5.69E+01
Cs-135	9.09E+02	8.34E+02	1.95E+02	0.00E+00	3.18E+02	1.15E+02	1.46E+01
Cs-136	2.81E+02	1.11E+03	7.42E+02	0.00E+00	6.02E+02	9.49E+01	8.90E+01
Cs-137	3.66E+03	4.87E+03	1.70E+03	0.00E+00	1.66E+03	6.44E+02	6.93E+01
Cs-138	2.54E+00	4.87E+00	2.44E+00	0.00E+00	3.60E+00	4.19E-01	2.21E-03
Cs-139	1.59E+00	2.35E+00	8.60E-01	0.00E+00	1.89E+00	2.07E-01	1.09E-15
Ba-139	4.55E+00	3.20E-03	1.32E-01	0.00E+00	3.02E-03	2.20E-03	4.06E+01
Ba-140	9.29E+02	1.14E+00	5.99E+01	0.00E+00	3.86E-01	7.65E-01	1.43E+03
La-140	1.14E-01	5.59E-02	1.49E-02	0.00E+00	0.00E+00	0.00E+00	3.21E+03
Ba-141	2.19E+00	1.64E-03	7.33E-02	0.00E+00	1.52E-03	1.12E-03	4.68E-06
La-141	1.49E-02	4.58E-03	7.56E-04	0.00E+00	0.00E+00	0.00E+00	8.11E+02
Ce-141	4.35E-01	2.90E-01	3.34E-02	0.00E+00	1.37E-01	0.00E+00	8.31E+02
Ba-142	9.78E-01	9.78E-04	6.02E-02	0.00E+00	8.27E-04	6.51E-04	3.00E-12
La-142	5.85E-03	2.60E-03	6.48E-04	0.00E+00	0.00E+00	0.00E+00	7.92E+01
Ce-143	7.69E-02	5.59E+01	6.25E-03	0.00E+00	2.51E-02	0.00E+00	1.68E+03
Pr-143	4.28E-01	1.71E-01	2.13E-02	0.00E+00	9.94E-02	0.00E+00	1.41E+03
Ce-144	2.28E+01	9.42E+00	1.22E+00	0.00E+00	5.63E+00	0.00E+00	5.72E+03
Pr-144	1.41E-03	5.76E-04	7.13E-05	0.00E+00	3.30E-04	0.00E+00	1.55E-06
Nd-147	3.07E-01	3.34E-01	2.00E-02	0.00E+00	1.96E-01	0.00E+00	1.20E+03
Pm-147	3.43E+00	3.26E-01	1.33E-01	0.00E+00	6.21E-01	0.00E+00	3.10E+02
Pm-148m	1.35E+00	3.43E-01	2.69E-01	0.00E+00	5.20E-01	0.00E+00	2.16E+03
Pm-148	3.34E-01	5.43E-02	2.73E-02	0.00E+00	9.81E-02	0.00E+00	3.24E+03
Pm-149	7.10E-02	9.98E-03	4.09E-03	0.00E+00	1.90E-02	0.00E+00	1.47E+03
Pm-151	3.23E-02	5.33E-03	2.70E-03	0.00E+00	9.58E-03	0.00E+00	1.20E+03
Sm-151	2.86E+00	5.49E-01	1.29E-01	0.00E+00	6.02E-01	0.00E+00	1.86E+02
Sm-153	3.99E-02	3.30E-02	2.43E-03	0.00E+00	1.08E-02	0.00E+00	9.32E+02

Table 3-9 (Page 3 of 3)
Drinking Water Ingestion Dose Commitment Factor for Teenager $\left(A_{i\tau}^{water}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	8.01E+00	1.93E+00	1.70E+00	0.00E+00	8.96E+00	0.00E+00	7.10E+02
Eu-154	2.59E+01	3.34E+00	2.35E+00	0.00E+00	1.49E+01	0.00E+00	1.76E+03
Eu-155	5.69E+00	5.49E-01	3.40E-01	0.00E+00	2.15E+00	0.00E+00	3.15E+03
Eu-156	6.28E-01	4.71E-01	7.69E-02	0.00E+00	3.17E-01	0.00E+00	2.41E+03
Tb-160	2.12E+00	0.00E+00	2.64E-01	0.00E+00	8.37E-01	0.00E+00	1.37E+03
Ho-166m	1.17E+01	3.60E+00	2.60E+00	0.00E+00	5.27E+00	0.00E+00	8.86E+02
W-181	4.64E-01	1.50E-01	1.57E-02	0.00E+00	0.00E+00	0.00E+00	1.28E+01
W-185	1.89E+01	6.25E+00	6.61E-01	0.00E+00	0.00E+00	0.00E+00	5.40E+02
W-187	4.78E+00	3.89E+00	1.36E+00	0.00E+00	0.00E+00	0.00E+00	1.05E+03
Np-239	5.76E-02	5.43E-03	3.02E-03	0.00E+00	1.70E-02	0.00E+00	8.73E+02
U-232	1.93E+05	0.00E+00	1.38E+04	0.00E+00	2.09E+04	0.00E+00	2.35E+03
U-233	4.06E+04	0.00E+00	2.47E+03	0.00E+00	9.49E+03	0.00E+00	2.18E+03
U-234	3.89E+04	0.00E+00	2.42E+03	0.00E+00	9.32E+03	0.00E+00	2.13E+03
U-235	3.73E+04	0.00E+00	2.27E+03	0.00E+00	8.73E+03	0.00E+00	2.71E+03
U-236	3.73E+04	0.00E+00	2.32E+03	0.00E+00	8.93E+03	0.00E+00	2.00E+03
U-237	2.58E+00	0.00E+00	6.87E-01	0.00E+00	1.06E+01	0.00E+00	6.84E+02
U-238	3.57E+04	0.00E+00	2.12E+03	0.00E+00	8.18E+03	0.00E+00	1.91E+03
Np-237	4.35E+04	3.12E+03	1.91E+03	0.00E+00	1.42E+04	0.00E+00	2.75E+03
Np-238	6.38E-01	1.71E-02	9.94E-03	0.00E+00	5.85E-02	0.00E+00	1.25E+03
Pu-238	2.19E+04	2.81E+03	5.95E+02	0.00E+00	2.55E+03	0.00E+00	2.53E+03
Pu-239	2.50E+04	3.04E+03	6.57E+02	0.00E+00	2.80E+03	0.00E+00	2.31E+03
Pu-240	2.50E+04	3.03E+03	6.57E+02	0.00E+00	2.80E+03	0.00E+00	2.35E+03
Pu-241	5.72E+02	2.75E+01	1.21E+01	0.00E+00	5.59E+01	0.00E+00	4.84E+01
Pu-242	2.32E+04	2.92E+03	6.35E+02	0.00E+00	2.70E+03	0.00E+00	2.26E+03
Pu-244	2.71E+04	3.34E+03	7.26E+02	0.00E+00	3.09E+03	0.00E+00	3.37E+03
Am-241	2.61E+04	2.46E+04	1.88E+03	0.00E+00	1.41E+04	0.00E+00	2.57E+03
Am-242m	2.64E+04	2.33E+04	1.90E+03	0.00E+00	1.41E+04	0.00E+00	3.24E+03
Am-243	2.60E+04	2.40E+04	1.84E+03	0.00E+00	1.38E+04	0.00E+00	3.02E+03
Cm-242	9.62E+02	1.01E+03	6.38E+01	0.00E+00	2.91E+02	0.00E+00	2.75E+03
Cm-243	2.13E+04	1.97E+04	1.34E+03	0.00E+00	6.25E+03	0.00E+00	2.71E+03
Cm-244	1.65E+04	1.56E+04	1.04E+03	0.00E+00	4.87E+03	0.00E+00	2.62E+03
Cm-245	3.24E+04	2.85E+04	2.00E+03	0.00E+00	9.32E+03	0.00E+00	2.44E+03
Cm-246	3.21E+04	2.85E+04	1.99E+03	0.00E+00	9.29E+03	0.00E+00	2.40E+03
Cm-247	3.13E+04	2.80E+04	1.96E+03	0.00E+00	9.16E+03	0.00E+00	3.15E+03
Cm-248	2.60E+05	2.31E+05	1.62E+04	0.00E+00	7.56E+04	0.00E+00	5.07E+04
Cf-252	1.13E+04	0.00E+00	2.74E+02	0.00E+00	0.00E+00	0.00E+00	9.98E+03

Units of mrem/hr per µCi/ml

Table 3-10 (Page 1 of 3)
Drinking Water Ingestion Dose Commitment Factor for Child $\left(A_{i\tau}^{water}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	3.79E+00	3.79E+00	3.79E+00	3.79E+00	3.79E+00	3.79E+00
C-14	3.96E+02	7.92E+01	7.92E+01	7.92E+01	7.92E+01	7.92E+01	7.92E+01
Na-22	1.92E+03	1.92E+03	1.92E+03	1.92E+03	1.92E+03	1.92E+03	1.92E+03
Na-24	1.90E+02	1.90E+02	1.90E+02	1.90E+02	1.90E+02	1.90E+02	1.90E+02
P-32	2.70E+04	1.26E+03	1.04E+03	0.00E+00	0.00E+00	0.00E+00	7.46E+02
Ca-41	1.13E+04	0.00E+00	1.24E+03	0.00E+00	0.00E+00	0.00E+00	6.21E+00
Sc-46	6.44E-01	8.83E-01	3.40E-01	0.00E+00	7.82E-01	0.00E+00	1.29E+03
Cr-51	0.00E+00	0.00E+00	2.91E-01	1.62E-01	4.42E-02	2.95E-01	1.54E+01
Mn-54	0.00E+00	3.50E+02	9.32E+01	0.00E+00	9.81E+01	0.00E+00	2.94E+02
Fe-55	3.76E+02	2.00E+02	6.18E+01	0.00E+00	0.00E+00	1.13E+02	3.70E+01
Mn-56	0.00E+00	1.09E+01	2.47E+00	0.00E+00	1.32E+01	0.00E+00	1.58E+03
Co-57	0.00E+00	1.61E+01	3.26E+01	0.00E+00	0.00E+00	0.00E+00	1.32E+02
Co-58	0.00E+00	5.89E+01	1.80E+02	0.00E+00	0.00E+00	0.00E+00	3.43E+02
Fe-59	5.40E+02	8.73E+02	4.35E+02	0.00E+00	0.00E+00	2.53E+02	9.09E+02
Co-60	0.00E+00	1.73E+02	5.10E+02	0.00E+00	0.00E+00	0.00E+00	9.58E+02
Ni-59	1.31E+03	3.50E+02	2.23E+02	0.00E+00	0.00E+00	0.00E+00	2.32E+01
Ni-63	1.76E+04	9.42E+02	5.99E+02	0.00E+00	0.00E+00	0.00E+00	6.35E+01
Cu-64	0.00E+00	8.01E+00	4.84E+00	0.00E+00	1.94E+01	0.00E+00	3.76E+02
Ni-65	7.26E+01	6.84E+00	3.99E+00	0.00E+00	0.00E+00	0.00E+00	8.37E+02
Zn-65	4.48E+02	1.19E+03	7.42E+02	0.00E+00	7.52E+02	0.00E+00	2.10E+02
Zn-69m	2.32E+01	3.96E+01	4.68E+00	0.00E+00	2.30E+01	0.00E+00	1.29E+03
Zn-69	1.43E+00	2.07E+00	1.91E-01	0.00E+00	1.26E+00	0.00E+00	1.31E+02
Se-79	0.00E+00	2.76E+02	6.12E+01	0.00E+00	4.48E+02	0.00E+00	1.81E+01
Br-82	0.00E+00	0.00E+00	2.47E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	5.59E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	6.48E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	2.98E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	2.19E+03	1.35E+03	0.00E+00	0.00E+00	0.00E+00	1.41E+02
Rb-87	0.00E+00	1.29E+03	5.99E+02	0.00E+00	0.00E+00	0.00E+00	1.94E+01
Rb-88	0.00E+00	6.21E+00	4.32E+00	0.00E+00	0.00E+00	0.00E+00	3.05E-01
Rb-89	0.00E+00	3.83E+00	3.40E+00	0.00E+00	0.00E+00	0.00E+00	3.34E-02
Sr-89	4.32E+04	0.00E+00	1.23E+03	0.00E+00	0.00E+00	0.00E+00	1.67E+03
Sr-90	8.37E+05	0.00E+00	1.68E+04	0.00E+00	0.00E+00	0.00E+00	7.49E+03
Y-90	1.34E+00	0.00E+00	3.60E-02	0.00E+00	0.00E+00	0.00E+00	3.83E+03
Sr-91	7.85E+02	0.00E+00	2.96E+01	0.00E+00	0.00E+00	0.00E+00	1.73E+03
Y-91m	1.25E-02	0.00E+00	4.55E-04	0.00E+00	0.00E+00	0.00E+00	2.45E+01
Y-91	1.97E+01	0.00E+00	5.27E-01	0.00E+00	0.00E+00	0.00E+00	2.62E+03
Sr-92	2.95E+02	0.00E+00	1.18E+01	0.00E+00	0.00E+00	0.00E+00	5.59E+03
Y-92	1.18E-01	0.00E+00	3.37E-03	0.00E+00	0.00E+00	0.00E+00	3.40E+03
Y-93	3.73E-01	0.00E+00	1.02E-02	0.00E+00	0.00E+00	0.00E+00	5.56E+03
Nb-93m	3.43E+00	8.57E-01	2.82E-01	0.00E+00	9.26E-01	0.00E+00	1.29E+02
Nb-95	7.36E-01	2.87E-01	2.05E-01	0.00E+00	2.69E-01	0.00E+00	5.30E+02
Nb-97	7.10E-03	1.28E-03	5.99E-04	0.00E+00	1.42E-03	0.00E+00	3.96E+02
Zr-93	5.46E+00	2.04E+00	1.46E+00	0.00E+00	7.92E+00	0.00E+00	7.75E+02
Zr-95	3.79E+00	8.34E-01	7.42E-01	0.00E+00	1.19E+00	0.00E+00	8.70E+02
Zr-97	2.29E-01	3.30E-02	1.95E-02	0.00E+00	4.74E-02	0.00E+00	5.00E+03
Mo-93	0.00E+00	7.88E+02	2.83E+01	0.00E+00	2.08E+02	0.00E+00	3.99E+01
Mo-99	0.00E+00	4.35E+02	1.08E+02	0.00E+00	9.29E+02	0.00E+00	3.60E+02
Tc-99	1.75E+01	1.95E+01	7.00E+00	0.00E+00	2.30E+02	1.72E+00	2.04E+02
Tc-99m	3.02E-02	5.92E-02	9.81E-01	0.00E+00	8.60E-01	3.01E-02	3.37E+01
Tc-101	3.50E-02	3.66E-02	4.64E-01	0.00E+00	6.25E-01	1.94E-02	1.16E-01
Ru-103	2.39E+01	0.00E+00	9.19E+00	0.00E+00	6.02E+01	0.00E+00	6.18E+02
Ru-105	2.11E+00	0.00E+00	7.65E-01	0.00E+00	1.85E+01	0.00E+00	1.38E+03
Rh-105	1.68E+01	9.03E+00	7.72E+00	0.00E+00	3.60E+01	0.00E+00	5.59E+02
Ru-106	3.83E+02	0.00E+00	4.78E+01	0.00E+00	5.17E+02	0.00E+00	5.95E+03
Pd-107	0.00E+00	1.54E+01	1.31E+00	0.00E+00	1.29E+02	0.00E+00	3.06E+01

Table 3-10 (Page 2 of 3)
Drinking Water Ingestion Dose Commitment Factor for Child $\left(A_{i\tau}^{water}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	1.85E+01	5.56E+00	0.00E+00	9.94E+01	0.00E+00	1.10E+03
Ag-110m	1.76E+01	1.19E+01	9.52E+00	0.00E+00	2.22E+01	0.00E+00	1.42E+03
Ag-111	8.11E+00	2.54E+00	1.67E+00	0.00E+00	7.65E+00	0.00E+00	1.55E+03
Cd-113m	0.00E+00	3.34E+02	1.42E+01	0.00E+00	3.43E+02	0.00E+00	8.60E+02
Cd-115m	0.00E+00	1.93E+02	8.21E+00	0.00E+00	1.43E+02	0.00E+00	2.62E+03
Sn-123	4.35E+03	5.40E+01	1.06E+02	5.72E+01	0.00E+00	0.00E+00	2.13E+03
Sn-125	1.16E+03	1.75E+01	5.20E+01	1.82E+01	0.00E+00	0.00E+00	3.60E+03
Sn-126	1.09E+04	1.36E+02	3.09E+02	3.73E+01	0.00E+00	0.00E+00	8.18E+02
Sb-124	3.63E+02	4.71E+00	1.27E+02	8.01E-01	0.00E+00	2.01E+02	2.27E+03
Sb-125	2.34E+02	1.81E+00	4.91E+01	2.17E-01	0.00E+00	1.31E+02	5.59E+02
Sb-126	1.44E+02	2.20E+00	5.17E+01	8.44E-01	0.00E+00	6.87E+01	2.90E+03
Sb-127	3.47E+01	5.36E-01	1.20E+01	3.86E-01	0.00E+00	1.50E+01	1.95E+03
Te-125m	3.73E+02	1.01E+02	4.97E+01	1.05E+02	0.00E+00	0.00E+00	3.60E+02
Te-127m	9.45E+02	2.54E+02	1.12E+02	2.26E+02	2.70E+03	0.00E+00	7.65E+02
Te-127	1.54E+01	4.15E+00	3.30E+00	1.07E+01	4.38E+01	0.00E+00	6.02E+02
Te-129m	1.59E+03	4.45E+02	2.47E+02	5.14E+02	4.68E+03	0.00E+00	1.94E+03
Te-129	4.38E+00	1.22E+00	1.04E+00	3.13E+00	1.28E+01	0.00E+00	2.73E+02
Te-133m	6.12E+00	2.47E+00	3.06E+00	4.74E+00	2.35E+01	0.00E+00	1.89E+02
Te-134	4.22E+00	1.90E+00	2.53E+00	3.34E+00	1.76E+01	0.00E+00	1.93E+01
I-129	4.55E+02	2.79E+02	2.49E+02	1.83E+05	4.71E+02	0.00E+00	1.40E+01
I-130	9.55E+01	1.93E+02	9.94E+01	2.13E+04	2.88E+02	0.00E+00	9.03E+01
I-131	5.63E+02	5.66E+02	3.22E+02	1.87E+05	9.29E+02	0.00E+00	5.04E+01
Te-131m	2.35E+02	8.14E+01	8.67E+01	1.67E+02	7.88E+02	0.00E+00	3.30E+03
Te-131	2.71E+00	8.27E-01	8.08E-01	2.08E+00	8.21E+00	0.00E+00	1.43E+01
I-132	2.62E+01	4.81E+01	2.21E+01	2.23E+03	7.36E+01	0.00E+00	5.66E+01
Te-132	3.30E+02	1.46E+02	1.77E+02	2.13E+02	1.36E+03	0.00E+00	1.47E+03
I-133	1.94E+02	2.39E+02	9.06E+01	4.45E+04	3.99E+02	0.00E+00	9.65E+01
Cs-134m	2.76E+00	4.09E+00	2.67E+00	0.00E+00	2.16E+00	3.57E-01	5.17E+00
Cs-134	7.65E+03	1.26E+04	2.65E+03	0.00E+00	3.89E+03	1.40E+03	6.77E+01
I-134	1.37E+01	2.54E+01	1.17E+01	5.85E+02	3.89E+01	0.00E+00	1.69E+01
I-135	5.72E+01	1.03E+02	4.87E+01	9.13E+03	1.58E+02	0.00E+00	7.85E+01
Cs-135	2.71E+03	1.89E+03	1.94E+02	0.00E+00	6.67E+02	2.23E+02	1.42E+01
Cs-136	7.69E+02	2.11E+03	1.37E+03	0.00E+00	1.13E+03	1.68E+02	7.42E+01
Cs-137	1.07E+04	1.02E+04	1.51E+03	0.00E+00	3.34E+03	1.20E+03	6.41E+01
Cs-138	7.46E+00	1.04E+01	6.57E+00	0.00E+00	7.29E+00	7.85E-01	4.78E+00
Cs-139	4.74E+00	5.27E+00	2.53E+00	0.00E+00	3.96E+00	3.99E-01	4.74E-04
Ba-139	1.35E+01	7.23E-03	3.92E-01	0.00E+00	6.31E-03	4.25E-03	7.82E+02
Ba-140	2.72E+03	2.38E+00	1.59E+02	0.00E+00	7.75E-01	1.42E+00	1.38E+03
La-140	3.30E-01	1.15E-01	3.89E-02	0.00E+00	0.00E+00	0.00E+00	3.22E+03
Ba-141	6.54E+00	3.66E-03	2.13E-01	0.00E+00	3.17E-03	2.15E-02	3.73E+00
La-141	4.45E-02	1.04E-02	2.25E-03	0.00E+00	0.00E+00	0.00E+00	2.31E+03
Ce-141	1.30E+00	6.48E-01	9.62E-02	0.00E+00	2.84E-01	0.00E+00	8.08E+02
Ba-142	2.86E+00	2.06E-03	1.60E-01	0.00E+00	1.66E-03	1.21E-03	3.73E-02
La-142	1.71E-02	5.46E-03	1.71E-03	0.00E+00	0.00E+00	0.00E+00	1.08E+03
Ce-143	2.29E-01	1.24E+02	1.80E-02	0.00E+00	5.20E-02	0.00E+00	1.82E+03
Pr-143	1.29E+00	3.86E-01	6.38E-02	0.00E+00	2.09E-01	0.00E+00	1.39E+03
Ce-144	6.80E+01	2.13E+01	3.63E+00	0.00E+00	1.18E+01	0.00E+00	5.56E+03
Pr-144	4.22E-03	1.31E-03	2.12E-04	0.00E+00	6.90E-04	0.00E+00	2.81E+00
Nd-147	9.13E-01	7.39E-01	5.72E-02	0.00E+00	4.06E-01	0.00E+00	1.17E+03
Pm-147	1.04E+01	7.42E-01	3.99E-01	0.00E+00	1.31E+00	0.00E+00	3.01E+02
Pm-148m	3.37E+00	6.71E-01	6.71E-01	0.00E+00	9.94E-01	0.00E+00	1.89E+03
Pm-148	9.88E-01	1.19E-01	7.69E-02	0.00E+00	2.02E-01	0.00E+00	3.17E+03
Pm-149	2.12E-01	2.26E-02	1.22E-02	0.00E+00	3.99E-02	0.00E+00	1.54E+03
Pm-151	9.55E-02	1.16E-02	7.56E-03	0.00E+00	1.97E-02	0.00E+00	1.32E+03
Sm-151	8.37E+00	1.25E+00	3.92E-01	0.00E+00	1.29E+00	0.00E+00	1.81E+02
Sm-153	1.19E-01	7.42E-02	7.16E-03	0.00E+00	2.26E-02	0.00E+00	9.88E+02

Table 3-10 (Page 3 of 3)
Drinking Water Ingestion Dose Commitment Factor for Child $\left(A_{i\tau}^{water}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	2.01E+01	3.66E+00	4.35E+00	0.00E+00	1.55E+01	0.00E+00	6.02E+02
Eu-154	7.52E+01	6.77E+00	6.18E+00	0.00E+00	2.97E+01	0.00E+00	1.57E+03
Eu-155	1.58E+01	1.13E+00	8.90E-01	0.00E+00	4.25E+00	0.00E+00	2.84E+03
Eu-156	1.84E+00	9.84E-01	2.04E-01	0.00E+00	6.35E-01	0.00E+00	2.23E+03
Tb-160	5.43E+00	0.00E+00	6.74E-01	0.00E+00	1.62E+00	0.00E+00	1.20E+03
Ho-166m	3.53E+01	7.39E+00	6.25E+00	0.00E+00	1.05E+01	0.00E+00	8.60E+02
W-181	1.38E+00	3.40E-01	4.68E-02	0.00E+00	0.00E+00	0.00E+00	1.24E+01
W-185	5.66E+01	1.41E+01	1.98E+00	0.00E+00	0.00E+00	0.00E+00	5.27E+02
W-187	1.40E+01	8.31E+00	3.73E+00	0.00E+00	0.00E+00	0.00E+00	1.17E+03
Np-239	1.72E-01	1.23E-02	8.67E-03	0.00E+00	3.57E-02	0.00E+00	9.13E+02
U-232	5.76E+05	0.00E+00	4.12E+04	0.00E+00	4.38E+04	0.00E+00	2.28E+03
U-233	1.22E+05	0.00E+00	7.36E+03	0.00E+00	2.00E+04	0.00E+00	2.11E+03
U-234	1.17E+05	0.00E+00	7.23E+03	0.00E+00	1.96E+04	0.00E+00	2.07E+03
U-235	1.12E+05	0.00E+00	6.77E+03	0.00E+00	1.83E+04	0.00E+00	2.63E+03
U-236	1.12E+05	0.00E+00	6.93E+03	0.00E+00	1.87E+04	0.00E+00	1.94E+03
U-237	7.72E+00	0.00E+00	2.05E+00	0.00E+00	2.23E+01	0.00E+00	6.80E+02
U-238	1.07E+05	0.00E+00	6.35E+03	0.00E+00	1.71E+04	0.00E+00	1.85E+03
Np-237	7.29E+04	4.81E+03	3.20E+03	0.00E+00	1.98E+04	0.00E+00	2.67E+03
Np-238	1.91E+00	3.86E-02	2.97E-02	0.00E+00	1.23E-01	0.00E+00	1.32E+03
Pu-238	3.89E+04	4.51E+03	1.03E+03	0.00E+00	3.76E+03	0.00E+00	2.45E+03
Pu-239	4.22E+04	4.51E+03	1.08E+03	0.00E+00	3.99E+03	0.00E+00	2.24E+03
Pu-240	4.19E+04	4.68E+03	1.08E+03	0.00E+00	3.99E+03	0.00E+00	2.28E+03
Pu-241	1.27E+03	5.17E+01	2.63E+01	0.00E+00	9.68E+01	0.00E+00	4.71E+01
Pu-242	3.89E+04	4.51E+03	1.04E+03	0.00E+00	3.83E+03	0.00E+00	2.19E+03
Pu-244	4.55E+04	5.17E+04	1.19E+03	0.00E+00	4.42E+03	0.00E+00	3.27E+03
Am-241	4.45E+04	3.83E+04	3.34E+03	0.00E+00	2.04E+04	0.00E+00	2.50E+03
Am-242m	4.58E+04	3.66E+04	3.40E+03	0.00E+00	2.06E+04	0.00E+00	3.14E+03
Am-243	4.38E+04	3.70E+04	3.22E+03	0.00E+00	1.98E+04	0.00E+00	2.93E+03
Cm-242	2.87E+03	2.29E+03	1.91E+02	0.00E+00	6.12E+02	0.00E+00	2.67E+03
Cm-243	4.19E+04	3.40E+04	2.70E+03	0.00E+00	1.01E+04	0.00E+00	2.63E+03
Cm-244	3.53E+04	2.86E+04	2.27E+03	0.00E+00	8.31E+03	0.00E+00	2.54E+03
Cm-245	5.46E+04	4.38E+04	3.43E+03	0.00E+00	1.34E+04	0.00E+00	2.37E+03
Cm-246	5.40E+04	4.38E+04	3.43E+03	0.00E+00	1.34E+04	0.00E+00	2.33E+03
Cm-247	5.27E+04	4.32E+04	3.37E+03	0.00E+00	1.32E+04	0.00E+00	3.06E+03
Cm-248	4.38E+05	3.57E+05	2.79E+04	0.00E+00	1.09E+05	0.00E+00	4.94E+04
Cf-252	3.43E+04	0.00E+00	8.31E+02	0.00E+00	0.00E+00	0.00E+00	9.68E+03

Units of mrem/hr per µCi/ml

Table 3-11 (Page 1 of 3)
Drinking Water Ingestion Dose Commitment Factor for Infant $\left(A_{i\tau}^{water}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	3.72E+00	3.72E+00	3.72E+00	3.72E+00	3.72E+00	3.72E+00
C-14	5.02E+02	1.07E+02	1.07E+02	1.07E+02	1.07E+02	1.07E+02	1.07E+02
Na-22	2.08E+03	2.08E+03	2.08E+03	2.08E+03	2.08E+03	2.08E+03	2.08E+03
Na-24	2.14E+02	2.14E+02	2.14E+02	2.14E+02	2.14E+02	2.14E+02	2.14E+02
P-32	3.60E+04	2.12E+03	1.39E+03	0.00E+00	0.00E+00	0.00E+00	4.87E+02
Ca-41	7.92E+03	0.00E+00	8.63E+02	0.00E+00	0.00E+00	0.00E+00	4.04E+00
Sc-46	7.94E-01	1.14E+00	3.58E-01	0.00E+00	7.53E-01	0.00E+00	7.47E+02
Cr-51	0.00E+00	0.00E+00	2.98E-01	1.95E-01	4.25E-02	3.79E-01	8.70E+00
Mn-54	0.00E+00	4.21E+02	9.54E+01	0.00E+00	9.33E+01	0.00E+00	1.55E+02
Fe-55	2.94E+02	1.90E+02	5.08E+01	0.00E+00	0.00E+00	9.29E+01	2.41E+01
Mn-56	0.00E+00	1.73E+01	2.98E+00	0.00E+00	1.49E+01	0.00E+00	1.57E+03
Co-57	0.00E+00	2.43E+01	3.96E+01	0.00E+00	0.00E+00	0.00E+00	8.30E+01
Co-58	0.00E+00	7.62E+01	1.90E+02	0.00E+00	0.00E+00	0.00E+00	1.90E+02
Fe-59	6.52E+02	1.14E+03	4.49E+02	0.00E+00	0.00E+00	3.37E+02	5.44E+02
Co-60	0.00E+00	2.29E+02	5.40E+02	0.00E+00	0.00E+00	0.00E+00	5.44E+02
Ni-59	1.00E+03	3.07E+02	1.73E+02	0.00E+00	0.00E+00	0.00E+00	1.52E+01
Ni-63	1.34E+04	8.30E+02	4.66E+02	0.00E+00	0.00E+00	0.00E+00	4.13E+01
Cu-64	0.00E+00	1.29E+01	5.97E+00	0.00E+00	2.18E+01	0.00E+00	2.65E+02
Ni-65	9.95E+01	1.13E+01	5.12E+00	0.00E+00	0.00E+00	0.00E+00	8.57E+02
Zn-65	3.89E+02	1.34E+03	6.16E+02	0.00E+00	6.48E+02	0.00E+00	1.13E+03
Zn-69m	3.17E+01	6.48E+01	5.90E+00	0.00E+00	2.62E+01	0.00E+00	8.97E+02
Zn-69	1.97E+00	3.56E+00	2.65E-01	0.00E+00	1.48E+00	0.00E+00	2.90E+02
Se-79	0.00E+00	4.44E+02	8.25E+01	0.00E+00	5.14E+02	0.00E+00	1.18E+01
Br-82	0.00E+00	0.00E+00	2.69E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	7.68E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	8.08E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	4.11E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	3.60E+03	1.78E+03	0.00E+00	0.00E+00	0.00E+00	9.21E+01
Rb-87	0.00E+00	1.88E+03	7.45E+02	0.00E+00	0.00E+00	0.00E+00	1.27E+01
Rb-88	0.00E+00	1.05E+01	5.78E+00	0.00E+00	0.00E+00	0.00E+00	1.03E+01
Rb-89	0.00E+00	6.05E+00	4.17E+00	0.00E+00	0.00E+00	0.00E+00	2.06E+00
Sr-89	5.31E+04	0.00E+00	1.52E+03	0.00E+00	0.00E+00	0.00E+00	1.09E+03
Sr-90	5.99E+05	0.00E+00	1.21E+04	0.00E+00	0.00E+00	0.00E+00	4.89E+03
Y-90	1.84E+00	0.00E+00	4.93E-02	0.00E+00	0.00E+00	0.00E+00	2.54E+03
Sr-91	1.06E+03	0.00E+00	3.83E+01	0.00E+00	0.00E+00	0.00E+00	1.25E+03
Y-91m	1.71E-02	0.00E+00	5.84E-04	0.00E+00	0.00E+00	0.00E+00	5.71E+01
Y-91	2.39E+01	0.00E+00	6.37E-01	0.00E+00	0.00E+00	0.00E+00	1.71E+03
Sr-92	4.06E+02	0.00E+00	1.51E+01	0.00E+00	0.00E+00	0.00E+00	4.38E+03
Y-92	1.62E-01	0.00E+00	4.55E-03	0.00E+00	0.00E+00	0.00E+00	3.09E+03
Y-93	5.14E-01	0.00E+00	1.40E-02	0.00E+00	0.00E+00	0.00E+00	4.06E+03
Nb-93m	2.60E+00	7.05E-01	2.20E-01	0.00E+00	6.88E-01	0.00E+00	8.42E+01
Nb-95	8.89E-01	3.66E-01	2.12E-01	0.00E+00	2.62E-01	0.00E+00	3.09E+02
Nb-97	9.71E-03	2.07E-03	7.47E-04	0.00E+00	1.62E-03	0.00E+00	6.54E+02
Zr-93	4.08E+00	1.94E+00	1.17E+00	0.00E+00	5.74E+00	0.00E+00	5.06E+02
Zr-95	4.36E+00	1.06E+00	7.53E-01	0.00E+00	1.14E+00	0.00E+00	5.29E+02
Zr-97	3.13E-01	5.38E-02	2.45E-02	0.00E+00	5.42E-02	0.00E+00	3.43E+03
Mo-93	0.00E+00	1.20E+03	3.85E+01	0.00E+00	2.39E+02	0.00E+00	2.56E+01
Mo-99	0.00E+00	7.20E+02	1.40E+02	0.00E+00	1.08E+03	0.00E+00	2.37E+02
Tc-99	2.29E+01	3.09E+01	9.63E+00	0.00E+00	2.60E+02	3.01E+00	1.34E+02
Tc-99m	4.06E-02	8.38E-02	1.08E+00	0.00E+00	9.02E-01	4.38E-02	2.43E+01
Tc-101	4.80E-02	6.05E-02	5.99E-01	0.00E+00	7.20E-01	3.30E-02	1.03E+01
Ru-103	3.13E+01	0.00E+00	1.05E+01	0.00E+00	6.52E+01	0.00E+00	3.81E+02
Ru-105	2.88E+00	0.00E+00	9.69E-01	0.00E+00	2.12E+01	0.00E+00	1.14E+03
Rh-105	2.31E+01	1.51E+01	1.01E+01	0.00E+00	4.19E+01	0.00E+00	3.75E+02
Ru-106	5.10E+02	0.00E+00	6.37E+01	0.00E+00	6.03E+02	0.00E+00	3.87E+03
Pd-107	0.00E+00	2.52E+01	1.79E+00	0.00E+00	1.44E+02	0.00E+00	2.00E+01

Table 3-11 (Page 2 of 3)
Drinking Water Ingestion Dose Commitment Factor for Infant $\left(A_{i\tau}^{water}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	3.17E+01	7.66E+00	0.00E+00	1.17E+02	0.00E+00	7.79E+02
Ag-110m	2.11E+01	1.54E+01	1.02E+01	0.00E+00	2.20E+01	0.00E+00	7.98E+02
Ag-111	1.10E+01	4.28E+00	2.26E+00	0.00E+00	8.93E+00	0.00E+00	1.02E+03
Cd-113m	0.00E+00	3.75E+02	1.38E+01	0.00E+00	2.84E+02	0.00E+00	5.63E+02
Cd-115m	0.00E+00	3.01E+02	1.04E+01	0.00E+00	1.57E+02	0.00E+00	1.71E+03
Sn-123	5.27E+03	8.23E+01	1.38E+02	8.27E+01	0.00E+00	0.00E+00	1.39E+03
Sn-125	1.57E+03	2.92E+01	6.96E+01	2.88E+01	0.00E+00	0.00E+00	2.35E+03
Sn-126	1.17E+04	1.54E+02	3.81E+02	4.04E+01	0.00E+00	0.00E+00	5.33E+02
Sb-124	4.53E+02	6.67E+00	1.40E+02	1.20E+00	0.00E+00	2.84E+02	1.40E+03
Sb-125	2.60E+02	2.52E+00	5.35E+01	3.26E-01	0.00E+00	1.51E+02	3.47E+02
Sb-126	1.71E+02	3.34E+00	6.16E+01	1.31E+00	0.00E+00	1.07E+02	1.77E+03
Sb-127	4.72E+01	8.42E-01	1.46E+01	6.01E-01	0.00E+00	2.43E+01	1.25E+03
Te-125m	4.93E+02	1.65E+02	6.67E+01	1.66E+02	0.00E+00	0.00E+00	2.35E+02
Te-127m	1.24E+03	4.11E+02	1.50E+02	3.58E+02	3.05E+03	0.00E+00	4.99E+02
Te-127	2.12E+01	7.09E+00	4.55E+00	1.72E+01	5.16E+01	0.00E+00	4.44E+02
Te-129m	2.12E+03	7.26E+02	3.26E+02	8.13E+02	5.29E+03	0.00E+00	1.26E+03
Te-129	6.01E+00	2.07E+00	1.40E+00	5.04E+00	1.50E+01	0.00E+00	4.80E+02
Te-133m	8.27E+00	3.79E+00	3.62E+00	7.30E+00	2.58E+01	0.00E+00	4.08E+02
Te-134	5.65E+00	2.84E+00	2.92E+00	5.06E+00	1.91E+01	0.00E+00	6.48E+01
I-129	6.05E+02	4.49E+02	3.28E+02	2.88E+05	5.31E+02	0.00E+00	8.97E+00
I-130	1.27E+02	2.79E+02	1.12E+02	3.13E+04	3.07E+02	0.00E+00	5.99E+01
I-131	7.60E+02	8.95E+02	3.94E+02	2.94E+05	1.05E+03	0.00E+00	3.20E+01
Te-131m	3.22E+02	1.30E+02	1.07E+02	2.62E+02	8.91E+02	0.00E+00	2.18E+03
Te-131	3.72E+00	1.38E+00	1.05E+00	3.32E+00	9.52E+00	0.00E+00	1.50E+02
I-132	3.51E+01	7.13E+01	2.54E+01	3.34E+03	7.96E+01	0.00E+00	5.78E+01
Te-132	4.40E+02	2.18E+02	2.03E+02	3.22E+02	1.36E+03	0.00E+00	8.06E+02
I-133	2.65E+02	3.85E+02	1.13E+02	7.01E+04	4.53E+02	0.00E+00	6.52E+01
Cs-134m	3.72E+00	6.20E+00	3.13E+00	0.00E+00	2.39E+00	5.50E-01	4.91E+00
Cs-134	7.98E+03	1.49E+04	1.50E+03	0.00E+00	3.83E+03	1.57E+03	4.04E+01
I-134	1.84E+01	3.77E+01	1.34E+01	8.78E+02	4.21E+01	0.00E+00	3.89E+01
I-135	7.70E+01	1.53E+02	5.59E+01	1.37E+04	1.71E+02	0.00E+00	5.54E+01
Cs-135	2.81E+03	2.56E+03	1.33E+02	0.00E+00	7.28E+02	2.77E+02	9.25E+00
Cs-136	9.71E+02	2.86E+03	1.07E+03	0.00E+00	1.14E+03	2.33E+02	4.34E+01
Cs-137	1.10E+04	1.29E+04	9.16E+02	0.00E+00	3.47E+03	1.41E+03	4.04E+01
Cs-138	1.02E+01	1.65E+01	8.02E+00	0.00E+00	8.25E+00	1.29E+00	2.65E+01
Cs-139	6.56E+00	8.97E+00	3.43E+00	0.00E+00	4.63E+00	6.98E-01	5.63E-01
Ba-139	1.86E+01	1.24E-02	5.40E-01	0.00E+00	7.43E-03	7.49E-03	1.18E+03
Ba-140	3.62E+03	3.62E+00	1.86E+02	0.00E+00	8.59E-01	2.22E+00	8.89E+02
La-140	4.47E-01	1.76E-01	4.53E-02	0.00E+00	0.00E+00	0.00E+00	2.07E+03
Ba-141	8.99E+00	6.16E-03	2.84E-01	0.00E+00	3.70E-03	3.75E-03	1.10E+02
La-141	6.12E-02	1.77E-02	3.09E-03	0.00E+00	0.00E+00	0.00E+00	2.03E+03
Ce-141	1.67E+00	1.02E+00	1.20E-01	0.00E+00	3.13E-01	0.00E+00	5.25E+02
Ba-142	3.89E+00	3.24E-03	1.92E-01	0.00E+00	1.86E-03	1.96E-03	1.61E+01
La-142	2.33E-02	8.55E-03	2.05E-03	0.00E+00	0.00E+00	0.00E+00	1.45E+03
Ce-143	3.13E-01	2.08E+02	2.37E-02	0.00E+00	6.05E-02	0.00E+00	1.21E+03
Pr-143	1.72E+00	6.43E-01	8.53E-02	0.00E+00	2.39E-01	0.00E+00	9.08E+02
Ce-144	6.31E+01	2.58E+01	3.53E+00	0.00E+00	1.04E+01	0.00E+00	3.62E+03
Pr-144	5.80E-03	2.24E-03	2.92E-04	0.00E+00	8.13E-04	0.00E+00	1.04E+02
Nd-147	1.17E+00	1.20E+00	7.36E-02	0.00E+00	4.63E-01	0.00E+00	7.62E+02
Pm-147	8.21E+00	6.92E-01	3.37E-01	0.00E+00	1.03E+00	0.00E+00	1.96E+02
Pm-148m	3.49E+00	8.85E-01	6.94E-01	0.00E+00	1.02E+00	0.00E+00	1.15E+03
Pm-148	1.34E+00	1.93E-01	9.74E-02	0.00E+00	2.31E-01	0.00E+00	2.06E+03
Pm-149	2.92E-01	3.83E-02	1.67E-02	0.00E+00	4.66E-02	0.00E+00	1.03E+03
Pm-151	1.31E-01	1.91E-02	9.65E-03	0.00E+00	2.26E-02	0.00E+00	8.83E+02
Sm-151	6.14E+00	1.41E+00	3.05E-01	0.00E+00	9.59E-01	0.00E+00	1.18E+02
Sm-153	1.63E-01	1.26E-01	9.69E-03	0.00E+00	2.65E-02	0.00E+00	6.60E+02

Table 3-11 (Page 3 of 3)
Drinking Water Ingestion Dose Commitment Factor for Infant $\left(A_{i\tau}^{water}\right)$

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	1.43E+01	3.79E+00	3.20E+00	0.00E+00	1.06E+01	0.00E+00	3.37E+02
Eu-154	5.59E+01	7.77E+00	4.66E+00	0.00E+00	2.11E+01	0.00E+00	9.69E+02
Eu-155	1.15E+01	1.32E+00	6.84E-01	0.00E+00	2.96E+00	0.00E+00	1.77E+03
Eu-156	2.41E+00	1.49E+00	2.37E-01	0.00E+00	6.90E-01	0.00E+00	1.41E+03
Tb-160	5.48E+00	0.00E+00	6.86E-01	0.00E+00	1.56E+00	0.00E+00	7.30E+02
Ho-166m	2.65E+01	5.69E+00	4.51E+00	0.00E+00	7.56E+00	0.00E+00	5.63E+02
W-181	1.87E+00	5.76E-01	6.43E-02	0.00E+00	0.00E+00	0.00E+00	8.08E+00
W-185	7.66E+01	2.39E+01	2.73E+00	0.00E+00	0.00E+00	0.00E+00	3.43E+02
W-187	1.91E+01	1.33E+01	4.59E+00	0.00E+00	0.00E+00	0.00E+00	7.81E+02
Np-239	2.35E-01	2.10E-02	1.19E-02	0.00E+00	4.19E-02	0.00E+00	6.07E+02
U-232	5.12E+05	0.00E+00	4.57E+04	0.00E+00	5.02E+04	0.00E+00	1.49E+03
U-233	1.08E+05	0.00E+00	8.19E+03	0.00E+00	2.29E+04	0.00E+00	1.38E+03
U-234	1.03E+05	0.00E+00	8.04E+03	0.00E+00	2.24E+04	0.00E+00	1.35E+03
U-235	9.88E+04	0.00E+00	7.53E+03	0.00E+00	2.10E+04	0.00E+00	1.71E+03
U-236	9.88E+04	0.00E+00	7.70E+03	0.00E+00	2.14E+04	0.00E+00	1.27E+03
U-237	1.05E+01	0.00E+00	2.79E+00	0.00E+00	2.60E+01	0.00E+00	4.47E+02
U-238	9.46E+04	0.00E+00	7.05E+03	0.00E+00	1.96E+04	0.00E+00	1.21E+03
Np-237	5.08E+04	3.37E+03	2.22E+03	0.00E+00	1.34E+04	0.00E+00	1.74E+03
Np-238	2.62E+00	6.60E-02	4.06E-02	0.00E+00	1.44E-01	0.00E+00	8.83E+02
Pu-238	2.71E+04	3.17E+03	7.20E+02	0.00E+00	2.56E+03	0.00E+00	1.60E+03
Pu-239	2.92E+04	3.28E+03	7.49E+02	0.00E+00	2.71E+03	0.00E+00	1.46E+03
Pu-240	2.92E+04	3.28E+03	7.49E+02	0.00E+00	2.71E+03	0.00E+00	1.49E+03
Pu-241	8.99E+02	3.72E+01	1.87E+01	0.00E+00	6.71E+01	0.00E+00	3.07E+01
Pu-242	2.71E+04	3.15E+03	7.22E+02	0.00E+00	2.60E+03	0.00E+00	1.43E+03
Pu-244	3.15E+04	3.62E+03	8.27E+02	0.00E+00	2.98E+03	0.00E+00	2.14E+03
Am-241	3.09E+04	2.69E+04	2.31E+03	0.00E+00	1.39E+04	0.00E+00	1.63E+03
Am-242m	3.20E+04	2.58E+04	2.39E+03	0.00E+00	1.41E+04	0.00E+00	2.05E+03
Am-243	3.05E+04	2.60E+04	2.24E+03	0.00E+00	1.35E+04	0.00E+00	1.91E+03
Cm-242	2.90E+03	2.69E+03	1.93E+02	0.00E+00	5.54E+02	0.00E+00	1.74E+03
Cm-243	2.96E+04	2.43E+04	1.90E+03	0.00E+00	6.92E+03	0.00E+00	1.71E+03
Cm-244	2.50E+04	2.05E+04	1.61E+03	0.00E+00	5.74E+03	0.00E+00	1.66E+03
Cm-245	3.79E+04	3.07E+04	2.39E+03	0.00E+00	9.14E+03	0.00E+00	1.54E+03
Cm-246	3.75E+04	3.07E+04	2.39E+03	0.00E+00	9.12E+03	0.00E+00	1.52E+03
Cm-247	3.66E+04	3.03E+04	2.35E+03	0.00E+00	8.97E+03	0.00E+00	2.00E+03
Cm-248	3.03E+05	2.50E+05	1.94E+04	0.00E+00	7.41E+04	0.00E+00	3.22E+04
Cf-252	2.58E+04	0.00E+00	6.24E+02	0.00E+00	0.00E+00	0.00E+00	6.33E+03

Units of mrem/hr per µCi/

4.0 Gaseous Effluents

4.1 Gaseous Effluents – General Information

4.1.1 This section reviews the offsite radiological limits applicable to the Dresden Station and presents in detail the equations and procedures used to assess compliance with these limits. This calculational approach incorporates certain simplifications such as:

- Pre-calculated atmospheric transport parameters are based on historical average atmospheric conditions. These historical meteorological conditions have resulted in the parameters shown in Table 4-2 through Table 4-10.
- Use of pre-calculated dose factors based on historical average atmospheric conditions. For example, a dose factor with units (mrad/yr) per (µCi/sec) is used to obtain dose rate in mrad/yr from noble gas release rate in µCi/sec.

4.1.2 The equations and parameters of this section are for use in calculating offsite radiation doses during routine operating conditions. They are not for use in calculating doses due to non-routine releases (e.g., accident releases).

4.1.3 An overview of the required compliance is given in Table 1-1. The dose components are itemized and referenced, and an indication of their regulatory application is noted. Additionally, the locations of dose receivers for each dose component are given in Table 1-2.

4.1.4 Airborne Release Point Classifications - The pattern of dispersion of airborne releases is dependent on the height of the release point relative to adjacent structures. Each release point is classified as one of the following three height-dependent types:

- Stack (or Elevated) Release Point (denoted by the letter S or subscript s): These are release points approximately twice the height of adjacent solid structures. Releases are treated as elevated releases unaffected by the presence of the adjacent structures.
- Ground Level Release Point (denoted by the letter G or subscript g): These are release points at ground level or lower than adjacent solid structures. Releases are considered drawn into the downwind wake of these structures and are treated as ground level releases.
- Vent (or Mixed Mode) Release Point (denoted by the letter V or subscript v): These are release points as high or higher that adjacent solid structures but lower than twice the structures' heights. These releases are treated as a mixture of elevated and ground level releases. The proportion of the release attributed to either elevated or ground level in a vent release is determined by the ratio of stack exit velocity to wind speed.

4.1.5 10CFR50 Appendix I and the RECs contain requirements for the use of gaseous radwaste treatment and ventilation exhaust treatment.

4.1.6 The station must project doses due to gaseous releases from the site at least once per 31 days. The calculational methods shown in sections 4.2.2 and 4.2.3 are used for this dose projection.

4.1.7 For a release attributable to a processing or effluent system shared by more than one reactor unit, the dose due to an individual unit is obtained by proportioning the effluents among the units sharing the system. Allocation of gaseous effluents is described in Section 2.2.5.

4.1.8 The categories of radionuclides considered for each of the airborne effluent exposure pathways are summarized in Table 4-43.

4.1.9 Until a suitable measurement scheme can be implemented for quantification of carbon-14 in gaseous effluents, C-14 releases should be estimated per the guidance in EPRI Technical Report 1021106 (Reference 115), section 3, or by using the proxy value of 5.1 Ci/GW_{th}-year in section 3.7 of the same reference.

4.2 Dose and Dose Rate Calculation Requirements

4.2.1 Instantaneous Dose Rates

4.2.1.1 To comply with required specifications, the effluent radiation monitors have a setpoint corresponding to an offsite total body dose rate below the limit (see Section 2.2.3). In addition, compliance is assessed by calculating offsite total body dose rate based on periodic samples obtained per station procedures.

4.2.1.2 Noble Gas: Total Body Dose Rate

RECs limit total body dose rate due to noble gases in gaseous effluents released from a site to areas at and beyond the site boundary to less than or equal to 500 mrem/yr at all times. The total body dose rate due to noble gases released in gaseous effluents is calculated by the following expression:

$$\dot{D}_{TB} = \sum_i \left[V_i \dot{Q}_{is} + K_i \left(\left(\overline{\chi/Q} \right)_v \dot{Q}_{iv} + \left(\overline{\chi/Q} \right)_g \dot{Q}_{ig} \right) \right] \qquad (4\text{-}1)$$

where:

		(units)
$\dot{D}_{TB}$	Total Body Dose Rate - Dose rate to the total body due to gamma radiation from noble gas radionuclides released in gaseous effluents.	[mrem/yr]
V_i	Finite Plume Total Body Dose Factor - Gamma total body dose rate at a specified location per unit of radioactivity release rate for noble gas radionuclide i released from a stack release point. The attenuation of gamma radiation due to passage through 5 cm of body tissue of 1 g/cm^3 density is taken into account in calculating this quantity. See Section 4.3.6 and Table 4-7.	[(mrem/yr)/(μCi/sec)]
$\dot{Q}_{is}, \dot{Q}_{iv}, \dot{Q}_{ig}$	Release Rate - Measured release rate of radionuclide i from a stack, vent, or ground level release point, respectively.	[μCi/sec]
K_i	Gamma Total Body Dose Factor – Total Body dose rate per unit of radioactivity concentration for radionuclide i. See Table 4-12.	[(mrem/yr)/(μCi/m^3)]
$\left(\overline{\chi/Q} \right)_{v,g}$	Relative Concentration Factor – Radioactivity concentration at a specified location per unit of radioactivity release rate for a vent or ground level release, respectively. See Table 4-3.	[(μCi/m^3)/(μCi/sec], simplified to [sec/m^3]

4.2.1.3 Noble Gas: Skin Dose Rate

RECs limit skin dose rate due to noble gases in gaseous effluents released from a site to areas at and beyond the site boundary to less than or equal to a dose rate of 3000 mrem/yr at all times. The skin dose rate due to noble gases released in gaseous effluents is calculated by the following expression:

$$\dot{D}_S = \sum_i \left[\left(L_i \left(\overline{\chi/Q} \right)_s + 1.1 B_i \right) \dot{Q}_{is} + \left(L_i + 1.1 M_i \right) \left(\left(\overline{\chi/Q} \right)_v \dot{Q}_{iv} + \left(\overline{\chi/Q} \right)_g \dot{Q}_{ig} \right) \right] \qquad (4\text{-}2)$$

where:

		(units)
$\dot{D}_S$	Skin Dose Rate - Dose rate to skin due to beta and gamma radiation from noble gas radionuclides released in gaseous effluents.	[mrem/yr]
L_i	Beta Skin Dose Factor - Beta skin dose rate per unit of radioactivity concentration for radionuclide i. Attenuation of beta radiation passing through 7 mg/cm^2 of dead skin is accounted for. See Table 4-12.	[(mrem/yr)/(µCi/m^3)]
$\left(\overline{\chi/Q}\right)_{s,v,g}$	Relative Concentration Factor – Radioactivity concentration at a specified location per unit of radioactivity release rate for a stack, vent, or ground level release, respectively. See Table 4-3.	[(µCi/m^3)/(µCi/sec], simplified to [sec/m^3]
1.1	Conversion factor to rem in tissue from rads in air.	[mrem/mrad]
B_i	Finite Plume Gamma Air Dose Factor - Gamma air dose rate at a specified location per unit of radioactivity release rate for radionuclide i released from a stack release point. See Section 4.3.6 and Table 4-6.	[(mrad/yr)/(µCi/sec)]
$\dot{Q}_{is}, \dot{Q}_{iv}, \dot{Q}_{ig}$	Release Rate - Measured release rate of radionuclide i from a stack, vent, or ground level release point, respectively.	[µCi/sec]
M_i	Gamma Air Dose Factor – Gamma air dose rate per unit of radioactivity concentration for radionuclide i. See Table 4-12.	[(mrad/yr)/(µCi/m^3)]

4.2.1.4 Non-Noble Gas Radionuclides: Organ Dose Rate

RECs limit the dose rate to any organ, due to radioactive materials in gaseous effluents released from a site to areas at and beyond the site boundary, to less than or equal to a dose rate of 1500 mrem/yr. The dose rate to any organ to the child age group due to inhalation is calculated by the following expression:

$$\dot{D}_{ja}^{NNG} = \sum_{ip} \left(P_i \left(W_s \dot{Q}_{is} + W_v \dot{Q}_{iv} + W_g \dot{Q}_{ig} \right) \right) \qquad (4\text{-}3)$$

where:

		(units)
$\dot{D}_{ja}^{NNG}$	Organ Dose Rate due to Non-Noble Gas Radionuclides - Rate of dose commitment to organ j of an individual in age group a via all pathways p due to non-noble gas radionuclides i released in gaseous effluents.	[mrem/yr]
P_i	Dose rate parameter for radionuclides other than noble gases, which includes pathway transport parameters of the ith nuclide, the receptor's usage of the pathway media, and the dosimetry of the exposure. See Sections 4.2.1.4.1 through 4.2.1.4.3.	[(mrem/yr)/(μCi/m^3)] or [(m^{2}mrem/yr)/(μCi/sec)]
W_s, W_v, W_g	Dispersion parameter for stack, vent, or ground level release point, respectively. D/Q or χ/Q, based on exposure pathway. See Tables 4-3 and 4-5.	[sec/m^3] or [m^{-2}]
$\dot{Q}_{is}, \dot{Q}_{iv}, \dot{Q}_{ig}$	Release Rate - Measured release rate of radionuclide i from a stack, vent, or ground level release point, respectively.	[μCi/sec]

RECs require the dose rate due to non-noble gas radioactive materials in airborne effluents be determined to be within the above limit in accordance with a sampling and analysis program specified in the RECs. To comply with this specification, the station obtains and analyzes samples in accordance with the sampling and analysis program in the RECs. The dose rate due to all pathways is calculated in each sector at the location of the highest offsite χ/Q or D/Q, depending on the pathway. The result for the sector with the highest organ dose rate is compared to the limit.

4.2.1.4.1 Calculation of P_i (Inhalation)

The inhalation dose rate parameter uses χ/Q as the W parameter for all radionuclides and is calculated by the following expression:

$$P_i^I = K'(BR_a)DFA_{ija} \qquad (4\text{-}4)$$

where:		(units)
P_i^I	Dose rate parameter for inhalation of radionuclides other than noble gases. See Tables 4-13 through 4-16.	[(mrem/yr)/(μCi/m³)]
K'	Conversion constant of 10^6 pCi/μCi.	[pCi/μCi]
BR_a	Individual Air Inhalation Rate - Air intake rate for individuals in age group a. See Table 1-5.	[m³/yr]
DFA_{ija}	Inhalation Dose Commitment Factor - Dose Commitment to organ j of an individual in age group a per unit of radionuclide i inhaled. See Tables 1-8 through 1-11.	[mrem/pCi]

4.2.1.4.2 Calculatio of P_i (Ground Plane)

Deposition onto the ground plane results in a ground plane concentration that is assumed to persist over a year with radiological decay the only operating removal mechanism for each radionuclide. The ground plane dose rate parameter uses D/Q as the W parameter for all radionuclides and is calculated by the following expression:

$$P_i^G = K'K''DFG_{ij}\left(\frac{1-e^{-\lambda_i t_e}}{\lambda_i}\right) \qquad (4\text{-}5)$$

where:		(units)
P_i^G	Dose rate parameter for exposure to radionuclides other than noble gases uniformly deposited on the ground plane. See Table 4-17.	[(m²mrem/yr)/(μCi/sec)]
K'	Conversion constant of 10^6 pCi per μCi.	[pCi/μCi]
K"	Conversion constant of 8760 hours per year.	[hr/yr]
DFG_{ij}	Ground Plane Dose Commitment Factor - Dose Commitment to organ j of an individual per unit of ground activity concentration due to standing on ground uniformly contaminated with radionuclide i. See Table 1-7.	[mrem/pCi]
λ_i	Radiological Decay Constant for radionuclide i. See Table 1-6.	[sec⁻¹]
t_e	Exposure period (1 year). See Table 4-22.	[sec]

4.2.1.4.3 Calculation of P_i (Food)

The methodology of NUREG-0133 (Reference 14) calculates dose rate using the grass-cow-milk pathway that is used here. Except tritium and C-14, which use χ/Q as the W parameter, the grass-cow-milk dose parameter uses D/Q as the W parameter for all nuclides and is calculated by the following expression:

$$P_i^F = K' r \frac{Q_F U_a^C}{Y_p(\lambda_i + \lambda_w)} (F_m)(DFL_{ija}) e^{-\lambda_i t_f} \qquad (4\text{-}6)$$

For tritium in milk:

$$P_i^F = K' K'' F_m Q_F U_a^C DFL_{ija} [0.75(0.5/H)] \qquad (4\text{-}7)$$

For Carbon-14 in milk (Regulatory Guide 1.109 equation C-8 converted for use in NUREG-0133 equations):

$$P_i^F = K' K'' p F_m Q_F U_a^C DFL_{ija} [0.11/0.16] \qquad (4\text{-}8)$$

where:		(units)
P_i^F	Dose rate parameter for ingestion of radionuclides other than noble gases. See Tables 4-18 through 4-21.	[(mrem/yr)/(µCi/m³)] or [(m²mrem/yr)/(µCi/sec)]
K'	Conversion constant of 10^6 pCi/µCi.	[pCi/µCi]
r	Fraction of deposited activity retained on vegetation, dimensionless. See Table 4-22.	
Q_F	Cow feed consumption rate. See Table 4-22.	[kg/day]
U_a^C	Milk Consumption Rate - Annual consumption (usage) rate of milk for individuals in age group a. See Table 1-5.	[L/yr]
Y_p	Grass yield. See Table 4-22.	[kg/m²]
λ_i	Radiological Decay Constant for radionuclide i. See Table 1-6.	[sec⁻¹]
λ_w	Constant for removal of activity on plant surfaces by weathering. See Table 4-22.	[sec⁻¹]
F_m	Stable Element Transfer Coefficient for Milk - Fraction of an animal's daily intake of radionuclide i which appears in each liter of milk. See Table 4-23.	[(pCi/L)/(pCi/day)], simplified to [day/L]
DFL_{ija}	Ingestion Dose Commitment Factor - Dose Commitment to organ j of an individual in age group a per unit of radionuclide i ingested. See Tables 1-12 through 1-15.	[mrem/pCi]
t_f	Transport time from pasture, to cow, to milk, to receptor. See Table 4-22.	[sec]

K''	Conversion constant of 8760 hours per year.	[hr/yr]
0.75	Fraction of total plant mass that is water, dimensionless. See Table 4-22.	
0.5	Ratio of tritium concentration in plant water to tritium concentration in atmospheric water, dimensionless. See Table 4-22.	
H	Absolute humidity of the atmosphere. See Table 4-22.	[g/m³]
p	Fractional equilibrium ratio for Carbon-14, dimensionless. See Table 4-22.	
0.11	Fraction of total plant mass that is natural carbon, dimensionless. See Table 4-22.	
0.16	Concentration of natural carbon in the atmosphere. See Table 4-22.	[g/m³]

4.2.2 Dose from Noble Gas Radionuclides

4.2.2.1 Gamma Air Dose

RECs limit the gamma air dose due to noble gas effluents released from each reactor unit to areas at and beyond the site boundary to the following:

- Less than or equal to 5 mrad per calendar quarter.
- Less than or equal to 10 mrad per calendar year.

The gamma air dose due to noble gases released in gaseous effluents is calculated by the following expression:

$$D_\gamma = (3.17E-08)\sum_i \left[B_i Q_{is} + M_i \left(\left(\frac{\chi}{Q} \right)_v Q_{iv} + \left(\frac{\chi}{Q} \right)_g Q_{ig} \right) \right] \qquad (4\text{-}5)$$

where:		(units)
D_γ	Gamma Air Dose - Dose to air due to gamma radiation from noble gas radionuclides released in gaseous effluents.	[mrad]
3.17E-08	Conversion factor to years from seconds.	[yr/sec]
B_i	Finite Plume Gamma Air Dose Factor - Gamma air dose rate at a specified location per unit of radioactivity release rate for radionuclide i released from a stack release point. See Section 4.3.6 and Table 4-6.	[(mrad/yr)/(μCi/sec)]
Q_{is}, Q_{iv}, Q_{ig}	Cumulative Radionuclide Release - Measured cumulative release of radionuclide i over the time period of interest from a stack, vent, or ground release point, respectively.	[μCi]
M_i	Gamma Air Dose Factor – Gamma air dose rate per unit of radioactivity concentration for radionuclide i. See Table 4-12.	[(mrad/yr)/(μCi/m^3)]
$\left(\frac{\chi}{Q}\right)_{v,g}$	Relative Concentration Factor – Radioactivity concentration at a specified location per unit of radioactivity release rate for a vent or ground level release, respectively. See Table 4-3.	[(μCi/m^3)/(μCi/sec], simplified to [sec/m^3]

RECs require determination of cumulative and projected gamma air dose contributions due to noble gases at least once per 31 days. Maximum values for all dose factors at or beyond the site boundary in each sector are used. After doses for all sectors are determined, the highest dose is compared with the RECs limit on gamma air dose.

4.2.2.2 Beta Air Dose

RECs limit beta air dose due to noble gases in gaseous effluents released from each reactor unit to areas at and beyond the site boundary to the following:

- Less than or equal to 10 mrad per calendar quarter.
- Less than or equal to 20 mrad per calendar year.

The beta air dose due to noble gases released in gaseous effluents is calculated by the following expression:

$$D_\beta = (3.17E-08)\sum_i \left(N_i \left(\left(\frac{\chi}{Q}\right)_s Q_{is} + \left(\frac{\chi}{Q}\right)_v Q_{iv} + \left(\frac{\chi}{Q}\right)_g Q_{ig} \right) \right) \qquad (4\text{-}6)$$

where:		(units)
D_β	Beta Air Dose - Dose to air due to beta radiation from noble gas radionuclides released in gaseous effluents.	[mrad]
3.17E-08	Conversion factor to years from seconds.	[yr/sec]
N_i	Beta Air Dose Factor - Beta air dose rate per unit of radioactivity concentration for radionuclide i. See Table 4-12	[(mrad/yr)/(μCi/m³)]
$\left(\frac{\chi}{Q}\right)_{s,v,g}$	Relative Concentration Factor – Radioactivity concentration at a specified location per unit of radioactivity release rate for a stack, vent, or ground level release, respectively. See Table 4-3.	[(μCi/m³)/(μCi/sec], simplified to [sec/m³]
Q_{is}, Q_{iv}, Q_{ig}	Cumulative Radionuclide Release - Measured cumulative release of radionuclide i over the time period of interest from a stack, vent, or ground release point, respectively.	[μCi]

RECs require determination of cumulative and projected beta air dose contributions due to noble gases at least once per 31 days.

Beta air dose is determined for each sector using the highest calculated offsite value of χ/Q for that sector. The highest dose is compared with the RECs limit on beta air dose.

4.2.2.3 Total Body Dose from Noble Gases

The total body dose to any receiver is due, in part, to gamma radiation emitted from radioactivity in airborne effluents. This component is added to others to demonstrate compliance to the requirements of 40CFR190 and 10CFR20.

The total body dose component due to gamma radiation from noble gases released in gaseous effluents is calculated by the following expression:

$$D_{TB}^{NG} = 3.17E-08 \sum_i \left[V_i Q_{is} + K_i \left(\left(\chi/Q \right)_v Q_{iv} + \left(\chi/Q \right)_g Q_{ig} \right) \right] \quad (4\text{-}7)$$

where:

		(units)
D_{TB}^{NG}	Total Body Dose - Dose to the total body due to gamma radiation from noble gas radionuclides released in gaseous effluents.	[mrem]
3.17E-08	Conversion factor to years from seconds.	[yr/sec]
V_i	Finite Plume Total Body Dose Factor - Gamma total body dose rate at a specified location per unit of radioactivity release rate for radionuclide i released from a stack, vent, or ground level release point, respectively. The attenuation of gamma radiation due to passage through 5 cm of body tissue of 1 g/cm^3 density is taken into account in calculating this quantity. See Section 4.3.6 and Table 4-7.	[(mrem/yr)/ (µCi/sec)]
Q_{is}, Q_{iv}, Q_{ig}	Cumulative Radionuclide Release - Measured cumulative release of radionuclide i over the time period of interest from a stack, vent, or ground release point, respectively.	[µCi]
K_i	Gamma Total Body Dose Factor – Total Body dose rate per unit of radioactivity concentration for radionuclide i. See Table 4-12.	[(mrem/yr)/(µCi/m^3)]
$\left(\chi/Q \right)_{v,g}$	Relative Concentration Factor – Radioactivity concentration at a specified location per unit of radioactivity release rate for a vent or ground level release, respectively. See Table 4-3.	[(µCi/m^3)/(µCi/sec], simplified to [sec/m^3]

The total body dose is also calculated for the 40CFR190 and 10CFR20 compliance assessments. In some cases, the total body dose may be required in 10CFR50 Appendix I assessments (See Part II Table 1-1).

4.2.2.4 Skin Dose from Noble Gases

Skin dose is evaluated for reference as there is skin dose design objective contained in 10CFR50 Appendix I. Note that in the unlikely event that if beta air dose guideline is exceeded, then the skin dose will require evaluation. The part of skin dose due to noble gases released in gaseous effluents is calculated by the following expression:

$$D_S = 3.17E-08 \sum_i \left[\left(L_i \left(\chi/Q \right)_s + 1.1 B_i \right) Q_{is} + \left(L_i + 1.1 M_i \right) \left(\left(\chi/Q \right)_v Q_{iv} + \left(\chi/Q \right)_g Q_{ig} \right) \right] \quad (4\text{-}8)$$

where:		(units)
D_s	Skin Dose - Dose to the skin due to beta and gamma radiation from noble gas radionuclides released in gaseous effluents.	[mrem]
3.17E-08	Conversion factor to years from seconds.	[yr/sec]
L_i	Beta Skin Dose Factor - Beta skin dose rate per unit of radioactivity concentration for radionuclide i. Attenuation of beta radiation passing through 7 mg/cm^2 of dead skin is accounted for. See Table 4-12.	[(mrem/yr)/(μCi/m^3)]
$\left(\chi/Q\right)_{s,v,g}$	Relative Concentration Factor – Radioactivity concentration at a specified location per unit of radioactivity release rate for a stack, vent, or ground level release, respectively. See Table 4-3.	[(μCi/m^3)/(μCi/sec)], simplified to [sec/m^3]
1.1	Conversion factor to rem in tissue from rads in air.	[mrem/mrad]
B_i	Finite Plume Gamma Air Dose Factor - Gamma air dose rate at a specified location per unit of radioactivity release rate for radionuclide i released from a stack release point. See Section 4.3.6 and Table 4-6.	[(mrad/yr)/(μCi/sec)]
Q_{is}, Q_{iv}, Q_{ig}	Cumulative Radionuclide Release - Measured cumulative release of radionuclide i over the time period of interest from a stack, vent, or ground release point, respectively.	[μCi]
M_i	Gamma Air Dose Factor – Gamma air dose rate per unit of radioactivity concentration for radionuclide i. See Table 4-12.	[(mrad/yr)/(μCi/m^3)]

4.2.3 Dose from Non-Noble Gas Radionuclides

RECs provide the following limits, based on 10CFR50 Appendix I, on the dose to a member of the public from specified non-noble gas radionuclides in gaseous effluents released from each unit to areas at and beyond the site boundary:

- Less than or equal to 7.5 mrem to any organ during any calendar quarter
- Less than or equal to 15 mrem to any organ during any calendar year

The individual dose components are also required as part of the 40CFR190 assessments and combined as part of the 10CFR20 assessment (See Table 1-1). The deep dose due to radionuclides deposited on the ground is considered to be a component of the deep dose equivalent for 10CFR20 compliance and an organ (total body) dose component for 10CFR50 Appendix I and 40CFR190 compliance.

Organ dose is calculated for releases in the time period under consideration. Specifically, organ dose is calculated as the sum of the contributions from the inhalation, ground plane, milk, meat, and vegetation pathways:

$$D_{ja}^{NNG} = 3.17E-08\sum_{ip}\left(R_i\left(W_sQ_s + W_vQ_v + W_gQ_g\right)\right) \qquad (4\text{-}9)$$

where:

		(units)
D_{ja}^{NNG}	Organ Dose due to Non-Noble Gas Radionuclides - Sum of the dose to organ j of an individual of age group a via pathways p due to non-noble gas radionuclides i released in gaseous effluents during a specified time period.	[mrem]
3.17E-08	Conversion factor to years from seconds.	[yr/sec]
R_i	Dose parameter for radionuclides other than noble gases, which includes pathway transport parameters of the ith nuclide, the receptor's usage of the pathway media, and the dosimetry of the exposure. See Sections 4.2.3.1 through 4.2.3.5.	[(mrem/yr)/(μCi/m^3)] or [(m^{2}mrem/yr)/(μCi/sec)]
W_s, W_v, W_g	Dispersion parameter for stack, vent, or ground level release point, respectively. D/Q or χ/Q, based on exposure pathway. See Tables 4-3 and 4-5.	[sec/m^3] or [m^{-2}]
Q_{is}, Q_{iv}, Q_{ig}	Cumulative Radionuclide Release - Measured cumulative release of radionuclide i over the time period of interest from a stack, vent, or ground release point, respectively.	[μCi]

RECs require cumulative and projected dose contributions for the specified non-noble gas radionuclides in airborne effluents to be determined at least once per 31 days. To comply with this specification, Dresden obtains and analyzes samples in accordance with the radioactive gaseous waste or gaseous effluent sampling and analysis program in the RECs. For each organ of each age group considered, the dose for each pathway is calculated in every sector. The calculation is based on the location assumptions discussed below in conjunction with the pathway equations. For each organ of each age group, the doses are summed in each sector over all pathways. The result for the sector with the highest total dose is compared to the limit.

4.2.3.1 Inhalation Pathway Factor, R_i^I

The inhalation dose parameter uses χ/Q as the W parameter for all radionuclides and is calculated by the following expression:

$$R_i^I = K'(BR_a)DFA_{ija} \qquad (4\text{-}10)$$

where:

		(units)
R_i^I	Inhalation Pathway Factor - Dose parameter for inhalation of radionuclides other than noble gases. See Tables 4-24 through 4-27.	[(mrem/yr)/(μCi/m³)]
K'	Conversion constant of 10^6 pCi/μCi	[pCi/μCi]
BR_a	Individual Air Inhalation Rate - Air intake rate for individuals in age group a. See Table 1-5.	[m³/yr]
DFA_{ija}	Inhalation Dose Commitment Factor - Dose Commitment to organ j of an individual in age group a per unit of radionuclide i inhaled. See Tables 1-8 through 1-11.	[mrem/pCi]

4.2.3.2 Ground Plane Pathway Factor, R_i^G

Deposition onto the ground plane results in a ground plane concentration that is assumed to persist over a thirty-year period (mid point of plant operating life) with radiological decay the only operating removal mechanism for each radionuclide. The ground plane dose parameter uses D/Q as the W parameter for all radionuclides and is calculated by the following expression:

$$R_i^G = K'K''(SF)DFG_{ij}\left(\frac{1-e^{-\lambda_i t}}{\lambda_i}\right) \qquad (4\text{-}11)$$

where:

		(units)
R_i^G	Ground Plane Pathway Factor - Dose parameter for exposure to radionuclides other than noble gases uniformly deposited on the ground plane. See Table 4-28.	[(m²mrem/yr)/(μCi/sec)]
K'	Conversion constant of 10^6 pCi per μCi.	[pCi/μCi]
K"	Conversion constant of 8760 hours per year	[hr/yr]
SF	Shielding Factor to account for shielding due to the occupancy of structures, dimensionless. See Table 4-22.	
DFG_{ij}	Ground Plane Dose Commitment Factor - Dose Commitment to organ j of an individual per unit of ground activity concentration due to standing on ground uniformly contaminated with radionuclide i. See Table 1-7.	[mrem/pCi]
λ_i	Radiological Decay Constant for radionuclide i. See Table 1-6.	[sec⁻¹]
t	Exposure time (30 years). See Table 4-22.	[sec]

4.2.3.3 Grass-Cow-Milk Pathway Factor, R_i^C

Milk cattle are considered to be fed from two sources, pasture grass and stored feeds. Except tritium and C-14, which use χ/Q as the W parameter, the grass-cow-milk dose parameter uses D/Q as the W parameter for all nuclides and is calculated as follows:

$$R_i^C = K' \frac{Q_F\left(U_a^C\right)}{\lambda_i + \lambda_w} F_m(r)\left(DFL_{ija}\right)\left[\frac{f_p f_s}{Y_p} + \frac{\left(1 - f_p f_s\right)e^{-\lambda_i t_h}}{Y_s}\right]e^{-\lambda_i t_f} \qquad (4\text{-}12)$$

For tritium in milk:

$$R_i^C = K'K'''F_m Q_F U_a^C DFL_{ija}\left[0.75(0.5/H)\right] \qquad (4\text{-}13)$$

For carbon-14 in milk (Regulatory Guide 1.109 equation C-8 converted for use in NUREG-0133 equations):

$$R_i^C = K'K'''pF_m Q_F U_a^C DFL_{ija}\left[0.11/0.16\right] \qquad (4\text{-}14)$$

where:		(units)
R_i^C	Grass-Cow-Milk Pathway Factor - Dose parameter for ingestion of radionuclides other than noble gases via the grass-cow-milk pathway. See Tables 4-29 through 4-32.	[(mrem/yr)/(μCi/m³)] or [(m²mrem/yr)/(μCi/sec)]
K'	Conversion constant of 10^6 pCi/μCi.	[pCi/μCi]
Q_F	Cow feed consumption rate. See Table 4-22.	[kg/day]
U_a^C	Milk Consumption Rate - Annual consumption (usage) rate of milk for individuals in age group a. See Table 1-5.	[L/yr]
λ_i	Radiological Decay Constant for radionuclide i. See Table 1-6.	[sec^{-1}]
λ_w	Constant for removal of activity on plant surfaces by weathering. See Table 4-22.	[sec^{-1}]
F_m	Stable Element Transfer Coefficient for Milk - Fraction of an animal's daily intake of radionuclide i which appears in each liter of milk. See Table 4-23.	[(pCi/L)/(pCi/day)], simplified to [day/L]
r	Fraction of deposited activity retained on vegetation, dimensionless. See Table 4-22.	
DFL_{ija}	Ingestion Dose Commitment Factor - Dose Commitment to organ j of an individual in age group a per unit of radionuclide i ingested. See Tables 1-12 through 1-15.	[mrem/pCi]
f_p	Fraction of the year the cow is on pasture, dimensionless. See Table 4-22.	

f_s	Fraction of the cow feed that is pasture grass while the cow is on pasture, dimensionless. See Table 4-22.	
Y_p	Grass yield. See Table 4-22	[kg/m^2]
Y_s	Stored field yield. See Table 4-22.	[kg/m^2]
t_h	Transport time from pasture, to harvest, to cow, to milk, to receptor. See Table 4-22	[sec]
t_f	Transport time from pasture, to cow, to milk, to receptor. See Table 4-22.	[sec]
K'''	Conversion constant of 1000 g/kg.	[g/kg]
0.75	Fraction of total plant mass that is water, dimensionless. See Table 4-22.	
0.5	Ratio of tritium concentration in plant water to tritium concentration in atmospheric water, dimensionless. See Table 4-22.	
H	Absolute humidity of the atmosphere. See Table 4-22	[g/m^3]
p	Fractional equilibrium ratio for Carbon-14, dimensionless. See Table 4-22.	
0.11	Fraction of total plant mass that is natural carbon, dimensionless. See Table 4-22.	
0.16	Concentration of natural carbon in the atmosphere. See Table 4-22.	[g/m^3]

This factor can also be used to calculate organ dose due to the grass-goat-milk pathway if applicable by substituting the proper consumption rate (from Regulatory Guide 1.109 (Reference 6) Table E-3) and nuclide transfer parameter (from Regulatory Guide 1.109 (Reference 6) Table E-2).

4.2.3.4 Grass-Cow-Meat Pathway Factor, R_i^M

The integrated concentration in meat follows in a similar manner to the development for the milk pathway. Except tritium and C-14, which use χ/Q as the W parameter, the grass-cow-meat dose parameter uses D/Q as the W parameter for all nuclides and is calculated as follows:

$$R_i^M = K' \frac{Q_F\left(U_a^M\right)}{\lambda_i + \lambda_w} F_f(r)\left(DFL_{ija}\right)\left[\frac{f_p f_s}{Y_p} + \frac{\left(1 - f_p f_s\right)e^{-\lambda_i t_h}}{Y_s}\right]e^{-\lambda_i t_s} \qquad (4\text{-}15)$$

For tritium in meat:

$$R_i^M = K'K'''F_f Q_F U_a^M DFL_{ija}\left[0.75(0.5/H)\right] \qquad (4\text{-}16)$$

For carbon-14 in meat (Regulatory Guide 1.109 equation C-8 converted for use in NUREG-0133 equations):

$$R_i^M = K'K'''pF_f Q_F U_a^M DFL_{ija}\left[0.11/0.16\right] \qquad (4\text{-}17)$$

where:		(units)
R_i^M	Grass-Cow-Meat Pathway Factor - Dose parameter for ingestion of radionuclides other than noble gases via the grass-cow-meat pathway. See Tables 4-33 through 4-36.	[(mrem/yr)/(μCi/m³)] or [(m²mrem/yr)/(μCi/sec)]
K'	Conversion constant of 10^6 pCi/μCi.	[pCi/μCi]
Q_F	Cow feed consumption rate. See Table 4-22.	[kg/day]
U_a^M	Meat Consumption Rate - Annual consumption (usage) rate of meat for individuals in age group a. See Table 1-5.	[kg/yr]
λ_i	Radiological Decay Constant for radionuclide i. See Table 1-6.	[sec^{-1}]
λ_w	Constant for removal of activity on plant surfaces by weathering. See Table 4-22.	[sec^{-1}]
F_f	Stable Element Transfer Coefficient for Meat - Fraction of an animal's daily intake of radionuclide i which appears in each kilogram of flesh. See Table 4-23.	[(pCi/L)/(pCi/day)], simplified to [day/kg]
r	Fraction of deposited activity retained on vegetation, dimensionless. See Table 4-22.	
DFL_{ija}	Ingestion Dose Commitment Factor - Dose Commitment to organ j of an individual in age group a per unit of radionuclide i ingested. See Tables 1-12 through 1-15.	[mrem/pCi]

f_p	Fraction of the year the cow is on pasture, dimensionless. See Table 4-22.	
f_s	Fraction of the cow feed that is pasture grass while the cow is on pasture, dimensionless. See Table 4-22.	
Y_p	Grass yield. See Table 4-22.	[kg/m^2]
Y_s	Stored field yield. See Table 4-22.	[kg/m^2]
t_h	Transport time from pasture, to harvest, to cow, to meat, to receptor. See Table 4-22	[sec]
t_s	Transport time from pasture, to cow, to meat, to receptor. See Table 4-22.	[sec]
K'''	Conversion constant of 1000 g/kg	[g/kg]
0.75	Fraction of total plant mass that is water, dimensionless. See Table 4-22.	
0.5	Ratio of tritium concentration in plant water to tritium concentration in atmospheric water, dimensionless. See Table 4-22.	
H	Absolute humidity of the atmosphere. See Table 4-22	[g/m^3]
p	Fractional equilibrium ratio for Carbon-14, dimensionless. See Table 4-22.	
0.11	Fraction of total plant mass that is natural carbon, dimensionless. See Table 4-22.	
0.16	Concentration of natural carbon in the atmosphere. See Table 4-22.	[g/m^3]

This factor can also be used to calculate organ dose due to the grass-goat-meat pathway if applicable by substituting the proper consumption rate (from Regulatory Guide 1.109 (Reference 6) Table E-3) and nuclide transfer parameter (from Regulatory Guide 1.109 (Reference 6) Table E-2).

4.2.3.5 Vegetation Pathway Factor, R_i^V

The integrated concentration in vegetation consumed by man follows the expression developed in the derivation of the milk factor. Man is considered to consume two types of vegetation, fresh and stored, that differ only in the time period between harvest and consumption. Except tritium and C-14, which use χ/Q as the W parameter, the vegetation dose parameter uses D/Q as the W parameter for all nuclides and is calculated as follows:

$$R_i^V = K'\left[\frac{(r)}{Y_v(\lambda_i + \lambda_w)}\right](DFL_{ija})\left[U_a^L f_L e^{-\lambda_i t_L} + U_a^S f_g e^{-\lambda_i t_g}\right] \qquad (4\text{-}18)$$

For tritium in vegetation:

$$R_i^V = K'K'''\left(U_a^L f_L + U_a^S f_g\right)DFL_{ija}\left[0.75(0.5/H)\right] \qquad (4\text{-}19)$$

For carbon-14 in vegetation (Regulatory Guide 1.109 equation C-8 converted for use in NUREG-0133 equations):

$$R_i^V = K'K'''p\left(U_a^L f_L + U_a^S f_g\right)DFL_{ija}\left[0.11/0.16\right] \qquad (4\text{-}20)$$

where:		(units)
R_i^V	Vegetation Pathway Factor - Dose parameter for ingestion of radionuclides other than noble gases via the vegetation pathway. See Tables 4-37 through 4-40.	[(mrem/yr)/(μCi/m³)] or [(m²mrem/yr)/(μCi/sec)]
K'	Conversion constant of 10^6 pCi/μCi	[pCi/μCi]
r	Fraction of deposited activity retained on vegetation, dimensionless. See Table 4-22.	
Y_v	Vegetation areal density. See Table 4-22.	[kg/m²]
λ_i	Radiological Decay Constant for radionuclide i. See Table 1-6.	[sec⁻¹]
λ_w	Constant for removal of activity on plant surfaces by weathering. See Table 4-22.	[sec⁻¹]
DFL_{ija}	Ingestion Dose Commitment Factor - Dose Commitment to organ j of an individual in age group a per unit of radionuclide i ingested. See Tables 1-12 through 1-15.	[mrem/pCi]
U_a^L	Fresh Leafy Vegetation Consumption Rate - Annual consumption (usage) rate of fresh leafy vegetation for individuals in age group a. See Table 1-5.	[kg/yr]
U_a^S	Stored Vegetation Consumption Rate - Annual consumption (usage) rate of stored vegetation for individuals in age group a. See Table 1-5.	[kg/yr]

f_L	Fraction of annual intake of fresh leafy vegetation grown locally, dimensionless. See Table 4-22.	
f_g	Fraction of annual intake of stored vegetation grown locally, dimensionless. See Table 4-22.	
t_L	Average time between harvest of leafy vegetation and consumption. See Table 4-22	[sec]
t_g	Average time between harvest of stored vegetation and consumption. See Table 4-22	[sec]
K'''	Conversion constant of 1000 g/kg	[g/kg]
0.75	Fraction of total plant mass that is water, dimensionless. See Table 4-22.	
0.5	Ratio of tritium concentration in plant water to tritium concentration in atmospheric water, dimensionless. See Table 4-22.	
H	Absolute humidity of the atmosphere. See Table 4-22	[g/m^3]
p	Fractional equilibrium ratio for Carbon-14, dimensionless. See Table 4-22.	
0.11	Fraction of total plant mass that is natural carbon, dimensionless. See Table 4-22.	
0.16	Concentration of natural carbon in the atmosphere. See Table 4-22.	[g/m^3]

4.3 Meteorological Models and Parameters for Airborne Effluent Calculations

4.3.1 Introduction

The equations used for calculation of doses due to radioactive airborne effluents are given previously in this section. The equations involve the following types of parameters:

- Meteorological Parameters
  These include χ/Q, D/Q and wind speed. Their values are based on historical average atmospheric conditions at Dresden for a selected multi-year historical period.
- Dose Factors
  These parameters are used to provide a simple way to calculate doses and dose rates due to gamma and beta radiation. Some of these parameters are independent of meteorological conditions. Others have values based on historical average atmospheric conditions for a selected multi-year historical period.
- Measured Release Parameters
  These are measured values of radioactivity releases and release rates.
- Radiological Decay Constants
  These are used to account for the radioactive decay between the release of radioactivity to the environment and the exposure of persons to it.
- Production/Exposure Parameters
  These are parameters characterizing agricultural production (e.g., length of growing season, transport times) and human exposure patterns (e.g., exposure period, breathing rate, food consumption rates). These parameters affect the quantities of radioactivity to which persons may be exposed.

This section discusses the methodology used to determine values of these parameters. Section 4.3.2 addresses how the historical meteorology of a site is characterized by use of a function called the joint frequency distribution. Section 4.3.2 and Sections 4.3.4 through 4.3.7 present equations that use the joint frequency distribution to obtain values for site-specific meteorological and dose parameters. Most of these equations involve a mathematical model of a plume known as the Gaussian plume model. This model is developed in Section 4.3.3. Various generic dose factors are discussed in Sections 4.3.8 through 4.3.11. The other parameters are discussed in the remaining sections.

4.3.2 Meteorological Data and Parameters

Predicting where airborne effluent will travel requires information on the following:

- Wind speed
- Wind direction
- Atmospheric turbulence

The greater the atmospheric turbulence, the more an effluent plume will tend to broaden and the more dilute the concentration will be. Atmospheric turbulence is affected by the general condition of the atmosphere (e.g., the vertical temperature distribution) and by local features (e.g., objects that protrude into the wind stream). A commonly used classification scheme for the degree of atmospheric turbulence associated with the general condition of the atmosphere involves seven stability classes:

A Extremely Unstable
B Moderately Unstable
C Slightly Unstable
D Neutral
E Slightly Stable
F Moderately Stable
G Extremely Stable

This classification scheme is based on Reference 5, Table 1. Each class is associated with a particular range of wind direction fluctuations and of vertical temperature gradients in the atmosphere. These are specified in Table 4-41.

4.3.2.1 Data

Historical atmospheric conditions at Dresden were recorded by an instrumented meteorological tower that measured wind speed, wind direction, and temperature at various heights. Hourly average values of wind speed, wind direction, and stability class were determined. The difference in temperature between two heights was used to assign an atmospheric stability class based on the correlation between temperature gradient and stability class in Table 4-41.

In obtaining the data, quality assurance checks and corrections were made. Also, corrections were applied to compensate for the limitations of wind sensors at low speeds. A calm was said to exist if the wind speed was less than that of the threshold of either the anemometer (wind speed meter) or the wind direction vane. For calm conditions, a wind speed equal to one-half of the higher threshold was assigned. For each stability class, the wind directions during calm conditions were assumed to be distributed in proportion to the observed wind direction distribution of the lowest non-calm wind speed class.

4.3.2.2 Joint Frequency Distribution

The data for a particular historical period are summarized by developing a joint frequency distribution (JFD). Each such distribution specifies the fraction of time during the historical period that the following jointly occur:

- Wind speed within a particular range (wind speed class).
- Downwind direction in one of the 16 sectors corresponding to the 16 principal compass directions (N, NNE, etc.).
- Atmospheric conditions corresponding to one of the seven atmospheric stability classes discussed in Section 4.3.2. Tables 4-8 through 4-10 contain this data.

Different JFDs are associated with the different release classifications defined in Section 4.1.4. One JFD is defined for stack releases, and another JFD is defined for ground level releases. Two JFDs are associated with vent (mixed mode) releases, one for the portion of the time the release is treated as elevated and the other for the portion of the time the release is treated as ground level.

4.3.2.2.1 Downwind Direction Versus Upwind Direction

Unless otherwise noted, any reference to wind direction in this document represents downwind direction, i.e., the direction in which the wind is blowing toward. This is because the parameters developed in this document are used to calculate radioactivity concentration and radiation dose downwind of a release point. In contrast, it is conventional for meteorologists to provide JFDs based on upwind direction, the direction from which the wind is blowing. For example, the JFDs presented in the annual operating reports of the nuclear power stations are obtained from a meteorological contractor and the directions specified in the reports are upwind directions. Users of JFDs should always be careful to ascertain whether the directions specified are upwind or downwind.

4.3.2.2.2 Stack JFD

For a stack release, the JFD is defined as follows:

$f_S(n, \theta, c)$ Joint Frequency Distribution, Stack Release

The fraction of hours during a period of observation that all of the following hold:

- The average wind speed is within wind speed class n.
- The downwind direction is within the sector denoted by θ.
- The atmospheric stability class is c.

This function is defined for application to a stack release point (see Section 4.1.4). Its value is based on hourly average wind data obtained at a height representative of the release point height.

The stack JFD is normalized to 1:

$$\sum_{n,\theta,c} f_s(n,\theta,c) = 1 \qquad (4\text{-}21)$$

4.3.2.2.3 Ground Level JFD

For a ground level release, the JFD $f_g(n, \theta, c)$ is defined in the same way as for a stack release except that the wind data are obtained at a height representative of a ground level release point. This height is taken as 35 feet.

The ground level JFD is normalized to 1:

$$\sum_{n,\theta,c} f_g(n,\theta,c) = 1 \tag{4-22}$$

4.3.2.2.4 Vent JFDs

In accordance with the approach recommended in Regulatory Guide 1.111 (Reference 7), the plume from a vent release is treated as elevated part of the time and as ground level the rest of the time. Two JFDs are determined:

- $\mathbf{f_{v,elev}(n,\theta,c)}$ characterizes the plume during the part of the time that it is considered elevated;
- $\mathbf{f_{v,gnd}(n,\theta,c)}$ characterizes the plume during the part of the time that it is considered ground level.

Their definitions are as follows:

$\mathbf{f_{v,elev}(n,\theta,c)}$ Joint Frequency Distribution, Elevated Portion of a Vent Release

The fraction of hours during a period of observation that the plume is considered elevated and that all of the following hold:

- The average wind speed is within wind speed class n.
- The downwind direction is within the sector denoted by θ.
- The atmospheric stability class is c.

$\mathbf{f_{v,gnd}(n,\theta,c)}$ Joint Frequency Distribution, Ground Level Portion of a Vent Release

The fraction of hours during a period of observation that the plume is considered ground level and that all of the following hold:

- The average wind speed is within wind speed class n.
- The downwind direction is within the sector denoted by θ.
- The atmospheric stability class is c.

The value of $\mathbf{f_{v,elev}(n, \theta,c)}$ is based on hourly average wind data at a height representative of the vent release point. Where the measurement height differed considerably from the release height, wind speed data for the release height was obtained by extrapolation. The value of $\mathbf{f_{v,gnd}(n, \theta,c)}$ is based on hourly average wind data obtained at a height representative of a ground level release point. This is taken as 35 feet.

The sum of these two JFDs is normalized to 1:

$$\sum_{n,\theta,c} \left(f_{v,elev}(n,\theta,c) + f_{v,gnd}(n,\theta,c)\right) = 1 \tag{4-23}$$

The prescription of Regulatory Guide 1.111 is used in determining the fraction of time that the plume is considered elevated and the fraction of time that it is considered ground level. The fractions are obtained from the ratio of stack exit velocity $\mathbf{W_o}$ to hourly average wind speed **u** at the height of the vent release point as follows:

- If $W_o/u > 5$, then the plume is considered elevated for the hour.
- If $W_o/u < 1$, then the plume is considered ground level for the hour.
- If $1 < W_o/u < 5$, the plume is considered to be a ground level release for a fraction G_t of the hour and an elevated release for a fraction $(1 - G_t)$ of the hour where G_t is defined as follows:

$$G_t = 2.58 - 1.58(W_o/u) \quad \text{for } 1.0 < W_o/u \leq 1.5 \qquad (4\text{-}24)$$
$$G_t = 0.30 - 0.06(W_o/u) \quad \text{for } 1.5 < W_o/u \leq 5.0 \qquad (4\text{-}25)$$

4.3.2.3 Average Wind Speed

Using the joint frequency distribution, average wind speeds are obtained for Dresden. Values are obtained for each downwind direction (N, NNE, etc.) and for various release point classifications (stack, vent, and ground level).

4.3.2.3.1 Stack Release

For a stack release, the following formula is used:

$$u_s(\theta) = \frac{\sum_{n,c}(f_s(n,\theta,c)u_n)}{\sum_{n,c}(f_s(n,\theta,c))} \qquad (4\text{-}26)$$

where: (units)

$u_s(\theta)$	Average Wind Speed, Stack Release - The average wind speed in downwind direction θ for a stack release.	[m/sec]
u_n	Wind Speed for Class **n** - A wind speed representative of wind speed class **n**. For each wind speed class except the highest, $\mathbf{u_n}$ is the average of the upper and lower limits of the wind speed range for the class. For the highest wind speed class, $\mathbf{u_n}$ is the lower limit of the wind speed range for the class.	[m/sec]

The parameter $\mathbf{f_s}$ is defined in Section 4.3.2.2.2.

4.3.2.3.2 Ground Level Release

For a ground level release, the following formula is used:

$$u_g(\theta) = \frac{\sum_{n,c}\left(f_g(n,\theta,c)u_n\right)}{\sum_{n,c}\left(f_g(n,\theta,c)\right)} \qquad (4\text{-}27)$$

where:		(units)
$u_g(\theta)$	Average Wind Speed, Ground Level Release - The average wind speed in downwind direction θ for a ground level release.	[m/sec]
u_n	Wind Speed for Class **n** - A wind speed representative of wind speed class **n**. For each wind speed class except the highest, $\mathbf{u_n}$ is the average of the upper and lower limits of the wind speed range for the class. For the highest wind speed class, $\mathbf{u_n}$ is the lower limit of the wind speed range for the class.	[m/sec]

The parameter $\mathbf{f_g}$ is defined in Section 4.3.2.2.3.

4.3.2.3.3 Vent Release

For a vent release, the following formula is used:

$$u_v(\theta) = \frac{\sum_{n,c}\left(\left(f_{v,elev}(n,\theta,c) + f_{v,gnd}(n,\theta,c)\right)u_n\right)}{\sum_{n,c}\left(f_{v,elev}(n,\theta,c) + f_{v,gnd}(n,\theta,c)\right)} \qquad (4\text{-}28)$$

where:		(units)
$u_v(\theta)$	Average Wind Speed, Vent Release - The average wind speed in downwind direction θ for a vent release.	[m/sec]
u_n	Wind Speed for Class **n** - A wind speed representative of wind speed class **n**. For each wind speed class except the highest, $\mathbf{u_n}$ is the average of the upper and lower limits of the wind speed range for the class. For the highest wind speed class, $\mathbf{u_n}$ is the lower limit of the wind speed range for the class.	[m/sec]

The parameters $\mathbf{f_{v,elev}}$ and $\mathbf{f_{v,gnd}}$ are defined in Section 4.3.2.2.4.

4.3.3 Gaussian Plume Models

As a plume of airborne effluents moves away from an elevated release point, the plume both broadens and meanders. It has been found that the time-averaged distribution of material in an effluent plume can be well represented mathematically by a Gaussian function.

4.3.3.1 Mathematical Representation

In a widely used form of the Gaussian plume model, the distribution of radioactivity in a plume is represented mathematically by the equation below:

$$\chi(x,y,z) = \left(\frac{\dot{Q}}{2\pi\sigma_y\sigma_z u}\right) e^{-\frac{y^2}{2\sigma_y^2}} \times \left(e^{-\frac{(z-h_e)^2}{2\sigma_z^2}} + e^{-\frac{(z+h_e)^2}{2\sigma_z^2}}\right) \qquad (4\text{-}29)$$

where:		(units)
$\chi(x,y,z)$	Radioactivity Concentration - The concentration of radioactivity at point **(x,y,z)**, where:	[μCi/m³]
	x Downwind Distance - Distance from the stack along an axis parallel to the wind direction.	[m]
	y Crosswind Distance - Distance from the plume centerline along an axis parallel to the crosswind direction.	[m]
	z Vertical Distance - Distance from the ground (grade level at the stack) along an axis parallel to the vertical direction.	[m]
$\dot{Q}$	Release Rate - Release rate of radioactivity.	[μCi/sec]
σ_y, σ_z	Horizontal and Vertical Dispersion Coefficients - Standard deviations of the Gaussian distributions describing the plume cross-sections in the **y** and **z** directions, respectively. The values of σ_y and σ_z depend on several parameters: • Downwind distance **x**. Because a plume broadens and meanders as it travels away from its release point, the values of σ_y and σ_z increase as **x** increases. • Atmospheric stability class. The plume is broadest for extremely unstable atmospheric conditions (Class A) and narrowest for extremely stable conditions (Class G). • Time period of averaging plume concentration. The values of σ_y and σ_z increase as the averaging period increases.	[m]
u	Average Wind Speed - The average wind speed. The average speed of travel of the plume in the **x** direction.	[m/sec]
h_e	Effective Release Height - The effective height of effluent release above grade elevation, which may be greater than the actual release height (see Section 4.3.4.1.1.1).	[m]

The two exponential functions of **z** in Equation 4-33 represent the emitted and reflected components of the plume. The reflected component (represented by the exponential with **(z + h_e)** in its argument) arises from the assumption that all material in a portion of the plume that touches ground is reflected upward. This assumption is conservative if one is calculating airborne radioactivity concentration.

4.3.3.2 Sector-Averaged Concentration

Sometimes, it is desired to determine the average concentration of radioactivity in a sector due to release at a constant rate over an extended period of time (e.g., a year). For such a case, it is reasonable to assume that the wind blows with equal likelihood toward all directions within the sector. From Equation 4-33, the following equation for ground level radioactivity concentration can be derived:

$$\chi_{sector} = \left(\frac{2.032\ f\ \dot{Q}}{\sigma_z\ u\ x} \right) e^{-\frac{h_e^2}{2\sigma_z^2}} \qquad (4\text{-}30)$$

where: (units)

χ_{sector} Sector-Averaged Ground Level Concentration - The time-averaged concentration of airborne radioactivity in a sector at ground level at a distance **x** from the release point. [μCi/m³]

2.032 $\sqrt{\frac{2}{\pi}}$ divided by the width in radians of a 22.5° sector (or $\frac{\pi}{8}$), (Reference 7) dimensionless.

f Sector Fraction - The fraction of time that the wind blows into the sector, dimensionless.

The other parameter definitions are the same as for Equation 4-33.

4.3.4 Relative Concentration Factor χ/Q

The relative concentration factor **χ/Q** (called "chi over Q") provides a simplified method of calculating the radioactivity concentration at a given point in an effluent plume when the release rate is known:

$$\chi = \dot{Q}\left(\chi/Q\right) \tag{4-31}$$

where:		(units)
χ	Concentration of Radioactivity - Concentration of radioactivity at point **(x,y,z)** in the atmosphere.	[μCi/m³]
$\dot{Q}$	Release Rate - Release rate of radioactivity.	[μCi/sec]
χ/Q	Relative Concentration Factor - Relative concentration factor for point **(x,y,z)**. The airborne radioactivity concentration at **(x,y,z)** per unit release rate.	[sec/m³]

Expressions for **χ/Q** based on Gaussian plume models can be obtained from the equations for concentration χ in Section 4.3.3 simply by dividing both sides of each equation by the release rate. For example, from Equation 4-34, we obtain the following expression for the sector-averaged **χ/Q**:

$$\chi_{sector}/\dot{Q} = \left(\frac{2.032\ f}{\sigma_z\ u\ x}\right) e^{-\frac{h_e^2}{2\sigma_z^2}} \tag{4-32}$$

The values of **χ/Q** used in ODCM calculations are both sector-averaged and time-averaged. The time averaging is based on the historical average atmospheric conditions of a specified multi-year time period (see Section 4.3.2) and is accomplished by use of the joint frequency distribution discussed in Section 4.3.2.2. The formulas used to obtain the time- and sector-averaged **χ/Q** are based on Equation 4-36, but vary depending on whether the release is a stack, ground level, or vent release. The three cases are discussed below.

4.3.4.1 Stack Release

For a stack release, the relative concentration factor is designated $(\chi/Q)_s$. Its value is obtained by the following formula:

$$\left(\overline{\chi/Q}\right)_s = \frac{2.032}{R}\sum_{n,c}\left(f_s(n,\theta,c)\left(\frac{e^{-\frac{h_e^2}{2\sigma_z^2}}}{u_n\sigma_z}\right)\right) \qquad (4\text{-}33)$$

where: (units)

$\left(\overline{\chi/Q}\right)_s$ Relative Concentration Factor, Stack Release - The time- and sector-averaged relative concentration factor due to a stack release for a point at ground level at distance **R** in downwind direction θ. [sec/m³]

2.032 $\sqrt{\frac{2}{\pi}}$ divided by the width in radians of a 22.5° sector ($\frac{\pi}{8}$), (Reference 7) dimensionless.

R Radius - Downwind distance from the release point to the point of interest. [m]

$f_s(n,\theta,c)$ Joint Frequency Distribution, Stack Release, defined in Section 4.3.2.2.2, dimensionless.

h_e Effective Release Height - The effective height of an effluent release above grade elevation. For a stack release, $\mathbf{h_e}$ is obtained by correcting the actual height of the release point for plume rise, terrain effects, and downwash as described in Section 4.3.4.1.1, below. [m]

σ_z Standard Vertical Dispersion Coefficient - A coefficient characterizing vertical plume spread in the Gaussian model for stability class **c** at radius **R** (see Table 4-42). [m]

u_n Wind Speed - A wind speed representative of wind speed class **n**. For each wind speed class except the highest, $\mathbf{u_n}$ is the average of the upper and lower limits of the wind speed range for the class. For the highest wind speed class, $\mathbf{u_n}$ is the lower limit of the wind speed range for the class. [m/sec]

This expression is recommended by the NRC in Regulatory Guide 1.111 (Reference 7) and is based on a model designated there as the "constant mean wind direction model." In this model it is assumed that the mean wind speed, the mean wind direction, and the atmospheric stability class determined at the release point also apply at all points within the region in which airborne concentration is being evaluated.

4.3.4.1.1 Effective Release Height

For a stack release, the effective height of an effluent plume is the height of the release point corrected for plume rise and terrain effects:

If $(h_s + h_{pr} - h_t) < 100$ meters, then $h_e = h_s + h_{pr} - h_t$ (4-34)

If $(h_s + h_{pr} - h_t) \geq 100$ meters, then $h_e = 100$ meters (4-35)

where:		(units)
h_e	Effective Release Height - The effective height of an effluent release above grade elevation.	[m]
h_s	Actual Release Height - The actual height of the release above grade elevation.	[m]
h_{pr}	Plume Rise - The rise of the plume due to its momentum and buoyancy. (See Section 4.3.4.1.1.1)	[m]
h_t	Terrain Correction Parameter - A parameter to account for the effect of terrain elevation on the effective height of a plume. Taken as zero (see Section 4.3.4.1.1.2).	[m]

4.3.4.1.1.1 Plume Rise

Because nuclear power stations generally have plumes that are not significantly warmer than room temperature, plume rise due to buoyancy is neglected. The formulas used to calculate plume rise due to momentum are given below.

Stability Classes A, B, C, and D

For these stability classes (corresponding to unstable and neutral conditions), $\mathbf{h_{pr}}$ is taken as the lesser of two quantities:

$$h_{pr} = \text{Minimum of } [(h_{pr})_1, (h_{pr})_2] \quad (4\text{-}36)$$

$$(h_{pr})_1 = (1.44)\left(\sqrt[3]{\left(\frac{W_o}{u}\right)^2}\right)\left(\sqrt[3]{\frac{R}{d}}\right)d - c \qquad (h_{pr})_2 = 3\left(1.5 - \frac{W_o}{u}\right)d \quad (4\text{-}37), (4\text{-}38)$$

where:		(units)
W_o	Stack Exit Velocity - The effluent stream velocity at the discharge point.	[m/sec]
u	Wind Speed	[m/sec]
R	Radius - Downwind distance from the release point to the point of interest.	[m]
d	Internal Stack Diameter - The internal diameter of the stack from which the effluent is released.	[m]
c	Downwash Correction - A parameter to account for downwash at low exit velocities, where:	[m]

$$c = 3\left(1.5 - \frac{W_o}{u}\right)d \text{ if } W_o < 1.5u \quad (4\text{-}39)$$

$$c = 0 \text{ if } W_o \geq 1.5u \quad (4\text{-}40)$$

Note that $\mathbf{(h_{pr})_1}$ can increase without limit as **R** increases; thus, the effect of $\mathbf{(h_{pr})_2}$ is to limit calculated plume rise at large distances from the nuclear power station.

Stability Classes E, F, and G

For these stability classes (corresponding to stable conditions), $\mathbf{h_{pr}}$ is taken as the minimum of four quantities:

$$h_{pr} = \text{Minimum of } [(h_{pr})_1, (h_{pr})_2, (h_{pr})_3, (h_{pr})_4] \quad (4\text{-}41)$$

$$(h_{pr})_3 = (4)\sqrt[4]{\frac{F}{S}} \quad (4\text{-}42)$$

$$(h_{pr})_4 = (1.5)\sqrt[3]{\frac{F}{u}}\sqrt[6]{\frac{1}{S}} \quad (4\text{-}43)$$

where: (units)

F Momentum Flux Parameter, defined as: [m^4/sec^2]

$$F = W_o^2\left(\frac{d}{2}\right)^2 \quad (4\text{-}44)$$

S Stability Parameter, defined as: [sec^{-2}]

Stability Class	S
E	8.70E-4
F	1.75E-3
G	2.45E-3

u Wind Speed [m/sec]

The quantities $(\mathbf{h_{pr}})_1$ and $(\mathbf{h_{pr}})_2$ are as defined by Equations 4-41 and 4-42.

4.3.4.1.1.2 Terrain Effects

Due to general flatness of the terrain in the vicinity of Dresden, the terrain correction parameter $\mathbf{h_t}$ was taken as zero in all calculations of meteorological dispersion and dose parameters for this Manual.

4.3.4.2 Ground Level Release

For a ground level release, the relative concentration factor is designated $(\chi/Q)_g$. Its value is obtained by the following formula:

$$\left(\overline{\chi/Q}\right)_g = \frac{2.032}{R}\sum_{n,c}\left(\frac{f_g(n,\theta,c)}{u_n S_z}\right) \qquad (4\text{-}45)$$

where: (units)

$\left(\overline{\chi/Q}\right)_g$ Relative Concentration Factor, Ground Level Release - The time- and sector-averaged relative concentration factor due to a ground level release for a point at ground level at distance **R** in downwind direction θ. [sec/m³]

$f_g(n,\theta,c)$ Joint Frequency Distribution, Ground Level Release, defined in Section 4.3.2.2.3, dimensionless.

S_z Wake-Corrected Vertical Dispersion Coefficient - The vertical dispersion coefficient corrected for building wake effects. The correction is made as described below. [m]

The remaining parameters are defined in Section 4.3.4.1.

Wake-Corrected Vertical Dispersion Coefficient

The wake-corrected vertical dispersion coefficient S_z in Equation 4-49 is taken as the lesser of two quantities:

$$S_z = \text{Minimum of } [(S_z)_1, (S_z)_2] \qquad (4\text{-}46)$$

$$(S_z)_1 = \sqrt{\sigma_z^2 + \frac{D^2}{2\pi}} \qquad (4\text{-}47)$$

$$(S_z)_2 = \sigma_z\sqrt{3} \qquad (4\text{-}48)$$

where: (units)

S_z Wake-Corrected Vertical Dispersion Coefficient - The vertical dispersion coefficient corrected for building wake effects. [m]

σ_z Standard Vertical Dispersion Coefficient - The coefficient characterizing vertical plume spread in the Gaussian model for stability class **c** at distance **R** (see Table 4-42). [m]

D Maximum Height of Neighboring Structure - The maximum height of any neighboring structure causing building wake effects (see Table 4-11). [m]

4.3.4.3 Vent Release

For a vent release, the relative concentration factor is designated $(\chi/Q)_v$. Its value is obtained by the following formula:

$$\left(\frac{\chi}{Q}\right)_v = \frac{2.032}{R}\sum_{n,c}\left(\frac{f_{v,elev}(n,\theta,c)}{u_n\sigma_z}e^{-\frac{h_e^2}{2\sigma_z^2}} + \frac{f_{v,gnd}(n,\theta,c)}{u_n S_z}\right) \qquad (4\text{-}49)$$

where: (units)

$\left(\frac{\chi}{Q}\right)_v$ Relative Concentration Factor, Vent Release - The time- and sector-averaged relative concentration factor due to a vent release for a point at ground level at distance **R** in downwind direction θ. [sec/m³]

The parameters $f_{v,elev}(n,\theta,c)$ and $f_{v,gnd}(n,\theta,c)$ are defined in Section 4.3.2.2.4. The parameter S_z is defined in Section 4.3.4.2. The remaining parameters are defined in Section 4.3.4.1.

4.3.4.4 Removal Mechanisms

In Regulatory Guide 1.111, the NRC allows various removal mechanisms to be considered in evaluating the radiological impact of airborne effluents. These include radioactive decay, dry deposition, wet deposition, and deposition over water. For simplicity, these removal mechanisms cited by the NRC are not accounted for in the evaluation or use of **χ/Q** in this Manual. This represents a conservative approximation as ignoring removal mechanisms increases the value of **χ/Q**.

4.3.5 Relative Deposition Factor D/Q

The quantity **D/Q** (called "D over Q") is defined to provide the following simple way of calculating the rate of deposition of radioactivity at a given point on the ground when the release rate is known.

$$\dot{d} = \dot{Q}\left(\frac{D}{Q}\right) \qquad (4\text{-}50)$$

where: (units)

$\dot{d}$ Deposition Rate - Rate of deposition of radioactivity at a specified point on the ground. [(μCi/m²)/sec]

$\dot{Q}$ Release Rate of radioactivity. [μCi/sec]

$\left(\frac{D}{Q}\right)$ Relative Deposition Factor - Relative deposition factor for a specified point on the ground. The deposition rate per unit release rate. [m⁻²]

The values of **D/Q** used in this manual are time-averaged. The time averaging is based on the historical average atmospheric conditions of a specified multi-year time period (see Section 4.3.2) and is accomplished by use of the joint frequency distribution described in Section 4.3.2.2. The formulas used to obtain **D/Q** vary depending on whether the release is a stack, ground level, or vent release. The three cases are discussed below.

4.3.5.1 Stack Release

For a stack release, the relative deposition factor is designated **(D/Q)$_s$**. Its value is obtained by the following formula:

$$\left(D/Q\right)_s = \frac{16}{2\pi R}\sum_{n,c}\left(f_s(n,\theta,c)D_r(c,R,h_e)\right) \qquad (4\text{-}51)$$

where:		(units)
$(D/Q)_S$	Relative Deposition Factor, Stack Release - The time-averaged relative deposition factor due to a stack release for a point at distance **R** in the direction θ.	[m^{-2}]
$2\pi/16$	Sector Width - The width of a sector over which the plume direction is assumed to be uniformly distributed (as in the model of Section 4.3.3.2). Taken as 1/16 of a circle, inverted in the equation.	[radian]
R	Radius - Downwind distance from the release point to the point of interest.	[m]
$f_S(n,\theta,c)$	Joint Frequency Distribution, Stack Release, defined in Section 4.3.2.2.2, dimensionless.	
$D_r(c,R,h_e)$	Relative Deposition Rate, Stack Release - The deposition rate per unit downwind distance [μCi/(sec-m)] divided by the source strength [μCi/sec] due to a stack release for stability class **c**, downwind distance **R**, and effective release height **h$_e$**. The value is based on Figures 7 to 9 of Regulatory Guide 1.111, which apply, respectively, to release heights of 30, 60, and 100 m. Linear interpolation is used to obtain values at intermediate release heights. If the effective release height is greater than 100 meters, then the data for 100 meters are used.	[m^{-1}]
h_e	Effective Release Height - The effective height of an effluent release above grade elevation.	[m]

4.3.5.2 Ground Level Release

For ground level release, the relative deposition factor is designated **$(D/Q)_g$**. Its value is obtained by the following formula:

$$\left(D/Q\right)_g = \frac{16}{2\pi R} D_r(R) \sum_{n,c} \left(f_g(n,\theta,c)\right) \qquad (4\text{-}52)$$

where:		(units)
$(D/Q)_g$	Relative Deposition Factor, Ground Level Release - The time-averaged relative deposition factor due to a ground level release for a point at distance **R** in the direction θ.	[m^{-2}]
$f_g(n,\theta,c)$	Joint Frequency Distribution, Ground Level Release, defined in Section 4.3.2.2.3, dimensionless.	
$D_r(R)$	Relative Deposition Rate, Ground Level - The deposition rate per unit downwind distance [μCi/(sec-m)] divided by the source strength [μCi/sec] due to a ground level release for downwind distance **R**. The value is taken from Figure 6 of Regulatory Guide 1.111 and is the same for all atmospheric stability classes.	[m^{-1}]

The remaining parameters are defined in Section 4.3.5.1.

4.3.5.3 Vent Release

For a vent release, the relative deposition factor is designated **$(D/Q)_v$**. Its value is obtained by the following formula:

$$\left(D/Q\right)_v = \frac{16}{2\pi R}\left(\sum_{n,c}\left(f_{v,elev}(n,\theta,c) D_r(c,R,h_e)\right) + D_r(R)\sum_{n,c}\left(f_{v,gnd}(n,\theta,c)\right)\right) \qquad (4\text{-}53)$$

where:		(units)
$(D/Q)_v$	Relative Deposition Factor, Vent Release - The time-averaged relative deposition factor due to a ground level release for a point at distance **R** in the direction θ.	[m^{-2}]

The parameters **$f_{v,elev}(n,\theta,c)$** and **$f_{v,gnd}(n,\theta,c)$** are defined in Section 4.3.2.2.4. The remaining parameters are defined in Sections 4.3.5.1 and 4.3.5.2.

4.3.6 Finite Plume Dose Factors (B_i, V_i)

Dose factors provide a simple way of calculating dose and dose rates due to gamma radiation. For example, using a dose factor **DF**$_i$, gamma air dose rate may be calculated as follows:

$$\dot{D} = \sum_i \dot{D}_i \tag{4-54}$$

$$\dot{D} = \sum_i \left(\dot{Q}_i DF_i\right) \tag{4-55}$$

where:		(units)
$\dot{D}$	Gamma Air Dose Rate - The gamma air dose rate due to all radionuclides released.	[mrad/yr]
$\dot{D}_i$	Gamma Air Dose Rate Due to Radionuclide **i**	[mrad/yr]
$\dot{Q}_i$	Release Rate of Radionuclide **i**	[μCi/sec]
DF_i	Gamma Air Dose Factor for Radionuclide **i** - A factor used to calculate gamma air dose or dose rate due to release of radionuclide **i**.	[(mrad/yr)/(μCi/sec)]

Gamma air and total body dose and dose rates due to gamma radiation from noble gas releases via elevated stacks are calculated using the finite plume model. The B_i and V_i factors for the radionuclides were calculated using the NRC computer code RABFIN and are based on the finite plume model of Regulatory Guide 1.109 (Reference 6).

4.3.6.1 Finite Plume Gamma Air Dose Factor (B_i)

The gamma air dose factors are used to calculate dose and dose rate to air due to gamma radiation and are calculated as follows:

$$B_i = \frac{K}{R} \sum_{n,c,k} \left[\frac{f_s(n,\theta,c) A_{ki} \mu_a(E_k) E_k I(h_e, u_n, c, \sigma_z, E_k)}{u_n} \right] \tag{4-56}$$

where:

$$K = \frac{260\,\text{mrad}(\text{radian})(\text{m}^3)(\text{transformation})}{\text{sec}(\text{Mev})(\text{Ci})} \left(\frac{16}{2\pi\,\text{radian}}\right)\left(10^{-6}\,\frac{\text{Ci}}{\mu\text{Ci}}\right)\left(3.17\times10^{7}\,\frac{\text{sec}}{\text{yr}}\right) \tag{4-57}$$

and:		(units)
B_i	Finite Plume Gamma Air Dose Factor - The gamma air dose factor at ground level for a stack release for radionuclide **i**, downwind sector θ, downwind distance **R** from the release point, and the average atmospheric conditions of a specified historical time period.	[(mrad/yr)/(μCi/sec)]
K	Numerical constant to reconcile units of Equation 4-60.	[(mrad-m^3-transformation) /(yr-MeV-μCi)]
R	Radius – Downwind distance from the release point to the point of interest.	[m]

$f_s(n,\theta,c)$	Joint Frequency Distribution, Stack Release, defined in Section 4.3.2.2.2, dimensionless.	
A_{ki}	Effective Photon Yield - The effective number of photons emitted with energy in energy group **k** per decay of nuclide **i**. The parameter $\mathbf{A_{ki}}$ is calculated on the basis of Section B.1 of Regulatory Guide 1.109 (Reference 6), where: $$A_{ki} = \frac{\sum_m (A_m E_m \mu_a(E_m))}{E_k \mu_a(E_k)} \quad (4\text{-}58)$$	[photons per transformation]
A_m	True Photon Yield - The actual number of photons emitted with energy $\mathbf{E_m}$ per decay of nuclide **i**.	[photons per transformation]
E_m	Photon Energy - The energy of the $\mathbf{m}^{th}$ photon within photon energy group **k**.	[MeV/photon]
$\mu_a(E_m)$	Air Energy Absorption Coefficient - The linear energy absorption coefficient for air for photon energy $\mathbf{E_m}$.	[m^{-1}]
$\mu_a(E_k)$	Air Energy Absorption Coefficient - The linear energy absorption coefficient for air for photon energy group **k**. The fraction of energy absorbed in air per unit of distance traveled for a beam of photons of energy $\mathbf{E_k}$. Distance is measured in units of linear thickness (meters).	[m^{-1}]
E_k	Photon Group Energy - An energy representative of photon energy group **k**. The photons emitted by each radionuclide are grouped into energy groups in order to facilitate analysis. All photons with energy in energy group **k** are assumed to have energy $\mathbf{E_k}$.	[MeV/photon]
I(...)	I Function - A parameter obtained by numerical evaluation of integrals that arise in the plume gamma dose problem. The value of **I** depends on the arguments **(...)** listed in the equation. A specific definition for **I** is given by Equation F-13 of Regulatory Guide 1.109. The integrals involved in calculating **I** arise from conceptually dividing up the radioactive plume into small elements of radioactivity and adding up the doses produced at the point of interest by all of the small elements. The distribution of radioactivity in the plume is represented by a sector-averaged Gaussian plume model like that discussed in Section 4.3.3.2, dimensionless.	
$2\pi/16$	Sector Width - The width of a sector over which the plume direction is assumed to be uniformly distributed (as in the model of Section 4.3.3.2). Taken as 1/16 of a circle, inverted in the equation.	[radian]
h_e	Effective Release Height - The effective height of an effluent release above grade elevation. See section 4.3.4.1.1	[m]
σ_z	Standard Vertical Dispersion Coefficient - A coefficient characterizing vertical plume spread in the Gaussian model for stability class **c** at radius **R** (see Table 4-42).	[m]
u_n	Wind Speed - A wind speed representative of wind speed class **n**. For each wind speed class except the highest, $\mathbf{u_n}$ is the average of the upper and lower limits of the wind speed range for the class. For the highest wind speed class, $\mathbf{u_n}$ is the lower limit of the wind speed range for the class.	[m/sec]

4.3.6.2 Finite Plume Total Body Dose Factors (V_i)

The total body dose factors are used to calculate doses and dose rates due to gamma irradiation of the total body.

To obtain the gamma total body dose factor for a stack release, Equation 4-60 is modified to account for the attenuation of gamma radiation by 5 cm of tissue with a density of 1 g/cm^3 and a factor added to convert mrad to mrem. The following expression results:

$$V_i = 1.1\frac{K}{R}\sum_{n,c,k}\left[\frac{f_s(n,\theta,c)A_{ki}\mu_a(E_k)E_k I(h_e,u_n,c,\sigma_z,E_k)}{u_n}e^{-\mu_a^T(E_k)t_d}\right] \quad (4\text{-}59)$$

where:		(units)
V_i	Gamma Total Body Dose Factor, Stack Release - The gamma total body dose factor at ground level for a stack release for radionuclide i, downwind sector θ, downwind distance R from the release point, and the average atmospheric conditions of a specified historical time period.	[(mrem/yr)/(μCi/sec)]
1.1	Conversion factor to rem in tissue from rads in air.	[mrem/mrad]
$\mu_a^T(E_k)$	Tissue Energy Absorption Coefficient - The mass energy absorption coefficient for tissue for photon energy group k. The fraction of energy absorbed in tissue per unit distance of travel for a beam of photons of energy E_k with a distance measured in units of density thickness (g/cm^2).	[cm^2/g]
t_d	Tissue Thickness – An assumed value of tissue thickness used in calculating total body dose. Taken as 5 g/cm^2 to represent 5 cm of tissue with a density of 1 g/cm^3. Accounts for the shielding of the inner, more radiosensitive parts of the body by the outer body parts.	[g/cm^2]

The remaining parameters are defined in Section 4.3.6.1.

Table 4-1
Critical Ranges

Direction	Site Boundary [a] (m)	Restricted Area Boundary (m)	Nearest Resident [b] (m)	Nearest Dairy Farm Within 5 km [c] (m)
N	768	466	2609	None
NNE	1207	698	1399	None
NE	1100	646	1419	None
ENE	1244	646	1438	None
E	1000	689	1874	None
ESE	988	661	1560	None
SE	1000	664	1008	None
SSE	792	744	868	None
S	841	814	875	None
SSW	853	789	5017	None
SW	1024	414	6398	None
WSW	1170	360	9434	None
W	1756	454	4971	None
WNW	1219	469	6846	None
NW	756	482	3826	None
NNW	671	466	1645	None

[a] Nearest land outside the site boundary. Used in calculating the meteorological dose factors in Tables 4-3, 4-6, and 4-7.

[b] By GPS survey (when available) or satellite mapping. Data current as of the 2010 Land Use Census.

[c] 2010 annual milch animal census. Used in calculating the D/Q values in Table 4-5, with a default value of 8000 meters used when there are no dairies within 5 miles.

Table 4-2
Average Wind Speeds for Dresden 1, 2, and 3

Downwind Direction	Average Wind Speed (m/sec)[a]		
	Elevated	Mixed Mode	Ground Level
N	7.2	5.7	4.2
NNE	6.9	5.5	3.9
NE	6.5	5.4	3.5
ENE	6.0	5.1	3.6
E	6.5	5.5	3.8
ESE	6.7	5.5	3.6
SE	6.2	5.2	3.0
SSE	6.0	5.0	2.9
S	5.6	4.4	2.4
SSW	5.6	4.6	2.6
SW	5.3	4.4	3.0
WSW	4.0	3.4	2.6
W	5.3	4.4	3.1
WNW	6.0	4.8	3.3
NW	5.6	4.5	3.3
NNW	6.0	4.9	3.6

[a] Based on Dresden site meteorological data, January 2000 through December 2009.

Table 4-3

χ/Q and D/Q Maxima At or Beyond the Site Boundary

Downwind Direction	Elevated (Stack) Release				Mixed Mode (Vent) Release			Ground Level Release		
	Radius	$(\chi/Q)_s$	Radius	$(D/Q)_s$	Radius	$(\chi/Q)_v$	$(D/Q)_v$	Radius	$(\chi/Q)_g$	$(D/Q)_g$
	(meters)	(sec/m^3)	(meters)	(m^{-2})	(meters)	(sec/m^3)	(m^{-2})	(meters)	(sec/m^3)	(m^{-2})
N	4023	1.471E-08	768	1.157E-09	768	4.235E-07	6.052E-09	768	3.659E-06	1.928E-08
NNE	4023	1.389E-08	1207	1.029E-09	1207	2.305E-07	3.005E-09	1207	1.783E-06	7.945E-09
NE	4023	1.144E-08	1100	9.204E-10	1100	2.182E-07	2.845E-09	1100	2.291E-06	8.624E-09
ENE	1244	1.283E-08	1244	1.099E-09	1244	1.420E-07	2.275E-09	1244	1.196E-06	5.290E-09
E	4023	1.569E-08	1000	1.346E-09	1000	2.626E-07	4.142E-09	1000	2.311E-06	1.144E-08
ESE	3219	1.629E-08	988	1.623E-09	988	2.554E-07	4.349E-09	988	2.417E-06	1.152E-08
SE	4023	1.388E-08	1000	1.166E-09	1000	2.096E-07	3.281E-09	1000	2.782E-06	9.657E-09
SSE	3219	1.248E-08	792	1.160E-09	792	2.361E-07	3.870E-09	792	3.566E-06	1.287E-08
S	4023	9.055E-09	841	8.020E-10	841	1.509E-07	2.342E-09	841	2.154E-06	6.910E-09
SSW	4023	1.017E-08	853	9.464E-10	853	1.577E-07	2.672E-09	853	1.692E-06	6.975E-09
SW	3219	1.348E-08	1024	1.058E-09	1024	1.443E-07	2.481E-09	1024	1.439E-06	8.024E-09
WSW	4023	1.493E-08	1170	7.760E-10	1170	9.991E-08	1.458E-09	1170	9.762E-07	4.578E-09
W	4023	1.275E-08	1756	5.886E-10	1756	1.097E-07	1.109E-09	1756	6.743E-07	3.018E-09
WNW	4023	8.966E-09	1219	4.716E-10	1219	1.307E-07	1.488E-09	1219	1.208E-06	5.389E-09
NW	4828	8.880E-09	756	5.425E-10	756	2.275E-07	2.260E-09	756	2.104E-06	9.017E-09
NNW	4023	1.165E-08	671	7.975E-10	671	3.377E-07	4.016E-09	671	3.635E-06	1.757E-08

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Notes: Radius is the approximate distance from midpoint between gaseous effluent release points to location of highest χ/Q or D/Q at or beyond the site boundary.

Table 4-4

χ/Q and D/Q Maxima At or Beyond the Restricted Area Boundary

Downwind Direction	Elevated (Stack) Release				Mixed Mode (Vent) Release			Ground Level Release		
	Radius (meters)	$(\chi/Q)_s$ (sec/m^3)	Radius (meters)	$(D/Q)_s$ (m^{-2})	Radius (meters)	$(\chi/Q)_v$ (sec/m^3)	$(D/Q)_v$ (m^{-2})	Radius (meters)	$(\chi/Q)_g$ (sec/m^3)	$(D/Q)_g$ (m^{-2})
N	4023	1.471E-08	466	1.303E-09	466	9.019E-07	1.172E-08	466	8.359E-06	4.229E-08
NNE	4023	1.389E-08	698	1.352E-09	698	4.536E-07	6.427E-09	698	4.281E-06	1.945E-08
NE	4023	1.144E-08	646	1.192E-09	646	4.581E-07	5.875E-09	646	5.557E-06	2.042E-08
ENE	805	1.299E-08	646	1.688E-09	646	3.474E-07	5.612E-09	646	3.455E-06	1.541E-08
E	4023	1.569E-08	689	1.602E-09	689	4.157E-07	6.751E-09	689	4.117E-06	2.095E-08
ESE	3219	1.629E-08	661	1.965E-09	661	4.181E-07	7.340E-09	661	4.508E-06	2.209E-08
SE	4023	1.388E-08	664	1.444E-09	664	3.487E-07	5.565E-09	664	5.363E-06	1.875E-08
SSE	3219	1.248E-08	744	1.194E-09	744	2.559E-07	4.180E-09	744	3.936E-06	1.423E-08
S	4023	9.055E-09	814	8.157E-10	814	1.574E-07	2.439E-09	814	2.265E-06	7.286E-09
SSW	4023	1.017E-08	789	9.867E-10	789	1.739E-07	2.941E-09	789	1.902E-06	7.916E-09
SW	3219	1.348E-08	414	1.514E-09	414	5.014E-07	6.761E-09	414	5.979E-06	3.357E-08
WSW	4023	1.493E-08	360	9.278E-10	360	4.487E-07	4.605E-09	360	6.422E-06	2.956E-08
W	4023	1.275E-08	454	9.120E-10	454	4.536E-07	5.267E-09	454	5.308E-06	2.734E-08
WNW	4023	8.966E-09	469	5.553E-10	469	4.367E-07	4.715E-09	469	5.616E-06	2.499E-08
NW	4828	8.880E-09	482	6.121E-10	482	4.588E-07	3.888E-09	482	4.447E-06	1.831E-08
NNW	4023	1.165E-08	466	8.632E-10	466	6.006E-07	6.243E-09	466	6.752E-06	3.105E-08

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Table 4-5

D/Q at the Nearest Milk Cow and Meat Animal Locations within 5 miles

Downwind Direction	Nearest Milk Cow D/Q (m^{-2})				Nearest Meat Animal D/Q (m^{-2})			
	Radius (meters)	Elevated Release	Mixed Release	Ground Release	Radius (meters)	Elevated Release	Mixed Release	Ground Release
N	8000	1.186E-10	1.559E-10	3.386E-10	2300	6.111E-10	1.228E-09	3.056E-09
NNE	8000	1.128E-10	1.476E-10	2.930E-10	8000	1.128E-10	1.476E-10	2.930E-10
NE	8000	9.250E-11	1.223E-10	2.720E-10	8000	9.250E-11	1.223E-10	2.720E-10
ENE	8000	1.016E-10	1.177E-10	2.053E-10	8000	1.016E-10	1.177E-10	2.053E-10
E	8000	1.438E-10	1.631E-10	3.091E-10	8000	1.438E-10	1.631E-10	3.091E-10
ESE	8000	1.533E-10	1.680E-10	3.051E-10	8000	1.533E-10	1.680E-10	3.051E-10
SE	8000	1.189E-10	1.305E-10	2.609E-10	8000	1.189E-10	1.305E-10	2.609E-10
SSE	8000	1.067E-10	1.159E-10	2.375E-10	8000	1.067E-10	1.159E-10	2.375E-10
S	8000	7.272E-11	7.799E-11	1.406E-10	8000	7.272E-11	7.799E-11	1.406E-10
SSW	8000	8.467E-11	8.981E-11	1.452E-10	8000	8.467E-11	8.981E-11	1.452E-10
SW	8000	1.076E-10	1.093E-10	2.244E-10	8000	1.076E-10	1.093E-10	2.244E-10
WSW	8000	1.011E-10	8.504E-11	1.602E-10	8000	1.011E-10	8.504E-11	1.602E-10
W	8000	9.489E-11	1.038E-10	2.103E-10	800	7.896E-10	2.880E-09	1.121E-08
WNW	8000	6.700E-11	8.379E-11	2.021E-10	800	5.114E-10	2.515E-09	1.077E-08
NW	8000	5.725E-11	6.740E-11	1.544E-10	800	5.311E-10	2.106E-09	8.231E-09
NNW	8000	8.427E-11	9.930E-11	2.486E-10	1600	5.850E-10	1.281E-09	4.181E-09

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Note: If there is no actual milk or meat producer within 5 miles of the station, one is assumed to be located at 8000 m.

Table 4-6
Maximum Offsite Finite Plume Gamma Air Dose Factors (B_i) at the Site Area Boundary (SAB)

Direction	Radius (m)	Ar-41	Kr-83m	Kr-85m	Kr-85	Kr-87	Kr-88	Kr-89
N	768	2.18E-03	1.01E-05	2.99E-04	3.98E-06	1.18E-03	3.01E-03	1.80E-03
NNE	1207	1.28E-03	5.18E-06	1.78E-04	2.38E-06	6.92E-04	1.82E-03	8.36E-04
NE	1100	1.25E-03	5.03E-06	1.70E-04	2.29E-06	6.70E-04	1.76E-03	8.30E-04
ENE	1244	9.87E-04	3.46E-06	1.32E-04	1.81E-06	5.28E-04	1.41E-03	5.97E-04
E	1000	1.60E-03	6.29E-06	2.16E-04	2.92E-06	8.61E-04	2.25E-03	1.12E-03
ESE	988	1.56E-03	6.25E-06	2.13E-04	2.86E-06	8.42E-04	2.18E-03	1.13E-03
SE	1000	1.39E-03	5.38E-06	1.87E-04	2.53E-06	7.46E-04	1.95E-03	9.66E-04
SSE	792	1.50E-03	6.22E-06	2.02E-04	2.72E-06	8.12E-04	2.08E-03	1.19E-03
S	841	1.06E-03	4.17E-06	1.40E-04	1.91E-06	5.70E-04	1.47E-03	7.93E-04
SSW	853	1.17E-03	4.57E-06	1.55E-04	2.11E-06	6.28E-04	1.63E-03	8.69E-04
SW	1024	1.12E-03	3.71E-06	1.46E-04	2.03E-06	5.98E-04	1.58E-03	7.42E-04
WSW	1170	9.36E-04	2.00E-06	1.13E-04	1.66E-06	4.93E-04	1.34E-03	5.35E-04
W	1756	5.87E-04	1.62E-06	7.80E-05	1.09E-06	3.10E-04	8.69E-04	2.73E-04
WNW	1219	7.13E-04	2.43E-06	9.49E-05	1.31E-06	3.81E-04	1.02E-03	4.32E-04
NW	756	1.36E-03	5.68E-06	1.79E-04	2.45E-06	7.34E-04	1.88E-03	1.07E-03
NNW	671	1.96E-03	8.72E-06	2.61E-04	3.53E-06	1.06E-03	2.69E-03	1.65E-03

Direction	Radius (m)	Xe-131m	Xe-133m	Xe-133	Xe-135m	Xe-135	Xe-137	Xe-138
N	768	1.06E-04	8.81E-05	9.10E-05	6.45E-04	4.60E-04	1.59E-04	1.89E-03
NNE	1207	6.22E-05	5.12E-05	5.33E-05	3.46E-04	2.74E-04	6.73E-05	1.09E-03
NE	1100	5.91E-05	4.87E-05	5.04E-05	3.38E-04	2.63E-04	6.75E-05	1.06E-03
ENE	1244	4.48E-05	3.69E-05	3.80E-05	2.55E-04	2.06E-04	4.62E-05	8.31E-04
E	1000	7.48E-05	6.17E-05	6.37E-05	4.41E-04	3.35E-04	9.31E-05	1.37E-03
ESE	988	7.42E-05	6.12E-05	6.35E-05	4.38E-04	3.29E-04	9.47E-05	1.34E-03
SE	1000	6.47E-05	5.33E-05	5.52E-05	3.81E-04	2.90E-04	7.98E-05	1.18E-03
SSE	792	7.01E-05	5.79E-05	5.97E-05	4.34E-04	3.12E-04	1.03E-04	1.29E-03
S	841	4.81E-05	3.98E-05	4.08E-05	2.98E-04	2.17E-04	6.70E-05	9.06E-04
SSW	853	5.31E-05	4.39E-05	4.51E-05	3.28E-04	2.40E-04	7.32E-05	9.98E-04
SW	1024	4.91E-05	4.03E-05	4.15E-05	2.99E-04	2.29E-04	5.96E-05	9.46E-04
WSW	1170	3.48E-05	2.84E-05	2.86E-05	2.30E-04	1.81E-04	3.91E-05	7.75E-04
W	1756	2.58E-05	2.11E-05	2.18E-05	1.34E-04	1.23E-04	1.83E-05	4.81E-04
WNW	1219	3.21E-05	2.63E-05	2.72E-05	1.84E-04	1.48E-04	3.36E-05	6.00E-04
NW	756	6.19E-05	5.13E-05	5.25E-05	3.90E-04	2.78E-04	9.15E-05	1.17E-03
NNW	671	9.14E-05	7.58E-05	7.77E-05	5.78E-04	4.04E-04	1.46E-04	1.69E-03

Table 4-7
Maximum Offsite Finite Plume Total Body Dose Factors (V_i) Based on 5 cm Depth at the Site Area Boundary (SAB)

Direction	Radius (m)	Ar-41	Kr-83m	Kr-85m	Kr-85	Kr-87	Kr-88	Kr-89
N	768	1.46E-03	1.35E-08	2.00E-04	2.62E-06	7.87E-04	2.00E-03	1.20E-03
NNE	1207	8.56E-04	7.49E-09	1.19E-04	1.57E-06	4.59E-04	1.21E-03	5.56E-04
NE	1100	8.30E-04	7.09E-09	1.14E-04	1.51E-06	4.45E-04	1.17E-03	5.53E-04
ENE	1244	6.58E-04	5.12E-09	8.83E-05	1.20E-06	3.51E-04	9.41E-04	3.97E-04
E	1000	1.07E-03	8.93E-09	1.45E-04	1.93E-06	5.72E-04	1.49E-03	7.48E-04
ESE	988	1.04E-03	8.98E-09	1.43E-04	1.89E-06	5.59E-04	1.45E-03	7.51E-04
SE	1000	9.23E-04	7.71E-09	1.25E-04	1.67E-06	4.95E-04	1.30E-03	6.43E-04
SSE	792	1.00E-03	8.57E-09	1.35E-04	1.80E-06	5.40E-04	1.38E-03	7.91E-04
S	841	7.06E-04	5.75E-09	9.37E-05	1.26E-06	3.79E-04	9.81E-04	5.28E-04
SSW	853	7.79E-04	6.35E-09	1.04E-04	1.39E-06	4.17E-04	1.08E-03	5.78E-04
SW	1024	7.44E-04	5.54E-09	9.81E-05	1.34E-06	3.97E-04	1.05E-03	4.94E-04
WSW	1170	6.24E-04	3.29E-09	7.57E-05	1.10E-06	3.28E-04	8.92E-04	3.56E-04
W	1756	3.91E-04	2.69E-09	5.23E-05	7.22E-07	2.06E-04	5.79E-04	1.82E-04
WNW	1219	4.75E-04	3.63E-09	6.36E-05	8.63E-07	2.53E-04	6.79E-04	2.88E-04
NW	756	9.08E-04	7.52E-09	1.20E-04	1.62E-06	4.88E-04	1.25E-03	7.10E-04
NNW	671	1.31E-03	1.14E-08	1.75E-04	2.33E-06	7.04E-04	1.79E-03	1.10E-03

Direction	Radius (m)	Xe-131m	Xe-133m	Xe-133	Xe-135m	Xe-135	Xe-137	Xe-138
N	768	6.04E-05	4.71E-05	5.29E-05	4.23E-04	3.06E-04	1.05E-04	1.26E-03
NNE	1207	3.56E-05	2.76E-05	3.11E-05	2.27E-04	1.82E-04	4.45E-05	7.29E-04
NE	1100	3.38E-05	2.63E-05	2.95E-05	2.22E-04	1.74E-04	4.46E-05	7.06E-04
ENE	1244	2.59E-05	2.01E-05	2.24E-05	1.68E-04	1.37E-04	3.06E-05	5.54E-04
E	1000	4.29E-05	3.34E-05	3.73E-05	2.90E-04	2.22E-04	6.15E-05	9.09E-04
ESE	988	4.25E-05	3.30E-05	3.71E-05	2.88E-04	2.19E-04	6.26E-05	8.91E-04
SE	1000	3.72E-05	2.89E-05	3.23E-05	2.51E-04	1.93E-04	5.28E-05	7.87E-04
SSE	792	4.01E-05	3.12E-05	3.49E-05	2.85E-04	2.07E-04	6.79E-05	8.62E-04
S	841	2.76E-05	2.15E-05	2.39E-05	1.96E-04	1.44E-04	4.43E-05	6.03E-04
SSW	853	3.05E-05	2.38E-05	2.64E-05	2.15E-04	1.59E-04	4.84E-05	6.65E-04
SW	1024	2.84E-05	2.21E-05	2.45E-05	1.97E-04	1.52E-04	3.94E-05	6.30E-04
WSW	1170	2.07E-05	1.61E-05	1.72E-05	1.52E-04	1.20E-04	2.59E-05	5.16E-04
W	1756	1.51E-05	1.16E-05	1.29E-05	8.82E-05	8.15E-05	1.21E-05	3.21E-04
WNW	1219	1.86E-05	1.44E-05	1.60E-05	1.21E-04	9.83E-05	2.22E-05	3.99E-04
NW	756	3.54E-05	2.77E-05	3.06E-05	2.56E-04	1.85E-04	6.05E-05	7.78E-04
NNW	671	1.96E-03	8.72E-06	2.61E-04	3.53E-06	1.06E-03	2.69E-03	1.65E-03

Dresden Site Meteorological Data 1/00 – 12/09

Table 4-8
Elevated Level Joint Frequency Distribution Table Summary
300-Foot Elevation Data

Summary Table of Percent by Direction and Class

Class	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
A	0.23	0.30	0.36	0.22	0.14	0.05	0.06	0.10	0.11	0.18	0.19	0.28	0.23	0.37	0.26	0.28	3.36
B	0.21	0.23	0.33	0.25	0.20	0.10	0.13	0.16	0.22	0.28	0.25	0.40	0.30	0.44	0.32	0.29	4.11
C	0.26	0.27	0.35	0.30	0.28	0.19	0.23	0.30	0.39	0.47	0.40	0.54	0.46	0.55	0.44	0.35	5.76
D	1.88	2.18	2.77	2.83	2.76	2.02	1.61	2.42	3.42	3.01	2.39	2.31	4.02	3.99	3.17	2.84	43.63
E	1.08	1.24	1.40	1.47	1.52	1.52	1.91	2.28	3.83	3.41	2.44	1.63	2.19	2.04	1.92	1.45	31.34
F	0.47	0.49	0.32	0.23	0.26	0.38	0.71	0.80	0.76	0.84	1.03	1.03	0.84	0.57	0.66	0.47	9.87
G	0.11	0.11	0.06	0.03	0.04	0.04	0.07	0.09	0.13	0.18	0.25	0.20	0.23	0.15	0.13	0.12	1.92
Total	4.24	4.82	5.59	5.33	5.20	4.30	4.72	6.15	8.86	8.37	6.95	6.39	8.27	8.11	6.90	5.80	99.99

Summary Table of Percent by Direction and Speed

Speed	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Calm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
<3.5	0.11	0.11	0.12	0.16	0.15	0.14	0.15	0.12	0.15	0.14	0.15	0.15	0.13	0.13	0.14	0.12	2.19
3.6-7.5	0.69	0.70	0.92	1.72	0.92	0.66	0.79	0.87	0.85	0.75	0.82	1.04	0.96	0.78	0.77	0.77	14.01
7.6-12.5	1.39	1.73	2.25	2.80	2.01	1.15	1.46	1.95	1.89	1.83	1.68	1.97	2.37	2.01	1.99	1.66	30.13
12.6-18.5	1.52	1.65	1.80	0.61	1.61	1.57	1.76	2.14	2.95	3.12	2.60	2.03	2.87	3.09	2.67	2.21	34.22
18.6-24.5	0.44	0.51	0.43	0.04	0.44	0.65	0.44	0.82	2.02	1.86	1.34	0.80	1.31	1.58	1.11	0.86	14.66
>24.5	0.08	0.12	0.06	0.00	0.08	0.14	0.10	0.24	1.01	0.66	0.35	0.39	0.62	0.52	0.21	0.18	4.76
Total	4.23	4.82	5.58	5.33	5.21	4.31	4.70	6.14	8.87	8.36	6.94	6.38	8.26	8.11	6.89	5.80	99.99

Summary Table of Percent by Class and Speed

Speed	A	B	C	D	E	F	G	Total
Calm	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.02
<3.5	0.02	0.03	0.08	0.88	0.65	0.43	0.12	2.19
3.6-7.5	0.59	0.78	1.19	5.93	3.52	1.60	0.40	14.01
7.6-12.5	1.34	1.47	2.02	12.44	8.98	3.24	0.65	30.13
12.6-18.5	0.92	1.16	1.54	13.88	12.27	3.83	0.61	34.22
18.6-24.5	0.39	0.51	0.66	7.46	4.75	0.76	0.14	14.66
>24.5	0.11	0.16	0.27	3.03	1.17	0.01	0.00	4.76
Total	3.36	4.11	5.76	43.63	31.34	9.87	1.92	99.98

NOTE: Wind directions in tables are presented in "wind from" and not "wind to" direction. Dresden Site Meteorological Data 1/00 – 12/09

Table 4-9
Mixed Mode Joint Frequency Distribution Table Summary
150 Foot Elevation Data

Summary Table of Percent by Direction and Class

Class	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
C	0.02	0.03	0.02	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.02	0.02	0.15
D	1.22	1.30	1.68	1.25	1.19	0.94	0.88	1.22	1.71	1.91	1.80	2.20	2.05	2.37	1.93	1.73	25.41
E	2.77	3.14	3.70	3.57	4.17	3.81	3.42	4.59	6.99	6.03	4.65	2.92	5.70	5.53	4.54	3.82	69.36
F	0.27	0.18	0.10	0.08	0.11	0.11	0.34	0.30	0.22	0.40	0.68	0.86	0.54	0.27	0.26	0.23	4.96
G	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.07
Total	4.28	4.67	5.50	4.92	5.47	4.86	4.64	6.12	8.92	8.34	7.14	6.00	8.30	8.18	6.75	5.81	99.98

Summary Table of Percent by Direction and Speed

Speed	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Calm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
<3.5	0.19	0.20	0.23	0.29	0.23	0.20	0.24	0.19	0.20	0.21	0.25	0.23	0.22	0.21	0.21	0.18	3.48
3.6-7.5	1.27	1.26	1.60	2.32	1.37	1.02	1.21	1.42	1.50	1.41	1.34	1.54	1.62	1.33	1.25	1.23	22.67
7.6-12.5	1.83	1.94	2.39	2.06	2.74	2.19	2.03	2.52	3.13	3.19	2.62	2.20	3.06	3.05	2.67	2.36	39.99
12.6-18.5	0.80	0.94	1.10	0.24	0.97	1.15	0.98	1.52	2.64	2.41	2.02	1.34	2.23	2.53	1.93	1.61	24.40
18.6-24.5	0.18	0.27	0.18	0.01	0.15	0.26	0.15	0.39	1.07	0.84	0.74	0.49	0.87	0.86	0.63	0.38	7.48
>24.5	0.02	0.05	0.01	0.00	0.02	0.04	0.04	0.08	0.38	0.30	0.17	0.19	0.31	0.20	0.07	0.07	1.93
Total	4.29	4.66	5.51	4.92	5.48	4.86	4.65	6.12	8.92	8.36	7.14	5.99	8.31	8.18	6.76	5.83	99.97

Summary Table of Percent by Class and Speed

Speed	A	B	C	D	E	F	G	Total
Calm	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.02
<3.5	0.00	0.00	0.00	0.51	2.33	0.63	0.01	3.48
3.6-7.5	0.00	0.00	0.02	5.94	14.57	2.10	0.04	22.67
7.6-12.5	0.00	0.01	0.08	9.62	28.28	2.00	0.01	39.99
12.6-18.5	0.00	0.01	0.03	6.48	17.64	0.24	0.00	24.40
18.6-24.5	0.00	0.00	0.01	2.34	5.12	0.00	0.00	7.48
>24.5	0.00	0.00	0.00	0.51	1.42	0.00	0.00	1.93
Total	0.00	0.03	0.15	25.41	69.36	4.96	0.07	99.98

NOTE: Wind directions in tables are presented in "wind from" and not "wind to" direction. Dresden Site Meteorological Data 1/00 – 12/09

Table 4-10
Ground Level Joint Frequency Distribution Table Summary
35 Foot Elevation Data

Summary Table of Percent by Direction and Class

Class	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
A	0.61	0.62	1.11	0.70	0.51	0.30	0.31	0.40	0.55	0.76	0.78	1.05	0.86	1.18	0.94	0.96	11.67
B	0.12	0.11	0.19	0.14	0.13	0.11	0.13	0.19	0.25	0.27	0.20	0.30	0.26	0.28	0.24	0.18	3.12
C	0.14	0.10	0.20	0.13	0.14	0.17	0.13	0.21	0.31	0.28	0.26	0.32	0.29	0.28	0.23	0.20	3.40
D	1.13	1.32	2.17	1.48	2.22	1.66	1.08	1.78	2.42	2.13	1.68	1.63	3.04	2.83	2.09	1.98	30.65
E	1.31	1.44	2.16	1.70	2.28	2.19	1.80	3.29	4.45	3.01	2.12	1.36	3.07	2.82	2.45	2.13	37.59
F	0.35	0.28	0.20	0.13	0.32	0.80	0.59	0.71	0.96	1.08	1.50	0.61	0.64	0.63	0.69	0.64	10.12
G	0.09	0.04	0.03	0.04	0.07	0.23	0.13	0.13	0.20	0.37	0.79	0.25	0.18	0.20	0.36	0.28	3.39
Total	3.75	3.91	6.06	4.32	5.67	5.46	4.17	6.71	9.14	7.90	7.33	5.52	8.34	8.22	7.00	6.37	99.94

Summary Table of Percent by Direction and Speed

Speed	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Calm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
<3.5	1.20	0.99	0.71	0.55	0.59	0.68	0.65	0.84	1.01	1.10	1.26	0.92	1.07	1.14	1.61	1.55	15.87
3.6-7.5	1.73	1.97	3.31	2.84	3.08	2.54	1.66	2.70	2.89	2.63	2.93	2.03	2.98	2.95	2.65	2.68	41.59
7.6-12.5	0.73	0.82	1.76	0.92	1.70	1.66	1.45	2.19	3.03	2.41	1.95	1.74	2.85	2.99	2.14	1.76	30.09
12.6-18.5	0.09	0.13	0.28	0.02	0.30	0.52	0.36	0.84	1.70	1.38	1.01	0.66	1.21	1.06	0.58	0.37	10.51
18.6-24.5	0.00	0.00	0.00	0.00	0.01	0.05	0.04	0.13	0.47	0.33	0.16	0.14	0.21	0.08	0.01	0.01	1.64
>24.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.04	0.02	0.03	0.02	0.00	0.00	0.00	0.17
Total	3.75	3.91	6.06	4.33	5.68	5.45	4.16	6.71	9.14	7.89	7.33	5.52	8.34	8.22	6.99	6.37	99.94

Summary Table of Percent by Class and Speed

Speed	A	B	C	D	E	F	G	Total
Calm	0.01	0.00	0.00	0.01	0.03	0.01	0.00	0.07
<3.5	0.27	0.17	0.22	2.09	5.93	4.81	2.39	15.87
3.6-7.5	4.94	1.22	1.35	10.65	17.70	4.76	0.97	41.59
7.6-12.5	4.70	1.20	1.25	11.97	10.43	0.53	0.02	30.09
12.6-18.5	1.58	0.45	0.51	5.03	2.92	0.01	0.00	10.51
18.6-24.5	0.17	0.07	0.07	0.80	0.53	0.00	0.00	1.64
>24.5	0.01	0.01	0.00	0.10	0.05	0.00	0.00	0.17
Total	11.67	3.12	3.40	30.65	37.59	10.12	3.39	99.93

NOTE: Wind directions in tables are presented in "wind from" and not "wind to" direction. Dresden Site Meteorological Data 1/00 – 12/09

Table 4-11
Station Characteristics for Dresden 1, 2, 3

STATION: Dresden Nuclear Power Station
LOCATION: Morris, Illinois

CHARACTERISTICS OF ELEVATED RELEASE POINT

1) Release Height = U1 91.44 m[a] / U2/3 94.49 m[a]
2) Diameter = U1 1.40 m / U2/3 3.35 m
3) Exit Speed = U1 17.9 m/s[a] / U2/3 16.6 m/s[a]
4) Heat Content = 70 Kcal/s[a]

CHARACTERISTICS OF VENT STACK RELEASE POINT

1) Release Height = 48.77 m[a]
2) Diameter = 2.74 m
3) Exit Speed = 12.0 m/s[a]

CHARACTERISTICS OF GROUND LEVEL RELEASE

1) Release Height = 0 m
2) Building Factor (D) = 42.8 m[a]

METEOROLOGICAL DATA

A 400 ft Tower is located 800 m WSW of elevated release point

Tower Data Used in Calculations

Release Point	Wind Speed and Direction	Differential Temperature
Elevated	300 ft	300-35 ft
Vent	150 ft	150-35 ft
Ground	35 ft	150-35 ft

[a] Used in calculating the meteorological and dose factors in Tables 4-3 through 4-7.

Table 4-12
Semi-Infinite Cloud Dose Factors for Noble Gases

Nuclide	Beta Air Dose Factor N_i (mrad/yr per µCi/m³)	Beta Skin Dose Factor L_i (mrem/yr per µCi/m³)	Gamma Air Dose Factor M_i (mrad/yr per µCi/m³)	Gamma Total Body Dose Factor K_i (mrem/yr per µCi/m³)
Kr-83m	2.88E+02	---	1.93E+01	7.56E-02
Kr-85m	1.97E+03	1.46E+03	1.23E+03	1.17E+03
Kr-85	1.95E+03	1.34E+03	1.72E+01	1.61E+01
Kr-87	1.03E+04	9.73E+03	6.17E+03	5.92E+03
Kr-88	2.93E+03	2.37E+03	1.52E+04	1.47E+04
Kr-89	1.06E+04	1.01E+04	1.73E+04	1.66E+04
Kr-90	7.83E+03	7.29E+03	1.63E+04	1.56E+04
Xe-131m	1.11E+03	4.76E+02	1.56E+02	9.15E+01
Xe-133m	1.48E+03	9.94E+02	3.27E+02	2.51E+02
Xe-133	1.05E+03	3.06E+02	3.53E+02	2.94E+02
Xe-135m	7.39E+02	7.11E+02	3.36E+03	3.12E+03
Xe-135	2.46E+03	1.86E+03	1.92E+03	1.81E+03
Xe-137	1.27E+04	1.22E+04	1.51E+03	1.42E+03
Xe-138	4.75E+03	4.13E+03	9.21E+03	8.83E+03
Ar-41	3.28E+03	2.69E+03	9.30E+03	8.84E+03

Source: Regulatory Guide 1.109 (Reference 6), Table B-1, converted to be expressed in terms of µCi.

Table 4-13 (Page 1 of 3)
Inhalation Dose Rate Parameters for Adult (P_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03
C-14	1.82E+04	3.41E+03	3.41E+03	3.41E+03	3.41E+03	3.41E+03	3.41E+03
Na-22	1.04E+05	1.04E+05	1.04E+05	1.04E+05	1.04E+05	1.04E+05	1.04E+05
Na-24	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04
P-32	1.32E+06	7.71E+04	5.01E+04	0.00E+00	0.00E+00	0.00E+00	8.64E+04
Ca-41	3.06E+05	0.00E+00	3.30E+04	0.00E+00	0.00E+00	3.06E+04	2.29E+03
Sc-46	4.41E+05	8.56E+05	2.49E+05	0.00E+00	7.99E+05	0.00E+00	2.58E+05
Cr-51	0.00E+00	0.00E+00	1.00E+02	5.95E+01	2.28E+01	1.44E+04	3.32E+03
Mn-54	0.00E+00	3.96E+04	6.30E+03	0.00E+00	9.84E+03	1.40E+06	7.74E+04
Fe-55	2.46E+04	1.70E+04	3.94E+03	0.00E+00	0.00E+00	7.21E+04	6.03E+03
Mn-56	0.00E+00	1.24E+00	1.83E-01	0.00E+00	1.30E+00	9.44E+03	2.02E+04
Co-57	0.00E+00	6.92E+02	6.71E+02	0.00E+00	0.00E+00	3.70E+05	3.14E+04
Co-58	0.00E+00	1.58E+03	2.07E+03	0.00E+00	0.00E+00	9.28E+05	1.06E+05
Fe-59	1.18E+04	2.78E+04	1.06E+04	0.00E+00	0.00E+00	1.02E+06	1.88E+05
Co-60	0.00E+00	1.15E+04	1.48E+04	0.00E+00	0.00E+00	5.97E+06	2.85E+05
Ni-59	3.25E+04	1.17E+04	5.42E+03	0.00E+00	0.00E+00	6.56E+04	4.89E+03
Ni-63	4.32E+05	3.14E+04	1.45E+04	0.00E+00	0.00E+00	1.78E+05	1.34E+04
Cu-64	0.00E+00	1.46E+00	6.15E-01	0.00E+00	4.62E+00	6.78E+03	4.90E+04
Ni-65	1.54E+00	2.10E-01	9.12E-02	0.00E+00	0.00E+00	5.60E+03	1.23E+04
Zn-65	3.24E+04	1.03E+05	4.66E+04	0.00E+00	6.90E+04	8.64E+05	5.34E+04
Zn-69m	8.16E+00	1.96E+01	1.79E+00	0.00E+00	1.18E+01	1.90E+04	1.37E+05
Zn-69	3.38E-02	6.51E-02	4.52E-03	0.00E+00	4.22E-02	9.20E+02	1.63E+01
Se-79	0.00E+00	3.06E+03	4.87E+02	0.00E+00	4.55E+03	3.58E+05	2.66E+04
Br-82	0.00E+00	0.00E+00	1.35E+04	0.00E+00	0.00E+00	0.00E+00	1.04E+04
Br-83	0.00E+00	0.00E+00	2.41E+02	0.00E+00	0.00E+00	0.00E+00	2.32E+02
Br-84	0.00E+00	0.00E+00	3.13E+02	0.00E+00	0.00E+00	0.00E+00	1.64E-03
Br-85	0.00E+00	0.00E+00	1.28E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.35E+05	5.90E+04	0.00E+00	0.00E+00	0.00E+00	1.66E+04
Rb-87	0.00E+00	7.89E+04	2.57E+04	0.00E+00	0.00E+00	0.00E+00	2.30E+03
Rb-88	0.00E+00	3.87E+02	1.93E+02	0.00E+00	0.00E+00	0.00E+00	3.34E-09
Rb-89	0.00E+00	2.56E+02	1.70E+02	0.00E+00	0.00E+00	0.00E+00	9.28E-12
Sr-89	3.04E+05	0.00E+00	8.72E+03	0.00E+00	0.00E+00	1.40E+06	3.50E+05
Sr-90	5.06E+07	0.00E+00	3.39E+06	0.00E+00	0.00E+00	9.60E+06	7.22E+05
Y-90	2.09E+03	0.00E+00	5.61E+01	0.00E+00	0.00E+00	1.70E+05	5.06E+05
Sr-91	6.19E+01	0.00E+00	2.50E+00	0.00E+00	0.00E+00	3.65E+04	1.91E+05
Y-91m	2.61E-01	0.00E+00	1.02E-02	0.00E+00	0.00E+00	1.92E+03	1.33E+00
Y-91	4.62E+05	0.00E+00	1.24E+04	0.00E+00	0.00E+00	1.70E+06	3.85E+05
Sr-92	6.74E+00	0.00E+00	2.91E-01	0.00E+00	0.00E+00	1.65E+04	4.30E+04
Y-92	1.03E+01	0.00E+00	3.02E-01	0.00E+00	0.00E+00	1.57E+04	7.35E+04
Y-93	9.44E+01	0.00E+00	2.61E+00	0.00E+00	0.00E+00	4.85E+04	4.22E+05
Nb-93m	2.48E+05	8.08E+04	1.99E+04	0.00E+00	9.28E+04	2.49E+05	1.90E+04
Nb-95	1.41E+04	7.82E+03	4.21E+03	0.00E+00	7.74E+03	5.05E+05	1.04E+05
Nb-97	2.22E-01	5.62E-02	2.05E-02	0.00E+00	6.54E-02	2.40E+03	2.42E+02
Zr-93	4.18E+05	2.34E+04	1.10E+04	0.00E+00	8.88E+04	1.70E+05	1.21E+04
Zr-95	1.07E+05	3.44E+04	2.33E+04	0.00E+00	5.42E+04	1.77E+06	1.50E+05
Zr-97	9.68E+01	1.96E+01	9.04E+00	0.00E+00	2.97E+01	7.87E+04	5.23E+05
Mo-93	0.00E+00	9.36E+03	2.54E+02	0.00E+00	2.84E+03	4.09E+05	3.03E+04
Mo-99	0.00E+00	1.21E+02	2.30E+01	0.00E+00	2.91E+02	9.12E+04	2.48E+05
Tc-99	2.50E+02	3.71E+02	1.00E+02	0.00E+00	4.68E+03	8.08E+05	6.03E+04
Tc-99m	1.03E-03	2.91E-03	3.70E-02	0.00E+00	4.42E-02	7.64E+02	4.16E+03
Tc-101	4.18E-05	6.02E-05	5.90E-04	0.00E+00	1.08E-03	3.99E+02	1.09E-11
Ru-103	1.53E+03	0.00E+00	6.58E+02	0.00E+00	5.83E+03	5.05E+05	1.10E+05
Ru-105	7.90E-01	0.00E+00	3.11E-01	0.00E+00	1.02E+00	1.10E+04	4.82E+04
Rh-105	7.39E+00	5.38E+00	3.54E+00	0.00E+00	2.29E+01	1.93E+04	8.72E+04
Ru-106	6.91E+04	0.00E+00	8.72E+03	0.00E+00	1.34E+05	9.36E+06	9.12E+05
Pd-107	0.00E+00	6.62E+02	4.70E+01	0.00E+00	5.26E+03	7.58E+04	5.65E+03

Table 4-13 (Page 2 of 3)
Inhalation Dose Rate Parameters for Adult (P_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	3.70E+00	9.28E-01	0.00E+00	1.88E+01	1.48E+04	1.22E+05
Ag-110m	1.08E+04	1.00E+04	5.94E+03	0.00E+00	1.97E+04	4.63E+06	3.02E+05
Ag-111	3.40E+02	1.42E+02	7.10E+01	0.00E+00	4.59E+02	1.86E+05	2.23E+05
Cd-113m	0.00E+00	1.23E+06	3.98E+04	0.00E+00	1.37E+06	1.66E+06	1.27E+05
Cd-115m	0.00E+00	1.97E+05	6.36E+03	0.00E+00	1.58E+05	1.41E+06	3.84E+05
Sn-123	2.42E+05	5.34E+03	7.86E+03	4.54E+03	0.00E+00	2.30E+06	3.14E+05
Sn-125	9.28E+03	2.50E+02	5.62E+02	2.07E+02	0.00E+00	5.90E+05	5.45E+05
Sn-126	1.26E+06	3.34E+04	4.80E+04	9.84E+03	0.00E+00	9.36E+06	1.27E+05
Sb-124	3.12E+04	5.89E+02	1.24E+04	7.55E+01	0.00E+00	2.48E+06	4.06E+05
Sb-125	5.34E+04	5.95E+02	1.26E+04	5.40E+01	0.00E+00	1.74E+06	1.01E+05
Sb-126	3.60E+03	7.30E+01	1.30E+03	2.20E+01	0.00E+00	7.66E+05	4.81E+05
Sb-127	2.64E+02	5.78E+00	1.02E+02	3.18E+00	0.00E+00	1.64E+05	3.02E+05
Te-125m	3.42E+03	1.58E+03	4.67E+02	1.05E+03	1.24E+04	3.14E+05	7.06E+04
Te-127m	1.26E+04	5.77E+03	1.57E+03	3.29E+03	4.58E+04	9.60E+05	1.50E+05
Te-127	1.40E+00	6.42E-01	3.10E-01	1.06E+00	5.10E+00	6.51E+03	5.74E+04
Te-129m	9.76E+03	4.67E+03	1.58E+03	3.44E+03	3.66E+04	1.16E+06	3.83E+05
Te-129	4.98E-02	2.39E-02	1.24E-02	3.90E-02	1.87E-01	1.94E+03	1.57E+02
Te-133m	5.79E-02	4.32E-02	3.34E-02	5.02E-02	2.99E-01	4.41E+03	4.39E+02
Te-134	3.07E-02	2.58E-02	1.26E-02	2.75E-02	1.74E-01	3.47E+03	2.38E-01
I-129	1.98E+04	1.69E+04	5.53E+04	4.43E+07	3.62E+04	0.00E+00	1.78E+03
I-130	4.58E+03	1.34E+04	5.28E+03	1.14E+06	2.09E+04	0.00E+00	7.69E+03
I-131	2.52E+04	3.58E+04	2.05E+04	1.19E+07	6.13E+04	0.00E+00	6.28E+03
Te-131m	6.99E+01	4.36E+01	2.90E+01	5.50E+01	3.09E+02	1.46E+05	5.56E+05
Te-131	1.11E-02	5.95E-03	3.59E-03	9.36E-03	4.37E-02	1.39E+03	1.84E+01
I-132	1.16E+03	3.26E+03	1.16E+03	1.14E+05	5.18E+03	0.00E+00	4.06E+02
Te-132	2.60E+02	2.15E+02	1.62E+02	1.90E+02	1.46E+03	2.88E+05	5.10E+05
I-133	8.64E+03	1.48E+04	4.52E+03	2.15E+06	2.58E+04	0.00E+00	8.88E+03
Cs-134m	1.27E+02	2.56E+02	1.38E+02	0.00E+00	1.46E+02	2.34E+01	6.34E+01
Cs-134	3.73E+05	8.48E+05	7.28E+05	0.00E+00	2.87E+05	9.76E+04	1.04E+04
I-134	6.44E+02	1.73E+03	6.15E+02	2.98E+04	2.75E+03	0.00E+00	1.01E+00
I-135	2.68E+03	6.98E+03	2.57E+03	4.48E+05	1.11E+04	0.00E+00	5.25E+03
Cs-135	1.17E+05	1.03E+05	4.79E+04	0.00E+00	4.09E+04	1.26E+04	1.69E+03
Cs-136	3.90E+04	1.46E+05	1.10E+05	0.00E+00	8.56E+04	1.20E+04	1.17E+04
Cs-137	4.78E+05	6.21E+05	4.28E+05	0.00E+00	2.22E+05	7.52E+04	8.40E+03
Cs-138	3.31E+02	6.21E+02	3.24E+02	0.00E+00	4.80E+02	4.86E+01	1.86E-03
Cs-139	2.05E+02	2.90E+02	1.11E+02	0.00E+00	2.44E+02	2.27E+01	4.39E-21
Ba-139	9.36E-01	6.66E-04	2.74E-02	0.00E+00	6.22E-04	3.76E+03	8.96E+02
Ba-140	3.90E+04	4.90E+01	2.57E+03	0.00E+00	1.67E+01	1.27E+06	2.18E+05
La-140	3.44E+02	1.74E+02	4.58E+01	0.00E+00	0.00E+00	1.36E+05	4.58E+05
Ba-141	1.00E-01	7.53E-05	3.36E-03	0.00E+00	7.00E-05	1.94E+03	1.16E-07
La-141	4.27E+00	1.33E+00	2.17E-01	0.00E+00	0.00E+00	1.08E+04	5.85E+04
Ce-141	1.99E+04	1.35E+04	1.53E+03	0.00E+00	6.26E+03	3.62E+05	1.20E+05
Ba-142	2.63E-02	2.70E-05	1.66E-03	0.00E+00	2.29E-05	1.19E+03	1.57E-16
La-142	6.83E-01	3.10E-01	7.72E-02	0.00E+00	0.00E+00	6.33E+03	2.11E+03
Ce-143	1.86E+02	1.38E+02	1.53E+01	0.00E+00	6.08E+01	7.98E+04	2.26E+05
Pr-143	9.36E+03	3.75E+03	4.64E+02	0.00E+00	2.16E+03	2.81E+05	2.00E+05
Ce-144	3.43E+06	1.43E+06	1.84E+05	0.00E+00	8.48E+05	7.78E+06	8.16E+05
Pr-144	3.01E-02	1.25E-02	1.53E-03	0.00E+00	7.05E-03	1.02E+03	2.15E-08
Nd-147	5.27E+03	6.10E+03	3.65E+02	0.00E+00	3.56E+03	2.21E+05	1.73E+05
Pm-147	6.70E+05	6.30E+04	2.55E+04	0.00E+00	1.19E+05	5.28E+05	4.43E+04
Pm-148m	7.86E+04	2.03E+04	1.55E+04	0.00E+00	3.08E+04	1.71E+06	3.34E+05
Pm-148	3.07E+03	5.10E+02	2.56E+02	0.00E+00	9.60E+02	3.13E+05	4.64E+05
Pm-149	2.75E+02	3.90E+01	1.59E+01	0.00E+00	7.35E+01	5.77E+04	2.00E+05
Pm-151	6.80E+01	1.14E+01	5.77E+00	0.00E+00	2.04E+01	3.15E+04	1.60E+05
Sm-151	6.87E+05	1.18E+05	2.84E+04	0.00E+00	1.33E+05	3.56E+05	2.60E+04
Sm-153	1.36E+02	1.14E+02	8.32E+00	0.00E+00	3.67E+01	3.31E+04	1.26E+05

Table 4-13 (Page 3 of 3)
Inhalation Dose Rate Parameters for Adult (P_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	1.90E+06	4.33E+05	3.81E+05	0.00E+00	2.68E+06	2.74E+06	1.27E+05
Eu-154	5.92E+06	7.28E+05	5.18E+05	0.00E+00	3.49E+06	4.67E+06	2.72E+05
Eu-155	8.08E+05	1.14E+05	7.37E+04	0.00E+00	5.27E+05	7.57E+05	4.76E+04
Eu-156	1.54E+04	1.18E+04	1.92E+03	0.00E+00	7.96E+03	6.85E+05	3.60E+05
Tb-160	1.77E+05	0.00E+00	2.20E+04	0.00E+00	7.28E+04	1.54E+06	2.14E+05
Ho-166m	2.70E+06	8.40E+05	6.40E+05	0.00E+00	1.26E+06	3.15E+06	1.27E+05
W-181	4.98E+01	1.62E+01	1.74E+00	0.00E+00	0.00E+00	1.37E+04	2.02E+03
W-185	1.56E+03	5.18E+02	5.45E+01	0.00E+00	0.00E+00	4.46E+05	8.56E+04
W-187	8.48E+00	7.08E+00	2.48E+00	0.00E+00	0.00E+00	2.90E+04	1.55E+05
Np-239	2.30E+02	2.26E+01	1.24E+01	0.00E+00	7.00E+01	3.76E+04	1.19E+05
U-232	4.11E+08	0.00E+00	2.93E+07	0.00E+00	4.45E+07	1.78E+09	3.37E+05
U-233	8.72E+07	0.00E+00	5.28E+06	0.00E+00	2.03E+07	4.26E+08	3.11E+05
U-234	8.32E+07	0.00E+00	5.17E+06	0.00E+00	1.99E+07	4.18E+08	3.05E+05
U-235	8.00E+07	0.00E+00	4.86E+06	0.00E+00	1.87E+07	3.92E+08	3.87E+05
U-236	8.00E+07	0.00E+00	4.96E+06	0.00E+00	1.91E+07	4.00E+08	2.86E+05
U-237	2.94E+02	0.00E+00	7.82E+01	0.00E+00	1.21E+03	8.16E+04	9.60E+04
U-238	7.66E+07	0.00E+00	4.54E+06	0.00E+00	1.74E+07	3.66E+08	2.73E+05
Np-237	1.25E+10	8.00E+09	5.50E+08	0.00E+00	4.08E+09	4.18E+08	3.94E+05
Np-238	2.37E+03	5.76E+02	3.69E+01	0.00E+00	2.18E+02	8.16E+04	1.70E+05
Pu-238	1.14E+10	7.77E+09	5.52E+08	0.00E+00	2.37E+09	1.46E+09	3.62E+05
Pu-239	1.33E+10	8.56E+09	6.20E+08	0.00E+00	2.64E+09	1.38E+09	3.30E+05
Pu-240	1.32E+10	8.56E+09	6.18E+08	0.00E+00	2.63E+09	1.38E+09	3.37E+05
Pu-241	2.74E+08	6.95E+07	1.03E+07	0.00E+00	4.74E+07	1.22E+06	6.92E+03
Pu-242	1.22E+10	8.24E+09	5.97E+08	0.00E+00	2.54E+09	1.32E+09	3.24E+05
Pu-244	1.43E+10	9.44E+09	6.83E+08	0.00E+00	2.91E+09	1.51E+09	4.82E+05
Am-241	1.34E+10	9.04E+09	5.37E+08	0.00E+00	4.03E+09	4.85E+08	3.68E+05
Am-242m	1.36E+10	8.48E+09	5.38E+08	0.00E+00	4.01E+09	1.95E+08	4.63E+05
Am-243	1.34E+10	8.80E+09	5.26E+08	0.00E+00	3.96E+09	4.60E+08	4.32E+05
Cm-242	1.78E+08	1.42E+08	7.87E+06	0.00E+00	3.58E+07	3.14E+08	3.93E+05
Cm-243	8.80E+09	6.09E+09	3.69E+08	0.00E+00	1.72E+09	5.05E+08	3.87E+05
Cm-244	6.70E+09	4.70E+09	2.81E+08	0.00E+00	1.31E+09	4.85E+08	3.74E+05
Cm-245	1.39E+10	9.12E+09	5.71E+08	0.00E+00	2.66E+09	4.68E+08	3.49E+05
Cm-246	1.38E+10	9.12E+09	5.70E+08	0.00E+00	2.66E+09	4.77E+08	3.43E+05
Cm-247	1.34E+10	8.96E+09	5.62E+08	0.00E+00	2.62E+09	4.68E+08	4.50E+05
Cm-248	1.12E+11	7.41E+10	4.63E+09	0.00E+00	2.16E+10	3.86E+09	7.27E+06
Cf-252	4.34E+09	0.00E+00	1.86E+08	0.00E+00	0.00E+00	1.59E+09	1.42E+06

Units of mrem/yr per $\mu Ci/m^3$

Table 4-14 (Page 1 of 3)
Inhalation Dose Rate Parameters for Teenager (P_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03
C-14	2.60E+04	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03
Na-22	1.41E+05	1.41E+05	1.41E+05	1.41E+05	1.41E+05	1.41E+05	1.41E+05
Na-24	1.38E+04	1.38E+04	1.38E+04	1.38E+04	1.38E+04	1.38E+04	1.38E+04
P-32	1.89E+06	1.10E+05	7.16E+04	0.00E+00	0.00E+00	0.00E+00	9.28E+04
Ca-41	3.24E+05	0.00E+00	3.50E+04	0.00E+00	0.00E+00	8.08E+08	2.42E+03
Sc-46	5.79E+05	1.13E+06	3.34E+05	0.00E+00	1.08E+06	0.00E+00	2.38E+05
Cr-51	0.00E+00	0.00E+00	1.35E+02	7.50E+01	3.07E+01	2.10E+04	3.00E+03
Mn-54	0.00E+00	5.11E+04	8.40E+03	0.00E+00	1.27E+04	1.98E+06	6.68E+04
Fe-55	3.34E+04	2.38E+04	5.54E+03	0.00E+00	0.00E+00	1.24E+05	6.39E+03
Mn-56	0.00E+00	1.70E+00	2.52E-01	0.00E+00	1.79E+00	1.52E+04	5.74E+04
Co-57	0.00E+00	9.44E+02	9.20E+02	0.00E+00	0.00E+00	5.86E+05	3.14E+04
Co-58	0.00E+00	2.07E+03	2.78E+03	0.00E+00	0.00E+00	1.34E+06	9.52E+04
Fe-59	1.59E+04	3.70E+04	1.43E+04	0.00E+00	0.00E+00	1.53E+06	1.78E+05
Co-60	0.00E+00	1.51E+04	1.98E+04	0.00E+00	0.00E+00	8.72E+06	2.59E+05
Ni-59	4.35E+04	1.62E+04	7.39E+03	0.00E+00	0.00E+00	1.13E+05	5.18E+03
Ni-63	5.80E+05	4.34E+04	1.98E+04	0.00E+00	0.00E+00	3.07E+05	1.42E+04
Cu-64	0.00E+00	2.03E+00	8.48E-01	0.00E+00	6.41E+00	1.11E+04	6.14E+04
Ni-65	2.18E+00	2.93E-01	1.27E-01	0.00E+00	0.00E+00	9.36E+03	3.67E+04
Zn-65	3.86E+04	1.34E+05	6.24E+04	0.00E+00	8.64E+04	1.24E+06	4.66E+04
Zn-69m	1.15E+01	2.71E+01	2.49E+00	0.00E+00	1.65E+01	3.14E+04	1.71E+05
Zn-69	4.83E-02	9.20E-02	6.46E-03	0.00E+00	6.02E-02	1.58E+03	2.85E+02
Se-79	0.00E+00	4.34E+03	6.97E+02	0.00E+00	6.50E+03	6.17E+05	2.82E+04
Br-82	0.00E+00	0.00E+00	1.82E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	3.44E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	4.33E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	1.83E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.90E+05	8.40E+04	0.00E+00	0.00E+00	0.00E+00	1.77E+04
Rb-87	0.00E+00	1.12E+05	3.66E+04	0.00E+00	0.00E+00	0.00E+00	2.44E+03
Rb-88	0.00E+00	5.46E+02	2.72E+02	0.00E+00	0.00E+00	0.00E+00	2.92E-05
Rb-89	0.00E+00	3.52E+02	2.33E+02	0.00E+00	0.00E+00	0.00E+00	3.38E-07
Sr-89	4.34E+05	0.00E+00	1.25E+04	0.00E+00	0.00E+00	2.42E+06	3.71E+05
Sr-90	5.84E+08	0.00E+00	3.92E+06	0.00E+00	0.00E+00	1.65E+07	7.65E+05
Y-90	2.98E+03	0.00E+00	8.00E+01	0.00E+00	0.00E+00	2.93E+05	5.59E+05
Sr-91	8.80E+01	0.00E+00	3.51E+00	0.00E+00	0.00E+00	6.07E+04	2.59E+05
Y-91m	3.70E-01	0.00E+00	1.42E-02	0.00E+00	0.00E+00	3.20E+03	3.02E+01
Y-91	6.61E+05	0.00E+00	1.77E+04	0.00E+00	0.00E+00	2.94E+06	4.09E+05
Sr-92	9.52E+00	0.00E+00	4.06E-01	0.00E+00	0.00E+00	2.74E+04	1.19E+05
Y-92	1.47E+01	0.00E+00	4.29E-01	0.00E+00	0.00E+00	2.68E+04	1.65E+05
Y-93	1.35E+02	0.00E+00	3.72E+00	0.00E+00	0.00E+00	8.32E+04	5.79E+05
Nb-93m	3.31E+05	1.09E+05	2.73E+04	0.00E+00	1.27E+05	4.29E+05	2.02E+04
Nb-95	1.86E+04	1.03E+04	5.66E+03	0.00E+00	1.00E+04	7.51E+05	9.68E+04
Nb-97	3.14E-01	7.78E-02	2.84E-02	0.00E+00	9.12E-02	3.93E+03	2.17E+03
Zr-93	5.46E+05	2.70E+05	1.47E+05	0.00E+00	9.28E+05	2.94E+06	1.28E+05
Zr-95	1.46E+05	4.58E+04	3.15E+04	0.00E+00	6.74E+04	2.69E+06	1.49E+05
Zr-97	1.38E+02	2.72E+01	1.26E+01	0.00E+00	4.12E+01	1.30E+05	6.30E+05
Mo-93	0.00E+00	1.33E+04	3.62E+02	0.00E+00	4.05E+03	7.05E+05	3.19E+04
Mo-99	0.00E+00	1.69E+02	3.22E+01	0.00E+00	4.11E+02	1.54E+05	2.69E+05
Tc-99	3.58E+02	5.26E+02	1.43E+02	0.00E+00	6.68E+03	1.39E+06	6.39E+04
Tc-99m	1.38E-03	3.86E-03	4.99E-02	0.00E+00	5.76E-02	1.15E+03	6.13E+03
Tc-101	5.92E-05	8.40E-05	8.24E-04	0.00E+00	1.52E-03	6.67E+02	8.72E-07
Ru-103	2.10E+03	0.00E+00	8.96E+02	0.00E+00	7.43E+03	7.83E+05	1.09E+05
Ru-105	1.12E+00	0.00E+00	4.34E-01	0.00E+00	1.41E+00	1.82E+04	9.04E+04
Rh-105	1.06E+01	7.58E+00	4.99E+00	0.00E+00	3.23E+01	3.27E+04	9.84E+04
Ru-106	9.84E+04	0.00E+00	1.24E+04	0.00E+00	1.90E+05	1.61E+07	9.60E+05
Pd-107	0.00E+00	9.36E+02	6.71E+01	0.00E+00	7.51E+03	1.30E+05	5.99E+03

Table 4-14 (Page 2 of 3)
Inhalation Dose Rate Parameters for Teenager (P_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	5.25E+00	1.33E+00	0.00E+00	2.69E+01	2.55E+04	1.57E+05
Ag-110m	1.38E+04	1.31E+04	7.99E+03	0.00E+00	2.50E+04	6.75E+06	2.73E+05
Ag-111	4.86E+02	2.02E+02	1.01E+02	0.00E+00	6.54E+02	3.20E+05	2.40E+05
Cd-113m	0.00E+00	1.74E+06	5.68E+04	0.00E+00	1.94E+06	2.87E+06	1.34E+05
Cd-115m	0.00E+00	2.78E+05	9.12E+03	0.00E+00	2.26E+05	2.42E+06	4.08E+05
Sn-123	3.45E+05	7.55E+03	1.12E+04	6.04E+03	0.00E+00	3.97E+06	3.33E+05
Sn-125	1.33E+04	3.54E+02	7.99E+02	2.76E+02	0.00E+00	1.01E+06	5.83E+05
Sn-126	1.74E+06	4.31E+04	6.59E+04	1.14E+04	0.00E+00	1.38E+07	1.34E+05
Sb-124	4.30E+04	7.94E+02	1.68E+04	9.76E+01	0.00E+00	3.85E+06	3.98E+05
Sb-125	7.38E+04	8.08E+02	1.72E+04	7.04E+01	0.00E+00	2.74E+06	9.92E+04
Sb-126	4.95E+03	1.02E+02	1.78E+03	2.80E+01	0.00E+00	1.24E+06	4.81E+05
Sb-127	3.71E+02	7.94E+00	1.40E+02	4.17E+00	0.00E+00	2.65E+05	3.15E+05
Te-125m	4.88E+03	2.24E+03	6.67E+02	1.40E+03	0.00E+00	5.36E+05	7.50E+04
Te-127m	1.80E+04	8.16E+03	2.18E+03	4.38E+03	6.54E+04	1.66E+06	1.59E+05
Te-127	2.01E+00	9.12E-01	4.42E-01	1.42E+00	7.28E+00	1.12E+04	8.08E+04
Te-129m	1.39E+04	6.58E+03	2.25E+03	4.58E+03	5.19E+04	1.98E+06	4.05E+05
Te-129	7.10E-02	3.38E-02	1.76E-02	5.18E-02	2.66E-01	3.30E+03	1.62E+03
Te-133m	8.08E-02	5.86E-02	4.57E-02	6.54E-02	4.06E-01	6.97E+03	9.84E+02
Te-134	4.25E-02	3.48E-02	2.91E-02	3.57E-02	2.33E-01	5.40E+03	1.10E+01
I-129	2.82E+04	2.35E+04	3.92E+04	2.93E+07	4.21E+04	0.00E+00	1.83E+03
I-130	6.24E+03	1.79E+04	7.17E+03	1.49E+06	2.75E+04	0.00E+00	9.12E+03
I-131	3.54E+04	4.91E+04	2.64E+04	1.46E+07	8.40E+04	0.00E+00	6.49E+03
Te-131m	9.84E+01	6.01E+01	4.02E+01	7.25E+01	4.39E+02	2.38E+05	6.21E+05
Te-131	1.58E-02	8.32E-03	5.04E-03	1.24E-02	6.18E-02	2.34E+03	1.51E+01
I-132	1.59E+03	4.38E+03	1.58E+03	1.51E+05	6.92E+03	0.00E+00	1.27E+03
Te-132	3.60E+02	2.90E+02	2.19E+02	2.46E+02	1.95E+03	4.49E+05	4.63E+05
I-133	1.22E+04	2.05E+04	6.22E+03	2.92E+06	3.59E+04	0.00E+00	1.03E+04
Cs-134m	1.76E+02	3.48E+02	1.88E+02	0.00E+00	2.03E+02	3.65E+01	1.62E+02
Cs-134	5.02E+05	1.13E+06	5.49E+05	0.00E+00	3.75E+05	1.46E+05	9.76E+03
I-134	8.88E+02	2.32E+03	8.40E+02	3.95E+04	3.66E+03	0.00E+00	2.04E+01
I-135	3.70E+03	9.44E+03	3.49E+03	6.21E+05	1.49E+04	0.00E+00	6.95E+03
Cs-135	1.66E+05	1.46E+05	3.58E+04	0.00E+00	5.84E+04	2.16E+04	1.78E+03
Cs-136	5.15E+04	1.94E+05	1.37E+05	0.00E+00	1.10E+05	1.78E+04	1.09E+04
Cs-137	6.70E+05	8.48E+05	3.11E+05	0.00E+00	3.04E+05	1.21E+05	8.48E+03
Cs-138	4.66E+02	8.56E+02	4.46E+02	0.00E+00	6.62E+02	7.87E+01	2.70E-01
Cs-139	2.92E+02	4.10E+02	1.58E+02	0.00E+00	3.47E+02	3.89E+01	1.33E-13
Ba-139	1.34E+00	9.44E-04	3.90E-02	0.00E+00	8.88E-04	6.46E+03	6.45E+03
Ba-140	5.47E+04	6.70E+01	3.52E+03	0.00E+00	2.28E+01	2.03E+06	2.29E+05
La-140	4.79E+02	2.36E+02	6.26E+01	0.00E+00	0.00E+00	2.14E+05	4.87E+05
Ba-141	1.42E-01	1.06E-04	4.74E-03	0.00E+00	9.84E-05	3.29E+03	7.46E-04
La-141	6.10E+00	1.88E+00	3.10E-01	0.00E+00	0.00E+00	1.85E+04	1.23E+05
Ce-141	2.84E+04	1.90E+04	2.17E+03	0.00E+00	8.88E+03	6.14E+05	1.26E+05
Ba-142	3.70E-02	3.70E-05	2.27E-03	0.00E+00	3.14E-05	1.91E+03	4.79E-10
La-142	9.60E-01	4.25E-01	1.06E-01	0.00E+00	0.00E+00	1.02E+04	1.20E+04
Ce-143	2.66E+02	1.94E+02	2.16E+01	0.00E+00	8.64E+01	1.30E+05	2.55E+05
Pr-143	1.34E+04	5.31E+03	6.62E+02	0.00E+00	3.09E+03	4.83E+05	2.14E+05
Ce-144	4.89E+06	2.02E+06	2.62E+05	0.00E+00	1.21E+06	1.34E+07	8.64E+05
Pr-144	4.30E-02	1.76E-02	2.18E-03	0.00E+00	1.01E-02	1.75E+03	2.35E-04
Nd-147	7.86E+03	8.56E+03	5.13E+02	0.00E+00	5.02E+03	3.72E+05	1.82E+05
Pm-147	9.20E+05	8.80E+04	3.60E+04	0.00E+00	1.68E+05	9.12E+05	4.70E+04
Pm-148m	1.06E+05	2.68E+04	2.10E+04	0.00E+00	4.06E+04	2.56E+06	3.28E+05
Pm-148	4.35E+03	7.10E+02	3.58E+02	0.00E+00	1.28E+03	5.22E+05	4.91E+05
Pm-149	3.93E+02	5.51E+01	2.27E+01	0.00E+00	1.05E+02	9.92E+04	2.23E+05
Pm-151	9.60E+01	1.59E+01	8.08E+00	0.00E+00	2.86E+01	5.25E+04	1.82E+05
Sm-151	8.56E+05	1.68E+05	3.89E+04	0.00E+00	1.82E+05	6.14E+05	2.82E+04
Sm-153	1.94E+02	1.61E+02	1.18E+01	0.00E+00	5.25E+01	5.69E+04	1.42E+05

Table 4-14 (Page 3 of 3)
Inhalation Dose Rate Parameters for Teenager (P_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	2.37E+06	5.75E+05	5.04E+05	0.00E+00	2.67E+06	4.01E+06	1.08E+05
Eu-154	7.54E+06	9.84E+05	6.88E+05	0.00E+00	4.35E+06	7.30E+06	2.67E+05
Eu-155	1.60E+06	1.57E+05	9.68E+04	0.00E+00	6.12E+05	1.21E+07	4.78E+05
Eu-156	2.16E+04	1.62E+04	2.64E+03	0.00E+00	1.09E+04	1.10E+06	3.65E+05
Tb-160	2.43E+05	0.00E+00	3.03E+04	0.00E+00	9.60E+04	2.38E+06	2.08E+05
Ho-166m	3.52E+06	1.09E+06	7.90E+05	0.00E+00	1.60E+06	4.99E+06	1.34E+05
W-181	7.12E+01	2.30E+01	2.41E+00	0.00E+00	0.00E+00	2.36E+04	2.15E+03
W-185	2.22E+03	7.34E+02	7.78E+01	0.00E+00	0.00E+00	7.68E+05	9.12E+04
W-187	1.20E+01	9.76E+00	3.43E+00	0.00E+00	0.00E+00	4.74E+04	1.77E+05
Np-239	3.38E+02	3.19E+01	1.77E+01	0.00E+00	1.00E+02	6.49E+04	1.32E+05
U-232	5.85E+08	0.00E+00	4.18E+07	0.00E+00	6.35E+07	3.07E+09	3.57E+05
U-233	1.24E+08	0.00E+00	7.54E+06	0.00E+00	2.90E+07	7.34E+08	3.30E+05
U-234	1.18E+08	0.00E+00	7.38E+06	0.00E+00	2.84E+07	7.19E+08	3.23E+05
U-235	1.14E+08	0.00E+00	6.94E+06	0.00E+00	2.67E+07	6.75E+08	4.10E+05
U-236	1.14E+08	0.00E+00	7.09E+06	0.00E+00	2.73E+07	6.90E+08	3.03E+05
U-237	4.20E+02	0.00E+00	1.12E+02	0.00E+00	1.73E+03	1.41E+05	1.03E+05
U-238	1.09E+08	0.00E+00	6.48E+06	0.00E+00	2.50E+07	6.31E+08	2.90E+05
Np-237	1.31E+10	8.48E+09	5.77E+08	0.00E+00	4.28E+09	7.19E+08	4.18E+05
Np-238	3.38E+03	8.16E+02	5.27E+01	0.00E+00	3.10E+02	1.40E+05	1.90E+05
Pu-238	1.20E+10	8.24E+09	5.78E+08	0.00E+00	2.48E+09	2.50E+09	3.83E+05
Pu-239	1.38E+10	8.96E+09	6.44E+08	0.00E+00	2.75E+09	2.34E+09	3.50E+05
Pu-240	1.38E+10	8.96E+09	6.43E+08	0.00E+00	2.74E+09	2.34E+09	3.57E+05
Pu-241	2.99E+08	7.65E+07	1.12E+07	0.00E+00	5.18E+07	2.08E+06	7.34E+03
Pu-242	1.28E+10	8.64E+09	6.20E+08	0.00E+00	2.65E+09	2.26E+09	3.43E+05
Pu-244	1.50E+10	9.92E+09	7.10E+08	0.00E+00	3.03E+09	2.58E+09	5.11E+05
Am-241	1.42E+10	9.60E+09	5.68E+08	0.00E+00	4.26E+09	8.40E+08	3.90E+05
Am-242m	1.43E+10	9.04E+09	5.72E+08	0.00E+00	4.24E+09	3.37E+08	4.91E+05
Am-243	1.42E+10	9.36E+09	5.56E+08	0.00E+00	4.17E+09	7.93E+08	4.58E+05
Cm-242	2.54E+08	2.01E+08	1.13E+07	0.00E+00	5.12E+07	5.41E+08	4.17E+05
Cm-243	9.52E+09	6.64E+09	4.00E+08	0.00E+00	1.87E+09	8.72E+08	4.10E+05
Cm-244	7.35E+09	5.22E+09	3.10E+08	0.00E+00	1.45E+09	8.40E+08	3.97E+05
Cm-245	1.46E+10	9.76E+09	6.02E+08	0.00E+00	2.82E+09	8.08E+08	3.70E+05
Cm-246	1.45E+10	9.76E+09	6.02E+08	0.00E+00	2.81E+09	8.24E+08	3.63E+05
Cm-247	1.42E+10	9.52E+09	5.93E+08	0.00E+00	2.77E+09	8.08E+08	4.78E+05
Cm-248	1.18E+11	7.86E+10	4.89E+09	0.00E+00	2.28E+10	6.66E+09	7.70E+06
Cf-252	5.73E+09	0.00E+00	2.46E+08	0.00E+00	0.00E+00	2.74E+09	1.51E+06

Units of mrem/yr per $\mu Ci/m^3$

Table 4-15 (Page 1 of 3)
Inhalation Dose Rate Parameters for Child (P_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03
C-14	3.59E+04	6.73E+03	6.73E+03	6.73E+03	6.73E+03	6.73E+03	6.73E+03
Na-22	1.63E+05	1.63E+05	1.63E+05	1.63E+05	1.63E+05	1.63E+05	1.63E+05
Na-24	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04
P-32	2.60E+06	1.14E+05	9.88E+04	0.00E+00	0.00E+00	0.00E+00	4.22E+04
Ca-41	2.61E+05	0.00E+00	2.85E+04	0.00E+00	0.00E+00	2.67E+08	1.09E+03
Sc-46	7.29E+05	9.99E+05	3.85E+05	0.00E+00	8.84E+05	0.00E+00	9.07E+04
Cr-51	0.00E+00	0.00E+00	1.54E+02	8.55E+01	2.43E+01	1.70E+04	1.08E+03
Mn-54	0.00E+00	4.29E+04	9.51E+03	0.00E+00	1.00E+04	1.58E+06	2.29E+04
Fe-55	4.74E+04	2.52E+04	7.77E+03	0.00E+00	0.00E+00	1.11E+05	2.87E+03
Mn-56	0.00E+00	1.66E+00	3.12E-01	0.00E+00	1.67E+00	1.31E+04	1.23E+05
Co-57	0.00E+00	9.03E+02	1.07E+03	0.00E+00	0.00E+00	5.07E+05	1.32E+04
Co-58	0.00E+00	1.77E+03	3.16E+03	0.00E+00	0.00E+00	1.11E+06	3.44E+04
Fe-59	2.07E+04	3.34E+04	1.67E+04	0.00E+00	0.00E+00	1.27E+06	7.07E+04
Co-60	0.00E+00	1.31E+04	2.26E+04	0.00E+00	0.00E+00	7.07E+06	9.62E+04
Ni-59	6.14E+04	1.73E+04	1.05E+04	0.00E+00	0.00E+00	1.01E+05	2.33E+03
Ni-63	8.21E+05	4.63E+04	2.80E+04	0.00E+00	0.00E+00	2.75E+05	6.33E+03
Cu-64	0.00E+00	1.99E+00	1.07E+00	0.00E+00	6.03E+00	9.58E+03	3.67E+04
Ni-65	2.99E+00	2.96E-01	1.64E-01	0.00E+00	0.00E+00	8.18E+03	8.40E+04
Zn-65	4.26E+04	1.13E+05	7.03E+04	0.00E+00	7.14E+04	9.95E+05	1.63E+04
Zn-69m	1.58E+01	2.69E+01	3.18E+00	0.00E+00	1.56E+01	2.72E+04	1.00E+05
Zn-69	6.70E-02	9.66E-02	8.92E-03	0.00E+00	5.85E-02	1.42E+03	1.02E+04
Se-79	0.00E+00	4.55E+03	9.62E+02	0.00E+00	6.33E+03	5.51E+05	1.27E+04
Br-82	0.00E+00	0.00E+00	2.09E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	4.74E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	5.48E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	2.53E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.98E+05	1.14E+05	0.00E+00	0.00E+00	0.00E+00	7.99E+03
Rb-87	0.00E+00	1.17E+05	5.07E+04	0.00E+00	0.00E+00	0.00E+00	1.10E+03
Rb-88	0.00E+00	5.62E+02	3.66E+02	0.00E+00	0.00E+00	0.00E+00	1.72E+01
Rb-89	0.00E+00	3.45E+02	2.90E+02	0.00E+00	0.00E+00	0.00E+00	1.89E+00
Sr-89	5.99E+05	0.00E+00	1.72E+04	0.00E+00	0.00E+00	2.16E+06	1.67E+05
Sr-90	6.77E+07	0.00E+00	4.51E+06	0.00E+00	0.00E+00	1.48E+07	3.43E+05
Y-90	4.11E+03	0.00E+00	1.11E+02	0.00E+00	0.00E+00	2.62E+05	2.68E+05
Sr-91	1.21E+02	0.00E+00	4.59E+00	0.00E+00	0.00E+00	5.33E+04	1.74E+05
Y-91m	5.07E-01	0.00E+00	1.84E-02	0.00E+00	0.00E+00	2.81E+03	1.72E+03
Y-91	9.14E+05	0.00E+00	2.44E+04	0.00E+00	0.00E+00	2.63E+06	1.84E+05
Sr-92	1.31E+01	0.00E+00	5.25E-01	0.00E+00	0.00E+00	2.40E+04	2.42E+05
Y-92	2.04E+01	0.00E+00	5.81E-01	0.00E+00	0.00E+00	2.39E+04	2.39E+05
Y-93	1.86E+02	0.00E+00	5.11E+00	0.00E+00	0.00E+00	7.44E+04	3.89E+05
Nb-93m	4.70E+05	1.17E+05	3.85E+04	0.00E+00	1.27E+05	3.85E+05	9.07E+03
Nb-95	2.35E+04	9.18E+03	6.55E+03	0.00E+00	8.62E+03	6.14E+05	3.70E+04
Nb-97	4.29E-01	7.70E-02	3.60E-02	0.00E+00	8.55E-02	3.42E+03	2.78E+04
Zr-93	7.66E+05	2.89E+05	2.05E+05	0.00E+00	1.11E+06	2.63E+06	5.44E+04
Zr-95	1.90E+05	4.18E+04	3.70E+04	0.00E+00	5.96E+04	2.23E+06	6.11E+04
Zr-97	1.88E+02	2.72E+01	1.60E+01	0.00E+00	3.89E+01	1.13E+05	3.51E+05
Mo-93	0.00E+00	1.39E+04	5.00E+02	0.00E+00	3.92E+03	6.29E+05	1.40E+04
Mo-99	0.00E+00	1.72E+02	4.26E+01	0.00E+00	3.92E+02	1.35E+05	1.27E+05
Tc-99	4.96E+02	5.51E+02	1.98E+02	0.00E+00	6.48E+03	1.25E+06	2.87E+04
Tc-99m	1.78E-03	3.48E-03	5.77E-02	0.00E+00	5.07E-02	9.51E+02	4.81E+03
Tc-101	8.10E-05	8.51E-05	1.08E-03	0.00E+00	1.45E-03	5.85E+02	1.63E+01
Ru-103	2.79E+03	0.00E+00	1.07E+03	0.00E+00	7.03E+03	6.62E+05	4.48E+04
Ru-105	1.53E+00	0.00E+00	5.55E-01	0.00E+00	1.34E+00	1.59E+04	9.95E+04
Rh-105	1.45E+01	7.77E+00	6.62E+00	0.00E+00	3.10E+01	2.89E+04	4.92E+04
Ru-106	1.36E+05	0.00E+00	1.69E+04	0.00E+00	1.84E+05	1.43E+07	4.29E+05
Pd-107	0.00E+00	9.81E+02	9.29E+01	0.00E+00	7.29E+03	1.17E+05	2.69E+03

Table 4-15 (Page 2 of 3)
Inhalation Dose Rate Parameters for Child (P_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	5.48E+00	1.83E+00	0.00E+00	2.61E+01	2.28E+04	9.58E+04
Ag-110m	1.69E+04	1.14E+04	9.14E+03	0.00E+00	2.12E+04	5.48E+06	1.00E+05
Ag-111	6.70E+02	2.10E+02	1.39E+02	0.00E+00	6.33E+02	2.86E+05	1.10E+05
Cd-113m	0.00E+00	1.82E+06	7.84E+04	0.00E+00	1.90E+06	2.57E+06	6.03E+04
Cd-115m	0.00E+00	2.92E+05	1.25E+04	0.00E+00	2.19E+05	2.17E+06	1.84E+05
Sn-123	4.77E+05	7.92E+03	1.55E+04	8.40E+03	0.00E+00	3.55E+06	1.50E+05
Sn-125	1.83E+04	3.68E+02	1.09E+03	3.81E+02	0.00E+00	8.99E+05	2.65E+05
Sn-126	2.31E+06	3.85E+04	8.73E+04	1.05E+04	0.00E+00	1.12E+07	6.03E+04
Sb-124	5.74E+04	7.40E+02	2.00E+04	1.26E+02	0.00E+00	3.24E+06	1.64E+05
Sb-125	9.84E+04	7.59E+02	2.07E+04	9.10E+01	0.00E+00	2.32E+06	4.03E+04
Sb-126	6.36E+03	9.69E+01	2.28E+03	3.70E+01	0.00E+00	1.06E+06	2.10E+05
Sb-127	5.03E+02	7.73E+00	1.74E+02	5.59E+00	0.00E+00	2.28E+05	1.41E+05
Te-125m	6.73E+03	2.33E+03	9.14E+02	1.92E+03	0.00E+00	4.77E+05	3.38E+04
Te-127m	2.49E+04	8.55E+03	3.02E+03	6.07E+03	6.36E+04	1.48E+06	7.14E+04
Te-127	2.77E+00	9.51E-01	6.11E-01	1.96E+00	7.07E+00	1.00E+04	5.62E+04
Te-129m	1.92E+04	6.85E+03	3.04E+03	6.33E+03	5.03E+04	1.76E+06	1.82E+05
Te-129	9.77E-02	3.50E-02	2.38E-02	7.14E-02	2.57E-01	2.93E+03	2.55E+04
Te-133m	1.08E-01	5.59E-02	5.55E-02	8.58E-02	3.74E-01	5.92E+03	1.76E+04
Te-134	5.66E-02	3.26E-02	3.48E-02	4.59E-02	2.11E-01	4.55E+03	1.80E+03
I-129	3.89E+04	2.37E+04	2.11E+04	1.58E+07	4.00E+04	0.00E+00	7.96E+02
I-130	8.18E+03	1.64E+04	8.44E+03	1.85E+06	2.45E+04	0.00E+00	5.11E+03
I-131	4.81E+04	4.81E+04	2.73E+04	1.62E+07	7.88E+04	0.00E+00	2.84E+03
Te-131m	1.34E+02	5.92E+01	5.07E+01	9.77E+01	4.00E+02	2.06E+05	3.08E+05
Te-131	2.17E-02	8.44E-03	6.59E-03	1.70E-02	5.88E-02	2.05E+03	1.33E+03
I-132	2.12E+03	4.07E+03	1.88E+03	1.94E+05	6.25E+03	0.00E+00	3.20E+03
Te-132	4.81E+02	2.72E+02	2.63E+02	3.17E+02	1.77E+03	3.77E+05	1.38E+05
I-133	1.66E+04	2.03E+04	7.70E+03	3.85E+06	3.38E+04	0.00E+00	5.48E+03
Cs-134m	2.34E+02	3.30E+02	2.26E+02	0.00E+00	1.83E+02	3.09E+01	2.93E+02
Cs-134	6.51E+05	1.01E+06	2.25E+05	0.00E+00	3.30E+05	1.21E+05	3.85E+03
I-134	1.17E+03	2.16E+03	9.95E+02	5.07E+04	3.30E+03	0.00E+00	9.55E+02
I-135	4.92E+03	8.73E+03	4.14E+03	7.92E+05	1.34E+04	0.00E+00	4.44E+03
Cs-135	2.31E+05	1.53E+05	1.65E+04	0.00E+00	5.66E+04	1.93E+04	8.03E+02
Cs-136	6.51E+04	1.71E+05	1.16E+05	0.00E+00	9.55E+04	1.45E+04	4.18E+03
Cs-137	9.07E+05	8.25E+05	1.28E+05	0.00E+00	2.82E+05	1.04E+05	3.62E+03
Cs-138	6.33E+02	8.40E+02	5.55E+02	0.00E+00	6.22E+02	6.81E+01	2.70E+02
Cs-139	4.03E+02	4.26E+02	2.15E+02	0.00E+00	3.36E+02	3.46E+01	2.68E-02
Ba-139	1.84E+00	9.84E-04	5.37E-02	0.00E+00	8.62E-04	5.77E+03	5.77E+04
Ba-140	7.40E+04	6.48E+01	4.33E+03	0.00E+00	2.11E+01	1.74E+06	1.02E+05
La-140	6.44E+02	2.25E+02	7.55E+01	0.00E+00	0.00E+00	1.83E+05	2.26E+05
Ba-141	1.96E-01	1.09E-04	6.36E-03	0.00E+00	9.47E-05	2.92E+03	2.75E+02
La-141	8.44E+00	1.96E+00	4.26E-01	0.00E+00	0.00E+00	1.66E+04	1.62E+05
Ce-141	3.92E+04	1.95E+04	2.90E+03	0.00E+00	8.55E+03	5.44E+05	5.66E+04
Ba-142	5.00E-02	3.60E-05	2.79E-03	0.00E+00	2.91E-05	1.64E+03	2.74E+00
La-142	1.30E+00	4.11E-01	1.29E-01	0.00E+00	0.00E+00	8.70E+03	7.59E+04
Ce-143	3.66E+02	1.99E+02	2.87E+01	0.00E+00	8.36E+01	1.15E+05	1.27E+05
Pr-143	1.85E+04	5.55E+03	9.14E+02	0.00E+00	3.00E+03	4.33E+05	9.73E+04
Ce-144	6.77E+06	2.12E+06	3.61E+05	0.00E+00	1.17E+06	1.20E+07	3.89E+05
Pr-144	5.96E-02	1.85E-02	3.00E-03	0.00E+00	9.77E-03	1.57E+03	1.97E+02
Nd-147	1.08E+04	8.73E+03	6.81E+02	0.00E+00	4.81E+03	3.28E+05	8.21E+04
Pm-147	1.30E+06	9.32E+04	5.03E+04	0.00E+00	1.65E+05	8.14E+05	2.11E+04
Pm-148m	1.22E+05	2.42E+04	2.42E+04	0.00E+00	3.60E+04	2.12E+06	1.32E+05
Pm-148	5.96E+03	7.18E+02	4.63E+02	0.00E+00	1.22E+03	4.59E+05	2.22E+05
Pm-149	5.44E+02	5.77E+01	3.13E+01	0.00E+00	1.02E+02	8.88E+04	1.08E+05
Pm-151	1.32E+02	1.60E+01	1.04E+01	0.00E+00	2.72E+01	4.59E+04	9.25E+04
Sm-151	1.16E+06	1.76E+05	5.51E+04	0.00E+00	1.81E+05	5.48E+05	1.27E+04
Sm-153	2.68E+02	1.67E+02	1.61E+01	0.00E+00	5.07E+01	5.07E+04	6.92E+04

Table 4-15 (Page 3 of 3)
Inhalation Dose Rate Parameters for Child (P_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	2.75E+06	5.07E+05	5.96E+05	0.00E+00	2.12E+06	3.33E+06	4.22E+04
Eu-154	1.01E+07	9.21E+05	8.40E+05	0.00E+00	4.03E+06	6.14E+06	1.10E+05
Eu-155	2.07E+06	1.50E+05	1.18E+05	0.00E+00	5.59E+05	1.03E+06	1.99E+05
Eu-156	2.92E+04	1.57E+04	3.24E+03	0.00E+00	1.01E+04	9.40E+05	1.57E+05
Tb-160	2.88E+05	0.00E+00	3.58E+04	0.00E+00	8.58E+04	1.98E+06	8.44E+04
Ho-166m	4.96E+06	1.04E+06	8.77E+05	0.00E+00	1.48E+06	4.18E+06	6.03E+04
W-181	9.84E+01	2.41E+01	3.33E+00	0.00E+00	0.00E+00	2.11E+04	9.66E+02
W-185	3.07E+03	7.70E+02	1.08E+02	0.00E+00	0.00E+00	6.88E+05	4.11E+04
W-187	1.63E+01	9.66E+00	4.33E+00	0.00E+00	0.00E+00	4.11E+04	9.10E+04
Np-239	4.66E+02	3.34E+01	2.35E+01	0.00E+00	9.73E+01	5.81E+04	6.40E+04
U-232	8.10E+08	0.00E+00	5.77E+07	0.00E+00	6.18E+07	2.75E+09	1.60E+05
U-233	1.72E+08	0.00E+00	1.04E+07	0.00E+00	2.82E+07	6.55E+08	1.48E+05
U-234	1.65E+08	0.00E+00	1.02E+07	0.00E+00	2.76E+07	6.44E+08	1.45E+05
U-235	1.58E+08	0.00E+00	9.58E+06	0.00E+00	2.59E+07	6.03E+08	1.84E+05
U-236	1.58E+08	0.00E+00	9.81E+06	0.00E+00	2.65E+07	6.18E+08	1.36E+05
U-237	5.81E+02	0.00E+00	1.54E+02	0.00E+00	1.68E+03	1.26E+05	4.77E+04
U-238	1.51E+08	0.00E+00	8.95E+06	0.00E+00	2.42E+07	5.66E+08	1.30E+05
Np-237	1.01E+10	5.99E+09	4.40E+08	0.00E+00	2.74E+09	6.44E+08	1.87E+05
Np-238	4.66E+03	8.51E+02	7.29E+01	0.00E+00	3.02E+02	1.25E+05	9.25E+04
Pu-238	9.44E+09	5.92E+09	4.48E+08	0.00E+00	1.65E+09	2.25E+09	1.72E+05
Pu-239	1.03E+10	6.22E+09	4.74E+08	0.00E+00	1.77E+09	2.12E+09	1.57E+05
Pu-240	1.03E+10	6.22E+09	4.70E+08	0.00E+00	1.76E+09	2.11E+09	1.60E+05
Pu-241	2.94E+08	6.48E+07	1.08E+07	0.00E+00	4.07E+07	1.87E+06	3.29E+03
Pu-242	9.58E+09	5.99E+09	4.55E+08	0.00E+00	1.70E+09	2.04E+09	1.54E+05
Pu-244	1.12E+10	6.85E+09	5.22E+08	0.00E+00	1.95E+09	2.33E+09	2.29E+05
Am-241	1.10E+10	6.81E+09	4.59E+08	0.00E+00	2.82E+09	7.47E+08	1.75E+05
Am-242m	1.14E+10	6.51E+09	4.70E+08	0.00E+00	2.85E+09	3.01E+08	2.21E+05
Am-243	1.09E+10	6.59E+09	4.44E+08	0.00E+00	2.75E+09	7.10E+08	2.05E+05
Cm-242	3.51E+08	2.10E+08	1.55E+07	0.00E+00	4.96E+07	4.85E+08	1.87E+05
Cm-243	8.58E+09	5.25E+09	3.68E+08	0.00E+00	1.38E+09	7.77E+08	1.84E+05
Cm-244	7.18E+09	4.37E+09	3.07E+08	0.00E+00	1.13E+09	7.47E+08	1.78E+05
Cm-245	1.13E+10	6.81E+09	4.74E+08	0.00E+00	1.86E+09	7.22E+08	1.66E+05
Cm-246	1.12E+10	6.81E+09	4.74E+08	0.00E+00	1.86E+09	7.36E+08	1.63E+05
Cm-247	1.09E+10	6.73E+09	4.66E+08	0.00E+00	1.83E+09	7.22E+08	2.15E+05
Cm-248	9.07E+10	5.55E+10	3.85E+09	0.00E+00	1.51E+10	5.96E+09	3.46E+06
Cf-252	8.07E+09	0.00E+00	3.45E+08	0.00E+00	0.00E+00	2.45E+09	6.81E+05

Units of mrem/yr per $\mu Ci/m^3$

Table 4-16 (Page 1 of 3)
Inhalation Dose Rate Parameters for Infant (P_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02
C-14	2.65E+04	5.31E+03	5.31E+03	5.31E+03	5.31E+03	5.31E+03	5.31E+03
Na-22	1.03E+05	1.03E+05	1.03E+05	1.03E+05	1.03E+05	1.03E+05	1.03E+05
Na-24	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04
P-32	2.03E+06	1.12E+05	7.74E+04	0.00E+00	0.00E+00	0.00E+00	1.61E+04
Ca-41	1.05E+05	0.00E+00	1.14E+04	0.00E+00	0.00E+00	9.72E+07	4.14E+02
Sc-46	5.25E+05	7.57E+05	2.37E+05	0.00E+00	4.98E+05	0.00E+00	3.07E+04
Cr-51	0.00E+00	0.00E+00	8.95E+01	5.75E+01	1.32E+01	1.28E+04	3.57E+02
Mn-54	0.00E+00	2.53E+04	4.98E+03	0.00E+00	4.98E+03	1.00E+06	7.06E+03
Fe-55	1.97E+04	1.17E+04	3.33E+03	0.00E+00	0.00E+00	8.69E+04	1.09E+03
Mn-56	0.00E+00	1.54E+00	2.21E-01	0.00E+00	1.10E+00	1.25E+04	7.17E+04
Co-57	0.00E+00	6.51E+02	6.41E+02	0.00E+00	0.00E+00	3.79E+05	4.86E+03
Co-58	0.00E+00	1.22E+03	1.82E+03	0.00E+00	0.00E+00	7.77E+05	1.11E+04
Fe-59	1.36E+04	2.35E+04	9.48E+03	0.00E+00	0.00E+00	1.02E+06	2.48E+04
Co-60	0.00E+00	8.02E+03	1.18E+04	0.00E+00	0.00E+00	4.51E+06	3.19E+04
Ni-59	2.53E+04	7.62E+03	4.34E+03	0.00E+00	0.00E+00	7.67E+04	8.88E+02
Ni-63	3.39E+05	2.04E+04	1.16E+04	0.00E+00	0.00E+00	2.09E+05	2.42E+03
Cu-64	0.00E+00	1.88E+00	7.74E-01	0.00E+00	3.98E+00	9.30E+03	1.50E+04
Ni-65	2.39E+00	2.84E-01	1.23E-01	0.00E+00	0.00E+00	8.12E+03	5.01E+04
Zn-65	1.93E+04	6.26E+04	3.11E+04	0.00E+00	3.25E+04	6.47E+05	5.14E+04
Zn-69m	1.26E+01	2.58E+01	2.34E+00	0.00E+00	1.04E+01	2.67E+04	4.09E+04
Zn-69	5.39E-02	9.67E-02	7.18E-03	0.00E+00	4.02E-02	1.47E+03	1.32E+04
Se-79	0.00E+00	3.15E+03	5.88E+02	0.00E+00	3.46E+03	4.19E+05	4.84E+03
Br-82	0.00E+00	0.00E+00	1.33E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	3.81E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	4.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	2.04E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.90E+05	8.82E+04	0.00E+00	0.00E+00	0.00E+00	3.04E+03
Rb-87	0.00E+00	1.24E+05	4.93E+04	0.00E+00	0.00E+00	0.00E+00	8.37E+02
Rb-88	0.00E+00	5.57E+02	2.87E+02	0.00E+00	0.00E+00	0.00E+00	3.39E+02
Rb-89	0.00E+00	3.21E+02	2.06E+02	0.00E+00	0.00E+00	0.00E+00	6.82E+01
Sr-89	3.98E+05	0.00E+00	1.14E+04	0.00E+00	0.00E+00	2.03E+06	6.40E+04
Sr-90	4.09E+07	0.00E+00	1.83E+06	0.00E+00	0.00E+00	1.12E+07	1.31E+05
Y-90	3.29E+03	0.00E+00	8.82E+01	0.00E+00	0.00E+00	2.69E+05	1.04E+05
Sr-91	9.56E+01	0.00E+00	3.46E+00	0.00E+00	0.00E+00	5.26E+04	7.34E+04
Y-91m	4.07E-01	0.00E+00	1.39E-02	0.00E+00	0.00E+00	2.79E+03	2.35E+03
Y-91	5.88E+05	0.00E+00	1.57E+04	0.00E+00	0.00E+00	2.45E+06	7.03E+04
Sr-92	1.05E+01	0.00E+00	3.91E-01	0.00E+00	0.00E+00	2.38E+04	1.40E+05
Y-92	1.64E+01	0.00E+00	4.61E-01	0.00E+00	0.00E+00	2.45E+04	1.27E+05
Y-93	1.50E+02	0.00E+00	4.07E+00	0.00E+00	0.00E+00	7.64E+04	1.67E+05
Nb-93m	1.93E+05	5.03E+04	1.61E+04	0.00E+00	5.15E+04	2.93E+05	3.46E+03
Nb-95	1.57E+04	6.43E+03	3.78E+03	0.00E+00	4.72E+03	4.79E+05	1.27E+04
Nb-97	3.42E-01	7.29E-02	2.63E-02	0.00E+00	5.70E-02	3.32E+03	2.69E+04
Zr-93	3.14E+05	1.33E+05	8.65E+04	0.00E+00	4.47E+05	1.92E+06	2.07E+04
Zr-95	1.15E+05	2.79E+04	2.03E+04	0.00E+00	3.11E+04	1.75E+06	2.17E+04
Zr-97	1.50E+02	2.56E+01	1.17E+01	0.00E+00	2.59E+01	1.10E+05	1.40E+05
Mo-93	0.00E+00	9.04E+03	3.11E+02	0.00E+00	2.16E+03	4.76E+05	5.26E+03
Mo-99	0.00E+00	1.65E+02	3.23E+01	0.00E+00	2.65E+02	1.35E+05	4.87E+04
Tc-99	2.93E+02	3.75E+02	1.24E+02	0.00E+00	3.49E+03	9.48E+05	1.09E+04
Tc-99m	1.40E-03	2.88E-03	3.72E-02	0.00E+00	3.11E-02	8.11E+02	2.03E+03
Tc-101	6.51E-05	8.23E-05	8.12E-04	0.00E+00	9.79E-04	5.84E+02	8.44E+02
Ru-103	2.02E+03	0.00E+00	6.79E+02	0.00E+00	4.24E+03	5.52E+05	1.61E+04
Ru-105	1.22E+00	0.00E+00	4.10E-01	0.00E+00	8.99E-01	1.57E+04	4.84E+04
Rh-105	1.16E+01	7.57E+00	5.08E+00	0.00E+00	2.10E+01	2.91E+04	1.92E+04
Ru-106	8.68E+04	0.00E+00	1.09E+04	0.00E+00	1.07E+05	1.16E+07	1.64E+05
Pd-107	0.00E+00	6.89E+02	5.75E+01	0.00E+00	3.85E+03	8.88E+04	1.03E+03

Table 4-16 (Page 2 of 3)
Inhalation Dose Rate Parameters for Infant (P_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	5.49E+00	1.47E+00	0.00E+00	1.79E+01	2.35E+04	3.99E+04
Ag-110m	9.98E+03	7.22E+03	5.00E+03	0.00E+00	1.09E+04	3.67E+06	3.30E+04
Ag-111	5.25E+02	2.03E+02	1.09E+02	0.00E+00	4.27E+02	2.88E+05	4.23E+04
Cd-113m	0.00E+00	9.34E+05	3.70E+04	0.00E+00	8.12E+05	1.96E+06	2.31E+04
Cd-115m	0.00E+00	2.42E+05	8.67E+03	0.00E+00	1.32E+05	2.06E+06	7.03E+04
Sn-123	2.93E+05	5.89E+03	1.02E+04	5.98E+03	0.00E+00	3.11E+06	5.71E+04
Sn-125	1.41E+04	3.51E+02	8.40E+02	3.46E+02	0.00E+00	9.00E+05	1.02E+05
Sn-126	1.16E+06	2.02E+04	4.93E+04	5.38E+03	0.00E+00	6.90E+06	2.31E+04
Sb-124	3.79E+04	5.56E+02	1.20E+04	1.01E+02	0.00E+00	2.65E+06	5.91E+04
Sb-125	5.17E+04	4.77E+02	1.09E+04	6.23E+01	0.00E+00	1.64E+06	1.47E+04
Sb-126	4.31E+03	8.41E+01	1.55E+03	3.29E+01	0.00E+00	9.63E+05	7.46E+04
Sb-127	3.95E+02	7.06E+00	1.23E+02	5.04E+00	0.00E+00	2.16E+05	5.29E+04
Te-125m	4.76E+03	1.99E+03	6.58E+02	1.62E+03	0.00E+00	4.47E+05	1.29E+04
Te-127m	1.67E+04	6.90E+03	2.07E+03	4.87E+03	3.75E+04	1.31E+06	2.73E+04
Te-127	2.23E+00	9.53E-01	4.89E-01	1.85E+00	4.86E+00	1.03E+04	2.44E+04
Te-129m	1.41E+04	6.09E+03	2.23E+03	5.47E+03	3.18E+04	1.68E+06	6.90E+04
Te-129	7.88E-02	3.47E-02	1.88E-02	6.75E-02	1.75E-01	3.00E+03	2.63E+04
Te-133m	8.58E-02	5.03E-02	3.84E-02	7.73E-02	2.41E-01	5.49E+03	2.23E+04
Te-134	4.45E-02	2.86E-02	2.35E-02	4.07E-02	1.34E-01	4.10E+03	3.54E+03
I-129	3.02E+04	2.23E+04	1.62E+04	1.46E+07	2.63E+04	0.00E+00	2.97E+02
I-130	6.36E+03	1.39E+04	5.57E+03	1.60E+06	1.53E+04	0.00E+00	1.99E+03
I-131	3.79E+04	4.44E+04	1.96E+04	1.48E+07	5.18E+04	0.00E+00	1.06E+03
Te-131m	1.07E+02	5.50E+01	3.63E+01	8.93E+01	2.65E+02	1.99E+05	1.19E+05
Te-131	1.74E-02	8.22E-03	5.00E-03	1.58E-02	3.99E-02	2.06E+03	8.22E+03
I-132	1.69E+03	3.54E+03	1.26E+03	1.69E+05	3.95E+03	0.00E+00	1.90E+03
Te-132	3.72E+02	2.37E+02	1.76E+02	2.79E+02	1.03E+03	3.40E+05	4.41E+04
I-133	1.32E+04	1.92E+04	5.60E+03	3.56E+06	2.24E+04	0.00E+00	2.16E+03
Cs-134m	1.85E+02	2.94E+02	1.55E+02	0.00E+00	1.19E+02	2.80E+01	1.62E+02
Cs-134	3.96E+05	7.03E+05	7.45E+04	0.00E+00	1.90E+05	7.97E+04	1.33E+03
I-134	9.21E+02	1.88E+03	6.65E+02	4.45E+04	2.09E+03	0.00E+00	1.29E+03
I-135	3.86E+03	7.60E+03	2.77E+03	6.96E+05	8.47E+03	0.00E+00	1.83E+03
Cs-135	1.40E+05	1.21E+05	6.62E+03	0.00E+00	3.61E+04	1.41E+04	3.05E+02
Cs-136	4.83E+04	1.35E+05	5.29E+04	0.00E+00	5.64E+04	1.18E+04	1.43E+03
Cs-137	5.49E+05	6.12E+05	4.55E+04	0.00E+00	1.72E+05	7.13E+04	1.33E+03
Cs-138	5.05E+02	7.81E+02	3.98E+02	0.00E+00	4.10E+02	6.54E+01	8.76E+02
Cs-139	3.25E+02	4.24E+02	1.71E+02	0.00E+00	2.31E+02	3.54E+01	1.86E+01
Ba-139	1.48E+00	9.84E-04	4.30E-02	0.00E+00	5.92E-04	5.95E+03	5.10E+04
Ba-140	5.60E+04	5.60E+01	2.90E+03	0.00E+00	1.34E+01	1.60E+06	3.84E+04
La-140	5.05E+02	2.00E+02	5.15E+01	0.00E+00	0.00E+00	1.68E+05	8.48E+04
Ba-141	1.57E-01	1.08E-04	4.97E-03	0.00E+00	6.50E-05	2.97E+03	4.75E+03
La-141	6.79E+00	1.96E+00	3.43E-01	0.00E+00	0.00E+00	1.71E+04	8.34E+04
Ce-141	2.77E+04	1.67E+04	1.99E+03	0.00E+00	5.25E+03	5.17E+05	2.16E+04
Ba-142	3.98E-02	3.30E-05	1.96E-03	0.00E+00	1.90E-05	1.55E+03	6.93E+02
La-142	1.03E+00	3.77E-01	9.04E-02	0.00E+00	0.00E+00	8.22E+03	5.95E+04
Ce-143	2.93E+02	1.93E+02	2.21E+01	0.00E+00	5.64E+01	1.16E+05	4.97E+04
Pr-143	1.40E+04	5.24E+03	6.99E+02	0.00E+00	1.97E+03	4.33E+05	3.72E+04
Ce-144	3.19E+06	1.21E+06	1.76E+05	0.00E+00	5.38E+05	9.84E+06	1.48E+05
Pr-144	4.79E-02	1.85E-02	2.41E-03	0.00E+00	6.72E-03	1.61E+03	4.28E+03
Nd-147	7.94E+03	8.13E+03	5.00E+02	0.00E+00	3.15E+03	3.22E+05	3.12E+04
Pm-147	5.47E+05	4.30E+04	2.18E+04	0.00E+00	6.90E+04	6.37E+05	8.05E+03
Pm-148m	7.00E+04	1.74E+04	1.39E+04	0.00E+00	2.03E+04	1.71E+06	4.72E+04
Pm-148	4.68E+03	6.75E+02	3.42E+02	0.00E+00	8.06E+02	4.48E+05	8.46E+04
Pm-149	4.34E+02	5.71E+01	2.49E+01	0.00E+00	6.94E+01	9.10E+04	4.21E+04
Pm-151	1.05E+02	1.54E+01	7.77E+00	0.00E+00	1.82E+01	4.55E+04	3.61E+04
Sm-151	4.73E+05	9.03E+04	2.28E+04	0.00E+00	7.34E+04	4.17E+05	4.84E+03
Sm-153	2.14E+02	1.65E+02	1.27E+01	0.00E+00	3.46E+01	5.18E+04	2.70E+04

Table 4-16 (Page 3 of 3)
Inhalation Dose Rate Parameters for Infant (P_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	1.10E+06	2.48E+05	2.41E+05	0.00E+00	8.32E+05	2.07E+06	1.38E+04
Eu-154	4.14E+06	4.84E+05	3.43E+05	0.00E+00	1.60E+06	4.27E+06	3.98E+04
Eu-155	8.36E+05	8.01E+04	4.84E+04	0.00E+00	2.21E+05	7.28E+05	7.27E+04
Eu-156	2.18E+04	1.34E+04	2.16E+03	0.00E+00	6.27E+03	8.57E+05	5.80E+04
Tb-160	1.57E+05	0.00E+00	1.96E+04	0.00E+00	4.48E+04	1.55E+06	3.00E+04
Ho-166m	2.03E+06	4.30E+05	3.51E+05	0.00E+00	5.91E+05	2.87E+06	2.31E+04
W-181	6.80E+01	2.04E+01	2.34E+00	0.00E+00	0.00E+00	1.86E+04	3.68E+02
W-185	2.20E+03	6.76E+02	7.81E+01	0.00E+00	0.00E+00	6.27E+05	1.57E+04
W-187	1.30E+01	9.02E+00	3.12E+00	0.00E+00	0.00E+00	3.96E+04	3.56E+04
Np-239	3.71E+02	3.32E+01	1.88E+01	0.00E+00	6.62E+01	5.95E+04	2.49E+04
U-232	3.60E+08	0.00E+00	2.98E+07	0.00E+00	3.36E+07	2.09E+09	6.10E+04
U-233	7.62E+07	0.00E+00	5.36E+06	0.00E+00	1.53E+07	4.98E+08	5.64E+04
U-234	7.31E+07	0.00E+00	5.25E+06	0.00E+00	1.50E+07	4.89E+08	5.53E+04
U-235	7.01E+07	0.00E+00	4.93E+06	0.00E+00	1.41E+07	4.59E+08	7.03E+04
U-236	7.01E+07	0.00E+00	5.04E+06	0.00E+00	1.44E+07	4.69E+08	5.19E+04
U-237	4.55E+02	0.00E+00	1.21E+02	0.00E+00	1.13E+03	1.28E+05	1.83E+04
U-238	6.71E+07	0.00E+00	4.61E+06	0.00E+00	1.32E+07	4.28E+08	4.96E+04
Np-237	4.03E+09	2.39E+09	1.76E+08	0.00E+00	1.08E+09	4.89E+08	7.14E+04
Np-238	3.74E+03	8.47E+02	5.82E+01	0.00E+00	2.06E+02	1.29E+05	3.61E+04
Pu-238	3.77E+09	2.35E+09	1.78E+08	0.00E+00	6.50E+08	1.26E+09	6.57E+04
Pu-239	4.10E+09	2.46E+09	1.88E+08	0.00E+00	6.93E+08	1.19E+09	5.99E+04
Pu-240	4.10E+09	2.45E+09	1.88E+08	0.00E+00	6.92E+08	1.19E+09	6.10E+04
Pu-241	1.18E+08	2.59E+07	4.35E+06	0.00E+00	1.61E+07	1.07E+06	1.26E+03
Pu-242	3.81E+09	2.37E+09	1.81E+08	0.00E+00	6.68E+08	1.14E+09	5.88E+04
Pu-244	4.44E+09	2.72E+09	2.07E+08	0.00E+00	7.64E+08	1.31E+09	8.76E+04
Am-241	4.41E+09	2.73E+09	1.83E+08	0.00E+00	1.11E+09	5.68E+08	6.69E+04
Am-242m	4.55E+09	2.60E+09	1.89E+08	0.00E+00	1.12E+09	2.30E+08	8.41E+04
Am-243	4.34E+09	2.63E+09	1.78E+08	0.00E+00	1.08E+09	5.39E+08	7.84E+04
Cm-242	1.79E+08	1.21E+08	7.98E+06	0.00E+00	2.37E+07	4.16E+08	7.14E+04
Cm-243	3.46E+09	2.13E+09	1.48E+08	0.00E+00	5.47E+08	5.94E+08	7.03E+04
Cm-244	2.90E+09	1.78E+09	1.24E+08	0.00E+00	4.49E+08	5.71E+08	6.80E+04
Cm-245	4.51E+09	2.74E+09	1.90E+08	0.00E+00	7.32E+08	5.49E+08	6.34E+04
Cm-246	4.48E+09	2.74E+09	1.90E+08	0.00E+00	7.32E+08	5.59E+08	6.23E+04
Cm-247	4.35E+09	2.70E+09	1.86E+08	0.00E+00	7.21E+08	5.49E+08	8.19E+04
Cm-248	3.61E+10	2.23E+10	1.54E+09	0.00E+00	5.94E+09	4.52E+09	1.32E+06
Cf-252	3.32E+09	0.00E+00	1.41E+08	0.00E+00	0.00E+00	1.92E+09	2.59E+05

Units of mrem/yr per $\mu Ci/m^3$

Table 4-17 (Page 1 of 3)
Dose Rate Parameters for Standing on Contaminated Ground (P_i^G)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI	Skin
H-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na-22	3.88E+09	3.88E+09	3.88E+09	3.88E+09	3.88E+09	3.88E+09	3.88E+09	4.37E+09
Na-24	1.71E+07	1.71E+07	1.71E+07	1.71E+07	1.71E+07	1.71E+07	1.71E+07	1.98E+07
P-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ca-41	9.42E+08	9.42E+08	9.42E+08	9.42E+08	9.42E+08	9.42E+08	9.42E+08	1.11E+09
Sc-46	1.13E+09	1.13E+09	1.13E+09	1.13E+09	1.13E+09	1.13E+09	1.13E+09	1.31E+09
Cr-51	6.65E+06	6.65E+06	6.65E+06	6.65E+06	6.65E+06	6.65E+06	6.65E+06	7.86E+06
Mn-54	1.10E+09	1.10E+09	1.10E+09	1.10E+09	1.10E+09	1.10E+09	1.10E+09	1.29E+09
Fe-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mn-56	1.29E+06	1.29E+06	1.29E+06	1.29E+06	1.29E+06	1.29E+06	1.29E+06	1.53E+06
Co-57	1.63E+08	1.63E+08	1.63E+08	1.63E+08	1.63E+08	1.63E+08	1.63E+08	1.80E+08
Co-58	5.26E+08	5.26E+08	5.26E+08	5.26E+08	5.26E+08	5.26E+08	5.26E+08	6.16E+08
Fe-59	3.89E+08	3.89E+08	3.89E+08	3.89E+08	3.89E+08	3.89E+08	3.89E+08	4.57E+08
Co-60	4.40E+09	4.40E+09	4.40E+09	4.40E+09	4.40E+09	4.40E+09	4.40E+09	5.18E+09
Ni-59	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cu-64	8.67E+05	8.67E+05	8.67E+05	8.67E+05	8.67E+05	8.67E+05	8.67E+05	9.82E+05
Ni-65	4.24E+05	4.24E+05	4.24E+05	4.24E+05	4.24E+05	4.24E+05	4.24E+05	4.93E+05
Zn-65	6.88E+08	6.88E+08	6.88E+08	6.88E+08	6.88E+08	6.88E+08	6.88E+08	7.92E+08
Zn-69m	1.81E+06	1.81E+06	1.81E+06	1.81E+06	1.81E+06	1.81E+06	1.81E+06	2.13E+06
Zn-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Se-79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-82	3.05E+07	3.05E+07	3.05E+07	3.05E+07	3.05E+07	3.05E+07	3.05E+07	3.53E+07
Br-83	6.96E+03	6.96E+03	6.96E+03	6.96E+03	6.96E+03	6.96E+03	6.96E+03	1.01E+04
Br-84	2.89E+05	2.89E+05	2.89E+05	2.89E+05	2.89E+05	2.89E+05	2.89E+05	3.38E+05
Br-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	1.28E+07	1.28E+07	1.28E+07	1.28E+07	1.28E+07	1.28E+07	1.28E+07	1.47E+07
Rb-87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-88	4.72E+04	4.72E+04	4.72E+04	4.72E+04	4.72E+04	4.72E+04	4.72E+04	5.40E+04
Rb-89	1.76E+05	1.76E+05	1.76E+05	1.76E+05	1.76E+05	1.76E+05	1.76E+05	2.11E+05
Sr-89	3.07E+04	3.07E+04	3.07E+04	3.07E+04	3.07E+04	3.07E+04	3.07E+04	3.56E+04
Sr-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-90	6.42E+03	6.42E+03	6.42E+03	6.42E+03	6.42E+03	6.42E+03	6.42E+03	7.58E+03
Sr-91	3.07E+06	3.07E+06	3.07E+06	3.07E+06	3.07E+06	3.07E+06	3.07E+06	3.59E+06
Y-91m	1.66E+05	1.66E+05	1.66E+05	1.66E+05	1.66E+05	1.66E+05	1.66E+05	1.43E+05
Y-91	1.51E+06	1.51E+06	1.51E+06	1.51E+06	1.51E+06	1.51E+06	1.51E+06	1.70E+06
Sr-92	1.11E+06	1.11E+06	1.11E+06	1.11E+06	1.11E+06	1.11E+06	1.11E+06	1.23E+06
Y-92	2.58E+05	2.58E+05	2.58E+05	2.58E+05	2.58E+05	2.58E+05	2.58E+05	3.06E+05
Y-93	2.62E+05	2.62E+05	2.62E+05	2.62E+05	2.62E+05	2.62E+05	2.62E+05	3.58E+05
Nb-93m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	2.30E+08	2.30E+08	2.30E+08	2.30E+08	2.30E+08	2.30E+08	2.30E+08	1.95E+08
Nb-97	2.51E+05	2.51E+05	2.51E+05	2.51E+05	2.51E+05	2.51E+05	2.51E+05	2.95E+05
Zr-93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	3.43E+08	3.43E+08	3.43E+08	3.43E+08	3.43E+08	3.43E+08	3.43E+08	3.98E+08
Zr-97	4.23E+06	4.23E+06	4.23E+06	4.23E+06	4.23E+06	4.23E+06	4.23E+06	4.92E+06
Mo-93	6.33E+06	6.33E+06	6.33E+06	6.33E+06	6.33E+06	6.33E+06	6.33E+06	2.57E+08
Mo-99	6.61E+06	6.61E+06	6.61E+06	6.61E+06	6.61E+06	6.61E+06	6.61E+06	5.71E+06
Tc-99	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tc-99m	2.63E+05	2.63E+05	2.63E+05	2.63E+05	2.63E+05	2.63E+05	2.63E+05	3.01E+05
Tc-101	2.91E+04	2.91E+04	2.91E+04	2.91E+04	2.91E+04	2.91E+04	2.91E+04	3.23E+04
Ru-103	1.80E+08	1.80E+08	1.80E+08	1.80E+08	1.80E+08	1.80E+08	1.80E+08	1.54E+08
Ru-105	9.09E+05	9.09E+05	9.09E+05	9.09E+05	9.09E+05	9.09E+05	9.09E+05	1.03E+06
Rh-105	1.06E+06	1.06E+06	1.06E+06	1.06E+06	1.06E+06	1.06E+06	1.06E+06	1.24E+06
Ru-106	3.60E+08	3.60E+08	3.60E+08	3.60E+08	3.60E+08	3.60E+08	3.60E+08	3.00E+08
Pd-107	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 4-17 (Page 2 of 3)
Dose Rate Parameters for Standing on Contaminated Ground (P_i^G)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI	Skin
Pd-109	2.14E+04	2.14E+04	2.14E+04	2.14E+04	2.14E+04	2.14E+04	2.14E+04	2.45E+04
Ag-110m	3.13E+09	3.13E+09	3.13E+09	3.13E+09	3.13E+09	3.13E+09	3.13E+09	3.65E+09
Ag-111	1.47E+06	1.47E+06	1.47E+06	1.47E+06	1.47E+06	1.47E+06	1.47E+06	1.71E+06
Cd-113m	6.20E+05	6.20E+05	6.20E+05	6.20E+05	6.20E+05	6.20E+05	6.20E+05	7.00E+05
Cd-115m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-123	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.83E+09
Sn-125	6.00E+06	6.00E+06	6.00E+06	6.00E+06	6.00E+06	6.00E+06	6.00E+06	6.95E+06
Sn-126	2.49E+09	2.49E+09	2.49E+09	2.49E+09	2.49E+09	2.49E+09	2.49E+09	2.76E+09
Sb-124	8.42E+08	8.42E+08	8.42E+08	8.42E+08	8.42E+08	8.42E+08	8.42E+08	9.71E+08
Sb-125	7.58E+08	7.58E+08	7.58E+08	7.58E+08	7.58E+08	7.58E+08	7.58E+08	8.55E+08
Sb-126	1.21E+08	1.21E+08	1.21E+08	1.21E+08	1.21E+08	1.21E+08	1.21E+08	1.35E+08
Sb-127	2.40E+07	2.40E+07	2.40E+07	2.40E+07	2.40E+07	2.40E+07	2.40E+07	2.77E+07
Te-125m	2.19E+06	2.19E+06	2.19E+06	2.19E+06	2.19E+06	2.19E+06	2.19E+06	3.00E+06
Te-127m	1.18E+05	1.18E+05	1.18E+05	1.18E+05	1.18E+05	1.18E+05	1.18E+05	1.40E+05
Te-127	4.25E+03	4.25E+03	4.25E+03	4.25E+03	4.25E+03	4.25E+03	4.25E+03	4.68E+03
Te-129m	2.82E+07	2.82E+07	2.82E+07	2.82E+07	2.82E+07	2.82E+07	2.82E+07	3.30E+07
Te-129	3.75E+04	3.75E+04	3.75E+04	3.75E+04	3.75E+04	3.75E+04	3.75E+04	4.43E+04
Te-133m	6.30E+05	6.30E+05	6.30E+05	6.30E+05	6.30E+05	6.30E+05	6.30E+05	7.14E+05
Te-134	3.17E+04	3.17E+04	3.17E+04	3.17E+04	3.17E+04	3.17E+04	3.17E+04	3.80E+04
I-129	1.24E+08	1.24E+08	1.24E+08	1.24E+08	1.24E+08	1.24E+08	1.24E+08	2.07E+08
I-130	7.87E+06	7.87E+06	7.87E+06	7.87E+06	7.87E+06	7.87E+06	7.87E+06	9.56E+06
I-131	2.46E+07	2.46E+07	2.46E+07	2.46E+07	2.46E+07	2.46E+07	2.46E+07	2.98E+07
Te-131m	1.15E+07	1.15E+07	1.15E+07	1.15E+07	1.15E+07	1.15E+07	1.15E+07	1.35E+07
Te-131	4.17E+04	4.17E+04	4.17E+04	4.17E+04	4.17E+04	4.17E+04	4.17E+04	4.93E+07
I-132	2.09E+06	2.09E+06	2.09E+06	2.09E+06	2.09E+06	2.09E+06	2.09E+06	1.78E+06
Te-132	6.05E+06	6.05E+06	6.05E+06	6.05E+06	6.05E+06	6.05E+06	6.05E+06	7.12E+06
I-133	3.50E+06	3.50E+06	3.50E+06	3.50E+06	3.50E+06	3.50E+06	3.50E+06	4.26E+06
Cs-134m	8.18E+04	8.18E+04	8.18E+04	8.18E+04	8.18E+04	8.18E+04	8.18E+04	9.63E+04
Cs-134	2.82E+09	2.82E+09	2.82E+09	2.82E+09	2.82E+09	2.82E+09	2.82E+09	3.28E+09
I-134	6.38E+05	6.38E+05	6.38E+05	6.38E+05	6.38E+05	6.38E+05	6.38E+05	7.58E+05
I-135	4.21E+06	4.21E+06	4.21E+06	4.21E+06	4.21E+06	4.21E+06	4.21E+06	3.61E+06
Cs-135	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-136	2.16E+08	2.16E+08	2.16E+08	2.16E+08	2.16E+08	2.16E+08	2.16E+08	2.44E+08
Cs-137	1.15E+09	1.15E+09	1.15E+09	1.15E+09	1.15E+09	1.15E+09	1.15E+09	1.34E+09
Cs-138	5.13E+05	5.13E+05	5.13E+05	5.13E+05	5.13E+05	5.13E+05	5.13E+05	5.86E+05
Cs-139	4.49E+04	4.49E+04	4.49E+04	4.49E+04	4.49E+04	4.49E+04	4.49E+04	5.13E+04
Ba-139	1.51E+05	1.51E+05	1.51E+05	1.51E+05	1.51E+05	1.51E+05	1.51E+05	1.70E+05
Ba-140	2.93E+07	2.93E+07	2.93E+07	2.93E+07	2.93E+07	2.93E+07	2.93E+07	3.35E+07
La-140	3.11E+07	3.11E+07	3.11E+07	3.11E+07	3.11E+07	3.11E+07	3.11E+07	2.74E+07
Ba-141	5.96E+04	5.96E+04	5.96E+04	5.96E+04	5.96E+04	5.96E+04	5.96E+04	6.79E+04
La-141	4.48E+04	4.48E+04	4.48E+04	4.48E+04	4.48E+04	4.48E+04	4.48E+04	5.02E+04
Ce-141	1.95E+07	1.95E+07	1.95E+07	1.95E+07	1.95E+07	1.95E+07	1.95E+07	2.20E+07
Ba-142	6.41E+04	6.41E+04	6.41E+04	6.41E+04	6.41E+04	6.41E+04	6.41E+04	7.30E+04
La-142	1.09E+06	1.09E+06	1.09E+06	1.09E+06	1.09E+06	1.09E+06	1.09E+06	1.30E+06
Ce-143	3.30E+06	3.30E+06	3.30E+06	3.30E+06	3.30E+06	3.30E+06	3.30E+06	3.75E+06
Pr-143	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ce-144	5.85E+07	5.85E+07	5.85E+07	5.85E+07	5.85E+07	5.85E+07	5.85E+07	6.77E+07
Pr-144	2.62E+03	2.62E+03	2.62E+03	2.62E+03	2.62E+03	2.62E+03	2.62E+03	3.01E+03
Nd-147	1.44E+07	1.44E+07	1.44E+07	1.44E+07	1.44E+07	1.44E+07	1.44E+07	1.20E+07
Pm-147	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pm-148m	6.34E+08	6.34E+08	6.34E+08	6.34E+08	6.34E+08	6.34E+08	6.34E+08	3.67E+09
Pm-148	2.70E+07	2.70E+07	2.70E+07	2.70E+07	2.70E+07	2.70E+07	2.70E+07	3.11E+07
Pm-149	6.04E+04	6.04E+04	6.04E+04	6.04E+04	6.04E+04	6.04E+04	6.04E+04	7.00E+04
Pm-151	2.84E+06	2.84E+06	2.84E+06	2.84E+06	2.84E+06	2.84E+06	2.84E+06	2.97E+06
Sm-151	1.32E+07	1.32E+07	1.32E+07	1.32E+07	1.32E+07	1.32E+07	1.32E+07	5.78E+07
Sm-153	5.74E+05	5.74E+05	5.74E+05	5.74E+05	5.74E+05	5.74E+05	5.74E+05	6.37E+05

Table 4-17 (Page 3 of 3)
Dose Rate Parameters for Standing on Contaminated Ground (P_i^G)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI	Skin
Eu-152	1.99E+09	1.99E+09	1.99E+09	1.99E+09	1.99E+09	1.99E+09	1.99E+09	2.30E+09
Eu-154	2.07E+09	2.07E+09	2.07E+09	2.07E+09	2.07E+09	2.07E+09	2.07E+09	2.39E+09
Eu-155	9.82E+07	9.82E+07	9.82E+07	9.82E+07	9.82E+07	9.82E+07	9.82E+07	1.12E+08
Eu-156	1.26E+08	1.26E+08	1.26E+08	1.26E+08	1.26E+08	1.26E+08	1.26E+08	1.44E+08
Tb-160	4.29E+08	4.29E+08	4.29E+08	4.29E+08	4.29E+08	4.29E+08	4.29E+08	7.66E+08
Ho-166m	2.46E+09	2.46E+09	2.46E+09	2.46E+09	2.46E+09	2.46E+09	2.46E+09	2.76E+09
W-181	2.43E+05	2.43E+05	2.43E+05	2.43E+05	2.43E+05	2.43E+05	2.43E+05	2.66E+05
W-185	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W-187	3.36E+06	3.36E+06	3.36E+06	3.36E+06	3.36E+06	3.36E+06	3.36E+06	3.90E+06
Np-239	2.44E+06	2.44E+06	2.44E+06	2.44E+06	2.44E+06	2.44E+06	2.44E+06	2.83E+06
U-232	7.12E+05	7.12E+05	7.12E+05	7.12E+05	7.12E+05	7.12E+05	7.12E+05	7.40E+06
U-233	6.35E+08	6.35E+08	6.35E+08	6.35E+08	6.35E+08	6.35E+08	6.35E+08	7.74E+08
U-234	1.75E+05	1.75E+05	1.75E+05	1.75E+05	1.75E+05	1.75E+05	1.75E+05	4.39E+07
U-235	8.84E+08	8.84E+08	8.84E+08	8.84E+08	8.84E+08	8.84E+08	8.84E+08	1.11E+09
U-236	5.80E+03	5.80E+03	5.80E+03	5.80E+03	5.80E+03	5.80E+03	5.80E+03	4.97E+06
U-237	7.37E+06	7.37E+06	7.37E+06	7.37E+06	7.37E+06	7.37E+06	7.37E+06	9.58E+06
U-238	3.04E+07	3.04E+07	3.04E+07	3.04E+07	3.04E+07	3.04E+07	3.04E+07	4.14E+07
Np-237	3.87E+08	3.87E+08	3.87E+08	3.87E+08	3.87E+08	3.87E+08	3.87E+08	4.42E+08
Np-238	6.47E+06	6.47E+06	6.47E+06	6.47E+06	6.47E+06	6.47E+06	6.47E+06	7.40E+06
Pu-238	4.95E+06	4.95E+06	4.95E+06	4.95E+06	4.95E+06	4.95E+06	4.95E+06	3.58E+05
Pu-239	2.13E+06	2.13E+06	2.13E+06	2.13E+06	2.13E+06	2.13E+06	2.13E+06	2.18E+05
Pu-240	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	4.97E+06	3.59E+05
Pu-241	1.83E+06	1.83E+06	1.83E+06	1.83E+06	1.83E+06	1.83E+06	1.83E+06	1.24E+06
Pu-242	3.04E+05	3.04E+05	3.04E+05	3.04E+05	3.04E+05	3.04E+05	3.04E+05	4.42E+06
Pu-244	2.47E+08	2.47E+08	2.47E+08	2.47E+08	2.47E+08	2.47E+08	2.47E+08	2.66E+08
Am-241	4.97E+07	4.97E+07	4.97E+07	4.97E+07	4.97E+07	4.97E+07	4.97E+07	7.18E+07
Am-242m	7.17E+06	7.17E+06	7.17E+06	7.17E+06	7.17E+06	7.17E+06	7.17E+06	4.96E+07
Am-243	3.59E+08	3.59E+08	3.59E+08	3.59E+08	3.59E+08	3.59E+08	3.59E+08	4.14E+08
Cm-242	7.72E+05	7.72E+05	7.72E+05	7.72E+05	7.72E+05	7.72E+05	7.72E+05	3.23E+06
Cm-243	6.28E+08	6.28E+08	6.28E+08	6.28E+08	6.28E+08	6.28E+08	6.28E+08	7.91E+08
Cm-244	7.86E+05	7.86E+05	7.86E+05	7.86E+05	7.86E+05	7.86E+05	7.86E+05	4.88E+06
Cm-245	2.62E+08	2.62E+08	2.62E+08	2.62E+08	2.62E+08	2.62E+08	2.62E+08	3.31E+08
Cm-246	2.76E+05	2.76E+05	2.76E+05	2.76E+05	2.76E+05	2.76E+05	2.76E+05	4.14E+06
Cm-247	6.08E+08	6.08E+08	6.08E+08	6.08E+08	6.08E+08	6.08E+08	6.08E+08	7.18E+08
Cm-248	1.88E+09	1.88E+09	1.88E+09	1.88E+09	1.88E+09	1.88E+09	1.88E+09	1.44E+09
Cf-252	1.60E+10	1.60E+10	1.60E+10	1.60E+10	1.60E+10	1.60E+10	1.60E+10	1.75E+10

Units of m^2mrem/yr per µCi/sec
Used for all age groups

Table 4-18 (Page 1 of 3)
Food Dose Rate Parameters for Adult (P_i^F)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	4.35E+02	4.35E+02	4.35E+02	4.35E+02	4.35E+02	4.35E+02
C-14	3.63E+05	7.26E+04	7.26E+04	7.26E+04	7.26E+04	7.26E+04	7.26E+04
Na-22	5.29E+09	5.29E+09	5.29E+09	5.29E+09	5.29E+09	5.29E+09	5.29E+09
Na-24	2.44E+06	2.44E+06	2.44E+06	2.44E+06	2.44E+06	2.44E+06	2.44E+06
P-32	1.71E+10	1.06E+09	6.61E+08	0.00E+00	0.00E+00	0.00E+00	1.92E+09
Ca-41	1.14E+10	0.00E+00	1.24E+09	0.00E+00	0.00E+00	0.00E+00	1.14E+07
Sc-46	1.79E+02	3.49E+02	1.01E+02	0.00E+00	3.25E+02	0.00E+00	1.70E+06
Cr-51	0.00E+00	0.00E+00	2.86E+04	1.71E+04	6.30E+03	3.79E+04	7.19E+06
Mn-54	0.00E+00	8.41E+06	1.61E+06	0.00E+00	2.50E+06	0.00E+00	2.58E+07
Fe-55	2.51E+07	1.74E+07	4.05E+06	0.00E+00	0.00E+00	9.68E+06	9.95E+06
Mn-56	0.00E+00	4.21E-03	7.47E-04	0.00E+00	5.35E-03	0.00E+00	1.34E-01
Co-57	0.00E+00	1.28E+06	2.13E+06	0.00E+00	0.00E+00	0.00E+00	3.25E+07
Co-58	0.00E+00	4.71E+06	1.06E+07	0.00E+00	0.00E+00	0.00E+00	9.55E+07
Fe-59	2.97E+07	6.98E+07	2.68E+07	0.00E+00	0.00E+00	1.95E+07	2.33E+08
Co-60	0.00E+00	1.64E+07	3.62E+07	0.00E+00	0.00E+00	0.00E+00	3.08E+08
Ni-59	5.05E+08	1.73E+08	8.44E+07	0.00E+00	0.00E+00	0.00E+00	3.57E+07
Ni-63	6.73E+09	4.66E+08	2.26E+08	0.00E+00	0.00E+00	0.00E+00	9.73E+07
Cu-64	0.00E+00	2.39E+04	1.12E+04	0.00E+00	6.03E+04	0.00E+00	2.04E+06
Ni-65	3.76E-01	4.88E-02	2.23E-02	0.00E+00	0.00E+00	0.00E+00	1.24E+00
Zn-65	1.37E+09	4.37E+09	1.97E+09	0.00E+00	2.92E+09	0.00E+00	2.75E+09
Zn-69m	1.79E+05	4.31E+05	3.94E+04	0.00E+00	2.61E+05	0.00E+00	2.63E+07
Zn-69	2.18E-12	4.17E-12	2.90E-13	0.00E+00	2.71E-12	0.00E+00	6.26E-13
Se-79	0.00E+00	9.15E+08	1.53E+08	0.00E+00	1.58E+09	0.00E+00	1.87E+08
Br-82	0.00E+00	0.00E+00	3.24E+07	0.00E+00	0.00E+00	0.00E+00	3.71E+07
Br-83	0.00E+00	0.00E+00	9.87E-02	0.00E+00	0.00E+00	0.00E+00	1.42E-01
Br-84	0.00E+00	0.00E+00	1.73E-23	0.00E+00	0.00E+00	0.00E+00	1.36E-28
Br-85	0.00E+00	0.00E+00	4.37E-301	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	2.59E+09	1.21E+09	0.00E+00	0.00E+00	0.00E+00	5.12E+08
Rb-87	0.00E+00	2.85E+09	9.92E+08	0.00E+00	0.00E+00	0.00E+00	1.34E+08
Rb-88	0.00E+00	2.44E-45	1.29E-45	0.00E+00	0.00E+00	0.00E+00	3.36E-56
Rb-89	0.00E+00	5.03E-53	3.54E-53	0.00E+00	0.00E+00	0.00E+00	2.92E-66
Sr-89	1.45E+09	0.00E+00	4.16E+07	0.00E+00	0.00E+00	0.00E+00	2.33E+08
Sr-90	5.38E+10	0.00E+00	1.08E+09	0.00E+00	0.00E+00	0.00E+00	1.35E+09
Y-90	7.09E+01	0.00E+00	1.90E+00	0.00E+00	0.00E+00	0.00E+00	7.52E+05
Sr-91	2.90E+04	0.00E+00	1.17E+03	0.00E+00	0.00E+00	0.00E+00	1.38E+05
Y-91m	6.27E-20	0.00E+00	2.43E-21	0.00E+00	0.00E+00	0.00E+00	1.84E-19
Y-91	8.59E+03	0.00E+00	2.30E+02	0.00E+00	0.00E+00	0.00E+00	4.73E+06
Sr-92	4.95E-01	0.00E+00	2.14E-02	0.00E+00	0.00E+00	0.00E+00	9.81E+00
Y-92	5.64E-05	0.00E+00	1.65E-06	0.00E+00	0.00E+00	0.00E+00	9.88E-01
Y-93	2.24E-01	0.00E+00	6.19E-03	0.00E+00	0.00E+00	0.00E+00	7.11E+03
Nb-93m	4.91E+05	1.60E+05	3.95E+04	0.00E+00	1.84E+05	0.00E+00	7.40E+07
Nb-95	8.26E+04	4.59E+04	2.47E+04	0.00E+00	4.54E+04	0.00E+00	2.79E+08
Nb-97	3.40E-12	8.59E-13	3.14E-13	0.00E+00	1.00E-12	0.00E+00	3.17E-09
Zr-93	1.62E+03	9.04E+01	4.21E+01	0.00E+00	3.43E+02	0.00E+00	9.39E+04
Zr-95	9.43E+02	3.03E+02	2.05E+02	0.00E+00	4.75E+02	0.00E+00	9.59E+05
Zr-97	4.34E-01	8.76E-02	4.01E-02	0.00E+00	1.32E-01	0.00E+00	2.71E+04
Mo-93	0.00E+00	4.35E+08	1.18E+07	0.00E+00	1.23E+08	0.00E+00	7.07E+07
Mo-99	0.00E+00	2.48E+07	4.72E+06	0.00E+00	5.61E+07	0.00E+00	5.74E+07
Tc-99	2.42E+07	3.59E+07	9.70E+06	0.00E+00	4.52E+08	3.05E+06	1.17E+09
Tc-99m	3.34E+00	9.44E+00	1.20E+02	0.00E+00	1.43E+02	4.63E+00	5.59E+03
Tc-101	3.05E-60	4.40E-60	4.31E-59	0.00E+00	7.91E-59	2.25E-60	1.32E-71
Ru-103	1.02E+03	0.00E+00	4.39E+02	0.00E+00	3.89E+03	0.00E+00	1.19E+05
Ru-105	8.64E-04	0.00E+00	3.41E-04	0.00E+00	1.12E-02	0.00E+00	5.29E-01
Rh-105	3.47E+05	2.54E+05	1.67E+05	0.00E+00	1.08E+06	0.00E+00	4.05E+07
Ru-106	2.04E+04	0.00E+00	2.58E+03	0.00E+00	3.94E+04	0.00E+00	1.32E+06
Pd-107	0.00E+00	1.14E+07	7.27E+05	0.00E+00	1.02E+08	0.00E+00	7.04E+07

Table 4-18 (Page 2 of 3)
Food Dose Rate Parameters for Adult (P_i^F)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	4.44E+04	1.00E+04	0.00E+00	2.53E+05	0.00E+00	4.92E+06
Ag-110m	5.82E+07	5.39E+07	3.20E+07	0.00E+00	1.06E+08	0.00E+00	2.20E+10
Ag-111	6.48E+06	2.71E+06	1.35E+06	0.00E+00	8.75E+06	0.00E+00	4.98E+09
Cd-113m	0.00E+00	2.94E+06	9.43E+04	0.00E+00	3.24E+06	0.00E+00	2.37E+07
Cd-115m	0.00E+00	1.26E+06	4.02E+04	0.00E+00	9.99E+05	0.00E+00	5.30E+07
Sn-123	5.36E+08	8.88E+06	1.31E+07	7.55E+06	0.00E+00	0.00E+00	1.09E+09
Sn-125	5.68E+07	1.15E+06	2.58E+06	9.48E+05	0.00E+00	0.00E+00	7.10E+08
Sn-126	1.63E+09	3.23E+07	4.64E+07	9.51E+06	0.00E+00	0.00E+00	4.70E+08
Sb-124	2.57E+07	4.86E+05	1.02E+07	6.24E+04	0.00E+00	2.00E+07	7.31E+08
Sb-125	2.04E+07	2.28E+05	4.86E+06	2.08E+04	0.00E+00	1.58E+07	2.25E+08
Sb-126	5.60E+06	1.14E+05	2.02E+06	3.43E+04	0.00E+00	3.43E+06	4.58E+08
Sb-127	4.50E+05	9.86E+03	1.73E+05	5.41E+03	0.00E+00	2.67E+05	1.03E+08
Te-125m	1.63E+07	5.90E+06	2.18E+06	4.90E+06	6.63E+07	0.00E+00	6.50E+07
Te-127m	4.58E+07	1.64E+07	5.58E+06	1.17E+07	1.86E+08	0.00E+00	1.54E+08
Te-127	6.56E+02	2.35E+02	1.42E+02	4.86E+02	2.67E+03	0.00E+00	5.17E+04
Te-129m	6.02E+07	2.25E+07	9.53E+06	2.07E+07	2.51E+08	0.00E+00	3.03E+08
Te-129	2.92E-10	1.10E-10	7.11E-11	2.24E-10	1.23E-09	0.00E+00	2.20E-10
Te-133m	2.19E-13	1.28E-13	1.24E-13	1.86E-13	1.27E-12	0.00E+00	4.40E-14
Te-134	9.41E-19	6.16E-19	3.78E-19	8.22E-19	5.95E-18	0.00E+00	1.04E-21
I-129	7.58E+08	6.52E+08	2.14E+09	1.68E+12	1.40E+09	0.00E+00	1.03E+08
I-130	4.21E+05	1.24E+06	4.90E+05	1.05E+08	1.94E+06	0.00E+00	1.07E+06
I-131	2.96E+08	4.24E+08	2.43E+08	1.39E+11	7.26E+08	0.00E+00	1.12E+08
Te-131m	3.62E+05	1.77E+05	1.47E+05	2.80E+05	1.79E+06	0.00E+00	1.76E+07
Te-131	3.95E-33	1.65E-33	1.25E-33	3.25E-33	1.73E-32	0.00E+00	5.60E-34
I-132	1.67E-01	4.47E-01	1.56E-01	1.56E+01	7.12E-01	0.00E+00	8.39E-02
Te-132	2.40E+06	1.55E+06	1.46E+06	1.72E+06	1.50E+07	0.00E+00	7.35E+07
I-133	3.88E+06	6.74E+06	2.06E+06	9.91E+08	1.18E+07	0.00E+00	6.06E+06
Cs-134m	1.76E-01	3.70E-01	1.89E-01	0.00E+00	2.01E-01	3.16E-02	1.31E-01
Cs-134	5.65E+09	1.35E+10	1.10E+10	0.00E+00	4.35E+09	1.45E+09	2.35E+08
I-134	2.11E-12	5.72E-12	2.05E-12	9.92E-11	9.10E-12	0.00E+00	4.99E-15
I-135	1.29E+04	3.38E+04	1.25E+04	2.23E+06	5.42E+04	0.00E+00	3.82E+04
Cs-135	1.81E+09	1.67E+09	7.41E+08	0.00E+00	6.32E+08	1.89E+08	3.90E+07
Cs-136	2.63E+08	1.04E+09	7.48E+08	0.00E+00	5.78E+08	7.93E+07	1.18E+08
Cs-137	7.38E+09	1.01E+10	6.61E+09	0.00E+00	3.43E+09	1.14E+09	1.95E+08
Cs-138	9.72E-24	1.92E-23	9.50E-24	0.00E+00	1.41E-23	1.39E-24	8.18E-29
Cs-139	8.67E-90	1.29E-89	4.70E-90	0.00E+00	1.03E-89	9.41E-91	2.80E-112
Ba-139	4.54E-08	3.24E-11	1.33E-09	0.00E+00	3.03E-11	1.84E-11	8.06E-08
Ba-140	2.69E+07	3.38E+04	1.76E+06	0.00E+00	1.15E+04	1.93E+04	5.54E+07
La-140	4.52E+00	2.28E+00	6.02E-01	0.00E+00	0.00E+00	0.00E+00	1.67E+05
Ba-141	4.65E-46	3.51E-49	1.57E-47	0.00E+00	3.26E-49	1.99E-49	2.19E-55
La-141	3.07E-05	9.54E-06	1.56E-06	0.00E+00	0.00E+00	0.00E+00	1.14E+00
Ce-141	4.84E+03	3.28E+03	3.72E+02	0.00E+00	1.52E+03	0.00E+00	1.25E+07
Ba-142	3.30E-80	3.39E-83	2.07E-81	0.00E+00	2.86E-83	1.92E-83	4.65E-98
La-142	1.90E-11	8.66E-12	2.16E-12	0.00E+00	0.00E+00	0.00E+00	6.32E-08
Ce-143	4.16E+01	3.08E+04	3.40E+00	0.00E+00	1.35E+01	0.00E+00	1.15E+06
Pr-143	1.58E+02	6.33E+01	7.83E+00	0.00E+00	3.66E+01	0.00E+00	6.92E+05
Ce-144	3.58E+05	1.50E+05	1.92E+04	0.00E+00	8.87E+04	0.00E+00	1.21E+08
Pr-144	6.71E-54	2.79E-54	3.41E-55	0.00E+00	1.57E-54	0.00E+00	9.65E-61
Nd-147	9.42E+01	1.09E+02	6.51E+00	0.00E+00	6.36E+01	0.00E+00	5.22E+05
Pm-147	2.87E+03	2.70E+02	1.09E+02	0.00E+00	5.10E+02	0.00E+00	3.40E+05
Pm-148m	8.57E+02	2.22E+02	1.70E+02	0.00E+00	3.35E+02	0.00E+00	1.88E+06
Pm-148	5.93E+01	9.85E+00	4.96E+00	0.00E+00	1.86E+01	0.00E+00	7.74E+05
Pm-149	4.28E+00	6.06E-01	2.47E-01	0.00E+00	1.14E+00	0.00E+00	1.14E+05
Pm-151	6.50E-01	1.09E-01	5.52E-02	0.00E+00	1.95E-01	0.00E+00	3.01E+04
Sm-151	2.67E+03	4.60E+02	1.10E+02	0.00E+00	5.14E+02	0.00E+00	2.03E+05
Sm-153	1.98E+00	1.65E+00	1.21E-01	0.00E+00	5.34E-01	0.00E+00	5.90E+04

Table 4-18 (Page 3 of 3)
Food Dose Rate Parameters for Adult (P_i^F)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	7.51E+03	1.71E+03	1.50E+03	0.00E+00	1.06E+04	0.00E+00	9.86E+05
Eu-154	2.37E+04	2.91E+03	2.07E+03	0.00E+00	1.39E+04	0.00E+00	2.11E+06
Eu-155	3.30E+03	4.67E+02	3.02E+02	0.00E+00	2.16E+03	0.00E+00	3.68E+05
Eu-156	2.51E+02	1.95E+02	3.14E+01	0.00E+00	1.30E+02	0.00E+00	1.33E+06
Tb-160	1.49E+03	0.00E+00	1.86E+02	0.00E+00	6.16E+02	0.00E+00	1.38E+06
Ho-166m	1.04E+04	3.26E+03	2.47E+03	0.00E+00	4.87E+03	0.00E+00	9.89E+05
W-181	3.39E+04	1.11E+04	1.18E+03	0.00E+00	0.00E+00	0.00E+00	1.26E+06
W-185	1.30E+06	4.32E+05	4.54E+04	0.00E+00	0.00E+00	0.00E+00	4.99E+07
W-187	6.52E+03	5.45E+03	1.91E+03	0.00E+00	0.00E+00	0.00E+00	1.79E+06
Np-239	3.68E+00	3.61E-01	1.99E-01	0.00E+00	1.13E+00	0.00E+00	7.41E+04
U-232	1.60E+10	0.00E+00	1.14E+09	0.00E+00	1.73E+09	0.00E+00	2.62E+08
U-233	3.37E+09	0.00E+00	2.04E+08	0.00E+00	7.84E+08	0.00E+00	2.42E+08
U-234	3.23E+09	0.00E+00	2.00E+08	0.00E+00	7.69E+08	0.00E+00	2.37E+08
U-235	3.10E+09	0.00E+00	1.88E+08	0.00E+00	7.23E+08	0.00E+00	3.02E+08
U-236	3.10E+09	0.00E+00	1.92E+08	0.00E+00	7.38E+08	0.00E+00	2.23E+08
U-237	5.65E+04	0.00E+00	1.50E+04	0.00E+00	2.32E+05	0.00E+00	1.99E+07
U-238	2.96E+09	0.00E+00	1.75E+08	0.00E+00	6.76E+08	0.00E+00	2.13E+08
Np-237	4.87E+07	3.46E+06	2.14E+06	0.00E+00	1.59E+07	0.00E+00	3.07E+06
Np-238	3.61E+01	9.73E-01	5.62E-01	0.00E+00	3.30E+00	0.00E+00	9.04E+04
Pu-238	9.73E+06	1.23E+06	2.64E+05	0.00E+00	1.13E+06	0.00E+00	1.13E+06
Pu-239	1.12E+07	1.35E+06	2.95E+05	0.00E+00	1.25E+06	0.00E+00	1.03E+06
Pu-240	1.12E+07	1.34E+06	2.95E+05	0.00E+00	1.25E+06	0.00E+00	1.05E+06
Pu-241	2.42E+05	1.15E+04	5.12E+03	0.00E+00	2.36E+04	0.00E+00	2.16E+04
Pu-242	1.04E+07	1.30E+06	2.84E+05	0.00E+00	1.21E+06	0.00E+00	1.01E+06
Pu-244	1.21E+07	1.49E+06	3.26E+05	0.00E+00	1.38E+06	0.00E+00	1.50E+06
Am-241	2.92E+07	2.72E+07	2.09E+06	0.00E+00	1.57E+07	0.00E+00	2.87E+06
Am-242m	2.94E+07	2.56E+07	2.10E+06	0.00E+00	1.56E+07	0.00E+00	3.61E+06
Am-243	2.91E+07	2.67E+07	2.05E+06	0.00E+00	1.54E+07	0.00E+00	3.36E+06
Cm-242	7.27E+05	7.73E+05	4.83E+04	0.00E+00	2.19E+05	0.00E+00	2.79E+06
Cm-243	2.31E+07	2.12E+07	1.45E+06	0.00E+00	6.75E+06	0.00E+00	3.01E+06
Cm-244	1.76E+07	1.65E+07	1.11E+06	0.00E+00	5.17E+06	0.00E+00	2.91E+06
Cm-245	3.62E+07	3.16E+07	2.23E+06	0.00E+00	1.04E+07	0.00E+00	2.72E+06
Cm-246	3.59E+07	3.15E+07	2.22E+06	0.00E+00	1.04E+07	0.00E+00	2.67E+06
Cm-247	3.50E+07	3.11E+07	2.19E+06	0.00E+00	1.02E+07	0.00E+00	3.51E+06
Cm-248	2.91E+08	2.56E+08	1.80E+07	0.00E+00	8.42E+07	0.00E+00	5.68E+07
Cf-252	9.93E+06	0.00E+00	2.39E+05	0.00E+00	0.00E+00	0.00E+00	1.10E+07

Units of mrem/yr per $\mu Ci/m^3$ for H-3 and C-14
Units of m^2mrem/yr per μCi/sec for all other nuclides

Table 4-19 (Page 1 of 3)
Food Dose Rate Parameters for Teenager (P_i^F)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	5.66E+02	5.66E+02	5.66E+02	5.66E+02	5.66E+02	5.66E+02
C-14	6.70E+05	1.34E+05	1.34E+05	1.34E+05	1.34E+05	1.34E+05	1.34E+05
Na-22	9.19E+09	9.19E+09	9.19E+09	9.19E+09	9.19E+09	9.19E+09	9.19E+09
Na-24	4.27E+06	4.27E+06	4.27E+06	4.27E+06	4.27E+06	4.27E+06	4.27E+06
P-32	3.15E+10	1.95E+09	1.22E+09	0.00E+00	0.00E+00	0.00E+00	2.65E+09
Ca-41	1.57E+10	0.00E+00	1.70E+09	0.00E+00	0.00E+00	0.00E+00	1.56E+07
Sc-46	3.04E+02	5.93E+02	1.76E+02	0.00E+00	5.67E+02	0.00E+00	2.02E+06
Cr-51	0.00E+00	0.00E+00	4.99E+04	2.77E+04	1.09E+04	7.13E+04	8.39E+06
Mn-54	0.00E+00	1.40E+07	2.78E+06	0.00E+00	4.18E+06	0.00E+00	2.87E+07
Fe-55	4.45E+07	3.16E+07	7.36E+06	0.00E+00	0.00E+00	2.00E+07	1.37E+07
Mn-56	0.00E+00	7.47E-03	1.33E-03	0.00E+00	9.45E-03	0.00E+00	4.92E-01
Co-57	0.00E+00	2.25E+06	3.76E+06	0.00E+00	0.00E+00	0.00E+00	4.19E+07
Co-58	0.00E+00	7.94E+06	1.83E+07	0.00E+00	0.00E+00	0.00E+00	1.09E+08
Fe-59	5.18E+07	1.21E+08	4.67E+07	0.00E+00	0.00E+00	3.81E+07	2.86E+08
Co-60	0.00E+00	2.78E+07	6.26E+07	0.00E+00	0.00E+00	0.00E+00	3.62E+08
Ni-59	8.82E+08	3.11E+08	1.50E+08	0.00E+00	0.00E+00	0.00E+00	4.88E+07
Ni-63	1.18E+10	8.35E+08	4.01E+08	0.00E+00	0.00E+00	0.00E+00	1.33E+08
Cu-64	0.00E+00	4.26E+04	2.00E+04	0.00E+00	1.08E+05	0.00E+00	3.30E+06
Ni-65	6.87E-01	8.78E-02	4.00E-02	0.00E+00	0.00E+00	0.00E+00	4.76E+00
Zn-65	2.11E+09	7.32E+09	3.41E+09	0.00E+00	4.68E+09	0.00E+00	3.10E+09
Zn-69m	3.27E+05	7.71E+05	7.07E+04	0.00E+00	4.69E+05	0.00E+00	4.24E+07
Zn-69	4.01E-12	7.65E-12	5.35E-13	0.00E+00	5.00E-12	0.00E+00	1.41E-11
Se-79	0.00E+00	1.67E+09	2.81E+08	0.00E+00	2.92E+09	0.00E+00	2.56E+08
Br-82	0.00E+00	0.00E+00	5.61E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	1.82E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	3.09E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	8.03E-301	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	4.73E+09	2.22E+09	0.00E+00	0.00E+00	0.00E+00	7.00E+08
Rb-87	0.00E+00	5.24E+09	1.83E+09	0.00E+00	0.00E+00	0.00E+00	1.83E+08
Rb-88	0.00E+00	4.42E-45	2.36E-45	0.00E+00	0.00E+00	0.00E+00	3.79E-52
Rb-89	0.00E+00	8.90E-53	6.30E-53	0.00E+00	0.00E+00	0.00E+00	1.36E-61
Sr-89	2.67E+09	0.00E+00	7.66E+07	0.00E+00	0.00E+00	0.00E+00	3.19E+08
Sr-90	8.13E+10	0.00E+00	1.63E+09	0.00E+00	0.00E+00	0.00E+00	1.86E+09
Y-90	1.30E+02	0.00E+00	3.51E+00	0.00E+00	0.00E+00	0.00E+00	1.07E+06
Sr-91	5.33E+04	0.00E+00	2.12E+03	0.00E+00	0.00E+00	0.00E+00	2.42E+05
Y-91m	1.15E-19	0.00E+00	4.39E-21	0.00E+00	0.00E+00	0.00E+00	5.42E-18
Y-91	1.58E+04	0.00E+00	4.24E+02	0.00E+00	0.00E+00	0.00E+00	6.48E+06
Sr-92	9.07E-01	0.00E+00	3.86E-02	0.00E+00	0.00E+00	0.00E+00	2.31E+01
Y-92	1.04E-04	0.00E+00	3.01E-06	0.00E+00	0.00E+00	0.00E+00	2.86E+00
Y-93	4.13E-01	0.00E+00	1.13E-02	0.00E+00	0.00E+00	0.00E+00	1.26E+04
Nb-93m	8.55E+05	2.81E+05	7.04E+04	0.00E+00	3.28E+05	0.00E+00	1.01E+08
Nb-95	1.41E+05	7.81E+04	4.30E+04	0.00E+00	7.57E+04	0.00E+00	3.34E+08
Nb-97	6.19E-12	1.54E-12	5.61E-13	0.00E+00	1.80E-12	0.00E+00	3.67E-08
Zr-93	2.76E+03	1.36E+03	7.43E+02	0.00E+00	4.81E+03	0.00E+00	1.29E+06
Zr-95	1.65E+03	5.21E+02	3.58E+02	0.00E+00	7.65E+02	0.00E+00	1.20E+06
Zr-97	7.90E-01	1.56E-01	7.20E-02	0.00E+00	2.37E-01	0.00E+00	4.23E+04
Mo-93	0.00E+00	7.93E+08	2.17E+07	0.00E+00	2.27E+08	0.00E+00	9.65E+07
Mo-99	0.00E+00	4.47E+07	8.53E+06	0.00E+00	1.02E+08	0.00E+00	8.01E+07
Tc-99	4.46E+07	6.56E+07	1.79E+07	0.00E+00	8.33E+08	6.78E+06	1.61E+09
Tc-99m	5.80E+00	1.62E+01	2.10E+02	0.00E+00	2.41E+02	8.97E+00	1.06E+04
Tc-101	5.58E-60	7.93E-60	7.79E-59	0.00E+00	1.43E-58	4.83E-60	1.36E-66
Ru-103	1.81E+03	0.00E+00	7.74E+02	0.00E+00	6.38E+03	0.00E+00	1.51E+05
Ru-105	1.58E-03	0.00E+00	6.13E-04	0.00E+00	1.99E-02	0.00E+00	1.27E+00
Rh-105	6.41E+05	4.63E+05	3.04E+05	0.00E+00	1.97E+06	0.00E+00	5.89E+07
Ru-106	3.75E+04	0.00E+00	4.73E+03	0.00E+00	7.24E+04	0.00E+00	1.80E+06
Pd-107	0.00E+00	2.07E+07	1.34E+06	0.00E+00	1.87E+08	0.00E+00	9.63E+07

Table 4-19 (Page 2 of 3)
Food Dose Rate Parameters for Teenager (P_i^F)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	8.12E+04	1.85E+04	0.00E+00	4.69E+05	0.00E+00	8.19E+06
Ag-110m	9.63E+07	9.11E+07	5.54E+07	0.00E+00	1.74E+08	0.00E+00	2.56E+10
Ag-111	1.19E+07	4.95E+06	2.49E+06	0.00E+00	1.61E+07	0.00E+00	6.91E+09
Cd-113m	0.00E+00	5.38E+06	1.73E+05	0.00E+00	5.95E+06	0.00E+00	3.23E+07
Cd-115m	0.00E+00	2.30E+06	7.41E+04	0.00E+00	1.84E+06	0.00E+00	7.27E+07
Sn-123	9.88E+08	1.62E+07	2.40E+07	1.30E+07	0.00E+00	0.00E+00	1.49E+09
Sn-125	1.05E+08	2.09E+06	4.73E+06	1.64E+06	0.00E+00	0.00E+00	9.86E+08
Sn-126	2.89E+09	5.39E+07	8.23E+07	1.42E+07	0.00E+00	0.00E+00	6.43E+08
Sb-124	4.59E+07	8.46E+05	1.79E+07	1.04E+05	0.00E+00	4.01E+07	9.25E+08
Sb-125	3.65E+07	3.99E+05	8.55E+06	3.49E+04	0.00E+00	3.21E+07	2.84E+08
Sb-126	9.99E+06	2.04E+05	3.59E+06	5.65E+04	0.00E+00	7.16E+06	5.91E+08
Sb-127	8.17E+05	1.75E+04	3.08E+05	9.18E+03	0.00E+00	5.56E+05	1.39E+08
Te-125m	3.00E+07	1.08E+07	4.02E+06	8.39E+06	0.00E+00	0.00E+00	8.86E+07
Te-127m	8.44E+07	2.99E+07	1.00E+07	2.01E+07	3.42E+08	0.00E+00	2.10E+08
Te-127	1.22E+03	4.31E+02	2.61E+02	8.38E+02	4.92E+03	0.00E+00	9.38E+04
Te-129m	1.10E+08	4.09E+07	1.74E+07	3.55E+07	4.61E+08	0.00E+00	4.13E+08
Te-129	5.37E-10	2.00E-10	1.31E-10	3.84E-10	2.25E-09	0.00E+00	2.94E-09
Te-133m	3.95E-13	2.24E-13	2.18E-13	3.13E-13	2.22E-12	0.00E+00	9.07E-13
Te-134	1.68E-18	1.08E-18	1.12E-18	1.38E-18	1.03E-17	0.00E+00	6.22E-20
I-129	1.39E+09	1.17E+09	1.96E+09	1.43E+12	2.10E+09	0.00E+00	1.37E+08
I-130	7.41E+05	2.14E+06	8.56E+05	1.75E+08	3.30E+06	0.00E+00	1.65E+06
I-131	5.37E+08	7.52E+08	4.04E+08	2.20E+11	1.30E+09	0.00E+00	1.49E+08
Te-131m	6.58E+05	3.15E+05	2.63E+05	4.75E+05	3.29E+06	0.00E+00	2.53E+07
Te-131	7.22E-33	2.98E-33	2.26E-33	5.57E-33	3.16E-32	0.00E+00	5.93E-34
I-132	2.96E-01	7.75E-01	2.78E-01	2.61E+01	1.22E+00	0.00E+00	3.38E-01
Te-132	4.29E+06	2.72E+06	2.56E+06	2.87E+06	2.61E+07	0.00E+00	8.61E+07
I-133	7.08E+06	1.20E+07	3.66E+06	1.68E+09	2.11E+07	0.00E+00	9.09E+06
Cs-134m	3.13E-01	6.49E-01	3.34E-01	0.00E+00	3.61E-01	6.34E-02	4.32E-01
Cs-134	9.82E+09	2.31E+10	1.07E+10	0.00E+00	7.34E+09	2.80E+09	2.87E+08
I-134	3.74E-12	9.92E-12	3.56E-12	1.65E-10	1.56E-11	0.00E+00	1.31E-13
I-135	2.29E+04	5.90E+04	2.19E+04	3.80E+06	9.33E+04	0.00E+00	6.54E+04
Cs-135	3.33E+09	3.05E+09	7.13E+08	0.00E+00	1.16E+09	4.21E+08	5.34E+07
Cs-136	4.48E+08	1.76E+09	1.18E+09	0.00E+00	9.60E+08	1.51E+08	1.42E+08
Cs-137	1.34E+10	1.78E+10	6.20E+09	0.00E+00	6.06E+09	2.35E+09	2.53E+08
Cs-138	1.76E-23	3.38E-23	1.69E-23	0.00E+00	2.50E-23	2.91E-24	1.54E-26
Cs-139	1.60E-89	2.35E-89	8.63E-90	0.00E+00	1.90E-89	2.08E-90	1.09E-104
Ba-139	8.40E-08	5.91E-11	2.45E-09	0.00E+00	5.57E-11	4.07E-11	7.50E-07
Ba-140	4.85E+07	5.95E+04	3.13E+06	0.00E+00	2.02E+04	4.00E+04	7.48E+07
La-140	8.11E+00	3.99E+00	1.06E+00	0.00E+00	0.00E+00	0.00E+00	2.29E+05
Ba-141	8.54E-46	6.38E-49	2.85E-47	0.00E+00	5.92E-49	4.36E-49	1.82E-51
La-141	5.66E-05	1.74E-05	2.87E-06	0.00E+00	0.00E+00	0.00E+00	3.08E+00
Ce-141	8.88E+03	5.93E+03	6.81E+02	0.00E+00	2.79E+03	0.00E+00	1.70E+07
Ba-142	5.97E-80	5.97E-83	3.68E-81	0.00E+00	5.06E-83	3.98E-83	1.83E-91
La-142	3.43E-11	1.53E-11	3.80E-12	0.00E+00	0.00E+00	0.00E+00	4.64E-07
Ce-143	7.65E+01	5.56E+04	6.21E+00	0.00E+00	2.50E+01	0.00E+00	1.67E+06
Pr-143	2.90E+02	1.16E+02	1.44E+01	0.00E+00	6.73E+01	0.00E+00	9.55E+05
Ce-144	6.58E+05	2.72E+05	3.54E+04	0.00E+00	1.63E+05	0.00E+00	1.66E+08
Pr-144	1.24E-53	5.06E-54	6.27E-55	0.00E+00	2.90E-54	0.00E+00	1.36E-56
Nd-147	1.81E+02	1.97E+02	1.18E+01	0.00E+00	1.16E+02	0.00E+00	7.11E+05
Pm-147	5.15E+03	4.89E+02	1.99E+02	0.00E+00	9.32E+02	0.00E+00	4.65E+05
Pm-148m	1.49E+03	3.78E+02	2.96E+02	0.00E+00	5.73E+02	0.00E+00	2.38E+06
Pm-148	1.09E+02	1.77E+01	8.93E+00	0.00E+00	3.20E+01	0.00E+00	1.06E+06
Pm-149	7.89E+00	1.11E+00	4.54E-01	0.00E+00	2.11E+00	0.00E+00	1.63E+05
Pm-151	1.19E+00	1.96E-01	9.93E-02	0.00E+00	3.53E-01	0.00E+00	4.41E+04
Sm-151	4.35E+03	8.37E+02	1.96E+02	0.00E+00	9.17E+02	0.00E+00	2.84E+05
Sm-153	3.64E+00	3.01E+00	2.22E-01	0.00E+00	9.85E-01	0.00E+00	8.50E+04

Table 4-19 (Page 3 of 3)
Food Dose Rate Parameters for Teenager (P_i^F)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	1.22E+04	2.93E+03	2.58E+03	0.00E+00	1.36E+04	0.00E+00	1.08E+06
Eu-154	3.93E+04	5.06E+03	3.57E+03	0.00E+00	2.26E+04	0.00E+00	2.67E+06
Eu-155	8.60E+03	8.31E+02	5.14E+02	0.00E+00	3.25E+03	0.00E+00	4.76E+06
Eu-156	4.55E+02	3.41E+02	5.57E+01	0.00E+00	2.29E+02	0.00E+00	1.74E+06
Tb-160	2.65E+03	0.00E+00	3.31E+02	0.00E+00	1.05E+03	0.00E+00	1.72E+06
Ho-166m	1.78E+04	5.48E+03	3.97E+03	0.00E+00	8.03E+03	0.00E+00	1.35E+06
W-181	6.27E+04	2.02E+04	2.12E+03	0.00E+00	0.00E+00	0.00E+00	1.72E+06
W-185	2.39E+06	7.88E+05	8.33E+04	0.00E+00	0.00E+00	0.00E+00	6.81E+07
W-187	1.19E+04	9.73E+03	3.41E+03	0.00E+00	0.00E+00	0.00E+00	2.63E+06
Np-239	7.01E+00	6.62E-01	3.67E-01	0.00E+00	2.08E+00	0.00E+00	1.06E+05
U-232	2.94E+10	0.00E+00	2.10E+09	0.00E+00	3.18E+09	0.00E+00	3.58E+08
U-233	6.18E+09	0.00E+00	3.76E+08	0.00E+00	1.45E+09	0.00E+00	3.32E+08
U-234	5.93E+09	0.00E+00	3.68E+08	0.00E+00	1.42E+09	0.00E+00	3.25E+08
U-235	5.68E+09	0.00E+00	3.46E+08	0.00E+00	1.33E+09	0.00E+00	4.13E+08
U-236	5.68E+09	0.00E+00	3.54E+08	0.00E+00	1.36E+09	0.00E+00	3.05E+08
U-237	1.04E+05	0.00E+00	2.77E+04	0.00E+00	4.28E+05	0.00E+00	2.76E+07
U-238	5.44E+09	0.00E+00	3.24E+08	0.00E+00	1.25E+09	0.00E+00	2.91E+08
Np-237	6.63E+07	4.76E+06	2.92E+06	0.00E+00	2.16E+07	0.00E+00	4.19E+06
Np-238	6.63E+01	1.78E+00	1.03E+00	0.00E+00	6.09E+00	0.00E+00	1.30E+05
Pu-238	1.34E+07	1.71E+06	3.63E+05	0.00E+00	1.55E+06	0.00E+00	1.54E+06
Pu-239	1.53E+07	1.85E+06	4.01E+05	0.00E+00	1.71E+06	0.00E+00	1.41E+06
Pu-240	1.52E+07	1.85E+06	4.01E+05	0.00E+00	1.71E+06	0.00E+00	1.43E+06
Pu-241	3.48E+05	1.67E+04	7.34E+03	0.00E+00	3.40E+04	0.00E+00	2.94E+04
Pu-242	1.41E+07	1.78E+06	3.87E+05	0.00E+00	1.65E+06	0.00E+00	1.38E+06
Pu-244	1.65E+07	2.03E+06	4.43E+05	0.00E+00	1.88E+06	0.00E+00	2.05E+06
Am-241	3.98E+07	3.75E+07	2.87E+06	0.00E+00	2.15E+07	0.00E+00	3.92E+06
Am-242m	4.02E+07	3.54E+07	2.89E+06	0.00E+00	2.14E+07	0.00E+00	4.94E+06
Am-243	3.97E+07	3.66E+07	2.80E+06	0.00E+00	2.10E+07	0.00E+00	4.60E+06
Cm-242	1.34E+06	1.41E+06	8.88E+04	0.00E+00	4.05E+05	0.00E+00	3.82E+06
Cm-243	3.24E+07	3.00E+07	2.04E+06	0.00E+00	9.51E+06	0.00E+00	4.12E+06
Cm-244	2.51E+07	2.37E+07	1.59E+06	0.00E+00	7.41E+06	0.00E+00	3.98E+06
Cm-245	4.94E+07	4.34E+07	3.04E+06	0.00E+00	1.42E+07	0.00E+00	3.72E+06
Cm-246	4.90E+07	4.34E+07	3.04E+06	0.00E+00	1.42E+07	0.00E+00	3.65E+06
Cm-247	4.77E+07	4.27E+07	2.99E+06	0.00E+00	1.40E+07	0.00E+00	4.80E+06
Cm-248	3.96E+08	3.52E+08	2.47E+07	0.00E+00	1.15E+08	0.00E+00	7.73E+07
Cf-252	1.70E+07	0.00E+00	4.11E+05	0.00E+00	0.00E+00	0.00E+00	1.50E+07

Units of mrem/yr per μCi/m^3 for H-3 and C-14
Units of m^{2}mrem/yr per μCi/sec for all other nuclides

Table 4-20 (Page 1 of 3)
Food Dose Rate Parameters for Child (P_i^F)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	8.97E+02	8.97E+02	8.97E+02	8.97E+02	8.97E+02	8.97E+02
C-14	1.65E+06	3.29E+05	3.29E+05	3.29E+05	3.29E+05	3.29E+05	3.29E+05
Na-22	1.90E+10	1.90E+10	1.90E+10	1.90E+10	1.90E+10	1.90E+10	1.90E+10
Na-24	8.88E+06	8.88E+06	8.88E+06	8.88E+06	8.88E+06	8.88E+06	8.88E+06
P-32	7.78E+10	3.64E+09	3.00E+09	0.00E+00	0.00E+00	0.00E+00	2.15E+09
Ca-41	2.28E+10	0.00E+00	2.49E+09	0.00E+00	0.00E+00	0.00E+00	1.25E+07
Sc-46	6.83E+02	9.36E+02	3.61E+02	0.00E+00	8.29E+02	0.00E+00	1.37E+06
Cr-51	0.00E+00	0.00E+00	1.02E+05	5.65E+04	1.54E+04	1.03E+05	5.40E+06
Mn-54	0.00E+00	2.10E+07	5.59E+06	0.00E+00	5.88E+06	0.00E+00	1.76E+07
Fe-55	1.12E+08	5.93E+07	1.84E+07	0.00E+00	0.00E+00	3.35E+07	1.10E+07
Mn-56	0.00E+00	1.30E-02	2.94E-03	0.00E+00	1.58E-02	0.00E+00	1.89E+00
Co-57	0.00E+00	3.84E+06	7.77E+06	0.00E+00	0.00E+00	0.00E+00	3.14E+07
Co-58	0.00E+00	1.21E+07	3.71E+07	0.00E+00	0.00E+00	0.00E+00	7.07E+07
Fe-59	1.20E+08	1.95E+08	9.69E+07	0.00E+00	0.00E+00	5.64E+07	2.03E+08
Co-60	0.00E+00	4.32E+07	1.27E+08	0.00E+00	0.00E+00	0.00E+00	2.39E+08
Ni-59	2.22E+09	5.90E+08	3.76E+08	0.00E+00	0.00E+00	0.00E+00	3.91E+07
Ni-63	2.96E+10	1.59E+09	1.01E+09	0.00E+00	0.00E+00	0.00E+00	1.07E+08
Cu-64	0.00E+00	7.49E+04	4.52E+04	0.00E+00	1.81E+05	0.00E+00	3.51E+06
Ni-65	1.68E+00	1.58E-01	9.24E-02	0.00E+00	0.00E+00	0.00E+00	1.94E+01
Zn-65	4.13E+09	1.10E+10	6.85E+09	0.00E+00	6.94E+09	0.00E+00	1.93E+09
Zn-69m	7.98E+05	1.36E+06	1.61E+05	0.00E+00	7.90E+05	0.00E+00	4.43E+07
Zn-69	9.87E-12	1.43E-11	1.32E-12	0.00E+00	8.65E-12	0.00E+00	8.99E-10
Se-79	0.00E+00	3.12E+09	6.92E+08	0.00E+00	5.07E+09	0.00E+00	2.05E+08
Br-82	0.00E+00	0.00E+00	1.15E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	4.47E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	7.00E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	1.98E-300	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	8.77E+09	5.39E+09	0.00E+00	0.00E+00	0.00E+00	5.64E+08
Rb-87	0.00E+00	9.75E+09	4.52E+09	0.00E+00	0.00E+00	0.00E+00	1.46E+08
Rb-88	0.00E+00	8.14E-45	5.66E-45	0.00E+00	0.00E+00	0.00E+00	3.99E-46
Rb-89	0.00E+00	1.56E-52	1.39E-52	0.00E+00	0.00E+00	0.00E+00	1.36E-54
Sr-89	6.62E+09	0.00E+00	1.89E+08	0.00E+00	0.00E+00	0.00E+00	2.56E+08
Sr-90	1.68E+11	0.00E+00	3.38E+09	0.00E+00	0.00E+00	0.00E+00	1.51E+09
Y-90	3.22E+02	0.00E+00	8.63E+00	0.00E+00	0.00E+00	0.00E+00	9.18E+05
Sr-91	1.31E+05	0.00E+00	4.94E+03	0.00E+00	0.00E+00	0.00E+00	2.89E+05
Y-91m	2.80E-19	0.00E+00	1.02E-20	0.00E+00	0.00E+00	0.00E+00	5.49E-16
Y-91	3.90E+04	0.00E+00	1.04E+03	0.00E+00	0.00E+00	0.00E+00	5.20E+06
Sr-92	2.21E+00	0.00E+00	8.88E-02	0.00E+00	0.00E+00	0.00E+00	4.19E+01
Y-92	2.56E-04	0.00E+00	7.32E-06	0.00E+00	0.00E+00	0.00E+00	7.39E+00
Y-93	1.02E+00	0.00E+00	2.79E-02	0.00E+00	0.00E+00	0.00E+00	1.51E+04
Nb-93m	2.15E+06	5.37E+05	1.77E+05	0.00E+00	5.80E+05	0.00E+00	8.10E+07
Nb-95	3.18E+05	1.24E+05	8.84E+04	0.00E+00	1.16E+05	0.00E+00	2.29E+08
Nb-97	1.50E-11	2.72E-12	1.27E-12	0.00E+00	3.01E-12	0.00E+00	8.38E-07
Zr-93	6.87E+03	2.57E+03	1.83E+03	0.00E+00	9.96E+03	0.00E+00	9.75E+05
Zr-95	3.83E+03	8.42E+02	7.50E+02	0.00E+00	1.21E+03	0.00E+00	8.79E+05
Zr-97	1.92E+00	2.78E-01	1.64E-01	0.00E+00	3.99E-01	0.00E+00	4.21E+04
Mo-93	0.00E+00	1.49E+09	5.34E+07	0.00E+00	3.92E+08	0.00E+00	7.53E+07
Mo-99	0.00E+00	8.14E+07	2.01E+07	0.00E+00	1.74E+08	0.00E+00	6.73E+07
Tc-99	1.10E+08	1.23E+08	4.40E+07	0.00E+00	1.44E+09	1.08E+07	1.29E+09
Tc-99m	1.33E+01	2.61E+01	4.32E+02	0.00E+00	3.79E+02	1.32E+01	1.48E+04
Tc-101	1.37E-59	1.43E-59	1.82E-58	0.00E+00	2.44E-58	7.57E-60	4.55E-59
Ru-103	4.28E+03	0.00E+00	1.65E+03	0.00E+00	1.08E+04	0.00E+00	1.11E+05
Ru-105	3.85E-03	0.00E+00	1.40E-03	0.00E+00	3.39E-02	0.00E+00	2.51E+00
Rh-105	1.57E+06	8.44E+05	7.21E+05	0.00E+00	3.36E+06	0.00E+00	5.23E+07
Ru-106	9.24E+04	0.00E+00	1.15E+04	0.00E+00	1.25E+05	0.00E+00	1.44E+06
Pd-107	0.00E+00	3.88E+07	3.30E+06	0.00E+00	3.25E+08	0.00E+00	7.71E+07

Table 4-20 (Page 2 of 3)
Food Dose Rate Parameters for Child (P_i^F)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	1.51E+05	4.54E+04	0.00E+00	8.12E+05	0.00E+00	8.95E+06
Ag-110m	2.09E+08	1.41E+08	1.13E+08	0.00E+00	2.63E+08	0.00E+00	1.68E+10
Ag-111	2.94E+07	9.21E+06	6.08E+06	0.00E+00	2.78E+07	0.00E+00	5.64E+09
Cd-113m	0.00E+00	1.00E+07	4.27E+05	0.00E+00	1.03E+07	0.00E+00	2.59E+07
Cd-115m	0.00E+00	4.29E+06	1.83E+05	0.00E+00	3.19E+06	0.00E+00	5.83E+07
Sn-123	2.44E+09	3.03E+07	5.95E+07	3.21E+07	0.00E+00	0.00E+00	1.20E+09
Sn-125	2.58E+08	3.89E+06	1.15E+07	4.03E+06	0.00E+00	0.00E+00	7.99E+08
Sn-126	6.85E+09	8.54E+07	1.95E+08	2.34E+07	0.00E+00	0.00E+00	5.14E+08
Sb-124	1.09E+08	1.41E+06	3.81E+07	2.40E+05	0.00E+00	6.03E+07	6.79E+08
Sb-125	8.70E+07	6.71E+05	1.82E+07	8.06E+04	0.00E+00	4.85E+07	2.08E+08
Sb-126	2.28E+07	3.49E+05	8.19E+06	1.34E+05	0.00E+00	1.09E+07	4.60E+08
Sb-127	1.97E+06	3.05E+04	6.83E+05	2.19E+04	0.00E+00	8.54E+05	1.11E+08
Te-125m	7.38E+07	2.00E+07	9.84E+06	2.07E+07	0.00E+00	0.00E+00	7.12E+07
Te-127m	2.08E+08	5.60E+07	2.47E+07	4.97E+07	5.93E+08	0.00E+00	1.68E+08
Te-127	2.99E+03	8.06E+02	6.41E+02	2.07E+03	8.50E+03	0.00E+00	1.17E+05
Te-129m	2.71E+08	7.58E+07	4.21E+07	8.75E+07	7.97E+08	0.00E+00	3.31E+08
Te-129	1.33E-09	3.70E-10	3.15E-10	9.46E-10	3.88E-09	0.00E+00	8.25E-08
Te-133m	9.46E-13	3.82E-13	4.74E-13	7.33E-13	3.63E-12	0.00E+00	2.92E-11
Te-134	3.99E-18	1.79E-18	2.39E-18	3.15E-18	1.66E-17	0.00E+00	1.82E-17
I-129	3.43E+09	2.11E+09	1.88E+09	1.38E+12	3.55E+09	0.00E+00	1.06E+08
I-130	1.73E+06	3.50E+06	1.80E+06	3.86E+08	5.23E+06	0.00E+00	1.64E+06
I-131	1.30E+09	1.31E+09	7.45E+08	4.33E+11	2.15E+09	0.00E+00	1.17E+08
Te-131m	1.60E+06	5.54E+05	5.89E+05	1.14E+06	5.36E+06	0.00E+00	2.25E+07
Te-131	1.77E-32	5.40E-33	5.27E-33	1.36E-32	5.36E-32	0.00E+00	9.31E-32
I-132	7.01E-01	1.29E+00	5.92E-01	5.97E+01	1.97E+00	0.00E+00	1.52E+00
Te-132	1.03E+07	4.54E+06	5.48E+06	6.61E+06	4.21E+07	0.00E+00	4.57E+07
I-133	1.72E+07	2.13E+07	8.05E+06	3.95E+09	3.55E+07	0.00E+00	8.57E+06
Cs-134m	7.42E-01	1.10E+00	7.18E-01	0.00E+00	5.80E-01	9.59E-02	1.39E+00
Cs-134	2.26E+10	3.72E+10	7.84E+09	0.00E+00	1.15E+10	4.13E+09	2.00E+08
I-134	8.87E-12	1.65E-11	7.57E-12	3.79E-10	2.52E-11	0.00E+00	1.09E-11
I-135	5.43E+04	9.77E+04	4.62E+04	8.66E+06	1.50E+05	0.00E+00	7.45E+04
Cs-135	8.19E+09	5.71E+09	5.85E+08	0.00E+00	2.01E+09	6.72E+08	4.27E+07
Cs-136	1.01E+09	2.78E+09	1.80E+09	0.00E+00	1.48E+09	2.21E+08	9.77E+07
Cs-137	3.22E+10	3.09E+10	4.55E+09	0.00E+00	1.01E+10	3.62E+09	1.93E+08
Cs-138	4.27E-23	5.94E-23	3.77E-23	0.00E+00	4.18E-23	4.50E-24	2.74E-23
Cs-139	3.92E-89	4.36E-89	2.09E-89	0.00E+00	3.27E-89	3.30E-90	3.92E-93
Ba-139	2.06E-07	1.10E-10	5.98E-09	0.00E+00	9.62E-11	6.48E-11	1.19E-05
Ba-140	1.17E+08	1.03E+05	6.84E+06	0.00E+00	3.34E+04	6.12E+04	5.93E+07
La-140	1.94E+01	6.79E+00	2.29E+00	0.00E+00	0.00E+00	0.00E+00	1.89E+05
Ba-141	2.10E-45	1.18E-48	6.83E-47	0.00E+00	1.02E-48	6.91E-48	1.20E-45
La-141	1.39E-04	3.25E-05	7.06E-06	0.00E+00	0.00E+00	0.00E+00	7.23E+00
Ce-141	2.19E+04	1.09E+04	1.62E+03	0.00E+00	4.78E+03	0.00E+00	1.36E+07
Ba-142	1.44E-79	1.04E-82	8.04E-81	0.00E+00	8.39E-83	6.10E-83	1.88E-81
La-142	8.30E-11	2.64E-11	8.28E-12	0.00E+00	0.00E+00	0.00E+00	5.24E-06
Ce-143	1.88E+02	1.02E+05	1.47E+01	0.00E+00	4.27E+01	0.00E+00	1.49E+06
Pr-143	7.18E+02	2.16E+02	3.56E+01	0.00E+00	1.17E+02	0.00E+00	7.75E+05
Ce-144	1.62E+06	5.09E+05	8.66E+04	0.00E+00	2.82E+05	0.00E+00	1.33E+08
Pr-144	3.06E-53	9.47E-54	1.54E-54	0.00E+00	5.01E-54	0.00E+00	2.04E-50
Nd-147	4.45E+02	3.60E+02	2.79E+01	0.00E+00	1.98E+02	0.00E+00	5.71E+05
Pm-147	1.29E+04	9.19E+02	4.94E+02	0.00E+00	1.62E+03	0.00E+00	3.72E+05
Pm-148m	3.06E+03	6.09E+02	6.09E+02	0.00E+00	9.03E+02	0.00E+00	1.72E+06
Pm-148	2.66E+02	3.20E+01	2.07E+01	0.00E+00	5.44E+01	0.00E+00	8.54E+05
Pm-149	1.95E+01	2.07E+00	1.12E+00	0.00E+00	3.66E+00	0.00E+00	1.41E+05
Pm-151	2.90E+00	3.53E-01	2.29E-01	0.00E+00	5.98E-01	0.00E+00	4.00E+04
Sm-151	1.05E+04	1.57E+03	4.93E+02	0.00E+00	1.62E+03	0.00E+00	2.27E+05
Sm-153	8.99E+00	5.59E+00	5.39E-01	0.00E+00	1.70E+00	0.00E+00	7.43E+04

Table 4-20 (Page 3 of 3)
Food Dose Rate Parameters for Child (P_i^F)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	2.52E+04	4.59E+03	5.45E+03	0.00E+00	1.94E+04	0.00E+00	7.55E+05
Eu-154	9.42E+04	8.47E+03	7.74E+03	0.00E+00	3.72E+04	0.00E+00	1.97E+06
Eu-155	1.97E+04	1.42E+03	1.11E+03	0.00E+00	5.30E+03	0.00E+00	3.54E+06
Eu-156	1.10E+03	5.88E+02	1.22E+02	0.00E+00	3.79E+02	0.00E+00	1.33E+06
Tb-160	5.61E+03	0.00E+00	6.96E+02	0.00E+00	1.67E+03	0.00E+00	1.24E+06
Ho-166m	4.44E+04	9.30E+03	7.86E+03	0.00E+00	1.32E+04	0.00E+00	1.08E+06
W-181	1.54E+05	3.79E+04	5.21E+03	0.00E+00	0.00E+00	0.00E+00	1.38E+06
W-185	5.89E+06	1.47E+06	2.06E+05	0.00E+00	0.00E+00	0.00E+00	5.48E+07
W-187	2.89E+04	1.71E+04	7.69E+03	0.00E+00	0.00E+00	0.00E+00	2.41E+06
Np-239	1.73E+01	1.24E+00	8.71E-01	0.00E+00	3.58E+00	0.00E+00	9.17E+04
U-232	7.24E+10	0.00E+00	5.18E+09	0.00E+00	5.51E+09	0.00E+00	2.87E+08
U-233	1.53E+10	0.00E+00	9.26E+08	0.00E+00	2.51E+09	0.00E+00	2.65E+08
U-234	1.47E+10	0.00E+00	9.09E+08	0.00E+00	2.46E+09	0.00E+00	2.60E+08
U-235	1.41E+10	0.00E+00	8.52E+08	0.00E+00	2.31E+09	0.00E+00	3.30E+08
U-236	1.41E+10	0.00E+00	8.72E+08	0.00E+00	2.36E+09	0.00E+00	2.44E+08
U-237	2.57E+05	0.00E+00	6.83E+04	0.00E+00	7.42E+05	0.00E+00	2.27E+07
U-238	1.35E+10	0.00E+00	7.98E+08	0.00E+00	2.16E+09	0.00E+00	2.33E+08
Np-237	9.17E+07	6.05E+06	4.03E+06	0.00E+00	2.49E+07	0.00E+00	3.36E+06
Np-238	1.64E+02	3.31E+00	2.55E+00	0.00E+00	1.06E+01	0.00E+00	1.13E+05
Pu-238	1.96E+07	2.27E+06	5.20E+05	0.00E+00	1.89E+06	0.00E+00	1.23E+06
Pu-239	2.12E+07	2.27E+06	5.45E+05	0.00E+00	2.01E+06	0.00E+00	1.13E+06
Pu-240	2.11E+07	2.35E+06	5.45E+05	0.00E+00	2.01E+06	0.00E+00	1.15E+06
Pu-241	6.35E+05	2.59E+04	1.32E+04	0.00E+00	4.86E+04	0.00E+00	2.36E+04
Pu-242	1.96E+07	2.27E+06	5.25E+05	0.00E+00	1.93E+06	0.00E+00	1.10E+06
Pu-244	2.29E+07	2.60E+07	6.01E+05	0.00E+00	2.22E+06	0.00E+00	1.65E+06
Am-241	5.59E+07	4.81E+07	4.20E+06	0.00E+00	2.56E+07	0.00E+00	3.14E+06
Am-242m	5.76E+07	4.61E+07	4.28E+06	0.00E+00	2.59E+07	0.00E+00	3.95E+06
Am-243	5.51E+07	4.65E+07	4.04E+06	0.00E+00	2.49E+07	0.00E+00	3.68E+06
Cm-242	3.30E+06	2.63E+06	2.19E+05	0.00E+00	7.02E+05	0.00E+00	3.07E+06
Cm-243	5.26E+07	4.27E+07	3.38E+06	0.00E+00	1.27E+07	0.00E+00	3.30E+06
Cm-244	4.43E+07	3.59E+07	2.84E+06	0.00E+00	1.04E+07	0.00E+00	3.19E+06
Cm-245	6.87E+07	5.51E+07	4.32E+06	0.00E+00	1.69E+07	0.00E+00	2.98E+06
Cm-246	6.79E+07	5.51E+07	4.32E+06	0.00E+00	1.69E+07	0.00E+00	2.92E+06
Cm-247	6.62E+07	5.43E+07	4.24E+06	0.00E+00	1.66E+07	0.00E+00	3.85E+06
Cm-248	5.51E+08	4.48E+08	3.50E+07	0.00E+00	1.37E+08	0.00E+00	6.21E+07
Cf-252	4.25E+07	0.00E+00	1.03E+06	0.00E+00	0.00E+00	0.00E+00	1.20E+07

Units of mrem/yr per μCi/m³ for H-3 and C-14
Units of m²mrem/yr per μCi/sec for all other nuclides

Table 4-21 (Page 1 of 3)
Food Dose Rate Parameters for Infant (P_i^F)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.36E+03	1.36E+03	1.36E+03	1.36E+03	1.36E+03	1.36E+03
C-14	3.23E+06	6.89E+05	6.89E+05	6.89E+05	6.89E+05	6.89E+05	6.89E+05
Na-22	3.18E+10	3.18E+10	3.18E+10	3.18E+10	3.18E+10	3.18E+10	3.18E+10
Na-24	1.55E+07	1.55E+07	1.55E+07	1.55E+07	1.55E+07	1.55E+07	1.55E+07
P-32	1.60E+11	9.43E+09	6.21E+09	0.00E+00	0.00E+00	0.00E+00	2.17E+09
Ca-41	2.46E+10	0.00E+00	2.69E+09	0.00E+00	0.00E+00	0.00E+00	1.26E+07
Sc-46	1.30E+03	1.88E+03	5.86E+02	0.00E+00	1.23E+03	0.00E+00	1.22E+06
Cr-51	0.00E+00	0.00E+00	1.61E+05	1.05E+05	2.30E+04	2.05E+05	4.70E+06
Mn-54	0.00E+00	3.90E+07	8.84E+06	0.00E+00	8.64E+06	0.00E+00	1.43E+07
Fe-55	1.35E+08	8.73E+07	2.33E+07	0.00E+00	0.00E+00	4.27E+07	1.11E+07
Mn-56	0.00E+00	3.19E-02	5.50E-03	0.00E+00	2.74E-02	0.00E+00	2.90E+00
Co-57	0.00E+00	8.95E+06	1.46E+07	0.00E+00	0.00E+00	0.00E+00	3.05E+07
Co-58	0.00E+00	2.42E+07	6.05E+07	0.00E+00	0.00E+00	0.00E+00	6.04E+07
Fe-59	2.24E+08	3.92E+08	1.54E+08	0.00E+00	0.00E+00	1.16E+08	1.87E+08
Co-60	0.00E+00	8.82E+07	2.08E+08	0.00E+00	0.00E+00	0.00E+00	2.10E+08
Ni-59	2.61E+09	7.99E+08	4.50E+08	0.00E+00	0.00E+00	0.00E+00	3.95E+07
Ni-63	3.49E+10	2.16E+09	1.21E+09	0.00E+00	0.00E+00	0.00E+00	1.07E+08
Cu-64	0.00E+00	1.86E+05	8.62E+04	0.00E+00	3.15E+05	0.00E+00	3.82E+06
Ni-65	3.56E+00	4.03E-01	1.83E-01	0.00E+00	0.00E+00	0.00E+00	3.07E+01
Zn-65	5.55E+09	1.90E+10	8.78E+09	0.00E+00	9.23E+09	0.00E+00	1.61E+10
Zn-69m	1.69E+06	3.44E+06	3.13E+05	0.00E+00	1.39E+06	0.00E+00	4.76E+07
Zn-69	2.10E-11	3.79E-11	2.82E-12	0.00E+00	1.57E-11	0.00E+00	3.09E-09
Se-79	0.00E+00	7.77E+09	1.44E+09	0.00E+00	9.00E+09	0.00E+00	2.07E+08
Br-82	0.00E+00	0.00E+00	1.94E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	9.49E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	1.35E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	4.21E-300	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	2.23E+10	1.10E+10	0.00E+00	0.00E+00	0.00E+00	5.69E+08
Rb-87	0.00E+00	2.19E+10	8.69E+09	0.00E+00	0.00E+00	0.00E+00	1.48E+08
Rb-88	0.00E+00	2.13E-44	1.17E-44	0.00E+00	0.00E+00	0.00E+00	2.08E-44
Rb-89	0.00E+00	3.82E-52	2.63E-52	0.00E+00	0.00E+00	0.00E+00	1.30E-52
Sr-89	1.26E+10	0.00E+00	3.61E+08	0.00E+00	0.00E+00	0.00E+00	2.59E+08
Sr-90	1.86E+11	0.00E+00	3.77E+09	0.00E+00	0.00E+00	0.00E+00	1.52E+09
Y-90	6.82E+02	0.00E+00	1.83E+01	0.00E+00	0.00E+00	0.00E+00	9.41E+05
Sr-91	2.73E+05	0.00E+00	9.87E+03	0.00E+00	0.00E+00	0.00E+00	3.23E+05
Y-91m	5.94E-19	0.00E+00	2.03E-20	0.00E+00	0.00E+00	0.00E+00	1.98E-15
Y-91	7.33E+04	0.00E+00	1.95E+03	0.00E+00	0.00E+00	0.00E+00	5.25E+06
Sr-92	4.71E+00	0.00E+00	1.75E-01	0.00E+00	0.00E+00	0.00E+00	5.08E+01
Y-92	5.44E-04	0.00E+00	1.53E-05	0.00E+00	0.00E+00	0.00E+00	1.04E+01
Y-93	2.16E+00	0.00E+00	5.90E-02	0.00E+00	0.00E+00	0.00E+00	1.71E+04
Nb-93m	2.52E+06	6.83E+05	2.13E+05	0.00E+00	6.67E+05	0.00E+00	8.16E+07
Nb-95	5.93E+05	2.44E+05	1.41E+05	0.00E+00	1.75E+05	0.00E+00	2.06E+08
Nb-97	3.18E-11	6.78E-12	2.45E-12	0.00E+00	5.30E-12	0.00E+00	2.14E-06
Zr-93	7.94E+03	3.78E+03	2.28E+03	0.00E+00	1.11E+04	0.00E+00	9.83E+05
Zr-95	6.80E+03	1.66E+03	1.18E+03	0.00E+00	1.79E+03	0.00E+00	8.26E+05
Zr-97	4.07E+00	6.99E-01	3.19E-01	0.00E+00	7.04E-01	0.00E+00	4.46E+04
Mo-93	0.00E+00	3.49E+09	1.12E+08	0.00E+00	6.97E+08	0.00E+00	7.47E+07
Mo-99	0.00E+00	2.08E+08	4.06E+07	0.00E+00	3.11E+08	0.00E+00	6.86E+07
Tc-99	2.22E+08	3.00E+08	9.36E+07	0.00E+00	2.53E+09	2.92E+07	1.30E+09
Tc-99m	2.77E+01	5.70E+01	7.35E+02	0.00E+00	6.14E+02	2.98E+01	1.66E+04
Tc-101	2.90E-59	3.66E-59	3.62E-58	0.00E+00	4.35E-58	1.99E-59	6.21E-57
Ru-103	8.67E+03	0.00E+00	2.90E+03	0.00E+00	1.80E+04	0.00E+00	1.05E+05
Ru-105	8.12E-03	0.00E+00	2.74E-03	0.00E+00	5.97E-02	0.00E+00	3.23E+00
Rh-105	3.33E+06	2.18E+06	1.46E+06	0.00E+00	6.05E+06	0.00E+00	5.41E+07
Ru-106	1.90E+05	0.00E+00	2.38E+04	0.00E+00	2.25E+05	0.00E+00	1.45E+06
Pd-107	0.00E+00	9.79E+07	6.95E+06	0.00E+00	5.59E+08	0.00E+00	7.78E+07

Table 4-21 (Page 2 of 3)
Food Dose Rate Parameters for Infant (P_i^F)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	4.01E+05	9.67E+04	0.00E+00	1.47E+06	0.00E+00	9.83E+06
Ag-110m	3.86E+08	2.82E+08	1.86E+08	0.00E+00	4.03E+08	0.00E+00	1.46E+10
Ag-111	6.17E+07	2.40E+07	1.27E+07	0.00E+00	5.01E+07	0.00E+00	5.72E+09
Cd-113m	0.00E+00	1.74E+07	6.42E+05	0.00E+00	1.32E+07	0.00E+00	2.62E+07
Cd-115m	0.00E+00	1.03E+07	3.59E+05	0.00E+00	5.40E+06	0.00E+00	5.89E+07
Sn-123	4.57E+09	7.14E+07	1.19E+08	7.18E+07	0.00E+00	0.00E+00	1.21E+09
Sn-125	5.38E+08	1.00E+07	2.39E+07	9.88E+06	0.00E+00	0.00E+00	8.06E+08
Sn-126	1.14E+10	1.49E+08	3.70E+08	3.93E+07	0.00E+00	0.00E+00	5.18E+08
Sb-124	2.09E+08	3.08E+06	6.49E+07	5.56E+05	0.00E+00	1.31E+08	6.46E+08
Sb-125	1.50E+08	1.45E+06	3.08E+07	1.87E+05	0.00E+00	8.66E+07	1.99E+08
Sb-126	4.18E+07	8.19E+05	1.51E+07	3.21E+05	0.00E+00	2.63E+07	4.33E+08
Sb-127	4.14E+06	7.39E+04	1.28E+06	5.27E+04	0.00E+00	2.14E+06	1.10E+08
Te-125m	1.51E+08	5.04E+07	2.04E+07	5.07E+07	0.00E+00	0.00E+00	7.18E+07
Te-127m	4.21E+08	1.40E+08	5.10E+07	1.22E+08	1.04E+09	0.00E+00	1.70E+08
Te-127	6.34E+03	2.13E+03	1.36E+03	5.16E+03	1.55E+04	0.00E+00	1.33E+05
Te-129m	5.57E+08	1.91E+08	8.58E+07	2.14E+08	1.39E+09	0.00E+00	3.33E+08
Te-129	2.81E-09	9.69E-10	6.56E-10	2.36E-09	7.00E-09	0.00E+00	2.25E-07
Te-133m	1.98E-12	9.05E-13	8.65E-13	1.74E-12	6.17E-12	0.00E+00	9.76E-11
Te-134	8.25E-18	4.14E-18	4.27E-18	7.39E-18	2.79E-17	0.00E+00	9.46E-17
I-129	7.06E+09	5.23E+09	3.83E+09	3.36E+12	6.20E+09	0.00E+00	1.05E+08
I-130	3.56E+06	7.83E+06	3.14E+06	8.78E+08	8.60E+06	0.00E+00	1.68E+06
I-131	2.72E+09	3.21E+09	1.41E+09	1.05E+12	3.74E+09	0.00E+00	1.14E+08
Te-131m	3.38E+06	1.36E+06	1.12E+06	2.76E+06	9.37E+06	0.00E+00	2.29E+07
Te-131	3.76E-32	1.39E-32	1.05E-32	3.35E-32	9.61E-32	0.00E+00	1.52E-30
I-132	1.45E+00	2.95E+00	1.05E+00	1.38E+02	3.29E+00	0.00E+00	2.39E+00
Te-132	2.11E+07	1.05E+07	9.75E+06	1.54E+07	6.54E+07	0.00E+00	3.87E+07
I-133	3.63E+07	5.29E+07	1.55E+07	9.62E+09	6.22E+07	0.00E+00	8.95E+06
Cs-134m	1.55E+00	2.58E+00	1.30E+00	0.00E+00	9.94E-01	2.29E-01	2.04E+00
Cs-134	3.65E+10	6.80E+10	6.87E+09	0.00E+00	1.75E+10	7.18E+09	1.85E+08
I-134	1.84E-11	3.77E-11	1.34E-11	8.78E-10	4.21E-11	0.00E+00	3.89E-11
I-135	1.13E+05	2.25E+05	8.19E+04	2.01E+07	2.50E+05	0.00E+00	8.13E+04
Cs-135	1.31E+10	1.19E+10	6.22E+08	0.00E+00	3.40E+09	1.29E+09	4.31E+07
Cs-136	1.98E+09	5.81E+09	2.17E+09	0.00E+00	2.32E+09	4.74E+08	8.83E+07
Cs-137	5.15E+10	6.02E+10	4.27E+09	0.00E+00	1.62E+10	6.55E+09	1.88E+08
Cs-138	9.01E-23	1.47E-22	7.10E-23	0.00E+00	7.31E-23	1.14E-23	2.34E-22
Cs-139	8.39E-89	1.15E-88	4.38E-89	0.00E+00	5.93E-89	8.93E-90	7.20E-90
Ba-139	4.39E-07	2.91E-10	1.27E-08	0.00E+00	1.75E-10	1.77E-10	2.78E-05
Ba-140	2.41E+08	2.41E+05	1.24E+07	0.00E+00	5.72E+04	1.48E+05	5.92E+07
La-140	4.06E+01	1.60E+01	4.11E+00	0.00E+00	0.00E+00	0.00E+00	1.88E+05
Ba-141	4.46E-45	3.06E-48	1.41E-46	0.00E+00	1.84E-48	1.86E-48	5.45E-44
La-141	2.96E-04	8.59E-05	1.50E-05	0.00E+00	0.00E+00	0.00E+00	9.85E+00
Ce-141	4.34E+04	2.64E+04	3.11E+03	0.00E+00	8.15E+03	0.00E+00	1.37E+07
Ba-142	3.03E-79	2.52E-82	1.49E-80	0.00E+00	1.45E-82	1.53E-82	1.25E-78
La-142	1.74E-10	6.40E-11	1.53E-11	0.00E+00	0.00E+00	0.00E+00	1.09E-05
Ce-143	3.97E+02	2.64E+05	3.01E+01	0.00E+00	7.68E+01	0.00E+00	1.54E+06
Pr-143	1.49E+03	5.55E+02	7.36E+01	0.00E+00	2.06E+02	0.00E+00	7.84E+05
Ce-144	2.33E+06	9.52E+05	1.30E+05	0.00E+00	3.85E+05	0.00E+00	1.33E+08
Pr-144	6.50E-53	2.51E-53	3.27E-54	0.00E+00	9.11E-54	0.00E+00	1.17E-48
Nd-147	8.81E+02	9.05E+02	5.55E+01	0.00E+00	3.49E+02	0.00E+00	5.74E+05
Pm-147	1.57E+04	1.32E+03	6.44E+02	0.00E+00	1.98E+03	0.00E+00	3.75E+05
Pm-148m	4.90E+03	1.24E+03	9.74E+02	0.00E+00	1.43E+03	0.00E+00	1.62E+06
Pm-148	5.57E+02	8.04E+01	4.05E+01	0.00E+00	9.60E+01	0.00E+00	8.58E+05
Pm-149	4.14E+01	5.43E+00	2.37E+00	0.00E+00	6.60E+00	0.00E+00	1.46E+05
Pm-151	6.14E+00	8.95E-01	4.53E-01	0.00E+00	1.06E+00	0.00E+00	4.14E+04
Sm-151	1.19E+04	2.74E+03	5.92E+02	0.00E+00	1.86E+03	0.00E+00	2.29E+05
Sm-153	1.90E+01	1.47E+01	1.13E+00	0.00E+00	3.08E+00	0.00E+00	7.68E+04

Table 4-21 (Page 3 of 3)
Food Dose Rate Parameters for Infant (P_i^F)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	2.76E+04	7.34E+03	6.19E+03	0.00E+00	2.06E+04	0.00E+00	6.52E+05
Eu-154	1.08E+05	1.50E+04	9.01E+03	0.00E+00	4.07E+04	0.00E+00	1.88E+06
Eu-155	2.21E+04	2.55E+03	1.32E+03	0.00E+00	5.71E+03	0.00E+00	3.41E+06
Eu-156	2.23E+03	1.38E+03	2.19E+02	0.00E+00	6.37E+02	0.00E+00	1.30E+06
Tb-160	8.76E+03	0.00E+00	1.10E+03	0.00E+00	2.49E+03	0.00E+00	1.17E+06
Ho-166m	5.14E+04	1.11E+04	8.76E+03	0.00E+00	1.47E+04	0.00E+00	1.09E+06
W-181	3.23E+05	9.91E+04	1.11E+04	0.00E+00	0.00E+00	0.00E+00	1.39E+06
W-185	1.23E+07	3.85E+06	4.39E+05	0.00E+00	0.00E+00	0.00E+00	5.51E+07
W-187	6.09E+04	4.23E+04	1.46E+04	0.00E+00	0.00E+00	0.00E+00	2.49E+06
Np-239	3.65E+01	3.26E+00	1.84E+00	0.00E+00	6.51E+00	0.00E+00	9.44E+04
U-232	9.95E+10	0.00E+00	8.88E+09	0.00E+00	9.74E+09	0.00E+00	2.89E+08
U-233	2.09E+10	0.00E+00	1.59E+09	0.00E+00	4.44E+09	0.00E+00	2.68E+08
U-234	2.01E+10	0.00E+00	1.56E+09	0.00E+00	4.36E+09	0.00E+00	2.62E+08
U-235	1.92E+10	0.00E+00	1.46E+09	0.00E+00	4.08E+09	0.00E+00	3.33E+08
U-236	1.92E+10	0.00E+00	1.50E+09	0.00E+00	4.15E+09	0.00E+00	2.46E+08
U-237	5.39E+05	0.00E+00	1.44E+05	0.00E+00	1.34E+06	0.00E+00	2.30E+07
U-238	1.84E+10	0.00E+00	1.37E+09	0.00E+00	3.82E+09	0.00E+00	2.35E+08
Np-237	9.87E+07	6.54E+06	4.32E+06	0.00E+00	2.61E+07	0.00E+00	3.39E+06
Np-238	3.48E+02	8.76E+00	5.39E+00	0.00E+00	1.91E+01	0.00E+00	1.17E+05
Pu-238	2.11E+07	2.47E+06	5.59E+05	0.00E+00	1.99E+06	0.00E+00	1.25E+06
Pu-239	2.27E+07	2.55E+06	5.82E+05	0.00E+00	2.11E+06	0.00E+00	1.14E+06
Pu-240	2.27E+07	2.55E+06	5.82E+05	0.00E+00	2.11E+06	0.00E+00	1.16E+06
Pu-241	6.97E+05	2.89E+04	1.45E+04	0.00E+00	5.20E+04	0.00E+00	2.38E+04
Pu-242	2.11E+07	2.45E+06	5.61E+05	0.00E+00	2.02E+06	0.00E+00	1.11E+06
Pu-244	2.45E+07	2.81E+06	6.43E+05	0.00E+00	2.32E+06	0.00E+00	1.66E+06
Am-241	6.01E+07	5.22E+07	4.48E+06	0.00E+00	2.69E+07	0.00E+00	3.17E+06
Am-242m	6.21E+07	5.02E+07	4.65E+06	0.00E+00	2.73E+07	0.00E+00	3.99E+06
Am-243	5.92E+07	5.06E+07	4.36E+06	0.00E+00	2.62E+07	0.00E+00	3.71E+06
Cm-242	5.15E+06	4.77E+06	3.42E+05	0.00E+00	9.84E+05	0.00E+00	3.09E+06
Cm-243	5.75E+07	4.72E+07	3.69E+06	0.00E+00	1.34E+07	0.00E+00	3.33E+06
Cm-244	4.84E+07	3.98E+07	3.12E+06	0.00E+00	1.11E+07	0.00E+00	3.22E+06
Cm-245	7.36E+07	5.96E+07	4.65E+06	0.00E+00	1.78E+07	0.00E+00	3.00E+06
Cm-246	7.28E+07	5.96E+07	4.65E+06	0.00E+00	1.77E+07	0.00E+00	2.95E+06
Cm-247	7.12E+07	5.88E+07	4.57E+06	0.00E+00	1.74E+07	0.00E+00	3.88E+06
Cm-248	5.88E+08	4.85E+08	3.77E+07	0.00E+00	1.44E+08	0.00E+00	6.25E+07
Cf-252	4.94E+07	0.00E+00	1.19E+06	0.00E+00	0.00E+00	0.00E+00	1.21E+07

Units of mrem/yr per μCi/m³ for H-3 and C-14
Units of m²mrem/yr per μCi/sec for all other nuclides

Table 4-22
Miscellaneous Dose Assessment Factors: Environmental Parameters

Parameter	Description	Value	Equation(s)	Basis[a]
0.11	Fraction of total plant mass that is natural carbon.	0.11	4-8, 4-18, 4-21, 4-24	A
0.16	Concentration of natural carbon in the atmosphere (g/m^3).	0.16	4-8, 4-18, 4-21, 4-24	A
0.5	Ratio of tritium concentration in plant water to tritium concentration in atmospheric water	0.5	4-7, 4-17, 4-20, 4-23	C,E,F,G
0.75	Fraction of total plant mass that is water	0.75	4-7, 4-17, 4-20, 4-23	C,E,F,G
f_g	Fraction of annual intake of stored vegetation grown locally.	0.76	4-22, 4-23, 4-24	G
f_L	Fraction of annual intake of fresh, leafy vegetation grown locally.	1	4-22, 4-23, 4-24	G
f_p	Fraction of the year the cow is on pasture.	0.5	4-16, 4-19	E,F
f_s	Fraction of cow feed that is pasture grass while the cow is on pasture.	0.5	4-16, 4-19	E,F
H	Atmosphere absolute humidity (g/m^3).	8.0	4-7, 4-17, 4-20, 4-23	C,E,F,G
λ_w	Constant for removal of activity on plant surfaces by weathering (14 day half life) (sec^{-1}).	5.73E-07	4-6, 4-16, 4-19, 4-22	C,E,F,G
p	Fractional equilibrium ratio for C-14. (unity for continuous releases)	1	4-8, 4-18, 4-21, 4-24	A
Q_F	Cow feed consumption rate (kg/day wet).	50.0	4-6, 4-7, 4-8, 4-16, 4-17, 4-18, 4-19, 4-20, 4-21	C,E,F
r	Fraction of deposited activity retained on vegetation.	radioiodine 1.0 particulates 0.2	4-6, 4-16, 4-19, 4-22	C,E,F,G
SF	Shielding factor of residential structures.	0.7	4-15	D
t	Exposure time (30 years) (sec).	9.46E+08	4-15	D [b]
t_e	Exposure period (1 year) (sec)	3.15E+07	4-5	B
t_f	Transport time from pasture, to cow, to milk, to receptor (2 days) (sec)	1.73E+05	4-6, 4-16	C,E
t_g	Average time between harvest of stored vegetation and consumption (60 days) (sec)	5.18E+06	4-22	G
t_h	Transport time from pasture, to harvest, to cow, to milk or meat, to receptor (90 days) (sec)	7.78E+06	4-16, 4-19	E,F
t_L	Average time between harvest of leafy vegetation and consumption (1 day) (sec)	8.64E+04	4-22	G
t_s	Transport time from pasture, to cow, to meat, to receptor (20 days) (sec)	1.73E+06	4-19	F [c]
Y_p	Grass yield (kg/m^2)	0.7	4-6, 4-16, 4-19	C,E,F
Y_s	Stored feed yield (kg/m^2)	2.0	4-16, 4-19	E,F
Y_v	Vegetation areal density (kg/m^2)	2.0	4-22	G

Table 4-22 (continued)
Miscellaneous Dose Assessment Factors: Environmental Parameters

[a] Basis key:

A: Regulatory Guide 1.109 (Reference 6), Equation C-8
B: NUREG-0133 (Reference 14), Section 5.2.1.2
C: NUREG-0133 (Reference 14), Section 5.2.1.3
D: NUREG-0133 (Reference 14), Section 5.3.1.2
E: NUREG-0133 (Reference 14), Section 5.3.1.3
F: NUREG-0133 (Reference 14), Section 5.3.1.4
G: NUREG-0133 (Reference 14), Section 5.3.1.5

[b] The parameter t is taken as the midpoint of plant operating life (based upon an assumed 60 year plant operating lifetime).

[c] The parameter t_f in NUREG-0133 5.3.1.4 is changed to t_s for the meat pathway to avoid confusion.

Table 4-23
Stable Element Transfer Data

Element	Cow Milk (F_m)	Meat (F_f)
H	1.0E-02	1.2E-02
C	1.2E-02	3.1E-02
Na	4.0E-02	3.0E-02
P	2.5E-02	4.6E-02
Ca	8.0E-03	4.0E-03
Sc	5.0E-06	1.6E-02
Cr	2.2E-03	2.4E-03
Mn	2.5E-04	8.0E-04
Fe	1.2E-03	4.0E-02
Co	1.0E-03	1.3E-02
Ni	6.7E-03	5.3E-03
Cu	1.4E-02	8.0E-03
Zn	3.9E-02	3.0E-02
Se	4.5E-02	1.5E-02
Br	5.0E-02	2.6E-02
Rb	3.0E-02	3.1E-02
Sr	8.0E-04	6.0E-04
Y	1.0E-05	4.6E-03
Zr	5.0E-06	3.4E-02
Nb	2.5E-03	2.8E-01
Mo	7.5E-03	8.0E-03
Tc	2.5E-02	4.0E-01
Ru	1.0E-06	4.0E-01
Rh	1.0E-02	1.5E-03
Pd	1.0E-02	4.0E-03
Ag	5.0E-02	1.7E-02
Cd	1.2E-04	5.3E-04
Sn	2.5E-03	8.0E-02
Sb	1.5E-03	4.0E-03
Te	1.0E-03	7.7E-02
I	6.0E-03	2.9E-03
Cs	1.2E-02	4.0E-03
Ba	4.0E-04	3.2E-03
La	5.0E-06	2.0E-04
Ce	1.0E-04	1.2E-03
Pr	5.0E-06	4.7E-03
Nd	5.0E-06	3.3E-03
Pm	5.0E-06	4.8E-03
Sm	5.0E-06	5.0E-03
Eu	5.0E-06	4.8E-03
Tb	5.0E-06	4.4E-03
Ho	5.0E-06	4.4E-03
W	5.0E-04	1.3E-03
U	5.0E-04	3.4E-04
Np	5.0E-06	2.0E-04
Pu	2.0E-06	1.4E-05
Am	5.0E-06	2.0E-04
Cm	5.0E-06	2.0E-04
Cf	5.0E-06	2.0E-04

Units of days/liter for milk
Units of days/kilogram for meat
Source: NUREG/CR-4013 (Reference 107) Table 3.1

Table 4-24 (Page 1 of 3)
Inhalation Pathway Factors for Adult (R_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03
C-14	1.82E+04	3.41E+03	3.41E+03	3.41E+03	3.41E+03	3.41E+03	3.41E+03
Na-22	1.04E+05	1.04E+05	1.04E+05	1.04E+05	1.04E+05	1.04E+05	1.04E+05
Na-24	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04
P-32	1.32E+06	7.71E+04	5.01E+04	0.00E+00	0.00E+00	0.00E+00	8.64E+04
Ca-41	3.06E+05	0.00E+00	3.30E+04	0.00E+00	0.00E+00	3.06E+04	2.29E+03
Sc-46	4.41E+05	8.56E+05	2.49E+05	0.00E+00	7.99E+05	0.00E+00	2.58E+05
Cr-51	0.00E+00	0.00E+00	1.00E+02	5.95E+01	2.28E+01	1.44E+04	3.32E+03
Mn-54	0.00E+00	3.96E+04	6.30E+03	0.00E+00	9.84E+03	1.40E+06	7.74E+04
Fe-55	2.46E+04	1.70E+04	3.94E+03	0.00E+00	0.00E+00	7.21E+04	6.03E+03
Mn-56	0.00E+00	1.24E+00	1.83E-01	0.00E+00	1.30E+00	9.44E+03	2.02E+04
Co-57	0.00E+00	6.92E+02	6.71E+02	0.00E+00	0.00E+00	3.70E+05	3.14E+04
Co-58	0.00E+00	1.58E+03	2.07E+03	0.00E+00	0.00E+00	9.28E+05	1.06E+05
Fe-59	1.18E+04	2.78E+04	1.06E+04	0.00E+00	0.00E+00	1.02E+06	1.88E+05
Co-60	0.00E+00	1.15E+04	1.48E+04	0.00E+00	0.00E+00	5.97E+06	2.85E+05
Ni-59	3.25E+04	1.17E+04	5.42E+03	0.00E+00	0.00E+00	6.56E+04	4.89E+03
Ni-63	4.32E+05	3.14E+04	1.45E+04	0.00E+00	0.00E+00	1.78E+05	1.34E+04
Cu-64	0.00E+00	1.46E+00	6.15E-01	0.00E+00	4.62E+00	6.78E+03	4.90E+04
Ni-65	1.54E+00	2.10E-01	9.12E-02	0.00E+00	0.00E+00	5.60E+03	1.23E+04
Zn-65	3.24E+04	1.03E+05	4.66E+04	0.00E+00	6.90E+04	8.64E+05	5.34E+04
Zn-69m	8.16E+00	1.96E+01	1.79E+00	0.00E+00	1.18E+01	1.90E+04	1.37E+05
Zn-69	3.38E-02	6.51E-02	4.52E-03	0.00E+00	4.22E-02	9.20E+02	1.63E+01
Se-79	0.00E+00	3.06E+03	4.87E+02	0.00E+00	4.55E+03	3.58E+05	2.66E+04
Br-82	0.00E+00	0.00E+00	1.35E+04	0.00E+00	0.00E+00	0.00E+00	1.04E+04
Br-83	0.00E+00	0.00E+00	2.41E+02	0.00E+00	0.00E+00	0.00E+00	2.32E+02
Br-84	0.00E+00	0.00E+00	3.13E+02	0.00E+00	0.00E+00	0.00E+00	1.64E-03
Br-85	0.00E+00	0.00E+00	1.28E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.35E+05	5.90E+04	0.00E+00	0.00E+00	0.00E+00	1.66E+04
Rb-87	0.00E+00	7.89E+04	2.57E+04	0.00E+00	0.00E+00	0.00E+00	2.30E+03
Rb-88	0.00E+00	3.87E+02	1.93E+02	0.00E+00	0.00E+00	0.00E+00	3.34E-09
Rb-89	0.00E+00	2.56E+02	1.70E+02	0.00E+00	0.00E+00	0.00E+00	9.28E-12
Sr-89	3.04E+05	0.00E+00	8.72E+03	0.00E+00	0.00E+00	1.40E+06	3.50E+05
Sr-90	5.06E+07	0.00E+00	3.39E+06	0.00E+00	0.00E+00	9.60E+06	7.22E+05
Y-90	2.09E+03	0.00E+00	5.61E+01	0.00E+00	0.00E+00	1.70E+05	5.06E+05
Sr-91	6.19E+01	0.00E+00	2.50E+00	0.00E+00	0.00E+00	3.65E+04	1.91E+05
Y-91m	2.61E-01	0.00E+00	1.02E-02	0.00E+00	0.00E+00	1.92E+03	1.33E+00
Y-91	4.62E+05	0.00E+00	1.24E+04	0.00E+00	0.00E+00	1.70E+06	3.85E+05
Sr-92	6.74E+00	0.00E+00	2.91E-01	0.00E+00	0.00E+00	1.65E+04	4.30E+04
Y-92	1.03E+01	0.00E+00	3.02E-01	0.00E+00	0.00E+00	1.57E+04	7.35E+04
Y-93	9.44E+01	0.00E+00	2.61E+00	0.00E+00	0.00E+00	4.85E+04	4.22E+05
Nb-93m	2.48E+05	8.08E+04	1.99E+04	0.00E+00	9.28E+04	2.49E+05	1.90E+04
Nb-95	1.41E+04	7.82E+03	4.21E+03	0.00E+00	7.74E+03	5.05E+05	1.04E+05
Nb-97	2.22E-01	5.62E-02	2.05E-02	0.00E+00	6.54E-02	2.40E+03	2.42E+02
Zr-93	4.18E+05	2.34E+04	1.10E+04	0.00E+00	8.88E+04	1.70E+05	1.21E+04
Zr-95	1.07E+05	3.44E+04	2.33E+04	0.00E+00	5.42E+04	1.77E+06	1.50E+05
Zr-97	9.68E+01	1.96E+01	9.04E+00	0.00E+00	2.97E+01	7.87E+04	5.23E+05
Mo-93	0.00E+00	9.36E+03	2.54E+02	0.00E+00	2.84E+03	4.09E+05	3.03E+04
Mo-99	0.00E+00	1.21E+02	2.30E+01	0.00E+00	2.91E+02	9.12E+04	2.48E+05
Tc-99	2.50E+02	3.71E+02	1.00E+02	0.00E+00	4.68E+03	8.08E+05	6.03E+04
Tc-99m	1.03E-03	2.91E-03	3.70E-02	0.00E+00	4.42E-02	7.64E+02	4.16E+03
Tc-101	4.18E-05	6.02E-05	5.90E-04	0.00E+00	1.08E-03	3.99E+02	1.09E-11
Ru-103	1.53E+03	0.00E+00	6.58E+02	0.00E+00	5.83E+03	5.05E+05	1.10E+05
Ru-105	7.90E-01	0.00E+00	3.11E-01	0.00E+00	1.02E+00	1.10E+04	4.82E+04
Rh-105	7.39E+00	5.38E+00	3.54E+00	0.00E+00	2.29E+01	1.93E+04	8.72E+04
Ru-106	6.91E+04	0.00E+00	8.72E+03	0.00E+00	1.34E+05	9.36E+06	9.12E+05
Pd-107	0.00E+00	6.62E+02	4.70E+01	0.00E+00	5.26E+03	7.58E+04	5.65E+03

Table 4-24 (Page 2 of 3)
Inhalation Pathway Factors for Adult (R_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	3.70E+00	9.28E-01	0.00E+00	1.88E+01	1.48E+04	1.22E+05
Ag-110m	1.08E+04	1.00E+04	5.94E+03	0.00E+00	1.97E+04	4.63E+06	3.02E+05
Ag-111	3.40E+02	1.42E+02	7.10E+01	0.00E+00	4.59E+02	1.86E+05	2.23E+05
Cd-113m	0.00E+00	1.23E+06	3.98E+04	0.00E+00	1.37E+06	1.66E+06	1.27E+05
Cd-115m	0.00E+00	1.97E+05	6.36E+03	0.00E+00	1.58E+05	1.41E+06	3.84E+05
Sn-123	2.42E+05	5.34E+03	7.86E+03	4.54E+03	0.00E+00	2.30E+06	3.14E+05
Sn-125	9.28E+03	2.50E+02	5.62E+02	2.07E+02	0.00E+00	5.90E+05	5.45E+05
Sn-126	1.26E+06	3.34E+04	4.80E+04	9.84E+03	0.00E+00	9.36E+06	1.27E+05
Sb-124	3.12E+04	5.89E+02	1.24E+04	7.55E+01	0.00E+00	2.48E+06	4.06E+05
Sb-125	5.34E+04	5.95E+02	1.26E+04	5.40E+01	0.00E+00	1.74E+06	1.01E+05
Sb-126	3.60E+03	7.30E+01	1.30E+03	2.20E+01	0.00E+00	7.66E+05	4.81E+05
Sb-127	2.64E+02	5.78E+00	1.02E+02	3.18E+00	0.00E+00	1.64E+05	3.02E+05
Te-125m	3.42E+03	1.58E+03	4.67E+02	1.05E+03	1.24E+04	3.14E+05	7.06E+04
Te-127m	1.26E+04	5.77E+03	1.57E+03	3.29E+03	4.58E+04	9.60E+05	1.50E+05
Te-127	1.40E+00	6.42E-01	3.10E-01	1.06E+00	5.10E+00	6.51E+03	5.74E+04
Te-129m	9.76E+03	4.67E+03	1.58E+03	3.44E+03	3.66E+04	1.16E+06	3.83E+05
Te-129	4.98E-02	2.39E-02	1.24E-02	3.90E-02	1.87E-01	1.94E+03	1.57E+02
Te-133m	5.79E-02	4.32E-02	3.34E-02	5.02E-02	2.99E-01	4.41E+03	4.39E+02
Te-134	3.07E-02	2.58E-02	1.26E-02	2.75E-02	1.74E-01	3.47E+03	2.38E-01
I-129	1.98E+04	1.69E+04	5.53E+04	4.43E+07	3.62E+04	0.00E+00	1.78E+03
I-130	4.58E+03	1.34E+04	5.28E+03	1.14E+06	2.09E+04	0.00E+00	7.69E+03
I-131	2.52E+04	3.58E+04	2.05E+04	1.19E+07	6.13E+04	0.00E+00	6.28E+03
Te-131m	6.99E+01	4.36E+01	2.90E+01	5.50E+01	3.09E+02	1.46E+05	5.56E+05
Te-131	1.11E-02	5.95E-03	3.59E-03	9.36E-03	4.37E-02	1.39E+03	1.84E+01
I-132	1.16E+03	3.26E+03	1.16E+03	1.14E+05	5.18E+03	0.00E+00	4.06E+02
Te-132	2.60E+02	2.15E+02	1.62E+02	1.90E+02	1.46E+03	2.88E+05	5.10E+05
I-133	8.64E+03	1.48E+04	4.52E+03	2.15E+06	2.58E+04	0.00E+00	8.88E+03
Cs-134m	1.27E+02	2.56E+02	1.38E+02	0.00E+00	1.46E+02	2.34E+01	6.34E+01
Cs-134	3.73E+05	8.48E+05	7.28E+05	0.00E+00	2.87E+05	9.76E+04	1.04E+04
I-134	6.44E+02	1.73E+03	6.15E+02	2.98E+04	2.75E+03	0.00E+00	1.01E+00
I-135	2.68E+03	6.98E+03	2.57E+03	4.48E+05	1.11E+04	0.00E+00	5.25E+03
Cs-135	1.17E+05	1.03E+05	4.79E+04	0.00E+00	4.09E+04	1.26E+04	1.69E+03
Cs-136	3.90E+04	1.46E+05	1.10E+05	0.00E+00	8.56E+04	1.20E+04	1.17E+04
Cs-137	4.78E+05	6.21E+05	4.28E+05	0.00E+00	2.22E+05	7.52E+04	8.40E+03
Cs-138	3.31E+02	6.21E+02	3.24E+02	0.00E+00	4.80E+02	4.86E+01	1.86E-03
Cs-139	2.05E+02	2.90E+02	1.11E+02	0.00E+00	2.44E+02	2.27E+01	4.39E-21
Ba-139	9.36E-01	6.66E-04	2.74E-02	0.00E+00	6.22E-04	3.76E+03	8.96E+02
Ba-140	3.90E+04	4.90E+01	2.57E+03	0.00E+00	1.67E+01	1.27E+06	2.18E+05
La-140	3.44E+02	1.74E+02	4.58E+01	0.00E+00	0.00E+00	1.36E+05	4.58E+05
Ba-141	1.00E-01	7.53E-05	3.36E-03	0.00E+00	7.00E-05	1.94E+03	1.16E-07
La-141	4.27E+00	1.33E+00	2.17E-01	0.00E+00	0.00E+00	1.08E+04	5.85E+04
Ce-141	1.99E+04	1.35E+04	1.53E+03	0.00E+00	6.26E+03	3.62E+05	1.20E+05
Ba-142	2.63E-02	2.70E-05	1.66E-03	0.00E+00	2.29E-05	1.19E+03	1.57E-16
La-142	6.83E-01	3.10E-01	7.72E-02	0.00E+00	0.00E+00	6.33E+03	2.11E+03
Ce-143	1.86E+02	1.38E+02	1.53E+01	0.00E+00	6.08E+01	7.98E+04	2.26E+05
Pr-143	9.36E+03	3.75E+03	4.64E+02	0.00E+00	2.16E+03	2.81E+05	2.00E+05
Ce-144	3.43E+06	1.43E+06	1.84E+05	0.00E+00	8.48E+05	7.78E+06	8.16E+05
Pr-144	3.01E-02	1.25E-02	1.53E-03	0.00E+00	7.05E-03	1.02E+03	2.15E-08
Nd-147	5.27E+03	6.10E+03	3.65E+02	0.00E+00	3.56E+03	2.21E+05	1.73E+05
Pm-147	6.70E+05	6.30E+04	2.55E+04	0.00E+00	1.19E+05	5.28E+05	4.43E+04
Pm-148m	7.86E+04	2.03E+04	1.55E+04	0.00E+00	3.08E+04	1.71E+06	3.34E+05
Pm-148	3.07E+03	5.10E+02	2.56E+02	0.00E+00	9.60E+02	3.13E+05	4.64E+05
Pm-149	2.75E+02	3.90E+01	1.59E+01	0.00E+00	7.35E+01	5.77E+04	2.00E+05
Pm-151	6.80E+01	1.14E+01	5.77E+00	0.00E+00	2.04E+01	3.15E+04	1.60E+05
Sm-151	6.87E+05	1.18E+05	2.84E+04	0.00E+00	1.33E+05	3.56E+05	2.60E+04
Sm-153	1.36E+02	1.14E+02	8.32E+00	0.00E+00	3.67E+01	3.31E+04	1.26E+05

Table 4-24 (Page 3 of 3)
Inhalation Pathway Factors for Adult (R_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	1.90E+06	4.33E+05	3.81E+05	0.00E+00	2.68E+06	2.74E+06	1.27E+05
Eu-154	5.92E+06	7.28E+05	5.18E+05	0.00E+00	3.49E+06	4.67E+06	2.72E+05
Eu-155	8.08E+05	1.14E+05	7.37E+04	0.00E+00	5.27E+05	7.57E+05	4.76E+04
Eu-156	1.54E+04	1.18E+04	1.92E+03	0.00E+00	7.96E+03	6.85E+05	3.60E+05
Tb-160	1.77E+05	0.00E+00	2.20E+04	0.00E+00	7.28E+04	1.54E+06	2.14E+05
Ho-166m	2.70E+06	8.40E+05	6.40E+05	0.00E+00	1.26E+06	3.15E+06	1.27E+05
W-181	4.98E+01	1.62E+01	1.74E+00	0.00E+00	0.00E+00	1.37E+04	2.02E+03
W-185	1.56E+03	5.18E+02	5.45E+01	0.00E+00	0.00E+00	4.46E+05	8.56E+04
W-187	8.48E+00	7.08E+00	2.48E+00	0.00E+00	0.00E+00	2.90E+04	1.55E+05
Np-239	2.30E+02	2.26E+01	1.24E+01	0.00E+00	7.00E+01	3.76E+04	1.19E+05
U-232	4.11E+08	0.00E+00	2.93E+07	0.00E+00	4.45E+07	1.78E+09	3.37E+05
U-233	8.72E+07	0.00E+00	5.28E+06	0.00E+00	2.03E+07	4.26E+08	3.11E+05
U-234	8.32E+07	0.00E+00	5.17E+06	0.00E+00	1.99E+07	4.18E+08	3.05E+05
U-235	8.00E+07	0.00E+00	4.86E+06	0.00E+00	1.87E+07	3.92E+08	3.87E+05
U-236	8.00E+07	0.00E+00	4.96E+06	0.00E+00	1.91E+07	4.00E+08	2.86E+05
U-237	2.94E+02	0.00E+00	7.82E+01	0.00E+00	1.21E+03	8.16E+04	9.60E+04
U-238	7.66E+07	0.00E+00	4.54E+06	0.00E+00	1.74E+07	3.66E+08	2.73E+05
Np-237	1.25E+10	8.00E+09	5.50E+08	0.00E+00	4.08E+09	4.18E+08	3.94E+05
Np-238	2.37E+03	5.76E+02	3.69E+01	0.00E+00	2.18E+02	8.16E+04	1.70E+05
Pu-238	1.14E+10	7.77E+09	5.52E+08	0.00E+00	2.37E+09	1.46E+09	3.62E+05
Pu-239	1.33E+10	8.56E+09	6.20E+08	0.00E+00	2.64E+09	1.38E+09	3.30E+05
Pu-240	1.32E+10	8.56E+09	6.18E+08	0.00E+00	2.63E+09	1.38E+09	3.37E+05
Pu-241	2.74E+08	6.95E+07	1.03E+07	0.00E+00	4.74E+07	1.22E+06	6.92E+03
Pu-242	1.22E+10	8.24E+09	5.97E+08	0.00E+00	2.54E+09	1.32E+09	3.24E+05
Pu-244	1.43E+10	9.44E+09	6.83E+08	0.00E+00	2.91E+09	1.51E+09	4.82E+05
Am-241	1.34E+10	9.04E+09	5.37E+08	0.00E+00	4.03E+09	4.85E+08	3.68E+05
Am-242m	1.36E+10	8.48E+09	5.38E+08	0.00E+00	4.01E+09	1.95E+08	4.63E+05
Am-243	1.34E+10	8.80E+09	5.26E+08	0.00E+00	3.96E+09	4.60E+08	4.32E+05
Cm-242	1.78E+08	1.42E+08	7.87E+06	0.00E+00	3.58E+07	3.14E+08	3.93E+05
Cm-243	8.80E+09	6.09E+09	3.69E+08	0.00E+00	1.72E+09	5.05E+08	3.87E+05
Cm-244	6.70E+09	4.70E+09	2.81E+08	0.00E+00	1.31E+09	4.85E+08	3.74E+05
Cm-245	1.39E+10	9.12E+09	5.71E+08	0.00E+00	2.66E+09	4.68E+08	3.49E+05
Cm-246	1.38E+10	9.12E+09	5.70E+08	0.00E+00	2.66E+09	4.77E+08	3.43E+05
Cm-247	1.34E+10	8.96E+09	5.62E+08	0.00E+00	2.62E+09	4.68E+08	4.50E+05
Cm-248	1.12E+11	7.41E+10	4.63E+09	0.00E+00	2.16E+10	3.86E+09	7.27E+06
Cf-252	4.34E+09	0.00E+00	1.86E+08	0.00E+00	0.00E+00	1.59E+09	1.42E+06

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Table 4-25 (Page 1 of 3)
Inhalation Pathway Factors for Teenager (R_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03
C-14	2.60E+04	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03
Na-22	1.41E+05	1.41E+05	1.41E+05	1.41E+05	1.41E+05	1.41E+05	1.41E+05
Na-24	1.38E+04	1.38E+04	1.38E+04	1.38E+04	1.38E+04	1.38E+04	1.38E+04
P-32	1.89E+06	1.10E+05	7.16E+04	0.00E+00	0.00E+00	0.00E+00	9.28E+04
Ca-41	3.24E+05	0.00E+00	3.50E+04	0.00E+00	0.00E+00	8.08E+08	2.42E+03
Sc-46	5.79E+05	1.13E+06	3.34E+05	0.00E+00	1.08E+06	0.00E+00	2.38E+05
Cr-51	0.00E+00	0.00E+00	1.35E+02	7.50E+01	3.07E+01	2.10E+04	3.00E+03
Mn-54	0.00E+00	5.11E+04	8.40E+03	0.00E+00	1.27E+04	1.98E+06	6.68E+04
Fe-55	3.34E+04	2.38E+04	5.54E+03	0.00E+00	0.00E+00	1.24E+05	6.39E+03
Mn-56	0.00E+00	1.70E+00	2.52E-01	0.00E+00	1.79E+00	1.52E+04	5.74E+04
Co-57	0.00E+00	9.44E+02	9.20E+02	0.00E+00	0.00E+00	5.86E+05	3.14E+04
Co-58	0.00E+00	2.07E+03	2.78E+03	0.00E+00	0.00E+00	1.34E+06	9.52E+04
Fe-59	1.59E+04	3.70E+04	1.43E+04	0.00E+00	0.00E+00	1.53E+06	1.78E+05
Co-60	0.00E+00	1.51E+04	1.98E+04	0.00E+00	0.00E+00	8.72E+06	2.59E+05
Ni-59	4.35E+04	1.62E+04	7.39E+03	0.00E+00	0.00E+00	1.13E+05	5.18E+03
Ni-63	5.80E+05	4.34E+04	1.98E+04	0.00E+00	0.00E+00	3.07E+05	1.42E+04
Cu-64	0.00E+00	2.03E+00	8.48E-01	0.00E+00	6.41E+00	1.11E+04	6.14E+04
Ni-65	2.18E+00	2.93E-01	1.27E-01	0.00E+00	0.00E+00	9.36E+03	3.67E+04
Zn-65	3.86E+04	1.34E+05	6.24E+04	0.00E+00	8.64E+04	1.24E+06	4.66E+04
Zn-69m	1.15E+01	2.71E+01	2.49E+00	0.00E+00	1.65E+01	3.14E+04	1.71E+05
Zn-69	4.83E-02	9.20E-02	6.46E-03	0.00E+00	6.02E-02	1.58E+03	2.85E+02
Se-79	0.00E+00	4.34E+03	6.97E+02	0.00E+00	6.50E+03	6.17E+05	2.82E+04
Br-82	0.00E+00	0.00E+00	1.82E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	3.44E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	4.33E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	1.83E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.90E+05	8.40E+04	0.00E+00	0.00E+00	0.00E+00	1.77E+04
Rb-87	0.00E+00	1.12E+05	3.66E+04	0.00E+00	0.00E+00	0.00E+00	2.44E+03
Rb-88	0.00E+00	5.46E+02	2.72E+02	0.00E+00	0.00E+00	0.00E+00	2.92E-05
Rb-89	0.00E+00	3.52E+02	2.33E+02	0.00E+00	0.00E+00	0.00E+00	3.38E-07
Sr-89	4.34E+05	0.00E+00	1.25E+04	0.00E+00	0.00E+00	2.42E+06	3.71E+05
Sr-90	5.84E+08	0.00E+00	3.92E+06	0.00E+00	0.00E+00	1.65E+07	7.65E+05
Y-90	2.98E+03	0.00E+00	8.00E+01	0.00E+00	0.00E+00	2.93E+05	5.59E+05
Sr-91	8.80E+01	0.00E+00	3.51E+00	0.00E+00	0.00E+00	6.07E+04	2.59E+05
Y-91m	3.70E-01	0.00E+00	1.42E-02	0.00E+00	0.00E+00	3.20E+03	3.02E+01
Y-91	6.61E+05	0.00E+00	1.77E+04	0.00E+00	0.00E+00	2.94E+06	4.09E+05
Sr-92	9.52E+00	0.00E+00	4.06E-01	0.00E+00	0.00E+00	2.74E+04	1.19E+05
Y-92	1.47E+01	0.00E+00	4.29E-01	0.00E+00	0.00E+00	2.68E+04	1.65E+05
Y-93	1.35E+02	0.00E+00	3.72E+00	0.00E+00	0.00E+00	8.32E+04	5.79E+05
Nb-93m	3.31E+05	1.09E+05	2.73E+04	0.00E+00	1.27E+05	4.29E+05	2.02E+04
Nb-95	1.86E+04	1.03E+04	5.66E+03	0.00E+00	1.00E+04	7.51E+05	9.68E+04
Nb-97	3.14E-01	7.78E-02	2.84E-02	0.00E+00	9.12E-02	3.93E+03	2.17E+03
Zr-93	5.46E+05	2.70E+05	1.47E+05	0.00E+00	9.28E+05	2.94E+06	1.28E+05
Zr-95	1.46E+05	4.58E+04	3.15E+04	0.00E+00	6.74E+04	2.69E+06	1.49E+05
Zr-97	1.38E+02	2.72E+01	1.26E+01	0.00E+00	4.12E+01	1.30E+05	6.30E+05
Mo-93	0.00E+00	1.33E+04	3.62E+02	0.00E+00	4.05E+03	7.05E+05	3.19E+04
Mo-99	0.00E+00	1.69E+02	3.22E+01	0.00E+00	4.11E+02	1.54E+05	2.69E+05
Tc-99	3.58E+02	5.26E+02	1.43E+02	0.00E+00	6.68E+03	1.39E+06	6.39E+04
Tc-99m	1.38E-03	3.86E-03	4.99E-02	0.00E+00	5.76E-02	1.15E+03	6.13E+03
Tc-101	5.92E-05	8.40E-05	8.24E-04	0.00E+00	1.52E-03	6.67E+02	8.72E-07
Ru-103	2.10E+03	0.00E+00	8.96E+02	0.00E+00	7.43E+03	7.83E+05	1.09E+05
Ru-105	1.12E+00	0.00E+00	4.34E-01	0.00E+00	1.41E+00	1.82E+04	9.04E+04
Rh-105	1.06E+01	7.58E+00	4.99E+00	0.00E+00	3.23E+01	3.27E+04	9.84E+04
Ru-106	9.84E+04	0.00E+00	1.24E+04	0.00E+00	1.90E+05	1.61E+07	9.60E+05
Pd-107	0.00E+00	9.36E+02	6.71E+01	0.00E+00	7.51E+03	1.30E+05	5.99E+03

Table 4-25 (Page 2 of 3)
Inhalation Pathway Factors for Teenager (R_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	5.25E+00	1.33E+00	0.00E+00	2.69E+01	2.55E+04	1.57E+05
Ag-110m	1.38E+04	1.31E+04	7.99E+03	0.00E+00	2.50E+04	6.75E+06	2.73E+05
Ag-111	4.86E+02	2.02E+02	1.01E+02	0.00E+00	6.54E+02	3.20E+05	2.40E+05
Cd-113m	0.00E+00	1.74E+06	5.68E+04	0.00E+00	1.94E+06	2.87E+06	1.34E+05
Cd-115m	0.00E+00	2.78E+05	9.12E+03	0.00E+00	2.26E+05	2.42E+06	4.08E+05
Sn-123	3.45E+05	7.55E+03	1.12E+04	6.04E+03	0.00E+00	3.97E+06	3.33E+05
Sn-125	1.33E+04	3.54E+02	7.99E+02	2.76E+02	0.00E+00	1.01E+06	5.83E+05
Sn-126	1.74E+06	4.31E+04	6.59E+04	1.14E+04	0.00E+00	1.38E+07	1.34E+05
Sb-124	4.30E+04	7.94E+02	1.68E+04	9.76E+01	0.00E+00	3.85E+06	3.98E+05
Sb-125	7.38E+04	8.08E+02	1.72E+04	7.04E+01	0.00E+00	2.74E+06	9.92E+04
Sb-126	4.95E+03	1.02E+02	1.78E+03	2.80E+01	0.00E+00	1.24E+06	4.81E+05
Sb-127	3.71E+02	7.94E+00	1.40E+02	4.17E+00	0.00E+00	2.65E+05	3.15E+05
Te-125m	4.88E+03	2.24E+03	6.67E+02	1.40E+03	0.00E+00	5.36E+05	7.50E+04
Te-127m	1.80E+04	8.16E+03	2.18E+03	4.38E+03	6.54E+04	1.66E+06	1.59E+05
Te-127	2.01E+00	9.12E-01	4.42E-01	1.42E+00	7.28E+00	1.12E+04	8.08E+04
Te-129m	1.39E+04	6.58E+03	2.25E+03	4.58E+03	5.19E+04	1.98E+06	4.05E+05
Te-129	7.10E-02	3.38E-02	1.76E-02	5.18E-02	2.66E-01	3.30E+03	1.62E+03
Te-133m	8.08E-02	5.86E-02	4.57E-02	6.54E-02	4.06E-01	6.97E+03	9.84E+02
Te-134	4.25E-02	3.48E-02	2.91E-02	3.57E-02	2.33E-01	5.40E+03	1.10E+01
I-129	2.82E+04	2.35E+04	3.92E+04	2.93E+07	4.21E+04	0.00E+00	1.83E+03
I-130	6.24E+03	1.79E+04	7.17E+03	1.49E+06	2.75E+04	0.00E+00	9.12E+03
I-131	3.54E+04	4.91E+04	2.64E+04	1.46E+07	8.40E+04	0.00E+00	6.49E+03
Te-131m	9.84E+01	6.01E+01	4.02E+01	7.25E+01	4.39E+02	2.38E+05	6.21E+05
Te-131	1.58E-02	8.32E-03	5.04E-03	1.24E-02	6.18E-02	2.34E+03	1.51E+01
I-132	1.59E+03	4.38E+03	1.58E+03	1.51E+05	6.92E+03	0.00E+00	1.27E+03
Te-132	3.60E+02	2.90E+02	2.19E+02	2.46E+02	1.95E+03	4.49E+05	4.63E+05
I-133	1.22E+04	2.05E+04	6.22E+03	2.92E+06	3.59E+04	0.00E+00	1.03E+04
Cs-134m	1.76E+02	3.48E+02	1.88E+02	0.00E+00	2.03E+02	3.65E+01	1.62E+02
Cs-134	5.02E+05	1.13E+06	5.49E+05	0.00E+00	3.75E+05	1.46E+05	9.76E+03
I-134	8.88E+02	2.32E+03	8.40E+02	3.95E+04	3.66E+03	0.00E+00	2.04E+01
I-135	3.70E+03	9.44E+03	3.49E+03	6.21E+05	1.49E+04	0.00E+00	6.95E+03
Cs-135	1.66E+05	1.46E+05	3.58E+04	0.00E+00	5.84E+04	2.16E+04	1.78E+03
Cs-136	5.15E+04	1.94E+05	1.37E+05	0.00E+00	1.10E+05	1.78E+04	1.09E+04
Cs-137	6.70E+05	8.48E+05	3.11E+05	0.00E+00	3.04E+05	1.21E+05	8.48E+03
Cs-138	4.66E+02	8.56E+02	4.46E+02	0.00E+00	6.62E+02	7.87E+01	2.70E-01
Cs-139	2.92E+02	4.10E+02	1.58E+02	0.00E+00	3.47E+02	3.89E+01	1.33E-13
Ba-139	1.34E+00	9.44E-04	3.90E-02	0.00E+00	8.88E-04	6.46E+03	6.45E+03
Ba-140	5.47E+04	6.70E+01	3.52E+03	0.00E+00	2.28E+01	2.03E+06	2.29E+05
La-140	4.79E+02	2.36E+02	6.26E+01	0.00E+00	0.00E+00	2.14E+05	4.87E+05
Ba-141	1.42E-01	1.06E-04	4.74E-03	0.00E+00	9.84E-05	3.29E+03	7.46E-04
La-141	6.10E+00	1.88E+00	3.10E-01	0.00E+00	0.00E+00	1.85E+04	1.23E+05
Ce-141	2.84E+04	1.90E+04	2.17E+03	0.00E+00	8.88E+03	6.14E+05	1.26E+05
Ba-142	3.70E-02	3.70E-05	2.27E-03	0.00E+00	3.14E-05	1.91E+03	4.79E-10
La-142	9.60E-01	4.25E-01	1.06E-01	0.00E+00	0.00E+00	1.02E+04	1.20E+04
Ce-143	2.66E+02	1.94E+02	2.16E+01	0.00E+00	8.64E+01	1.30E+05	2.55E+05
Pr-143	1.34E+04	5.31E+03	6.62E+02	0.00E+00	3.09E+03	4.83E+05	2.14E+05
Ce-144	4.89E+06	2.02E+06	2.62E+05	0.00E+00	1.21E+06	1.34E+07	8.64E+05
Pr-144	4.30E-02	1.76E-02	2.18E-03	0.00E+00	1.01E-02	1.75E+03	2.35E-04
Nd-147	7.86E+03	8.56E+03	5.13E+02	0.00E+00	5.02E+03	3.72E+05	1.82E+05
Pm-147	9.20E+05	8.80E+04	3.60E+04	0.00E+00	1.68E+05	9.12E+05	4.70E+04
Pm-148m	1.06E+05	2.68E+04	2.10E+04	0.00E+00	4.06E+04	2.56E+06	3.28E+05
Pm-148	4.35E+03	7.10E+02	3.58E+02	0.00E+00	1.28E+03	5.22E+05	4.91E+05
Pm-149	3.93E+02	5.51E+01	2.27E+01	0.00E+00	1.05E+02	9.92E+04	2.23E+05
Pm-151	9.60E+01	1.59E+01	8.08E+00	0.00E+00	2.86E+01	5.25E+04	1.82E+05
Sm-151	8.56E+05	1.68E+05	3.89E+04	0.00E+00	1.82E+05	6.14E+05	2.82E+04
Sm-153	1.94E+02	1.61E+02	1.18E+01	0.00E+00	5.25E+01	5.69E+04	1.42E+05

Table 4-25 (Page 3 of 3)
Inhalation Pathway Factors for Teenager (R_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	2.37E+06	5.75E+05	5.04E+05	0.00E+00	2.67E+06	4.01E+06	1.08E+05
Eu-154	7.54E+06	9.84E+05	6.88E+05	0.00E+00	4.35E+06	7.30E+06	2.67E+05
Eu-155	1.60E+06	1.57E+05	9.68E+04	0.00E+00	6.12E+05	1.21E+07	4.78E+05
Eu-156	2.16E+04	1.62E+04	2.64E+03	0.00E+00	1.09E+04	1.10E+06	3.65E+05
Tb-160	2.43E+05	0.00E+00	3.03E+04	0.00E+00	9.60E+04	2.38E+06	2.08E+05
Ho-166m	3.52E+06	1.09E+06	7.90E+05	0.00E+00	1.60E+06	4.99E+06	1.34E+05
W-181	7.12E+01	2.30E+01	2.41E+00	0.00E+00	0.00E+00	2.36E+04	2.15E+03
W-185	2.22E+03	7.34E+02	7.78E+01	0.00E+00	0.00E+00	7.68E+05	9.12E+04
W-187	1.20E+01	9.76E+00	3.43E+00	0.00E+00	0.00E+00	4.74E+04	1.77E+05
Np-239	3.38E+02	3.19E+01	1.77E+01	0.00E+00	1.00E+02	6.49E+04	1.32E+05
U-232	5.85E+08	0.00E+00	4.18E+07	0.00E+00	6.35E+07	3.07E+09	3.57E+05
U-233	1.24E+08	0.00E+00	7.54E+06	0.00E+00	2.90E+07	7.34E+08	3.30E+05
U-234	1.18E+08	0.00E+00	7.38E+06	0.00E+00	2.84E+07	7.19E+08	3.23E+05
U-235	1.14E+08	0.00E+00	6.94E+06	0.00E+00	2.67E+07	6.75E+08	4.10E+05
U-236	1.14E+08	0.00E+00	7.09E+06	0.00E+00	2.73E+07	6.90E+08	3.03E+05
U-237	4.20E+02	0.00E+00	1.12E+02	0.00E+00	1.73E+03	1.41E+05	1.03E+05
U-238	1.09E+08	0.00E+00	6.48E+06	0.00E+00	2.50E+07	6.31E+08	2.90E+05
Np-237	1.31E+10	8.48E+09	5.77E+08	0.00E+00	4.28E+09	7.19E+08	4.18E+05
Np-238	3.38E+03	8.16E+02	5.27E+01	0.00E+00	3.10E+02	1.40E+05	1.90E+05
Pu-238	1.20E+10	8.24E+09	5.78E+08	0.00E+00	2.48E+09	2.50E+09	3.83E+05
Pu-239	1.38E+10	8.96E+09	6.44E+08	0.00E+00	2.75E+09	2.34E+09	3.50E+05
Pu-240	1.38E+10	8.96E+09	6.43E+08	0.00E+00	2.74E+09	2.34E+09	3.57E+05
Pu-241	2.99E+08	7.65E+07	1.12E+07	0.00E+00	5.18E+07	2.08E+06	7.34E+03
Pu-242	1.28E+10	8.64E+09	6.20E+08	0.00E+00	2.65E+09	2.26E+09	3.43E+05
Pu-244	1.50E+10	9.92E+09	7.10E+08	0.00E+00	3.03E+09	2.58E+09	5.11E+05
Am-241	1.42E+10	9.60E+09	5.68E+08	0.00E+00	4.26E+09	8.40E+08	3.90E+05
Am-242m	1.43E+10	9.04E+09	5.72E+08	0.00E+00	4.24E+09	3.37E+08	4.91E+05
Am-243	1.42E+10	9.36E+09	5.56E+08	0.00E+00	4.17E+09	7.93E+08	4.58E+05
Cm-242	2.54E+08	2.01E+08	1.13E+07	0.00E+00	5.12E+07	5.41E+08	4.17E+05
Cm-243	9.52E+09	6.64E+09	4.00E+08	0.00E+00	1.87E+09	8.72E+08	4.10E+05
Cm-244	7.35E+09	5.22E+09	3.10E+08	0.00E+00	1.45E+09	8.40E+08	3.97E+05
Cm-245	1.46E+10	9.76E+09	6.02E+08	0.00E+00	2.82E+09	8.08E+08	3.70E+05
Cm-246	1.45E+10	9.76E+09	6.02E+08	0.00E+00	2.81E+09	8.24E+08	3.63E+05
Cm-247	1.42E+10	9.52E+09	5.93E+08	0.00E+00	2.77E+09	8.08E+08	4.78E+05
Cm-248	1.18E+11	7.86E+10	4.89E+09	0.00E+00	2.28E+10	6.66E+09	7.70E+06
Cf-252	5.73E+09	0.00E+00	2.46E+08	0.00E+00	0.00E+00	2.74E+09	1.51E+06

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Table 4-26 (Page 1 of 3)
Inhalation Pathway Factors for Child (R_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03
C-14	3.59E+04	6.73E+03	6.73E+03	6.73E+03	6.73E+03	6.73E+03	6.73E+03
Na-22	1.63E+05	1.63E+05	1.63E+05	1.63E+05	1.63E+05	1.63E+05	1.63E+05
Na-24	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04
P-32	2.60E+06	1.14E+05	9.88E+04	0.00E+00	0.00E+00	0.00E+00	4.22E+04
Ca-41	2.61E+05	0.00E+00	2.85E+04	0.00E+00	0.00E+00	2.67E+08	1.09E+03
Sc-46	7.29E+05	9.99E+05	3.85E+05	0.00E+00	8.84E+05	0.00E+00	9.07E+04
Cr-51	0.00E+00	0.00E+00	1.54E+02	8.55E+01	2.43E+01	1.70E+04	1.08E+03
Mn-54	0.00E+00	4.29E+04	9.51E+03	0.00E+00	1.00E+04	1.58E+06	2.29E+04
Fe-55	4.74E+04	2.52E+04	7.77E+03	0.00E+00	0.00E+00	1.11E+05	2.87E+03
Mn-56	0.00E+00	1.66E+00	3.12E-01	0.00E+00	1.67E+00	1.31E+04	1.23E+05
Co-57	0.00E+00	9.03E+02	1.07E+03	0.00E+00	0.00E+00	5.07E+05	1.32E+04
Co-58	0.00E+00	1.77E+03	3.16E+03	0.00E+00	0.00E+00	1.11E+06	3.44E+04
Fe-59	2.07E+04	3.34E+04	1.67E+04	0.00E+00	0.00E+00	1.27E+06	7.07E+04
Co-60	0.00E+00	1.31E+04	2.26E+04	0.00E+00	0.00E+00	7.07E+06	9.62E+04
Ni-59	6.14E+04	1.73E+04	1.05E+04	0.00E+00	0.00E+00	1.01E+05	2.33E+03
Ni-63	8.21E+05	4.63E+04	2.80E+04	0.00E+00	0.00E+00	2.75E+05	6.33E+03
Cu-64	0.00E+00	1.99E+00	1.07E+00	0.00E+00	6.03E+00	9.58E+03	3.67E+04
Ni-65	2.99E+00	2.96E-01	1.64E-01	0.00E+00	0.00E+00	8.18E+03	8.40E+04
Zn-65	4.26E+04	1.13E+05	7.03E+04	0.00E+00	7.14E+04	9.95E+05	1.63E+04
Zn-69m	1.58E+01	2.69E+01	3.18E+00	0.00E+00	1.56E+01	2.72E+04	1.00E+05
Zn-69	6.70E-02	9.66E-02	8.92E-03	0.00E+00	5.85E-02	1.42E+03	1.02E+04
Se-79	0.00E+00	4.55E+03	9.62E+02	0.00E+00	6.33E+03	5.51E+05	1.27E+04
Br-82	0.00E+00	0.00E+00	2.09E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	4.74E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	5.48E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	2.53E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.98E+05	1.14E+05	0.00E+00	0.00E+00	0.00E+00	7.99E+03
Rb-87	0.00E+00	1.17E+05	5.07E+04	0.00E+00	0.00E+00	0.00E+00	1.10E+03
Rb-88	0.00E+00	5.62E+02	3.66E+02	0.00E+00	0.00E+00	0.00E+00	1.72E+01
Rb-89	0.00E+00	3.45E+02	2.90E+02	0.00E+00	0.00E+00	0.00E+00	1.89E+00
Sr-89	5.99E+05	0.00E+00	1.72E+04	0.00E+00	0.00E+00	2.16E+06	1.67E+05
Sr-90	6.77E+07	0.00E+00	4.51E+06	0.00E+00	0.00E+00	1.48E+07	3.43E+05
Y-90	4.11E+03	0.00E+00	1.11E+02	0.00E+00	0.00E+00	2.62E+05	2.68E+05
Sr-91	1.21E+02	0.00E+00	4.59E+00	0.00E+00	0.00E+00	5.33E+04	1.74E+05
Y-91m	5.07E-01	0.00E+00	1.84E-02	0.00E+00	0.00E+00	2.81E+03	1.72E+03
Y-91	9.14E+05	0.00E+00	2.44E+04	0.00E+00	0.00E+00	2.63E+06	1.84E+05
Sr-92	1.31E+01	0.00E+00	5.25E-01	0.00E+00	0.00E+00	2.40E+04	2.42E+05
Y-92	2.04E+01	0.00E+00	5.81E-01	0.00E+00	0.00E+00	2.39E+04	2.39E+05
Y-93	1.86E+02	0.00E+00	5.11E+00	0.00E+00	0.00E+00	7.44E+04	3.89E+05
Nb-93m	4.70E+05	1.17E+05	3.85E+04	0.00E+00	1.27E+05	3.85E+05	9.07E+03
Nb-95	2.35E+04	9.18E+03	6.55E+03	0.00E+00	8.62E+03	6.14E+05	3.70E+04
Nb-97	4.29E-01	7.70E-02	3.60E-02	0.00E+00	8.55E-02	3.42E+03	2.78E+04
Zr-93	7.66E+05	2.89E+05	2.05E+05	0.00E+00	1.11E+06	2.63E+06	5.44E+04
Zr-95	1.90E+05	4.18E+04	3.70E+04	0.00E+00	5.96E+04	2.23E+06	6.11E+04
Zr-97	1.88E+02	2.72E+01	1.60E+01	0.00E+00	3.89E+01	1.13E+05	3.51E+05
Mo-93	0.00E+00	1.39E+04	5.00E+02	0.00E+00	3.92E+03	6.29E+05	1.40E+04
Mo-99	0.00E+00	1.72E+02	4.26E+01	0.00E+00	3.92E+02	1.35E+05	1.27E+05
Tc-99	4.96E+02	5.51E+02	1.98E+02	0.00E+00	6.48E+03	1.25E+06	2.87E+04
Tc-99m	1.78E-03	3.48E-03	5.77E-02	0.00E+00	5.07E-02	9.51E+02	4.81E+03
Tc-101	8.10E-05	8.51E-05	1.08E-03	0.00E+00	1.45E-03	5.85E+02	1.63E+01
Ru-103	2.79E+03	0.00E+00	1.07E+03	0.00E+00	7.03E+03	6.62E+05	4.48E+04
Ru-105	1.53E+00	0.00E+00	5.55E-01	0.00E+00	1.34E+00	1.59E+04	9.95E+04
Rh-105	1.45E+01	7.77E+00	6.62E+00	0.00E+00	3.10E+01	2.89E+04	4.92E+04
Ru-106	1.36E+05	0.00E+00	1.69E+04	0.00E+00	1.84E+05	1.43E+07	4.29E+05
Pd-107	0.00E+00	9.81E+02	9.29E+01	0.00E+00	7.29E+03	1.17E+05	2.69E+03

Table 4-26 (Page 2 of 3)
Inhalation Pathway Factors for Child (R_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	5.48E+00	1.83E+00	0.00E+00	2.61E+01	2.28E+04	9.58E+04
Ag-110m	1.69E+04	1.14E+04	9.14E+03	0.00E+00	2.12E+04	5.48E+06	1.00E+05
Ag-111	6.70E+02	2.10E+02	1.39E+02	0.00E+00	6.33E+02	2.86E+05	1.10E+05
Cd-113m	0.00E+00	1.82E+06	7.84E+04	0.00E+00	1.90E+06	2.57E+06	6.03E+04
Cd-115m	0.00E+00	2.92E+05	1.25E+04	0.00E+00	2.19E+05	2.17E+06	1.84E+05
Sn-123	4.77E+05	7.92E+03	1.55E+04	8.40E+03	0.00E+00	3.55E+06	1.50E+05
Sn-125	1.83E+04	3.68E+02	1.09E+03	3.81E+02	0.00E+00	8.99E+05	2.65E+05
Sn-126	2.31E+06	3.85E+04	8.73E+04	1.05E+04	0.00E+00	1.12E+07	6.03E+04
Sb-124	5.74E+04	7.40E+02	2.00E+04	1.26E+02	0.00E+00	3.24E+06	1.64E+05
Sb-125	9.84E+04	7.59E+02	2.07E+04	9.10E+01	0.00E+00	2.32E+06	4.03E+04
Sb-126	6.36E+03	9.69E+01	2.28E+03	3.70E+01	0.00E+00	1.06E+06	2.10E+05
Sb-127	5.03E+02	7.73E+00	1.74E+02	5.59E+00	0.00E+00	2.28E+05	1.41E+05
Te-125m	6.73E+03	2.33E+03	9.14E+02	1.92E+03	0.00E+00	4.77E+05	3.38E+04
Te-127m	2.49E+04	8.55E+03	3.02E+03	6.07E+03	6.36E+04	1.48E+06	7.14E+04
Te-127	2.77E+00	9.51E-01	6.11E-01	1.96E+00	7.07E+00	1.00E+04	5.62E+04
Te-129m	1.92E+04	6.85E+03	3.04E+03	6.33E+03	5.03E+04	1.76E+06	1.82E+05
Te-129	9.77E-02	3.50E-02	2.38E-02	7.14E-02	2.57E-01	2.93E+03	2.55E+04
Te-133m	1.08E-01	5.59E-02	5.55E-02	8.58E-02	3.74E-01	5.92E+03	1.76E+04
Te-134	5.66E-02	3.26E-02	3.48E-02	4.59E-02	2.11E-01	4.55E+03	1.80E+03
I-129	3.89E+04	2.37E+04	2.11E+04	1.58E+07	4.00E+04	0.00E+00	7.96E+02
I-130	8.18E+03	1.64E+04	8.44E+03	1.85E+06	2.45E+04	0.00E+00	5.11E+03
I-131	4.81E+04	4.81E+04	2.73E+04	1.62E+07	7.88E+04	0.00E+00	2.84E+03
Te-131m	1.34E+02	5.92E+01	5.07E+01	9.77E+01	4.00E+02	2.06E+05	3.08E+05
Te-131	2.17E-02	8.44E-03	6.59E-03	1.70E-02	5.88E-02	2.05E+03	1.33E+03
I-132	2.12E+03	4.07E+03	1.88E+03	1.94E+05	6.25E+03	0.00E+00	3.20E+03
Te-132	4.81E+02	2.72E+02	2.63E+02	3.17E+02	1.77E+03	3.77E+05	1.38E+05
I-133	1.66E+04	2.03E+04	7.70E+03	3.85E+06	3.38E+04	0.00E+00	5.48E+03
Cs-134m	2.34E+02	3.30E+02	2.26E+02	0.00E+00	1.83E+02	3.09E+01	2.93E+02
Cs-134	6.51E+05	1.01E+06	2.25E+05	0.00E+00	3.30E+05	1.21E+05	3.85E+03
I-134	1.17E+03	2.16E+03	9.95E+02	5.07E+04	3.30E+03	0.00E+00	9.55E+02
I-135	4.92E+03	8.73E+03	4.14E+03	7.92E+05	1.34E+04	0.00E+00	4.44E+03
Cs-135	2.31E+05	1.53E+05	1.65E+04	0.00E+00	5.66E+04	1.93E+04	8.03E+02
Cs-136	6.51E+04	1.71E+05	1.16E+05	0.00E+00	9.55E+04	1.45E+04	4.18E+03
Cs-137	9.07E+05	8.25E+05	1.28E+05	0.00E+00	2.82E+05	1.04E+05	3.62E+03
Cs-138	6.33E+02	8.40E+02	5.55E+02	0.00E+00	6.22E+02	6.81E+01	2.70E+02
Cs-139	4.03E+02	4.26E+02	2.15E+02	0.00E+00	3.36E+02	3.46E+01	2.68E-02
Ba-139	1.84E+00	9.84E-04	5.37E-02	0.00E+00	8.62E-04	5.77E+03	5.77E+04
Ba-140	7.40E+04	6.48E+01	4.33E+03	0.00E+00	2.11E+01	1.74E+06	1.02E+05
La-140	6.44E+02	2.25E+02	7.55E+01	0.00E+00	0.00E+00	1.83E+05	2.26E+05
Ba-141	1.96E-01	1.09E-04	6.36E-03	0.00E+00	9.47E-05	2.92E+03	2.75E+02
La-141	8.44E+00	1.96E+00	4.26E-01	0.00E+00	0.00E+00	1.66E+04	1.62E+05
Ce-141	3.92E+04	1.95E+04	2.90E+03	0.00E+00	8.55E+03	5.44E+05	5.66E+04
Ba-142	5.00E-02	3.60E-05	2.79E-03	0.00E+00	2.91E-05	1.64E+03	2.74E+00
La-142	1.30E+00	4.11E-01	1.29E-01	0.00E+00	0.00E+00	8.70E+03	7.59E+04
Ce-143	3.66E+02	1.99E+02	2.87E+01	0.00E+00	8.36E+01	1.15E+05	1.27E+05
Pr-143	1.85E+04	5.55E+03	9.14E+02	0.00E+00	3.00E+03	4.33E+05	9.73E+04
Ce-144	6.77E+06	2.12E+06	3.61E+05	0.00E+00	1.17E+06	1.20E+07	3.89E+05
Pr-144	5.96E-02	1.85E-02	3.00E-03	0.00E+00	9.77E-03	1.57E+03	1.97E+02
Nd-147	1.08E+04	8.73E+03	6.81E+02	0.00E+00	4.81E+03	3.28E+05	8.21E+04
Pm-147	1.30E+06	9.32E+04	5.03E+04	0.00E+00	1.65E+05	8.14E+05	2.11E+04
Pm-148m	1.22E+05	2.42E+04	2.42E+04	0.00E+00	3.60E+04	2.12E+06	1.32E+05
Pm-148	5.96E+03	7.18E+02	4.63E+02	0.00E+00	1.22E+03	4.59E+05	2.22E+05
Pm-149	5.44E+02	5.77E+01	3.13E+01	0.00E+00	1.02E+02	8.88E+04	1.08E+05
Pm-151	1.32E+02	1.60E+01	1.04E+01	0.00E+00	2.72E+01	4.59E+04	9.25E+04
Sm-151	1.16E+06	1.76E+05	5.51E+04	0.00E+00	1.81E+05	5.48E+05	1.27E+04
Sm-153	2.68E+02	1.67E+02	1.61E+01	0.00E+00	5.07E+01	5.07E+04	6.92E+04

Table 4-26 (Page 3 of 3)
Inhalation Pathway Factors for Child (R_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	2.75E+06	5.07E+05	5.96E+05	0.00E+00	2.12E+06	3.33E+06	4.22E+04
Eu-154	1.01E+07	9.21E+05	8.40E+05	0.00E+00	4.03E+06	6.14E+06	1.10E+05
Eu-155	2.07E+06	1.50E+05	1.18E+05	0.00E+00	5.59E+05	1.03E+06	1.99E+05
Eu-156	2.92E+04	1.57E+04	3.24E+03	0.00E+00	1.01E+04	9.40E+05	1.57E+05
Tb-160	2.88E+05	0.00E+00	3.58E+04	0.00E+00	8.58E+04	1.98E+06	8.44E+04
Ho-166m	4.96E+06	1.04E+06	8.77E+05	0.00E+00	1.48E+06	4.18E+06	6.03E+04
W-181	9.84E+01	2.41E+01	3.33E+00	0.00E+00	0.00E+00	2.11E+04	9.66E+02
W-185	3.07E+03	7.70E+02	1.08E+02	0.00E+00	0.00E+00	6.88E+05	4.11E+04
W-187	1.63E+01	9.66E+00	4.33E+00	0.00E+00	0.00E+00	4.11E+04	9.10E+04
Np-239	4.66E+02	3.34E+01	2.35E+01	0.00E+00	9.73E+01	5.81E+04	6.40E+04
U-232	8.10E+08	0.00E+00	5.77E+07	0.00E+00	6.18E+07	2.75E+09	1.60E+05
U-233	1.72E+08	0.00E+00	1.04E+07	0.00E+00	2.82E+07	6.55E+08	1.48E+05
U-234	1.65E+08	0.00E+00	1.02E+07	0.00E+00	2.76E+07	6.44E+08	1.45E+05
U-235	1.58E+08	0.00E+00	9.58E+06	0.00E+00	2.59E+07	6.03E+08	1.84E+05
U-236	1.58E+08	0.00E+00	9.81E+06	0.00E+00	2.65E+07	6.18E+08	1.36E+05
U-237	5.81E+02	0.00E+00	1.54E+02	0.00E+00	1.68E+03	1.26E+05	4.77E+04
U-238	1.51E+08	0.00E+00	8.95E+06	0.00E+00	2.42E+07	5.66E+08	1.30E+05
Np-237	1.01E+10	5.99E+09	4.40E+08	0.00E+00	2.74E+09	6.44E+08	1.87E+05
Np-238	4.66E+03	8.51E+02	7.29E+01	0.00E+00	3.02E+02	1.25E+05	9.25E+04
Pu-238	9.44E+09	5.92E+09	4.48E+08	0.00E+00	1.65E+09	2.25E+09	1.72E+05
Pu-239	1.03E+10	6.22E+09	4.74E+08	0.00E+00	1.77E+09	2.12E+09	1.57E+05
Pu-240	1.03E+10	6.22E+09	4.70E+08	0.00E+00	1.76E+09	2.11E+09	1.60E+05
Pu-241	2.94E+08	6.48E+07	1.08E+07	0.00E+00	4.07E+07	1.87E+06	3.29E+03
Pu-242	9.58E+09	5.99E+09	4.55E+08	0.00E+00	1.70E+09	2.04E+09	1.54E+05
Pu-244	1.12E+10	6.85E+09	5.22E+08	0.00E+00	1.95E+09	2.33E+09	2.29E+05
Am-241	1.10E+10	6.81E+09	4.59E+08	0.00E+00	2.82E+09	7.47E+08	1.75E+05
Am-242m	1.14E+10	6.51E+09	4.70E+08	0.00E+00	2.85E+09	3.01E+08	2.21E+05
Am-243	1.09E+10	6.59E+09	4.44E+08	0.00E+00	2.75E+09	7.10E+08	2.05E+05
Cm-242	3.51E+08	2.10E+08	1.55E+07	0.00E+00	4.96E+07	4.85E+08	1.87E+05
Cm-243	8.58E+09	5.25E+09	3.68E+08	0.00E+00	1.38E+09	7.77E+08	1.84E+05
Cm-244	7.18E+09	4.37E+09	3.07E+08	0.00E+00	1.13E+09	7.47E+08	1.78E+05
Cm-245	1.13E+10	6.81E+09	4.74E+08	0.00E+00	1.86E+09	7.22E+08	1.66E+05
Cm-246	1.12E+10	6.81E+09	4.74E+08	0.00E+00	1.86E+09	7.36E+08	1.63E+05
Cm-247	1.09E+10	6.73E+09	4.66E+08	0.00E+00	1.83E+09	7.22E+08	2.15E+05
Cm-248	9.07E+10	5.55E+10	3.85E+09	0.00E+00	1.51E+10	5.96E+09	3.46E+06
Cf-252	8.07E+09	0.00E+00	3.45E+08	0.00E+00	0.00E+00	2.45E+09	6.81E+05

Units of mrem/yr per $\mu Ci/m^3$

Table 4-27 (Page 1 of 3)
Inhalation Pathway Factors for Infant (R_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02
C-14	2.65E+04	5.31E+03	5.31E+03	5.31E+03	5.31E+03	5.31E+03	5.31E+03
Na-22	1.03E+05	1.03E+05	1.03E+05	1.03E+05	1.03E+05	1.03E+05	1.03E+05
Na-24	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04
P-32	2.03E+06	1.12E+05	7.74E+04	0.00E+00	0.00E+00	0.00E+00	1.61E+04
Ca-41	1.05E+05	0.00E+00	1.14E+04	0.00E+00	0.00E+00	9.72E+07	4.14E+02
Sc-46	5.25E+05	7.57E+05	2.37E+05	0.00E+00	4.98E+05	0.00E+00	3.07E+04
Cr-51	0.00E+00	0.00E+00	8.95E+01	5.75E+01	1.32E+01	1.28E+04	3.57E+02
Mn-54	0.00E+00	2.53E+04	4.98E+03	0.00E+00	4.98E+03	1.00E+06	7.06E+03
Fe-55	1.97E+04	1.17E+04	3.33E+03	0.00E+00	0.00E+00	8.69E+04	1.09E+03
Mn-56	0.00E+00	1.54E+00	2.21E-01	0.00E+00	1.10E+00	1.25E+04	7.17E+04
Co-57	0.00E+00	6.51E+02	6.41E+02	0.00E+00	0.00E+00	3.79E+05	4.86E+03
Co-58	0.00E+00	1.22E+03	1.82E+03	0.00E+00	0.00E+00	7.77E+05	1.11E+04
Fe-59	1.36E+04	2.35E+04	9.48E+03	0.00E+00	0.00E+00	1.02E+06	2.48E+04
Co-60	0.00E+00	8.02E+03	1.18E+04	0.00E+00	0.00E+00	4.51E+06	3.19E+04
Ni-59	2.53E+04	7.62E+03	4.34E+03	0.00E+00	0.00E+00	7.67E+04	8.88E+02
Ni-63	3.39E+05	2.04E+04	1.16E+04	0.00E+00	0.00E+00	2.09E+05	2.42E+03
Cu-64	0.00E+00	1.88E+00	7.74E-01	0.00E+00	3.98E+00	9.30E+03	1.50E+04
Ni-65	2.39E+00	2.84E-01	1.23E-01	0.00E+00	0.00E+00	8.12E+03	5.01E+04
Zn-65	1.93E+04	6.26E+04	3.11E+04	0.00E+00	3.25E+04	6.47E+05	5.14E+04
Zn-69m	1.26E+01	2.58E+01	2.34E+00	0.00E+00	1.04E+01	2.67E+04	4.09E+04
Zn-69	5.39E-02	9.67E-02	7.18E-03	0.00E+00	4.02E-02	1.47E+03	1.32E+04
Se-79	0.00E+00	3.15E+03	5.88E+02	0.00E+00	3.46E+03	4.19E+05	4.84E+03
Br-82	0.00E+00	0.00E+00	1.33E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	3.81E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	4.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	2.04E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.90E+05	8.82E+04	0.00E+00	0.00E+00	0.00E+00	3.04E+03
Rb-87	0.00E+00	1.24E+05	4.93E+04	0.00E+00	0.00E+00	0.00E+00	8.37E+02
Rb-88	0.00E+00	5.57E+02	2.87E+02	0.00E+00	0.00E+00	0.00E+00	3.39E+02
Rb-89	0.00E+00	3.21E+02	2.06E+02	0.00E+00	0.00E+00	0.00E+00	6.82E+01
Sr-89	3.98E+05	0.00E+00	1.14E+04	0.00E+00	0.00E+00	2.03E+06	6.40E+04
Sr-90	4.09E+07	0.00E+00	1.83E+06	0.00E+00	0.00E+00	1.12E+07	1.31E+05
Y-90	3.29E+03	0.00E+00	8.82E+01	0.00E+00	0.00E+00	2.69E+05	1.04E+05
Sr-91	9.56E+01	0.00E+00	3.46E+00	0.00E+00	0.00E+00	5.26E+04	7.34E+04
Y-91m	4.07E-01	0.00E+00	1.39E-02	0.00E+00	0.00E+00	2.79E+03	2.35E+03
Y-91	5.88E+05	0.00E+00	1.57E+04	0.00E+00	0.00E+00	2.45E+06	7.03E+04
Sr-92	1.05E+01	0.00E+00	3.91E-01	0.00E+00	0.00E+00	2.38E+04	1.40E+05
Y-92	1.64E+01	0.00E+00	4.61E-01	0.00E+00	0.00E+00	2.45E+04	1.27E+05
Y-93	1.50E+02	0.00E+00	4.07E+00	0.00E+00	0.00E+00	7.64E+04	1.67E+05
Nb-93m	1.93E+05	5.03E+04	1.61E+04	0.00E+00	5.15E+04	2.93E+05	3.46E+03
Nb-95	1.57E+04	6.43E+03	3.78E+03	0.00E+00	4.72E+03	4.79E+05	1.27E+04
Nb-97	3.42E-01	7.29E-02	2.63E-02	0.00E+00	5.70E-02	3.32E+03	2.69E+04
Zr-93	3.14E+05	1.33E+05	8.65E+04	0.00E+00	4.47E+05	1.92E+06	2.07E+04
Zr-95	1.15E+05	2.79E+04	2.03E+04	0.00E+00	3.11E+04	1.75E+06	2.17E+04
Zr-97	1.50E+02	2.56E+01	1.17E+01	0.00E+00	2.59E+01	1.10E+05	1.40E+05
Mo-93	0.00E+00	9.04E+03	3.11E+02	0.00E+00	2.16E+03	4.76E+05	5.26E+03
Mo-99	0.00E+00	1.65E+02	3.23E+01	0.00E+00	2.65E+02	1.35E+05	4.87E+04
Tc-99	2.93E+02	3.75E+02	1.24E+02	0.00E+00	3.49E+03	9.48E+05	1.09E+04
Tc-99m	1.40E-03	2.88E-03	3.72E-02	0.00E+00	3.11E-02	8.11E+02	2.03E+03
Tc-101	6.51E-05	8.23E-05	8.12E-04	0.00E+00	9.79E-04	5.84E+02	8.44E+02
Ru-103	2.02E+03	0.00E+00	6.79E+02	0.00E+00	4.24E+03	5.52E+05	1.61E+04
Ru-105	1.22E+00	0.00E+00	4.10E-01	0.00E+00	8.99E-01	1.57E+04	4.84E+04
Rh-105	1.16E+01	7.57E+00	5.08E+00	0.00E+00	2.10E+01	2.91E+04	1.92E+04
Ru-106	8.68E+04	0.00E+00	1.09E+04	0.00E+00	1.07E+05	1.16E+07	1.64E+05
Pd-107	0.00E+00	6.89E+02	5.75E+01	0.00E+00	3.85E+03	8.88E+04	1.03E+03

Table 4-27 (Page 2 of 3)
Inhalation Pathway Factors for Infant (R_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	5.49E+00	1.47E+00	0.00E+00	1.79E+01	2.35E+04	3.99E+04
Ag-110m	9.98E+03	7.22E+03	5.00E+03	0.00E+00	1.09E+04	3.67E+06	3.30E+04
Ag-111	5.25E+02	2.03E+02	1.09E+02	0.00E+00	4.27E+02	2.88E+05	4.23E+04
Cd-113m	0.00E+00	9.34E+05	3.70E+04	0.00E+00	8.12E+05	1.96E+06	2.31E+04
Cd-115m	0.00E+00	2.42E+05	8.67E+03	0.00E+00	1.32E+05	2.06E+06	7.03E+04
Sn-123	2.93E+05	5.89E+03	1.02E+04	5.98E+03	0.00E+00	3.11E+06	5.71E+04
Sn-125	1.41E+04	3.51E+02	8.40E+02	3.46E+02	0.00E+00	9.00E+05	1.02E+05
Sn-126	1.16E+06	2.02E+04	4.93E+04	5.38E+03	0.00E+00	6.90E+06	2.31E+04
Sb-124	3.79E+04	5.56E+02	1.20E+04	1.01E+02	0.00E+00	2.65E+06	5.91E+04
Sb-125	5.17E+04	4.77E+02	1.09E+04	6.23E+01	0.00E+00	1.64E+06	1.47E+04
Sb-126	4.31E+03	8.41E+01	1.55E+03	3.29E+01	0.00E+00	9.63E+05	7.46E+04
Sb-127	3.95E+02	7.06E+00	1.23E+02	5.04E+00	0.00E+00	2.16E+05	5.29E+04
Te-125m	4.76E+03	1.99E+03	6.58E+02	1.62E+03	0.00E+00	4.47E+05	1.29E+04
Te-127m	1.67E+04	6.90E+03	2.07E+03	4.87E+03	3.75E+04	1.31E+06	2.73E+04
Te-127	2.23E+00	9.53E-01	4.89E-01	1.85E+00	4.86E+00	1.03E+04	2.44E+04
Te-129m	1.41E+04	6.09E+03	2.23E+03	5.47E+03	3.18E+04	1.68E+06	6.90E+04
Te-129	7.88E-02	3.47E-02	1.88E-02	6.75E-02	1.75E-01	3.00E+03	2.63E+04
Te-133m	8.58E-02	5.03E-02	3.84E-02	7.73E-02	2.41E-01	5.49E+03	2.23E+04
Te-134	4.45E-02	2.86E-02	2.35E-02	4.07E-02	1.34E-01	4.10E+03	3.54E+03
I-129	3.02E+04	2.23E+04	1.62E+04	1.46E+07	2.63E+04	0.00E+00	2.97E+02
I-130	6.36E+03	1.39E+04	5.57E+03	1.60E+06	1.53E+04	0.00E+00	1.99E+03
I-131	3.79E+04	4.44E+04	1.96E+04	1.48E+07	5.18E+04	0.00E+00	1.06E+03
Te-131m	1.07E+02	5.50E+01	3.63E+01	8.93E+01	2.65E+02	1.99E+05	1.19E+05
Te-131	1.74E-02	8.22E-03	5.00E-03	1.58E-02	3.99E-02	2.06E+03	8.22E+03
I-132	1.69E+03	3.54E+03	1.26E+03	1.69E+05	3.95E+03	0.00E+00	1.90E+03
Te-132	3.72E+02	2.37E+02	1.76E+02	2.79E+02	1.03E+03	3.40E+05	4.41E+04
I-133	1.32E+04	1.92E+04	5.60E+03	3.56E+06	2.24E+04	0.00E+00	2.16E+03
Cs-134m	1.85E+02	2.94E+02	1.55E+02	0.00E+00	1.19E+02	2.80E+01	1.62E+02
Cs-134	3.96E+05	7.03E+05	7.45E+04	0.00E+00	1.90E+05	7.97E+04	1.33E+03
I-134	9.21E+02	1.88E+03	6.65E+02	4.45E+04	2.09E+03	0.00E+00	1.29E+03
I-135	3.86E+03	7.60E+03	2.77E+03	6.96E+05	8.47E+03	0.00E+00	1.83E+03
Cs-135	1.40E+05	1.21E+05	6.62E+03	0.00E+00	3.61E+04	1.41E+04	3.05E+02
Cs-136	4.83E+04	1.35E+05	5.29E+04	0.00E+00	5.64E+04	1.18E+04	1.43E+03
Cs-137	5.49E+05	6.12E+05	4.55E+04	0.00E+00	1.72E+05	7.13E+04	1.33E+03
Cs-138	5.05E+02	7.81E+02	3.98E+02	0.00E+00	4.10E+02	6.54E+01	8.76E+02
Cs-139	3.25E+02	4.24E+02	1.71E+02	0.00E+00	2.31E+02	3.54E+01	1.86E+01
Ba-139	1.48E+00	9.84E-04	4.30E-02	0.00E+00	5.92E-04	5.95E+03	5.10E+04
Ba-140	5.60E+04	5.60E+01	2.90E+03	0.00E+00	1.34E+01	1.60E+06	3.84E+04
La-140	5.05E+02	2.00E+02	5.15E+01	0.00E+00	0.00E+00	1.68E+05	8.48E+04
Ba-141	1.57E-01	1.08E-04	4.97E-03	0.00E+00	6.50E-05	2.97E+03	4.75E+03
La-141	6.79E+00	1.96E+00	3.43E-01	0.00E+00	0.00E+00	1.71E+04	8.34E+04
Ce-141	2.77E+04	1.67E+04	1.99E+03	0.00E+00	5.25E+03	5.17E+05	2.16E+04
Ba-142	3.98E-02	3.30E-05	1.96E-03	0.00E+00	1.90E-05	1.55E+03	6.93E+02
La-142	1.03E+00	3.77E-01	9.04E-02	0.00E+00	0.00E+00	8.22E+03	5.95E+04
Ce-143	2.93E+02	1.93E+02	2.21E+01	0.00E+00	5.64E+01	1.16E+05	4.97E+04
Pr-143	1.40E+04	5.24E+03	6.99E+02	0.00E+00	1.97E+03	4.33E+05	3.72E+04
Ce-144	3.19E+06	1.21E+06	1.76E+05	0.00E+00	5.38E+05	9.84E+06	1.48E+05
Pr-144	4.79E-02	1.85E-02	2.41E-03	0.00E+00	6.72E-03	1.61E+03	4.28E+03
Nd-147	7.94E+03	8.13E+03	5.00E+02	0.00E+00	3.15E+03	3.22E+05	3.12E+04
Pm-147	5.47E+05	4.30E+04	2.18E+04	0.00E+00	6.90E+04	6.37E+05	8.05E+03
Pm-148m	7.00E+04	1.74E+04	1.39E+04	0.00E+00	2.03E+04	1.71E+06	4.72E+04
Pm-148	4.68E+03	6.75E+02	3.42E+02	0.00E+00	8.06E+02	4.48E+05	8.46E+04
Pm-149	4.34E+02	5.71E+01	2.49E+01	0.00E+00	6.94E+01	9.10E+04	4.21E+04
Pm-151	1.05E+02	1.54E+01	7.77E+00	0.00E+00	1.82E+01	4.55E+04	3.61E+04
Sm-151	4.73E+05	9.03E+04	2.28E+04	0.00E+00	7.34E+04	4.17E+05	4.84E+03
Sm-153	2.14E+02	1.65E+02	1.27E+01	0.00E+00	3.46E+01	5.18E+04	2.70E+04

Table 4-27 (Page 3 of 3)
Inhalation Pathway Factors for Infant (R_i^I)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	1.10E+06	2.48E+05	2.41E+05	0.00E+00	8.32E+05	2.07E+06	1.38E+04
Eu-154	4.14E+06	4.84E+05	3.43E+05	0.00E+00	1.60E+06	4.27E+06	3.98E+04
Eu-155	8.36E+05	8.01E+04	4.84E+04	0.00E+00	2.21E+05	7.28E+05	7.27E+04
Eu-156	2.18E+04	1.34E+04	2.16E+03	0.00E+00	6.27E+03	8.57E+05	5.80E+04
Tb-160	1.57E+05	0.00E+00	1.96E+04	0.00E+00	4.48E+04	1.55E+06	3.00E+04
Ho-166m	2.03E+06	4.30E+05	3.51E+05	0.00E+00	5.91E+05	2.87E+06	2.31E+04
W-181	6.80E+01	2.04E+01	2.34E+00	0.00E+00	0.00E+00	1.86E+04	3.68E+02
W-185	2.20E+03	6.76E+02	7.81E+01	0.00E+00	0.00E+00	6.27E+05	1.57E+04
W-187	1.30E+01	9.02E+00	3.12E+00	0.00E+00	0.00E+00	3.96E+04	3.56E+04
Np-239	3.71E+02	3.32E+01	1.88E+01	0.00E+00	6.62E+01	5.95E+04	2.49E+04
U-232	3.60E+08	0.00E+00	2.98E+07	0.00E+00	3.36E+07	2.09E+09	6.10E+04
U-233	7.62E+07	0.00E+00	5.36E+06	0.00E+00	1.53E+07	4.98E+08	5.64E+04
U-234	7.31E+07	0.00E+00	5.25E+06	0.00E+00	1.50E+07	4.89E+08	5.53E+04
U-235	7.01E+07	0.00E+00	4.93E+06	0.00E+00	1.41E+07	4.59E+08	7.03E+04
U-236	7.01E+07	0.00E+00	5.04E+06	0.00E+00	1.44E+07	4.69E+08	5.19E+04
U-237	4.55E+02	0.00E+00	1.21E+02	0.00E+00	1.13E+03	1.28E+05	1.83E+04
U-238	6.71E+07	0.00E+00	4.61E+06	0.00E+00	1.32E+07	4.28E+08	4.96E+04
Np-237	4.03E+09	2.39E+09	1.76E+08	0.00E+00	1.08E+09	4.89E+08	7.14E+04
Np-238	3.74E+03	8.47E+02	5.82E+01	0.00E+00	2.06E+02	1.29E+05	3.61E+04
Pu-238	3.77E+09	2.35E+09	1.78E+08	0.00E+00	6.50E+08	1.26E+09	6.57E+04
Pu-239	4.10E+09	2.46E+09	1.88E+08	0.00E+00	6.93E+08	1.19E+09	5.99E+04
Pu-240	4.10E+09	2.45E+09	1.88E+08	0.00E+00	6.92E+08	1.19E+09	6.10E+04
Pu-241	1.18E+08	2.59E+07	4.35E+06	0.00E+00	1.61E+07	1.07E+06	1.26E+03
Pu-242	3.81E+09	2.37E+09	1.81E+08	0.00E+00	6.68E+08	1.14E+09	5.88E+04
Pu-244	4.44E+09	2.72E+09	2.07E+08	0.00E+00	7.64E+08	1.31E+09	8.76E+04
Am-241	4.41E+09	2.73E+09	1.83E+08	0.00E+00	1.11E+09	5.68E+08	6.69E+04
Am-242m	4.55E+09	2.60E+09	1.89E+08	0.00E+00	1.12E+09	2.30E+08	8.41E+04
Am-243	4.34E+09	2.63E+09	1.78E+08	0.00E+00	1.08E+09	5.39E+08	7.84E+04
Cm-242	1.79E+08	1.21E+08	7.98E+06	0.00E+00	2.37E+07	4.16E+08	7.14E+04
Cm-243	3.46E+09	2.13E+09	1.48E+08	0.00E+00	5.47E+08	5.94E+08	7.03E+04
Cm-244	2.90E+09	1.78E+09	1.24E+08	0.00E+00	4.49E+08	5.71E+08	6.80E+04
Cm-245	4.51E+09	2.74E+09	1.90E+08	0.00E+00	7.32E+08	5.49E+08	6.34E+04
Cm-246	4.48E+09	2.74E+09	1.90E+08	0.00E+00	7.32E+08	5.59E+08	6.23E+04
Cm-247	4.35E+09	2.70E+09	1.86E+08	0.00E+00	7.21E+08	5.49E+08	8.19E+04
Cm-248	3.61E+10	2.23E+10	1.54E+09	0.00E+00	5.94E+09	4.52E+09	1.32E+06
Cf-252	3.32E+09	0.00E+00	1.41E+08	0.00E+00	0.00E+00	1.92E+09	2.59E+05

Units of mrem/yr per $\mu Ci/m^3$

Table 4-28 (Page 1 of 3)
Ground Plane Pathway Factors (R_i^G)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI	Skin
H-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na-22	1.16E+10	1.16E+10	1.16E+10	1.16E+10	1.16E+10	1.16E+10	1.16E+10	1.31E+10
Na-24	1.19E+07	1.19E+07	1.19E+07	1.19E+07	1.19E+07	1.19E+07	1.19E+07	1.39E+07
P-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ca-41	1.98E+10	1.98E+10	1.98E+10	1.98E+10	1.98E+10	1.98E+10	1.98E+10	2.33E+10
Sc-46	8.33E+08	8.33E+08	8.33E+08	8.33E+08	8.33E+08	8.33E+08	8.33E+08	9.61E+08
Cr-51	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	4.66E+06	5.51E+06
Mn-54	1.39E+09	1.39E+09	1.39E+09	1.39E+09	1.39E+09	1.39E+09	1.39E+09	1.63E+09
Fe-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mn-56	9.03E+05	9.03E+05	9.03E+05	9.03E+05	9.03E+05	9.03E+05	9.03E+05	1.07E+06
Co-57	1.88E+08	1.88E+08	1.88E+08	1.88E+08	1.88E+08	1.88E+08	1.88E+08	2.07E+08
Co-58	3.79E+08	3.79E+08	3.79E+08	3.79E+08	3.79E+08	3.79E+08	3.79E+08	4.44E+08
Fe-59	2.73E+08	2.73E+08	2.73E+08	2.73E+08	2.73E+08	2.73E+08	2.73E+08	3.21E+08
Co-60	2.45E+10	2.45E+10	2.45E+10	2.45E+10	2.45E+10	2.45E+10	2.45E+10	2.89E+10
Ni-59	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cu-64	6.07E+05	6.07E+05	6.07E+05	6.07E+05	6.07E+05	6.07E+05	6.07E+05	6.88E+05
Ni-65	2.97E+05	2.97E+05	2.97E+05	2.97E+05	2.97E+05	2.97E+05	2.97E+05	3.45E+05
Zn-65	7.47E+08	7.47E+08	7.47E+08	7.47E+08	7.47E+08	7.47E+08	7.47E+08	8.59E+08
Zn-69m	1.27E+06	1.27E+06	1.27E+06	1.27E+06	1.27E+06	1.27E+06	1.27E+06	1.49E+06
Zn-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Se-79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-82	2.14E+07	2.14E+07	2.14E+07	2.14E+07	2.14E+07	2.14E+07	2.14E+07	2.47E+07
Br-83	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03	7.08E+03
Br-84	2.03E+05	2.03E+05	2.03E+05	2.03E+05	2.03E+05	2.03E+05	2.03E+05	2.36E+05
Br-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	8.99E+06	8.99E+06	8.99E+06	8.99E+06	8.99E+06	8.99E+06	8.99E+06	1.03E+07
Rb-87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-88	3.31E+04	3.31E+04	3.31E+04	3.31E+04	3.31E+04	3.31E+04	3.31E+04	3.78E+04
Rb-89	1.23E+05	1.23E+05	1.23E+05	1.23E+05	1.23E+05	1.23E+05	1.23E+05	1.48E+05
Sr-89	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.51E+04
Sr-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-90	4.49E+03	4.49E+03	4.49E+03	4.49E+03	4.49E+03	4.49E+03	4.49E+03	5.31E+03
Sr-91	2.15E+06	2.15E+06	2.15E+06	2.15E+06	2.15E+06	2.15E+06	2.15E+06	2.51E+06
Y-91m	1.16E+05	1.16E+05	1.16E+05	1.16E+05	1.16E+05	1.16E+05	1.16E+05	1.00E+05
Y-91	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.21E+06
Sr-92	7.77E+05	7.77E+05	7.77E+05	7.77E+05	7.77E+05	7.77E+05	7.77E+05	8.63E+05
Y-92	1.80E+05	1.80E+05	1.80E+05	1.80E+05	1.80E+05	1.80E+05	1.80E+05	2.14E+05
Y-93	1.83E+05	1.83E+05	1.83E+05	1.83E+05	1.83E+05	1.83E+05	1.83E+05	2.51E+05
Nb-93m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	1.61E+08	1.61E+08	1.61E+08	1.61E+08	1.61E+08	1.61E+08	1.61E+08	1.37E+08
Nb-97	1.76E+05	1.76E+05	1.76E+05	1.76E+05	1.76E+05	1.76E+05	1.76E+05	2.07E+05
Zr-93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	2.45E+08	2.45E+08	2.45E+08	2.45E+08	2.45E+08	2.45E+08	2.45E+08	2.84E+08
Zr-97	2.96E+06	2.96E+06	2.96E+06	2.96E+06	2.96E+06	2.96E+06	2.96E+06	3.44E+06
Mo-93	1.32E+08	1.32E+08	1.32E+08	1.32E+08	1.32E+08	1.32E+08	1.32E+08	5.39E+09
Mo-99	4.63E+06	4.63E+06	4.63E+06	4.63E+06	4.63E+06	4.63E+06	4.63E+06	3.99E+06
Tc-99	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tc-99m	1.84E+05	1.84E+05	1.84E+05	1.84E+05	1.84E+05	1.84E+05	1.84E+05	2.11E+05
Tc-101	2.04E+04	2.04E+04	2.04E+04	2.04E+04	2.04E+04	2.04E+04	2.04E+04	2.26E+04
Ru-103	1.26E+08	1.26E+08	1.26E+08	1.26E+08	1.26E+08	1.26E+08	1.26E+08	1.08E+08
Ru-105	6.36E+05	6.36E+05	6.36E+05	6.36E+05	6.36E+05	6.36E+05	6.36E+05	7.21E+05
Rh-105	7.43E+05	7.43E+05	7.43E+05	7.43E+05	7.43E+05	7.43E+05	7.43E+05	8.67E+05
Ru-106	5.07E+08	5.07E+08	5.07E+08	5.07E+08	5.07E+08	5.07E+08	5.07E+08	4.22E+08
Pd-107	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 4-28 (Page 2 of 3)
Ground Plane Pathway Factors (R_i^G)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI	Skin
Pd-109	1.50E+04	1.50E+04	1.50E+04	1.50E+04	1.50E+04	1.50E+04	1.50E+04	1.71E+04
Ag-110m	3.44E+09	3.44E+09	3.44E+09	3.44E+09	3.44E+09	3.44E+09	3.44E+09	4.01E+09
Ag-111	1.03E+06	1.03E+06	1.03E+06	1.03E+06	1.03E+06	1.03E+06	1.03E+06	1.20E+06
Cd-113m	6.87E+06	6.87E+06	6.87E+06	6.87E+06	6.87E+06	6.87E+06	6.87E+06	7.76E+06
Cd-115m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-123	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.38E+09
Sn-125	4.20E+06	4.20E+06	4.20E+06	4.20E+06	4.20E+06	4.20E+06	4.20E+06	4.86E+06
Sn-126	5.22E+10	5.22E+10	5.22E+10	5.22E+10	5.22E+10	5.22E+10	5.22E+10	5.80E+10
Sb-124	5.98E+08	5.98E+08	5.98E+08	5.98E+08	5.98E+08	5.98E+08	5.98E+08	6.90E+08
Sb-125	2.40E+09	2.40E+09	2.40E+09	2.40E+09	2.40E+09	2.40E+09	2.40E+09	2.71E+09
Sb-126	8.44E+07	8.44E+07	8.44E+07	8.44E+07	8.44E+07	8.44E+07	8.44E+07	9.48E+07
Sb-127	1.68E+07	1.68E+07	1.68E+07	1.68E+07	1.68E+07	1.68E+07	1.68E+07	1.94E+07
Te-125m	1.55E+06	1.55E+06	1.55E+06	1.55E+06	1.55E+06	1.55E+06	1.55E+06	2.13E+06
Te-127m	9.16E+04	9.16E+04	9.16E+04	9.16E+04	9.16E+04	9.16E+04	9.16E+04	1.08E+05
Te-127	2.98E+03	2.98E+03	2.98E+03	2.98E+03	2.98E+03	2.98E+03	2.98E+03	3.28E+03
Te-129m	1.98E+07	1.98E+07	1.98E+07	1.98E+07	1.98E+07	1.98E+07	1.98E+07	2.31E+07
Te-129	2.62E+04	2.62E+04	2.62E+04	2.62E+04	2.62E+04	2.62E+04	2.62E+04	3.10E+04
Te-133m	4.41E+05	4.41E+05	4.41E+05	4.41E+05	4.41E+05	4.41E+05	4.41E+05	5.00E+05
Te-134	2.22E+04	2.22E+04	2.22E+04	2.22E+04	2.22E+04	2.22E+04	2.22E+04	2.66E+04
I-129	2.61E+09	2.61E+09	2.61E+09	2.61E+09	2.61E+09	2.61E+09	2.61E+09	4.35E+09
I-130	5.51E+06	5.51E+06	5.51E+06	5.51E+06	5.51E+06	5.51E+06	5.51E+06	6.69E+06
I-131	1.72E+07	1.72E+07	1.72E+07	1.72E+07	1.72E+07	1.72E+07	1.72E+07	2.09E+07
Te-131m	8.03E+06	8.03E+06	8.03E+06	8.03E+06	8.03E+06	8.03E+06	8.03E+06	9.46E+06
Te-131	2.92E+04	2.92E+04	2.92E+04	2.92E+04	2.92E+04	2.92E+04	2.92E+04	3.45E+07
I-132	1.46E+06	1.46E+06	1.46E+06	1.46E+06	1.46E+06	1.46E+06	1.46E+06	1.25E+06
Te-132	4.23E+06	4.23E+06	4.23E+06	4.23E+06	4.23E+06	4.23E+06	4.23E+06	4.98E+06
I-133	2.45E+06	2.45E+06	2.45E+06	2.45E+06	2.45E+06	2.45E+06	2.45E+06	2.98E+06
Cs-134m	5.73E+04	5.73E+04	5.73E+04	5.73E+04	5.73E+04	5.73E+04	5.73E+04	6.74E+04
Cs-134	6.91E+09	6.91E+09	6.91E+09	6.91E+09	6.91E+09	6.91E+09	6.91E+09	8.06E+09
I-134	4.47E+05	4.47E+05	4.47E+05	4.47E+05	4.47E+05	4.47E+05	4.47E+05	5.30E+05
I-135	2.95E+06	2.95E+06	2.95E+06	2.95E+06	2.95E+06	2.95E+06	2.95E+06	2.53E+06
Cs-135	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-136	1.51E+08	1.51E+08	1.51E+08	1.51E+08	1.51E+08	1.51E+08	1.51E+08	1.71E+08
Cs-137	1.76E+10	1.76E+10	1.76E+10	1.76E+10	1.76E+10	1.76E+10	1.76E+10	2.05E+10
Cs-138	3.59E+05	3.59E+05	3.59E+05	3.59E+05	3.59E+05	3.59E+05	3.59E+05	4.10E+05
Cs-139	3.14E+04	3.14E+04	3.14E+04	3.14E+04	3.14E+04	3.14E+04	3.14E+04	3.59E+04
Ba-139	1.06E+05	1.06E+05	1.06E+05	1.06E+05	1.06E+05	1.06E+05	1.06E+05	1.19E+05
Ba-140	2.05E+07	2.05E+07	2.05E+07	2.05E+07	2.05E+07	2.05E+07	2.05E+07	2.35E+07
La-140	2.18E+07	2.18E+07	2.18E+07	2.18E+07	2.18E+07	2.18E+07	2.18E+07	1.92E+07
Ba-141	4.17E+04	4.17E+04	4.17E+04	4.17E+04	4.17E+04	4.17E+04	4.17E+04	4.75E+04
La-141	3.14E+04	3.14E+04	3.14E+04	3.14E+04	3.14E+04	3.14E+04	3.14E+04	3.51E+04
Ce-141	1.37E+07	1.37E+07	1.37E+07	1.37E+07	1.37E+07	1.37E+07	1.37E+07	1.54E+07
Ba-142	4.49E+04	4.49E+04	4.49E+04	4.49E+04	4.49E+04	4.49E+04	4.49E+04	5.11E+04
La-142	7.60E+05	7.60E+05	7.60E+05	7.60E+05	7.60E+05	7.60E+05	7.60E+05	9.11E+05
Ce-143	2.31E+06	2.31E+06	2.31E+06	2.31E+06	2.31E+06	2.31E+06	2.31E+06	2.63E+06
Pr-143	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ce-144	6.95E+07	6.95E+07	6.95E+07	6.95E+07	6.95E+07	6.95E+07	6.95E+07	8.04E+07
Pr-144	1.83E+03	1.83E+03	1.83E+03	1.83E+03	1.83E+03	1.83E+03	1.83E+03	2.11E+03
Nd-147	1.01E+07	1.01E+07	1.01E+07	1.01E+07	1.01E+07	1.01E+07	1.01E+07	8.39E+06
Pm-147	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pm-148m	4.45E+08	4.45E+08	4.45E+08	4.45E+08	4.45E+08	4.45E+08	4.45E+08	2.58E+09
Pm-148	1.89E+07	1.89E+07	1.89E+07	1.89E+07	1.89E+07	1.89E+07	1.89E+07	2.18E+07
Pm-149	4.23E+04	4.23E+04	4.23E+04	4.23E+04	4.23E+04	4.23E+04	4.23E+04	4.90E+04
Pm-151	1.99E+06	1.99E+06	1.99E+06	1.99E+06	1.99E+06	1.99E+06	1.99E+06	2.08E+06
Sm-151	2.49E+08	2.49E+08	2.49E+08	2.49E+08	2.49E+08	2.49E+08	2.49E+08	1.09E+09
Sm-153	4.02E+05	4.02E+05	4.02E+05	4.02E+05	4.02E+05	4.02E+05	4.02E+05	4.46E+05

Table 4-28 (Page 3 of 3)
Ground Plane Pathway Factors (R_i^G)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI	Skin
Eu-152	2.19E+10	2.19E+10	2.19E+10	2.19E+10	2.19E+10	2.19E+10	2.19E+10	2.54E+10
Eu-154	1.74E+10	1.74E+10	1.74E+10	1.74E+10	1.74E+10	1.74E+10	1.74E+10	2.00E+10
Eu-155	5.20E+08	5.20E+08	5.20E+08	5.20E+08	5.20E+08	5.20E+08	5.20E+08	5.90E+08
Eu-156	8.82E+07	8.82E+07	8.82E+07	8.82E+07	8.82E+07	8.82E+07	8.82E+07	1.01E+08
Tb-160	3.09E+08	3.09E+08	3.09E+08	3.09E+08	3.09E+08	3.09E+08	3.09E+08	5.53E+08
Ho-166m	5.12E+10	5.12E+10	5.12E+10	5.12E+10	5.12E+10	5.12E+10	5.12E+10	5.75E+10
W-181	1.94E+05	1.94E+05	1.94E+05	1.94E+05	1.94E+05	1.94E+05	1.94E+05	2.13E+05
W-185	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W-187	2.35E+06	2.35E+06	2.35E+06	2.35E+06	2.35E+06	2.35E+06	2.35E+06	2.73E+06
Np-239	1.71E+06	1.71E+06	1.71E+06	1.71E+06	1.71E+06	1.71E+06	1.71E+06	1.98E+06
U-232	1.31E+07	1.31E+07	1.31E+07	1.31E+07	1.31E+07	1.31E+07	1.31E+07	1.36E+08
U-233	1.33E+10	1.33E+10	1.33E+10	1.33E+10	1.33E+10	1.33E+10	1.33E+10	1.62E+10
U-234	3.67E+06	3.67E+06	3.67E+06	3.67E+06	3.67E+06	3.67E+06	3.67E+06	9.22E+08
U-235	1.86E+10	1.86E+10	1.86E+10	1.86E+10	1.86E+10	1.86E+10	1.86E+10	2.32E+10
U-236	1.22E+05	1.22E+05	1.22E+05	1.22E+05	1.22E+05	1.22E+05	1.22E+05	1.04E+08
U-237	5.16E+06	5.16E+06	5.16E+06	5.16E+06	5.16E+06	5.16E+06	5.16E+06	6.71E+06
U-238	6.38E+08	6.38E+08	6.38E+08	6.38E+08	6.38E+08	6.38E+08	6.38E+08	8.70E+08
Np-237	8.12E+09	8.12E+09	8.12E+09	8.12E+09	8.12E+09	8.12E+09	8.12E+09	9.28E+09
Np-238	4.53E+06	4.53E+06	4.53E+06	4.53E+06	4.53E+06	4.53E+06	4.53E+06	5.18E+06
Pu-238	9.30E+07	9.30E+07	9.30E+07	9.30E+07	9.30E+07	9.30E+07	9.30E+07	6.72E+06
Pu-239	4.47E+07	4.47E+07	4.47E+07	4.47E+07	4.47E+07	4.47E+07	4.47E+07	4.58E+06
Pu-240	1.04E+08	1.04E+08	1.04E+08	1.04E+08	1.04E+08	1.04E+08	1.04E+08	7.53E+06
Pu-241	2.09E+07	2.09E+07	2.09E+07	2.09E+07	2.09E+07	2.09E+07	2.09E+07	1.41E+07
Pu-242	6.38E+06	6.38E+06	6.38E+06	6.38E+06	6.38E+06	6.38E+06	6.38E+06	9.28E+07
Pu-244	5.19E+09	5.19E+09	5.19E+09	5.19E+09	5.19E+09	5.19E+09	5.19E+09	5.58E+09
Am-241	1.02E+09	1.02E+09	1.02E+09	1.02E+09	1.02E+09	1.02E+09	1.02E+09	1.47E+09
Am-242m	1.41E+08	1.41E+08	1.41E+08	1.41E+08	1.41E+08	1.41E+08	1.41E+08	9.76E+08
Am-243	7.53E+09	7.53E+09	7.53E+09	7.53E+09	7.53E+09	7.53E+09	7.53E+09	8.69E+09
Cm-242	6.86E+05	6.86E+05	6.86E+05	6.86E+05	6.86E+05	6.86E+05	6.86E+05	2.87E+06
Cm-243	9.47E+09	9.47E+09	9.47E+09	9.47E+09	9.47E+09	9.47E+09	9.47E+09	1.19E+10
Cm-244	1.00E+07	1.00E+07	1.00E+07	1.00E+07	1.00E+07	1.00E+07	1.00E+07	6.21E+07
Cm-245	5.50E+09	5.50E+09	5.50E+09	5.50E+09	5.50E+09	5.50E+09	5.50E+09	6.95E+09
Cm-246	5.79E+06	5.79E+06	5.79E+06	5.79E+06	5.79E+06	5.79E+06	5.79E+06	8.68E+07
Cm-247	1.28E+10	1.28E+10	1.28E+10	1.28E+10	1.28E+10	1.28E+10	1.28E+10	1.51E+10
Cm-248	3.95E+10	3.95E+10	3.95E+10	3.95E+10	3.95E+10	3.95E+10	3.95E+10	3.03E+10
Cf-252	4.86E+10	4.86E+10	4.86E+10	4.86E+10	4.86E+10	4.86E+10	4.86E+10	5.30E+10

Units of m^2mrem/yr per µCi/sec
Used for all age groups

Table 4-29 (Page 1 of 3)
Grass-Cow-Milk Pathway Factors for Adult (R_i^C)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	4.35E+02	4.35E+02	4.35E+02	4.35E+02	4.35E+02	4.35E+02
C-14	3.63E+05	7.26E+04	7.26E+04	7.26E+04	7.26E+04	7.26E+04	7.26E+04
Na-22	2.62E+09	2.62E+09	2.62E+09	2.62E+09	2.62E+09	2.62E+09	2.62E+09
Na-24	6.11E+05	6.11E+05	6.11E+05	6.11E+05	6.11E+05	6.11E+05	6.11E+05
P-32	4.33E+09	2.69E+08	1.67E+08	0.00E+00	0.00E+00	0.00E+00	4.87E+08
Ca-41	5.86E+09	0.00E+00	6.34E+08	0.00E+00	0.00E+00	0.00E+00	5.83E+06
Sc-46	6.72E+01	1.31E+02	3.80E+01	0.00E+00	1.22E+02	0.00E+00	6.36E+05
Cr-51	0.00E+00	0.00E+00	7.93E+03	4.74E+03	1.75E+03	1.05E+04	2.00E+06
Mn-54	0.00E+00	3.91E+06	7.47E+05	0.00E+00	1.16E+06	0.00E+00	1.20E+07
Fe-55	1.25E+07	8.61E+06	2.01E+06	0.00E+00	0.00E+00	4.81E+06	4.94E+06
Mn-56	0.00E+00	1.05E-03	1.87E-04	0.00E+00	1.34E-03	0.00E+00	3.36E-02
Co-57	0.00E+00	5.87E+05	9.76E+05	0.00E+00	0.00E+00	0.00E+00	1.49E+07
Co-58	0.00E+00	1.69E+06	3.79E+06	0.00E+00	0.00E+00	0.00E+00	3.43E+07
Fe-59	9.35E+06	2.20E+07	8.43E+06	0.00E+00	0.00E+00	6.14E+06	7.33E+07
Co-60	0.00E+00	8.27E+06	1.82E+07	0.00E+00	0.00E+00	0.00E+00	1.55E+08
Ni-59	2.59E+08	8.89E+07	4.33E+07	0.00E+00	0.00E+00	0.00E+00	1.83E+07
Ni-63	3.45E+09	2.39E+08	1.16E+08	0.00E+00	0.00E+00	0.00E+00	4.98E+07
Cu-64	0.00E+00	5.98E+03	2.81E+03	0.00E+00	1.51E+04	0.00E+00	5.09E+05
Ni-65	9.39E-02	1.22E-02	5.57E-03	0.00E+00	0.00E+00	0.00E+00	3.09E-01
Zn-65	6.22E+08	1.98E+09	8.94E+08	0.00E+00	1.32E+09	0.00E+00	1.25E+09
Zn-69m	4.49E+04	1.08E+05	9.84E+03	0.00E+00	6.52E+04	0.00E+00	6.57E+06
Zn-69	5.45E-13	1.04E-12	7.25E-14	0.00E+00	6.77E-13	0.00E+00	1.57E-13
Se-79	0.00E+00	4.69E+08	7.82E+07	0.00E+00	8.11E+08	0.00E+00	9.59E+07
Br-82	0.00E+00	0.00E+00	8.09E+06	0.00E+00	0.00E+00	0.00E+00	9.27E+06
Br-83	0.00E+00	0.00E+00	2.47E-02	0.00E+00	0.00E+00	0.00E+00	3.56E-02
Br-84	0.00E+00	0.00E+00	4.32E-24	0.00E+00	0.00E+00	0.00E+00	3.40E-29
Br-85	0.00E+00	0.00E+00	1.09E-301	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	6.73E+08	3.13E+08	0.00E+00	0.00E+00	0.00E+00	1.33E+08
Rb-87	0.00E+00	1.46E+09	5.09E+08	0.00E+00	0.00E+00	0.00E+00	6.84E+07
Rb-88	0.00E+00	6.09E-46	3.23E-46	0.00E+00	0.00E+00	0.00E+00	8.41E-57
Rb-89	0.00E+00	1.26E-53	8.84E-54	0.00E+00	0.00E+00	0.00E+00	7.31E-67
Sr-89	4.74E+08	0.00E+00	1.36E+07	0.00E+00	0.00E+00	0.00E+00	7.60E+07
Sr-90	2.75E+10	0.00E+00	5.52E+08	0.00E+00	0.00E+00	0.00E+00	6.91E+08
Y-90	1.77E+01	0.00E+00	4.75E-01	0.00E+00	0.00E+00	0.00E+00	1.88E+05
Sr-91	7.26E+03	0.00E+00	2.93E+02	0.00E+00	0.00E+00	0.00E+00	3.46E+04
Y-91m	1.57E-20	0.00E+00	6.07E-22	0.00E+00	0.00E+00	0.00E+00	4.60E-20
Y-91	2.92E+03	0.00E+00	7.82E+01	0.00E+00	0.00E+00	0.00E+00	1.61E+06
Sr-92	1.24E-01	0.00E+00	5.36E-03	0.00E+00	0.00E+00	0.00E+00	2.45E+00
Y-92	1.41E-05	0.00E+00	4.12E-07	0.00E+00	0.00E+00	0.00E+00	2.47E-01
Y-93	5.61E-02	0.00E+00	1.55E-03	0.00E+00	0.00E+00	0.00E+00	1.78E+03
Nb-93m	2.50E+05	8.17E+04	2.01E+04	0.00E+00	9.39E+04	0.00E+00	3.77E+07
Nb-95	2.43E+04	1.35E+04	7.27E+03	0.00E+00	1.34E+04	0.00E+00	8.20E+07
Nb-97	8.49E-13	2.15E-13	7.84E-14	0.00E+00	2.51E-13	0.00E+00	7.92E-10
Zr-93	8.28E+02	4.63E+01	2.16E+01	0.00E+00	1.76E+02	0.00E+00	4.81E+04
Zr-95	3.29E+02	1.06E+02	7.15E+01	0.00E+00	1.66E+02	0.00E+00	3.35E+05
Zr-97	1.09E-01	2.19E-02	1.00E-02	0.00E+00	3.31E-02	0.00E+00	6.78E+03
Mo-93	0.00E+00	2.23E+08	6.03E+06	0.00E+00	6.33E+07	0.00E+00	3.62E+07
Mo-99	0.00E+00	6.20E+06	1.18E+06	0.00E+00	1.40E+07	0.00E+00	1.44E+07
Tc-99	1.24E+07	1.84E+07	4.97E+06	0.00E+00	2.32E+08	1.56E+06	6.02E+08
Tc-99m	8.36E-01	2.36E+00	3.01E+01	0.00E+00	3.59E+01	1.16E+00	1.40E+03
Tc-101	7.63E-61	1.10E-60	1.08E-59	0.00E+00	1.98E-59	5.61E-61	3.30E-72
Ru-103	3.09E+02	0.00E+00	1.33E+02	0.00E+00	1.18E+03	0.00E+00	3.61E+04
Ru-105	2.16E-04	0.00E+00	8.53E-05	0.00E+00	2.79E-03	0.00E+00	1.32E-01
Rh-105	8.69E+04	6.35E+04	4.19E+04	0.00E+00	2.70E+05	0.00E+00	1.01E+07
Ru-106	9.62E+03	0.00E+00	1.22E+03	0.00E+00	1.86E+04	0.00E+00	6.23E+05
Pd-107	0.00E+00	5.82E+06	3.72E+05	0.00E+00	5.23E+07	0.00E+00	3.61E+07

Table 4-29 (Page 2 of 3)
Grass-Cow-Milk Pathway Factors for Adult (R_i^C)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	1.11E+04	2.50E+03	0.00E+00	6.33E+04	0.00E+00	1.23E+06
Ag-110m	2.65E+07	2.45E+07	1.45E+07	0.00E+00	4.81E+07	0.00E+00	9.99E+09
Ag-111	1.62E+06	6.78E+05	3.38E+05	0.00E+00	2.19E+06	0.00E+00	1.24E+09
Cd-113m	0.00E+00	1.50E+06	4.80E+04	0.00E+00	1.65E+06	0.00E+00	1.21E+07
Cd-115m	0.00E+00	3.96E+05	1.26E+04	0.00E+00	3.15E+05	0.00E+00	1.67E+07
Sn-123	2.21E+08	3.66E+06	5.39E+06	3.11E+06	0.00E+00	0.00E+00	4.50E+08
Sn-125	1.42E+07	2.87E+05	6.46E+05	2.38E+05	0.00E+00	0.00E+00	1.78E+08
Sn-126	8.37E+08	1.65E+07	2.38E+07	4.87E+06	0.00E+00	0.00E+00	2.41E+08
Sb-124	8.83E+06	1.67E+05	3.50E+06	2.14E+04	0.00E+00	6.88E+06	2.51E+08
Sb-125	1.02E+07	1.13E+05	2.42E+06	1.03E+04	0.00E+00	7.83E+06	1.12E+08
Sb-126	1.41E+06	2.87E+04	5.09E+05	8.63E+03	0.00E+00	8.64E+05	1.15E+08
Sb-127	1.13E+05	2.46E+03	4.32E+04	1.35E+03	0.00E+00	6.67E+04	2.57E+07
Te-125m	5.53E+06	2.00E+06	7.41E+05	1.66E+06	2.25E+07	0.00E+00	2.21E+07
Te-127m	1.82E+07	6.52E+06	2.22E+06	4.66E+06	7.40E+07	0.00E+00	6.11E+07
Te-127	1.64E+02	5.89E+01	3.55E+01	1.21E+02	6.68E+02	0.00E+00	1.29E+04
Te-129m	1.75E+07	6.54E+06	2.77E+06	6.02E+06	7.31E+07	0.00E+00	8.82E+07
Te-129	7.30E-11	2.74E-11	1.78E-11	5.60E-11	3.07E-10	0.00E+00	5.51E-11
Te-133m	5.49E-14	3.21E-14	3.09E-14	4.64E-14	3.17E-13	0.00E+00	1.10E-14
Te-134	2.35E-19	1.54E-19	9.44E-20	2.05E-19	1.49E-18	0.00E+00	2.61E-22
I-129	3.89E+08	3.34E+08	1.09E+09	8.59E+11	7.18E+08	0.00E+00	5.28E+07
I-130	1.05E+05	3.11E+05	1.23E+05	2.63E+07	4.85E+05	0.00E+00	2.68E+05
I-131	7.41E+07	1.06E+08	6.07E+07	3.47E+10	1.82E+08	0.00E+00	2.80E+07
Te-131m	9.04E+04	4.42E+04	3.68E+04	7.00E+04	4.48E+05	0.00E+00	4.39E+06
Te-131	9.88E-34	4.13E-34	3.12E-34	8.12E-34	4.33E-33	0.00E+00	1.40E-34
I-132	4.18E-02	1.12E-01	3.91E-02	3.91E+00	1.78E-01	0.00E+00	2.10E-02
Te-132	6.01E+05	3.89E+05	3.65E+05	4.29E+05	3.74E+06	0.00E+00	1.84E+07
I-133	9.69E+05	1.69E+06	5.14E+05	2.48E+08	2.94E+06	0.00E+00	1.52E+06
Cs-134m	4.40E-02	9.25E-02	4.73E-02	0.00E+00	5.02E-02	7.91E-03	3.26E-02
Cs-134	2.78E+09	6.61E+09	5.41E+09	0.00E+00	2.14E+09	7.10E+08	1.16E+08
I-134	5.27E-13	1.43E-12	5.12E-13	2.48E-11	2.28E-12	0.00E+00	1.25E-15
I-135	3.23E+03	8.45E+03	3.12E+03	5.57E+05	1.36E+04	0.00E+00	9.55E+03
Cs-135	9.27E+08	8.56E+08	3.80E+08	0.00E+00	3.24E+08	9.70E+07	2.00E+07
Cs-136	6.64E+07	2.62E+08	1.89E+08	0.00E+00	1.46E+08	2.00E+07	2.98E+07
Cs-137	3.77E+09	5.16E+09	3.38E+09	0.00E+00	1.75E+09	5.82E+08	9.99E+07
Cs-138	2.43E-24	4.80E-24	2.38E-24	0.00E+00	3.52E-24	3.48E-25	2.05E-29
Cs-139	2.17E-90	3.23E-90	1.18E-90	0.00E+00	2.59E-90	2.35E-91	6.99E-113
Ba-139	1.14E-08	8.09E-12	3.33E-10	0.00E+00	7.57E-12	4.59E-12	2.01E-08
Ba-140	6.77E+06	8.51E+03	4.44E+05	0.00E+00	2.89E+03	4.87E+03	1.39E+07
La-140	1.13E+00	5.69E-01	1.50E-01	0.00E+00	0.00E+00	0.00E+00	4.18E+04
Ba-141	1.16E-46	8.78E-50	3.92E-48	0.00E+00	8.16E-50	4.98E-50	5.47E-56
La-141	7.68E-06	2.38E-06	3.90E-07	0.00E+00	0.00E+00	0.00E+00	2.84E-01
Ce-141	1.40E+03	9.45E+02	1.07E+02	0.00E+00	4.39E+02	0.00E+00	3.61E+06
Ba-142	8.25E-81	8.48E-84	5.19E-82	0.00E+00	7.16E-84	4.80E-84	1.16E-98
La-142	4.76E-12	2.16E-12	5.39E-13	0.00E+00	0.00E+00	0.00E+00	1.58E-08
Ce-143	1.04E+01	7.69E+03	8.51E-01	0.00E+00	3.39E+00	0.00E+00	2.87E+05
Pr-143	3.99E+01	1.60E+01	1.98E+00	0.00E+00	9.24E+00	0.00E+00	1.75E+05
Ce-144	1.65E+05	6.89E+04	8.85E+03	0.00E+00	4.09E+04	0.00E+00	5.57E+07
Pr-144	1.68E-54	6.96E-55	8.53E-56	0.00E+00	3.93E-55	0.00E+00	2.41E-61
Nd-147	2.36E+01	2.73E+01	1.63E+00	0.00E+00	1.60E+01	0.00E+00	1.31E+05
Pm-147	1.42E+03	1.34E+02	5.41E+01	0.00E+00	2.53E+02	0.00E+00	1.68E+05
Pm-148m	2.64E+02	6.83E+01	5.23E+01	0.00E+00	1.03E+02	0.00E+00	5.79E+05
Pm-148	1.48E+01	2.46E+00	1.24E+00	0.00E+00	4.65E+00	0.00E+00	1.93E+05
Pm-149	1.07E+00	1.51E-01	6.18E-02	0.00E+00	2.86E-01	0.00E+00	2.84E+04
Pm-151	1.63E-01	2.73E-02	1.38E-02	0.00E+00	4.88E-02	0.00E+00	7.51E+03
Sm-151	1.36E+03	2.35E+02	5.64E+01	0.00E+00	2.63E+02	0.00E+00	1.04E+05
Sm-153	4.95E-01	4.13E-01	3.02E-02	0.00E+00	1.34E-01	0.00E+00	1.47E+04

Table 4-29 (Page 3 of 3)
Grass-Cow-Milk Pathway Factors for Adult (R_i^C)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	3.83E+03	8.71E+02	7.65E+02	0.00E+00	5.39E+03	0.00E+00	5.02E+05
Eu-154	1.20E+04	1.48E+03	1.05E+03	0.00E+00	7.06E+03	0.00E+00	1.07E+06
Eu-155	1.66E+03	2.35E+02	1.52E+02	0.00E+00	1.09E+03	0.00E+00	1.85E+05
Eu-156	6.40E+01	4.95E+01	7.98E+00	0.00E+00	3.30E+01	0.00E+00	3.39E+05
Tb-160	5.39E+02	0.00E+00	6.71E+01	0.00E+00	2.22E+02	0.00E+00	4.96E+05
Ho-166m	5.35E+03	1.67E+03	1.27E+03	0.00E+00	2.50E+03	0.00E+00	5.07E+05
W-181	1.38E+04	4.50E+03	4.82E+02	0.00E+00	0.00E+00	0.00E+00	5.12E+05
W-185	4.72E+05	1.57E+05	1.65E+04	0.00E+00	0.00E+00	0.00E+00	1.82E+07
W-187	1.63E+03	1.36E+03	4.77E+02	0.00E+00	0.00E+00	0.00E+00	4.47E+05
Np-239	9.19E-01	9.03E-02	4.98E-02	0.00E+00	2.82E-01	0.00E+00	1.85E+04
U-232	8.16E+09	0.00E+00	5.83E+08	0.00E+00	8.84E+08	0.00E+00	1.34E+08
U-233	1.73E+09	0.00E+00	1.05E+08	0.00E+00	4.02E+08	0.00E+00	1.24E+08
U-234	1.66E+09	0.00E+00	1.02E+08	0.00E+00	3.94E+08	0.00E+00	1.22E+08
U-235	1.59E+09	0.00E+00	9.63E+07	0.00E+00	3.70E+08	0.00E+00	1.55E+08
U-236	1.59E+09	0.00E+00	9.82E+07	0.00E+00	3.78E+08	0.00E+00	1.14E+08
U-237	1.41E+04	0.00E+00	3.76E+03	0.00E+00	5.81E+04	0.00E+00	4.97E+06
U-238	1.52E+09	0.00E+00	8.99E+07	0.00E+00	3.47E+08	0.00E+00	1.09E+08
Np-237	2.50E+07	1.77E+06	1.10E+06	0.00E+00	8.16E+06	0.00E+00	1.57E+06
Np-238	9.03E+00	2.43E-01	1.40E-01	0.00E+00	8.24E-01	0.00E+00	2.26E+04
Pu-238	4.98E+06	6.31E+05	1.35E+05	0.00E+00	5.79E+05	0.00E+00	5.77E+05
Pu-239	5.74E+06	6.90E+05	1.51E+05	0.00E+00	6.42E+05	0.00E+00	5.28E+05
Pu-240	5.74E+06	6.89E+05	1.51E+05	0.00E+00	6.42E+05	0.00E+00	5.37E+05
Pu-241	1.23E+05	5.85E+03	2.61E+03	0.00E+00	1.20E+04	0.00E+00	1.10E+04
Pu-242	5.32E+06	6.65E+05	1.46E+05	0.00E+00	6.19E+05	0.00E+00	5.17E+05
Pu-244	6.21E+06	7.61E+05	1.67E+05	0.00E+00	7.09E+05	0.00E+00	7.71E+05
Am-241	1.49E+07	1.40E+07	1.07E+06	0.00E+00	8.06E+06	0.00E+00	1.47E+06
Am-242m	1.51E+07	1.31E+07	1.07E+06	0.00E+00	8.01E+06	0.00E+00	1.85E+06
Am-243	1.49E+07	1.37E+07	1.05E+06	0.00E+00	7.90E+06	0.00E+00	1.72E+06
Cm-242	3.12E+05	3.32E+05	2.07E+04	0.00E+00	9.42E+04	0.00E+00	1.20E+06
Cm-243	1.18E+07	1.08E+07	7.39E+05	0.00E+00	3.45E+06	0.00E+00	1.54E+06
Cm-244	8.97E+06	8.40E+06	5.64E+05	0.00E+00	2.63E+06	0.00E+00	1.48E+06
Cm-245	1.86E+07	1.62E+07	1.14E+06	0.00E+00	5.33E+06	0.00E+00	1.39E+06
Cm-246	1.84E+07	1.62E+07	1.14E+06	0.00E+00	5.31E+06	0.00E+00	1.37E+06
Cm-247	1.80E+07	1.59E+07	1.12E+06	0.00E+00	5.23E+06	0.00E+00	1.80E+06
Cm-248	1.49E+08	1.31E+08	9.25E+06	0.00E+00	4.32E+07	0.00E+00	2.91E+07
Cf-252	4.92E+06	0.00E+00	1.19E+05	0.00E+00	0.00E+00	0.00E+00	5.43E+06

Units of mrem/yr per μCi/m^3 for H-3 and C-14
Units of m^{2}mrem/yr per μCi/sec for all other nuclides

Table 4-30 (Page 1 of 3)
Grass-Cow-Milk Pathway Factors for Teenager (R_i^C)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	5.66E+02	5.66E+02	5.66E+02	5.66E+02	5.66E+02	5.66E+02
C-14	6.70E+05	1.34E+05	1.34E+05	1.34E+05	1.34E+05	1.34E+05	1.34E+05
Na-22	4.55E+09	4.55E+09	4.55E+09	4.55E+09	4.55E+09	4.55E+09	4.55E+09
Na-24	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06	1.07E+06
P-32	7.99E+09	4.95E+08	3.10E+08	0.00E+00	0.00E+00	0.00E+00	6.72E+08
Ca-41	8.05E+09	0.00E+00	8.71E+08	0.00E+00	0.00E+00	0.00E+00	7.97E+06
Sc-46	1.14E+02	2.22E+02	6.58E+01	0.00E+00	2.13E+02	0.00E+00	7.56E+05
Cr-51	0.00E+00	0.00E+00	1.39E+04	7.70E+03	3.04E+03	1.98E+04	2.33E+06
Mn-54	0.00E+00	6.52E+06	1.29E+06	0.00E+00	1.94E+06	0.00E+00	1.34E+07
Fe-55	2.21E+07	1.57E+07	3.66E+06	0.00E+00	0.00E+00	9.94E+06	6.79E+06
Mn-56	0.00E+00	1.87E-03	3.32E-04	0.00E+00	2.36E-03	0.00E+00	1.23E-01
Co-57	0.00E+00	1.03E+06	1.73E+06	0.00E+00	0.00E+00	0.00E+00	1.92E+07
Co-58	0.00E+00	2.85E+06	6.56E+06	0.00E+00	0.00E+00	0.00E+00	3.93E+07
Fe-59	1.63E+07	3.81E+07	1.47E+07	0.00E+00	0.00E+00	1.20E+07	9.01E+07
Co-60	0.00E+00	1.40E+07	3.16E+07	0.00E+00	0.00E+00	0.00E+00	1.83E+08
Ni-59	4.52E+08	1.60E+08	7.67E+07	0.00E+00	0.00E+00	0.00E+00	2.50E+07
Ni-63	6.05E+09	4.27E+08	2.05E+08	0.00E+00	0.00E+00	0.00E+00	6.81E+07
Cu-64	0.00E+00	1.06E+04	5.01E+03	0.00E+00	2.69E+04	0.00E+00	8.26E+05
Ni-65	1.72E-01	2.20E-02	1.00E-02	0.00E+00	0.00E+00	0.00E+00	1.19E+00
Zn-65	9.55E+08	3.32E+09	1.55E+09	0.00E+00	2.12E+09	0.00E+00	1.40E+09
Zn-69m	8.17E+04	1.93E+05	1.77E+04	0.00E+00	1.17E+05	0.00E+00	1.06E+07
Zn-69	1.00E-12	1.91E-12	1.34E-13	0.00E+00	1.25E-12	0.00E+00	3.52E-12
Se-79	0.00E+00	8.58E+08	1.44E+08	0.00E+00	1.49E+09	0.00E+00	1.31E+08
Br-82	0.00E+00	0.00E+00	1.40E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	4.55E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	7.73E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	2.01E-301	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.23E+09	5.76E+08	0.00E+00	0.00E+00	0.00E+00	1.81E+08
Rb-87	0.00E+00	2.68E+09	9.37E+08	0.00E+00	0.00E+00	0.00E+00	9.37E+07
Rb-88	0.00E+00	1.11E-45	5.89E-46	0.00E+00	0.00E+00	0.00E+00	9.48E-53
Rb-89	0.00E+00	2.23E-53	1.57E-53	0.00E+00	0.00E+00	0.00E+00	3.41E-62
Sr-89	8.73E+08	0.00E+00	2.50E+07	0.00E+00	0.00E+00	0.00E+00	1.04E+08
Sr-90	4.15E+10	0.00E+00	8.30E+08	0.00E+00	0.00E+00	0.00E+00	9.48E+08
Y-90	3.26E+01	0.00E+00	8.77E-01	0.00E+00	0.00E+00	0.00E+00	2.69E+05
Sr-91	1.33E+04	0.00E+00	5.30E+02	0.00E+00	0.00E+00	0.00E+00	6.05E+04
Y-91m	2.87E-20	0.00E+00	1.10E-21	0.00E+00	0.00E+00	0.00E+00	1.35E-18
Y-91	5.38E+03	0.00E+00	1.44E+02	0.00E+00	0.00E+00	0.00E+00	2.20E+06
Sr-92	2.27E-01	0.00E+00	9.66E-03	0.00E+00	0.00E+00	0.00E+00	5.77E+00
Y-92	2.61E-05	0.00E+00	7.54E-07	0.00E+00	0.00E+00	0.00E+00	7.15E-01
Y-93	1.03E-01	0.00E+00	2.83E-03	0.00E+00	0.00E+00	0.00E+00	3.16E+03
Nb-93m	4.36E+05	1.43E+05	3.58E+04	0.00E+00	1.67E+05	0.00E+00	5.15E+07
Nb-95	4.14E+04	2.30E+04	1.27E+04	0.00E+00	2.23E+04	0.00E+00	9.83E+07
Nb-97	1.55E-12	3.84E-13	1.40E-13	0.00E+00	4.49E-13	0.00E+00	9.17E-09
Zr-93	1.41E+03	6.98E+02	3.81E+02	0.00E+00	2.47E+03	0.00E+00	6.59E+05
Zr-95	5.76E+02	1.82E+02	1.25E+02	0.00E+00	2.67E+02	0.00E+00	4.19E+05
Zr-97	1.98E-01	3.91E-02	1.80E-02	0.00E+00	5.93E-02	0.00E+00	1.06E+04
Mo-93	0.00E+00	4.06E+08	1.11E+07	0.00E+00	1.17E+08	0.00E+00	4.94E+07
Mo-99	0.00E+00	1.12E+07	2.13E+06	0.00E+00	2.56E+07	0.00E+00	2.00E+07
Tc-99	2.29E+07	3.36E+07	9.16E+06	0.00E+00	4.27E+08	3.48E+06	8.23E+08
Tc-99m	1.45E+00	4.04E+00	5.24E+01	0.00E+00	6.02E+01	2.24E+00	2.65E+03
Tc-101	1.39E-60	1.98E-60	1.95E-59	0.00E+00	3.59E-59	1.21E-60	3.39E-67
Ru-103	5.50E+02	0.00E+00	2.35E+02	0.00E+00	1.94E+03	0.00E+00	4.59E+04
Ru-105	3.95E-04	0.00E+00	1.53E-04	0.00E+00	4.98E-03	0.00E+00	3.19E-01
Rh-105	1.60E+05	1.16E+05	7.60E+04	0.00E+00	4.92E+05	0.00E+00	1.47E+07
Ru-106	1.77E+04	0.00E+00	2.23E+03	0.00E+00	3.41E+04	0.00E+00	8.49E+05
Pd-107	0.00E+00	1.06E+07	6.85E+05	0.00E+00	9.61E+07	0.00E+00	4.94E+07

Table 4-30 (Page 2 of 3)
Grass-Cow-Milk Pathway Factors for Teenager (R_i^C)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	2.03E+04	4.61E+03	0.00E+00	1.17E+05	0.00E+00	2.05E+06
Ag-110m	4.37E+07	4.14E+07	2.52E+07	0.00E+00	7.90E+07	0.00E+00	1.16E+10
Ag-111	2.98E+06	1.24E+06	6.23E+05	0.00E+00	4.03E+06	0.00E+00	1.73E+09
Cd-113m	0.00E+00	2.74E+06	8.81E+04	0.00E+00	3.03E+06	0.00E+00	1.65E+07
Cd-115m	0.00E+00	7.23E+05	2.33E+04	0.00E+00	5.78E+05	0.00E+00	2.29E+07
Sn-123	4.07E+08	6.68E+06	9.90E+06	5.35E+06	0.00E+00	0.00E+00	6.15E+08
Sn-125	2.62E+07	5.23E+05	1.18E+06	4.10E+05	0.00E+00	0.00E+00	2.47E+08
Sn-126	1.48E+09	2.76E+07	4.22E+07	7.27E+06	0.00E+00	0.00E+00	3.30E+08
Sb-124	1.57E+07	2.90E+05	6.14E+06	3.57E+04	0.00E+00	1.38E+07	3.17E+08
Sb-125	1.82E+07	1.98E+05	4.25E+06	1.73E+04	0.00E+00	1.60E+07	1.41E+08
Sb-126	2.51E+06	5.14E+04	9.03E+05	1.42E+04	0.00E+00	1.80E+06	1.49E+08
Sb-127	2.04E+05	4.37E+03	7.71E+04	2.30E+03	0.00E+00	1.39E+05	3.47E+07
Te-125m	1.02E+07	3.68E+06	1.36E+06	2.85E+06	0.00E+00	0.00E+00	3.01E+07
Te-127m	3.36E+07	1.19E+07	3.99E+06	7.99E+06	1.36E+08	0.00E+00	8.37E+07
Te-127	3.04E+02	1.08E+02	6.54E+01	2.10E+02	1.23E+03	0.00E+00	2.35E+04
Te-129m	3.20E+07	1.19E+07	5.07E+06	1.03E+07	1.34E+08	0.00E+00	1.20E+08
Te-129	1.34E-10	5.01E-11	3.27E-11	9.60E-11	5.64E-10	0.00E+00	7.35E-10
Te-133m	9.87E-14	5.61E-14	5.45E-14	7.83E-14	5.55E-13	0.00E+00	2.27E-13
Te-134	4.19E-19	2.69E-19	2.81E-19	3.44E-19	2.57E-18	0.00E+00	1.56E-20
I-129	7.15E+08	6.01E+08	1.00E+09	7.31E+11	1.07E+09	0.00E+00	7.01E+07
I-130	1.85E+05	5.36E+05	2.14E+05	4.37E+07	8.25E+05	0.00E+00	4.12E+05
I-131	1.34E+08	1.88E+08	1.01E+08	5.49E+10	3.24E+08	0.00E+00	3.72E+07
Te-131m	1.64E+05	7.89E+04	6.58E+04	1.19E+05	8.22E+05	0.00E+00	6.33E+06
Te-131	1.81E-33	7.44E-34	5.64E-34	1.39E-33	7.89E-33	0.00E+00	1.48E-34
I-132	7.40E-02	1.94E-01	6.95E-02	6.53E+00	3.05E-01	0.00E+00	8.44E-02
Te-132	1.07E+06	6.80E+05	6.40E+05	7.17E+05	6.52E+06	0.00E+00	2.15E+07
I-133	1.77E+06	3.00E+06	9.16E+05	4.19E+08	5.27E+06	0.00E+00	2.27E+06
Cs-134m	7.83E-02	1.62E-01	8.34E-02	0.00E+00	9.03E-02	1.59E-02	1.08E-01
Cs-134	4.83E+09	1.14E+10	5.27E+09	0.00E+00	3.61E+09	1.38E+09	1.41E+08
I-134	9.36E-13	2.48E-12	8.91E-13	4.14E-11	3.91E-12	0.00E+00	3.27E-14
I-135	5.74E+03	1.48E+04	5.47E+03	9.50E+05	2.33E+04	0.00E+00	1.64E+04
Cs-135	1.71E+09	1.56E+09	3.66E+08	0.00E+00	5.97E+08	2.16E+08	2.74E+07
Cs-136	1.13E+08	4.45E+08	2.99E+08	0.00E+00	2.42E+08	3.82E+07	3.58E+07
Cs-137	6.84E+09	9.10E+09	3.17E+09	0.00E+00	3.10E+09	1.20E+09	1.29E+08
Cs-138	4.41E-24	8.46E-24	4.23E-24	0.00E+00	6.25E-24	7.27E-25	3.84E-27
Cs-139	3.99E-90	5.88E-90	2.16E-90	0.00E+00	4.75E-90	5.20E-91	2.73E-105
Ba-139	2.10E-08	1.48E-11	6.12E-10	0.00E+00	1.39E-11	1.02E-11	1.87E-07
Ba-140	1.22E+07	1.50E+04	7.88E+05	0.00E+00	5.08E+03	1.01E+04	1.89E+07
La-140	2.03E+00	9.96E-01	2.65E-01	0.00E+00	0.00E+00	0.00E+00	5.72E+04
Ba-141	2.13E-46	1.59E-49	7.13E-48	0.00E+00	1.48E-49	1.09E-49	4.55E-52
La-141	1.41E-05	4.35E-06	7.18E-07	0.00E+00	0.00E+00	0.00E+00	7.71E-01
Ce-141	2.56E+03	1.71E+03	1.97E+02	0.00E+00	8.05E+02	0.00E+00	4.89E+06
Ba-142	1.49E-80	1.49E-83	9.19E-82	0.00E+00	1.26E-83	9.94E-84	4.59E-92
La-142	8.59E-12	3.81E-12	9.50E-13	0.00E+00	0.00E+00	0.00E+00	1.16E-07
Ce-143	1.91E+01	1.39E+04	1.55E+00	0.00E+00	6.24E+00	0.00E+00	4.18E+05
Pr-143	7.33E+01	2.93E+01	3.65E+00	0.00E+00	1.70E+01	0.00E+00	2.41E+05
Ce-144	3.03E+05	1.26E+05	1.63E+04	0.00E+00	7.50E+04	0.00E+00	7.63E+07
Pr-144	3.09E-54	1.27E-54	1.57E-55	0.00E+00	7.26E-55	0.00E+00	3.41E-57
Nd-147	4.55E+01	4.94E+01	2.96E+00	0.00E+00	2.90E+01	0.00E+00	1.78E+05
Pm-147	2.56E+03	2.42E+02	9.88E+01	0.00E+00	4.62E+02	0.00E+00	2.30E+05
Pm-148m	4.59E+02	1.16E+02	9.10E+01	0.00E+00	1.76E+02	0.00E+00	7.33E+05
Pm-148	2.72E+01	4.43E+00	2.23E+00	0.00E+00	8.01E+00	0.00E+00	2.64E+05
Pm-149	1.97E+00	2.77E-01	1.14E-01	0.00E+00	5.28E-01	0.00E+00	4.08E+04
Pm-151	2.97E-01	4.91E-02	2.48E-02	0.00E+00	8.82E-02	0.00E+00	1.10E+04
Sm-151	2.23E+03	4.29E+02	1.01E+02	0.00E+00	4.70E+02	0.00E+00	1.45E+05
Sm-153	9.10E-01	7.53E-01	5.54E-02	0.00E+00	2.46E-01	0.00E+00	2.13E+04

Table 4-30 (Page 3 of 3)
Grass-Cow-Milk Pathway Factors for Teenager (R_i^C)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	6.20E+03	1.49E+03	1.32E+03	0.00E+00	6.94E+03	0.00E+00	5.49E+05
Eu-154	1.99E+04	2.57E+03	1.81E+03	0.00E+00	1.15E+04	0.00E+00	1.36E+06
Eu-155	4.33E+03	4.18E+02	2.59E+02	0.00E+00	1.64E+03	0.00E+00	2.40E+06
Eu-156	1.16E+02	8.67E+01	1.42E+01	0.00E+00	5.84E+01	0.00E+00	4.43E+05
Tb-160	9.57E+02	0.00E+00	1.19E+02	0.00E+00	3.78E+02	0.00E+00	6.19E+05
Ho-166m	9.12E+03	2.81E+03	2.03E+03	0.00E+00	4.11E+03	0.00E+00	6.92E+05
W-181	2.55E+04	8.23E+03	8.61E+02	0.00E+00	0.00E+00	0.00E+00	7.01E+05
W-185	8.70E+05	2.87E+05	3.04E+04	0.00E+00	0.00E+00	0.00E+00	2.48E+07
W-187	2.98E+03	2.43E+03	8.52E+02	0.00E+00	0.00E+00	0.00E+00	6.58E+05
Np-239	1.75E+00	1.65E-01	9.19E-02	0.00E+00	5.19E-01	0.00E+00	2.66E+04
U-232	1.50E+10	0.00E+00	1.07E+09	0.00E+00	1.63E+09	0.00E+00	1.83E+08
U-233	3.17E+09	0.00E+00	1.93E+08	0.00E+00	7.41E+08	0.00E+00	1.70E+08
U-234	3.04E+09	0.00E+00	1.89E+08	0.00E+00	7.28E+08	0.00E+00	1.66E+08
U-235	2.91E+09	0.00E+00	1.77E+08	0.00E+00	6.82E+08	0.00E+00	2.12E+08
U-236	2.91E+09	0.00E+00	1.81E+08	0.00E+00	6.98E+08	0.00E+00	1.56E+08
U-237	2.61E+04	0.00E+00	6.94E+03	0.00E+00	1.07E+05	0.00E+00	6.90E+06
U-238	2.79E+09	0.00E+00	1.66E+08	0.00E+00	6.39E+08	0.00E+00	1.49E+08
Np-237	3.40E+07	2.44E+06	1.49E+06	0.00E+00	1.11E+07	0.00E+00	2.15E+06
Np-238	1.66E+01	4.44E-01	2.59E-01	0.00E+00	1.52E+00	0.00E+00	3.26E+04
Pu-238	6.84E+06	8.76E+05	1.86E+05	0.00E+00	7.96E+05	0.00E+00	7.89E+05
Pu-239	7.82E+06	9.50E+05	2.05E+05	0.00E+00	8.76E+05	0.00E+00	7.22E+05
Pu-240	7.81E+06	9.48E+05	2.05E+05	0.00E+00	8.75E+05	0.00E+00	7.35E+05
Pu-241	1.77E+05	8.51E+03	3.74E+03	0.00E+00	1.73E+04	0.00E+00	1.50E+04
Pu-242	7.25E+06	9.14E+05	1.98E+05	0.00E+00	8.43E+05	0.00E+00	7.07E+05
Pu-244	8.46E+06	1.04E+06	2.27E+05	0.00E+00	9.66E+05	0.00E+00	1.05E+06
Am-241	2.04E+07	1.92E+07	1.47E+06	0.00E+00	1.10E+07	0.00E+00	2.01E+06
Am-242m	2.06E+07	1.82E+07	1.48E+06	0.00E+00	1.10E+07	0.00E+00	2.53E+06
Am-243	2.03E+07	1.88E+07	1.44E+06	0.00E+00	1.08E+07	0.00E+00	2.36E+06
Cm-242	5.74E+05	6.06E+05	3.81E+04	0.00E+00	1.74E+05	0.00E+00	1.64E+06
Cm-243	1.65E+07	1.53E+07	1.04E+06	0.00E+00	4.86E+06	0.00E+00	2.11E+06
Cm-244	1.28E+07	1.21E+07	8.09E+05	0.00E+00	3.78E+06	0.00E+00	2.03E+06
Cm-245	2.53E+07	2.23E+07	1.56E+06	0.00E+00	7.28E+06	0.00E+00	1.91E+06
Cm-246	2.51E+07	2.22E+07	1.56E+06	0.00E+00	7.26E+06	0.00E+00	1.87E+06
Cm-247	2.45E+07	2.19E+07	1.53E+06	0.00E+00	7.16E+06	0.00E+00	2.46E+06
Cm-248	2.03E+08	1.80E+08	1.26E+07	0.00E+00	5.90E+07	0.00E+00	3.96E+07
Cf-252	8.45E+06	0.00E+00	2.04E+05	0.00E+00	0.00E+00	0.00E+00	7.43E+06

Units of mrem/yr per μCi/m^3 for H-3 and C-14
Units of m^{2}mrem/yr per μCi/sec for all other nuclides

Table 4-31 (Page 1 of 3)
Grass-Cow-Milk Pathway Factors for Child (R_i^C)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	8.97E+02	8.97E+02	8.97E+02	8.97E+02	8.97E+02	8.97E+02
C-14	1.65E+06	3.29E+05	3.29E+05	3.29E+05	3.29E+05	3.29E+05	3.29E+05
Na-22	9.44E+09	9.44E+09	9.44E+09	9.44E+09	9.44E+09	9.44E+09	9.44E+09
Na-24	2.22E+06	2.22E+06	2.22E+06	2.22E+06	2.22E+06	2.22E+06	2.22E+06
P-32	1.97E+10	9.22E+08	7.60E+08	0.00E+00	0.00E+00	0.00E+00	5.45E+08
Ca-41	1.17E+10	0.00E+00	1.28E+09	0.00E+00	0.00E+00	0.00E+00	6.41E+06
Sc-46	2.56E+02	3.51E+02	1.35E+02	0.00E+00	3.11E+02	0.00E+00	5.13E+05
Cr-51	0.00E+00	0.00E+00	2.83E+04	1.57E+04	4.29E+03	2.86E+04	1.50E+06
Mn-54	0.00E+00	9.75E+06	2.60E+06	0.00E+00	2.73E+06	0.00E+00	8.18E+06
Fe-55	5.55E+07	2.94E+07	9.12E+06	0.00E+00	0.00E+00	1.66E+07	5.45E+06
Mn-56	0.00E+00	3.26E-03	7.35E-04	0.00E+00	3.94E-03	0.00E+00	4.72E-01
Co-57	0.00E+00	1.76E+06	3.56E+06	0.00E+00	0.00E+00	0.00E+00	1.44E+07
Co-58	0.00E+00	4.35E+06	1.33E+07	0.00E+00	0.00E+00	0.00E+00	2.54E+07
Fe-59	3.79E+07	6.12E+07	3.05E+07	0.00E+00	0.00E+00	1.78E+07	6.38E+07
Co-60	0.00E+00	2.18E+07	6.42E+07	0.00E+00	0.00E+00	0.00E+00	1.21E+08
Ni-59	1.14E+09	3.02E+08	1.93E+08	0.00E+00	0.00E+00	0.00E+00	2.01E+07
Ni-63	1.52E+10	8.13E+08	5.16E+08	0.00E+00	0.00E+00	0.00E+00	5.47E+07
Cu-64	0.00E+00	1.87E+04	1.13E+04	0.00E+00	4.52E+04	0.00E+00	8.78E+05
Ni-65	4.20E-01	3.96E-02	2.31E-02	0.00E+00	0.00E+00	0.00E+00	4.85E+00
Zn-65	1.87E+09	4.99E+09	3.11E+09	0.00E+00	3.15E+09	0.00E+00	8.77E+08
Zn-69m	1.99E+05	3.40E+05	4.02E+04	0.00E+00	1.97E+05	0.00E+00	1.11E+07
Zn-69	2.47E-12	3.57E-12	3.30E-13	0.00E+00	2.16E-12	0.00E+00	2.25E-10
Se-79	0.00E+00	1.60E+09	3.55E+08	0.00E+00	2.60E+09	0.00E+00	1.05E+08
Br-82	0.00E+00	0.00E+00	2.88E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	1.12E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	1.75E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	4.95E-301	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	2.27E+09	1.40E+09	0.00E+00	0.00E+00	0.00E+00	1.46E+08
Rb-87	0.00E+00	5.00E+09	2.31E+09	0.00E+00	0.00E+00	0.00E+00	7.49E+07
Rb-88	0.00E+00	2.04E-45	1.41E-45	0.00E+00	0.00E+00	0.00E+00	9.98E-47
Rb-89	0.00E+00	3.91E-53	3.47E-53	0.00E+00	0.00E+00	0.00E+00	3.40E-55
Sr-89	2.16E+09	0.00E+00	6.17E+07	0.00E+00	0.00E+00	0.00E+00	8.36E+07
Sr-90	8.60E+10	0.00E+00	1.73E+09	0.00E+00	0.00E+00	0.00E+00	7.69E+08
Y-90	8.06E+01	0.00E+00	2.16E+00	0.00E+00	0.00E+00	0.00E+00	2.29E+05
Sr-91	3.27E+04	0.00E+00	1.24E+03	0.00E+00	0.00E+00	0.00E+00	7.22E+04
Y-91m	7.01E-20	0.00E+00	2.55E-21	0.00E+00	0.00E+00	0.00E+00	1.37E-16
Y-91	1.33E+04	0.00E+00	3.55E+02	0.00E+00	0.00E+00	0.00E+00	1.77E+06
Sr-92	5.54E-01	0.00E+00	2.22E-02	0.00E+00	0.00E+00	0.00E+00	1.05E+01
Y-92	6.39E-05	0.00E+00	1.83E-06	0.00E+00	0.00E+00	0.00E+00	1.85E+00
Y-93	2.54E-01	0.00E+00	6.97E-03	0.00E+00	0.00E+00	0.00E+00	3.79E+03
Nb-93m	1.10E+06	2.74E+05	9.00E+04	0.00E+00	2.96E+05	0.00E+00	4.13E+07
Nb-95	9.36E+04	3.64E+04	2.60E+04	0.00E+00	3.42E+04	0.00E+00	6.74E+07
Nb-97	3.76E-12	6.79E-13	3.17E-13	0.00E+00	7.53E-13	0.00E+00	2.10E-07
Zr-93	3.52E+03	1.32E+03	9.38E+02	0.00E+00	5.10E+03	0.00E+00	5.00E+05
Zr-95	1.34E+03	2.94E+02	2.62E+02	0.00E+00	4.21E+02	0.00E+00	3.07E+05
Zr-97	4.81E-01	6.95E-02	4.10E-02	0.00E+00	9.97E-02	0.00E+00	1.05E+04
Mo-93	0.00E+00	7.62E+08	2.74E+07	0.00E+00	2.01E+08	0.00E+00	3.86E+07
Mo-99	0.00E+00	2.04E+07	5.03E+06	0.00E+00	4.35E+07	0.00E+00	1.68E+07
Tc-99	5.64E+07	6.28E+07	2.26E+07	0.00E+00	7.40E+08	5.56E+06	6.59E+08
Tc-99m	3.32E+00	6.52E+00	1.08E+02	0.00E+00	9.47E+01	3.31E+00	3.71E+03
Tc-101	3.42E-60	3.58E-60	4.54E-59	0.00E+00	6.10E-59	1.89E-60	1.14E-59
Ru-103	1.30E+03	0.00E+00	5.00E+02	0.00E+00	3.27E+03	0.00E+00	3.36E+04
Ru-105	9.63E-04	0.00E+00	3.49E-04	0.00E+00	8.47E-03	0.00E+00	6.29E-01
Rh-105	3.93E+05	2.11E+05	1.80E+05	0.00E+00	8.41E+05	0.00E+00	1.31E+07
Ru-106	4.36E+04	0.00E+00	5.44E+03	0.00E+00	5.88E+04	0.00E+00	6.78E+05
Pd-107	0.00E+00	1.99E+07	1.69E+06	0.00E+00	1.67E+08	0.00E+00	3.95E+07

Table 4-31 (Page 2 of 3)
Grass-Cow-Milk Pathway Factors for Child (R_i^C)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	3.79E+04	1.13E+04	0.00E+00	2.03E+05	0.00E+00	2.24E+06
Ag-110m	9.49E+07	6.41E+07	5.12E+07	0.00E+00	1.19E+08	0.00E+00	7.62E+09
Ag-111	7.36E+06	2.30E+06	1.52E+06	0.00E+00	6.95E+06	0.00E+00	1.41E+09
Cd-113m	0.00E+00	5.11E+06	2.18E+05	0.00E+00	5.26E+06	0.00E+00	1.32E+07
Cd-115m	0.00E+00	1.35E+06	5.76E+04	0.00E+00	1.00E+06	0.00E+00	1.84E+07
Sn-123	1.01E+09	1.25E+07	2.45E+07	1.32E+07	0.00E+00	0.00E+00	4.93E+08
Sn-125	6.46E+07	9.73E+05	2.89E+06	1.01E+06	0.00E+00	0.00E+00	2.00E+08
Sn-126	3.51E+09	4.37E+07	9.97E+07	1.20E+07	0.00E+00	0.00E+00	2.64E+08
Sb-124	3.73E+07	4.83E+05	1.31E+07	8.23E+04	0.00E+00	2.07E+07	2.33E+08
Sb-125	4.32E+07	3.33E+05	9.06E+06	4.00E+04	0.00E+00	2.41E+07	1.03E+08
Sb-126	5.74E+06	8.78E+04	2.06E+06	3.37E+04	0.00E+00	2.74E+06	1.16E+08
Sb-127	4.92E+05	7.61E+03	1.71E+05	5.48E+03	0.00E+00	2.14E+05	2.77E+07
Te-125m	2.50E+07	6.79E+06	3.34E+06	7.03E+06	0.00E+00	0.00E+00	2.42E+07
Te-127m	8.28E+07	2.23E+07	9.83E+06	1.98E+07	2.36E+08	0.00E+00	6.71E+07
Te-127	7.47E+02	2.01E+02	1.60E+02	5.17E+02	2.13E+03	0.00E+00	2.92E+04
Te-129m	7.90E+07	2.21E+07	1.23E+07	2.55E+07	2.32E+08	0.00E+00	9.63E+07
Te-129	3.32E-10	9.25E-11	7.87E-11	2.37E-10	9.70E-10	0.00E+00	2.06E-08
Te-133m	2.36E-13	9.56E-14	1.18E-13	1.83E-13	9.08E-13	0.00E+00	7.29E-12
Te-134	9.97E-19	4.48E-19	5.98E-19	7.88E-19	4.15E-18	0.00E+00	4.55E-18
I-129	1.76E+09	1.08E+09	9.64E+08	7.06E+11	1.82E+09	0.00E+00	5.43E+07
I-130	4.33E+05	8.75E+05	4.51E+05	9.64E+07	1.31E+06	0.00E+00	4.09E+05
I-131	3.26E+08	3.28E+08	1.86E+08	1.08E+11	5.38E+08	0.00E+00	2.92E+07
Te-131m	4.00E+05	1.38E+05	1.47E+05	2.85E+05	1.34E+06	0.00E+00	5.62E+06
Te-131	4.43E-33	1.35E-33	1.32E-33	3.39E-33	1.34E-32	0.00E+00	2.33E-32
I-132	1.75E-01	3.22E-01	1.48E-01	1.49E+01	4.93E-01	0.00E+00	3.79E-01
Te-132	2.56E+06	1.13E+06	1.37E+06	1.65E+06	1.05E+07	0.00E+00	1.14E+07
I-133	4.30E+06	5.32E+06	2.01E+06	9.88E+08	8.86E+06	0.00E+00	2.14E+06
Cs-134m	1.86E-01	2.75E-01	1.79E-01	0.00E+00	1.45E-01	2.40E-02	3.47E-01
Cs-134	1.11E+10	1.83E+10	3.85E+09	0.00E+00	5.66E+09	2.03E+09	9.85E+07
I-134	2.22E-12	4.12E-12	1.89E-12	9.47E-11	6.29E-12	0.00E+00	2.73E-12
I-135	1.36E+04	2.44E+04	1.16E+04	2.16E+06	3.75E+04	0.00E+00	1.86E+04
Cs-135	4.20E+09	2.92E+09	3.00E+08	0.00E+00	1.03E+09	3.45E+08	2.19E+07
Cs-136	2.55E+08	7.02E+08	4.54E+08	0.00E+00	3.74E+08	5.57E+07	2.47E+07
Cs-137	1.65E+10	1.58E+10	2.33E+09	0.00E+00	5.14E+09	1.85E+09	9.87E+07
Cs-138	1.07E-23	1.48E-23	9.41E-24	0.00E+00	1.04E-23	1.12E-24	6.84E-24
Cs-139	9.81E-90	1.09E-89	5.24E-90	0.00E+00	8.19E-90	8.25E-91	9.81E-94
Ba-139	5.16E-08	2.76E-11	1.50E-09	0.00E+00	2.41E-11	1.62E-11	2.98E-06
Ba-140	2.95E+07	2.59E+04	1.72E+06	0.00E+00	8.42E+03	1.54E+04	1.50E+07
La-140	4.86E+00	1.70E+00	5.72E-01	0.00E+00	0.00E+00	0.00E+00	4.73E+04
Ba-141	5.25E-46	2.94E-49	1.71E-47	0.00E+00	2.54E-49	1.73E-48	2.99E-46
La-141	3.49E-05	8.13E-06	1.76E-06	0.00E+00	0.00E+00	0.00E+00	1.81E+00
Ce-141	6.31E+03	3.15E+03	4.67E+02	0.00E+00	1.38E+03	0.00E+00	3.93E+06
Ba-142	3.60E-80	2.59E-83	2.01E-81	0.00E+00	2.10E-83	1.52E-83	4.70E-82
La-142	2.07E-11	6.61E-12	2.07E-12	0.00E+00	0.00E+00	0.00E+00	1.31E-06
Ce-143	4.69E+01	2.54E+04	3.68E+00	0.00E+00	1.07E+01	0.00E+00	3.72E+05
Pr-143	1.81E+02	5.45E+01	9.00E+00	0.00E+00	2.95E+01	0.00E+00	1.96E+05
Ce-144	7.48E+05	2.34E+05	3.99E+04	0.00E+00	1.30E+05	0.00E+00	6.11E+07
Pr-144	7.65E-54	2.37E-54	3.85E-55	0.00E+00	1.25E-54	0.00E+00	5.10E-51
Nd-147	1.12E+02	9.04E+01	7.00E+00	0.00E+00	4.96E+01	0.00E+00	1.43E+05
Pm-147	6.39E+03	4.56E+02	2.45E+02	0.00E+00	8.05E+02	0.00E+00	1.85E+05
Pm-148m	9.42E+02	1.88E+02	1.88E+02	0.00E+00	2.78E+02	0.00E+00	5.29E+05
Pm-148	6.65E+01	7.99E+00	5.18E+00	0.00E+00	1.36E+01	0.00E+00	2.14E+05
Pm-149	4.86E+00	5.17E-01	2.80E-01	0.00E+00	9.14E-01	0.00E+00	3.53E+04
Pm-151	7.25E-01	8.82E-02	5.74E-02	0.00E+00	1.50E-01	0.00E+00	1.00E+04
Sm-151	5.39E+03	8.02E+02	2.53E+02	0.00E+00	8.29E+02	0.00E+00	1.16E+05
Sm-153	2.25E+00	1.40E+00	1.35E-01	0.00E+00	4.25E-01	0.00E+00	1.86E+04

Table 4-31 (Page 3 of 3)
Grass-Cow-Milk Pathway Factors for Child (R_i^C)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	1.28E+04	2.34E+03	2.78E+03	0.00E+00	9.88E+03	0.00E+00	3.84E+05
Eu-154	4.78E+04	4.30E+03	3.93E+03	0.00E+00	1.89E+04	0.00E+00	9.99E+05
Eu-155	9.90E+03	7.13E+02	5.59E+02	0.00E+00	2.67E+03	0.00E+00	1.79E+06
Eu-156	2.79E+02	1.50E+02	3.10E+01	0.00E+00	9.64E+01	0.00E+00	3.39E+05
Tb-160	2.02E+03	0.00E+00	2.51E+02	0.00E+00	6.03E+02	0.00E+00	4.49E+05
Ho-166m	2.28E+04	4.76E+03	4.03E+03	0.00E+00	6.79E+03	0.00E+00	5.54E+05
W-181	6.27E+04	1.54E+04	2.12E+03	0.00E+00	0.00E+00	0.00E+00	5.62E+05
W-185	2.15E+06	5.36E+05	7.50E+04	0.00E+00	0.00E+00	0.00E+00	2.00E+07
W-187	7.23E+03	4.28E+03	1.92E+03	0.00E+00	0.00E+00	0.00E+00	6.02E+05
Np-239	4.32E+00	3.10E-01	2.18E-01	0.00E+00	8.96E-01	0.00E+00	2.29E+04
U-232	3.70E+10	0.00E+00	2.65E+09	0.00E+00	2.82E+09	0.00E+00	1.47E+08
U-233	7.84E+09	0.00E+00	4.74E+08	0.00E+00	1.29E+09	0.00E+00	1.36E+08
U-234	7.53E+09	0.00E+00	4.66E+08	0.00E+00	1.26E+09	0.00E+00	1.33E+08
U-235	7.21E+09	0.00E+00	4.36E+08	0.00E+00	1.18E+09	0.00E+00	1.69E+08
U-236	7.21E+09	0.00E+00	4.47E+08	0.00E+00	1.21E+09	0.00E+00	1.25E+08
U-237	6.43E+04	0.00E+00	1.71E+04	0.00E+00	1.86E+05	0.00E+00	5.67E+06
U-238	6.89E+09	0.00E+00	4.09E+08	0.00E+00	1.10E+09	0.00E+00	1.19E+08
Np-237	4.70E+07	3.10E+06	2.06E+06	0.00E+00	1.28E+07	0.00E+00	1.72E+06
Np-238	4.09E+01	8.28E-01	6.37E-01	0.00E+00	2.64E+00	0.00E+00	2.84E+04
Pu-238	1.00E+07	1.16E+06	2.66E+05	0.00E+00	9.68E+05	0.00E+00	6.32E+05
Pu-239	1.09E+07	1.16E+06	2.79E+05	0.00E+00	1.03E+06	0.00E+00	5.78E+05
Pu-240	1.08E+07	1.21E+06	2.79E+05	0.00E+00	1.03E+06	0.00E+00	5.89E+05
Pu-241	3.23E+05	1.32E+04	6.72E+03	0.00E+00	2.47E+04	0.00E+00	1.20E+04
Pu-242	1.00E+07	1.16E+06	2.69E+05	0.00E+00	9.87E+05	0.00E+00	5.66E+05
Pu-244	1.17E+07	1.33E+07	3.08E+05	0.00E+00	1.14E+06	0.00E+00	8.43E+05
Am-241	2.87E+07	2.47E+07	2.15E+06	0.00E+00	1.31E+07	0.00E+00	1.61E+06
Am-242m	2.95E+07	2.36E+07	2.19E+06	0.00E+00	1.33E+07	0.00E+00	2.02E+06
Am-243	2.83E+07	2.38E+07	2.07E+06	0.00E+00	1.28E+07	0.00E+00	1.89E+06
Cm-242	1.42E+06	1.13E+06	9.41E+04	0.00E+00	3.01E+05	0.00E+00	1.32E+06
Cm-243	2.69E+07	2.18E+07	1.73E+06	0.00E+00	6.46E+06	0.00E+00	1.69E+06
Cm-244	2.26E+07	1.83E+07	1.45E+06	0.00E+00	5.32E+06	0.00E+00	1.63E+06
Cm-245	3.52E+07	2.83E+07	2.21E+06	0.00E+00	8.66E+06	0.00E+00	1.53E+06
Cm-246	3.48E+07	2.82E+07	2.21E+06	0.00E+00	8.64E+06	0.00E+00	1.50E+06
Cm-247	3.39E+07	2.78E+07	2.17E+06	0.00E+00	8.52E+06	0.00E+00	1.97E+06
Cm-248	2.83E+08	2.30E+08	1.80E+07	0.00E+00	7.02E+07	0.00E+00	3.18E+07
Cf-252	2.11E+07	0.00E+00	5.10E+05	0.00E+00	0.00E+00	0.00E+00	5.95E+06

Units of mrem/yr per μCi/m³ for H-3 and C-14
Units of m²mrem/yr per μCi/sec for all other nuclides

Table 4-32 (Page 1 of 3)
Grass-Cow-Milk Pathway Factors for Infant (R_i^C)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.36E+03	1.36E+03	1.36E+03	1.36E+03	1.36E+03	1.36E+03
C-14	3.23E+06	6.89E+05	6.89E+05	6.89E+05	6.89E+05	6.89E+05	6.89E+05
Na-22	1.58E+10	1.58E+10	1.58E+10	1.58E+10	1.58E+10	1.58E+10	1.58E+10
Na-24	3.86E+06	3.86E+06	3.86E+06	3.86E+06	3.86E+06	3.86E+06	3.86E+06
P-32	4.06E+10	2.39E+09	1.57E+09	0.00E+00	0.00E+00	0.00E+00	5.49E+08
Ca-41	1.26E+10	0.00E+00	1.38E+09	0.00E+00	0.00E+00	0.00E+00	6.44E+06
Sc-46	4.87E+02	7.03E+02	2.20E+02	0.00E+00	4.63E+02	0.00E+00	4.59E+05
Cr-51	0.00E+00	0.00E+00	4.48E+04	2.92E+04	6.38E+03	5.68E+04	1.30E+06
Mn-54	0.00E+00	1.81E+07	4.11E+06	0.00E+00	4.02E+06	0.00E+00	6.66E+06
Fe-55	6.71E+07	4.33E+07	1.16E+07	0.00E+00	0.00E+00	2.12E+07	5.50E+06
Mn-56	0.00E+00	7.98E-03	1.37E-03	0.00E+00	6.85E-03	0.00E+00	7.24E-01
Co-57	0.00E+00	4.10E+06	6.67E+06	0.00E+00	0.00E+00	0.00E+00	1.40E+07
Co-58	0.00E+00	8.70E+06	2.17E+07	0.00E+00	0.00E+00	0.00E+00	2.17E+07
Fe-59	7.07E+07	1.23E+08	4.86E+07	0.00E+00	0.00E+00	3.65E+07	5.90E+07
Co-60	0.00E+00	4.44E+07	1.05E+08	0.00E+00	0.00E+00	0.00E+00	1.06E+08
Ni-59	1.34E+09	4.10E+08	2.31E+08	0.00E+00	0.00E+00	0.00E+00	2.02E+07
Ni-63	1.79E+10	1.11E+09	6.21E+08	0.00E+00	0.00E+00	0.00E+00	5.50E+07
Cu-64	0.00E+00	4.65E+04	2.15E+04	0.00E+00	7.87E+04	0.00E+00	9.55E+05
Ni-65	8.90E-01	1.01E-01	4.58E-02	0.00E+00	0.00E+00	0.00E+00	7.67E+00
Zn-65	2.52E+09	8.63E+09	3.98E+09	0.00E+00	4.19E+09	0.00E+00	7.29E+09
Zn-69m	4.21E+05	8.60E+05	7.84E+04	0.00E+00	3.48E+05	0.00E+00	1.19E+07
Zn-69	5.26E-12	9.46E-12	7.04E-13	0.00E+00	3.93E-12	0.00E+00	7.72E-10
Se-79	0.00E+00	3.98E+09	7.40E+08	0.00E+00	4.61E+09	0.00E+00	1.06E+08
Br-82	0.00E+00	0.00E+00	4.84E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	2.37E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	3.38E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	1.05E-300	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	5.77E+09	2.85E+09	0.00E+00	0.00E+00	0.00E+00	1.48E+08
Rb-87	0.00E+00	1.12E+10	4.45E+09	0.00E+00	0.00E+00	0.00E+00	7.56E+07
Rb-88	0.00E+00	5.33E-45	2.92E-45	0.00E+00	0.00E+00	0.00E+00	5.20E-45
Rb-89	0.00E+00	9.55E-53	6.58E-53	0.00E+00	0.00E+00	0.00E+00	3.25E-53
Sr-89	4.11E+09	0.00E+00	1.18E+08	0.00E+00	0.00E+00	0.00E+00	8.45E+07
Sr-90	9.50E+10	0.00E+00	1.93E+09	0.00E+00	0.00E+00	0.00E+00	7.76E+08
Y-90	1.70E+02	0.00E+00	4.57E+00	0.00E+00	0.00E+00	0.00E+00	2.35E+05
Sr-91	6.82E+04	0.00E+00	2.47E+03	0.00E+00	0.00E+00	0.00E+00	8.07E+04
Y-91m	1.49E-19	0.00E+00	5.06E-21	0.00E+00	0.00E+00	0.00E+00	4.95E-16
Y-91	2.49E+04	0.00E+00	6.64E+02	0.00E+00	0.00E+00	0.00E+00	1.79E+06
Sr-92	1.18E+00	0.00E+00	4.37E-02	0.00E+00	0.00E+00	0.00E+00	1.27E+01
Y-92	1.36E-04	0.00E+00	3.82E-06	0.00E+00	0.00E+00	0.00E+00	2.59E+00
Y-93	5.41E-01	0.00E+00	1.47E-02	0.00E+00	0.00E+00	0.00E+00	4.28E+03
Nb-93m	1.29E+06	3.48E+05	1.09E+05	0.00E+00	3.40E+05	0.00E+00	4.16E+07
Nb-95	1.75E+05	7.19E+04	4.16E+04	0.00E+00	5.16E+04	0.00E+00	6.07E+07
Nb-97	7.95E-12	1.70E-12	6.11E-13	0.00E+00	1.32E-12	0.00E+00	5.35E-07
Zr-93	4.07E+03	1.94E+03	1.17E+03	0.00E+00	5.71E+03	0.00E+00	5.04E+05
Zr-95	2.38E+03	5.79E+02	4.10E+02	0.00E+00	6.24E+02	0.00E+00	2.88E+05
Zr-97	1.02E+00	1.75E-01	7.98E-02	0.00E+00	1.76E-01	0.00E+00	1.11E+04
Mo-93	0.00E+00	1.79E+09	5.76E+07	0.00E+00	3.57E+08	0.00E+00	3.83E+07
Mo-99	0.00E+00	5.20E+07	1.01E+07	0.00E+00	7.77E+07	0.00E+00	1.71E+07
Tc-99	1.14E+08	1.54E+08	4.80E+07	0.00E+00	1.30E+09	1.50E+07	6.65E+08
Tc-99m	6.91E+00	1.43E+01	1.84E+02	0.00E+00	1.53E+02	7.45E+00	4.14E+03
Tc-101	7.26E-60	9.14E-60	9.05E-59	0.00E+00	1.09E-58	4.99E-60	1.55E-57
Ru-103	2.63E+03	0.00E+00	8.81E+02	0.00E+00	5.48E+03	0.00E+00	3.20E+04
Ru-105	2.03E-03	0.00E+00	6.84E-04	0.00E+00	1.49E-02	0.00E+00	8.08E-01
Rh-105	8.33E+05	5.45E+05	3.66E+05	0.00E+00	1.51E+06	0.00E+00	1.35E+07
Ru-106	8.97E+04	0.00E+00	1.12E+04	0.00E+00	1.06E+05	0.00E+00	6.81E+05
Pd-107	0.00E+00	5.02E+07	3.56E+06	0.00E+00	2.86E+08	0.00E+00	3.99E+07

Table 4-32 (Page 2 of 3)
Grass-Cow-Milk Pathway Factors for Infant (R_i^C)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	1.00E+05	2.42E+04	0.00E+00	3.68E+05	0.00E+00	2.46E+06
Ag-110m	1.75E+08	1.28E+08	8.47E+07	0.00E+00	1.83E+08	0.00E+00	6.64E+09
Ag-111	1.54E+07	6.00E+06	3.18E+06	0.00E+00	1.25E+07	0.00E+00	1.43E+09
Cd-113m	0.00E+00	8.87E+06	3.27E+05	0.00E+00	6.72E+06	0.00E+00	1.33E+07
Cd-115m	0.00E+00	3.26E+06	1.13E+05	0.00E+00	1.70E+06	0.00E+00	1.86E+07
Sn-123	1.88E+09	2.94E+07	4.92E+07	2.96E+07	0.00E+00	0.00E+00	4.98E+08
Sn-125	1.35E+08	2.51E+06	5.98E+06	2.47E+06	0.00E+00	0.00E+00	2.02E+08
Sn-126	5.83E+09	7.65E+07	1.90E+08	2.01E+07	0.00E+00	0.00E+00	2.66E+08
Sb-124	7.18E+07	1.06E+06	2.23E+07	1.91E+05	0.00E+00	4.50E+07	2.22E+08
Sb-125	7.43E+07	7.19E+05	1.53E+07	9.30E+04	0.00E+00	4.30E+07	9.90E+07
Sb-126	1.05E+07	2.06E+05	3.80E+06	8.08E+04	0.00E+00	6.61E+06	1.09E+08
Sb-127	1.04E+06	1.85E+04	3.20E+05	1.32E+04	0.00E+00	5.34E+05	2.74E+07
Te-125m	5.12E+07	1.71E+07	6.92E+06	1.72E+07	0.00E+00	0.00E+00	2.44E+07
Te-127m	1.68E+08	5.56E+07	2.03E+07	4.84E+07	4.13E+08	0.00E+00	6.76E+07
Te-127	1.59E+03	5.31E+02	3.41E+02	1.29E+03	3.87E+03	0.00E+00	3.33E+04
Te-129m	1.62E+08	5.56E+07	2.50E+07	6.23E+07	4.05E+08	0.00E+00	9.68E+07
Te-129	7.03E-10	2.42E-10	1.64E-10	5.89E-10	1.75E-09	0.00E+00	5.62E-08
Te-133m	4.94E-13	2.26E-13	2.16E-13	4.36E-13	1.54E-12	0.00E+00	2.44E-11
Te-134	2.06E-18	1.04E-18	1.07E-18	1.85E-18	6.98E-18	0.00E+00	2.37E-17
I-129	3.62E+09	2.68E+09	1.96E+09	1.72E+12	3.18E+09	0.00E+00	5.36E+07
I-130	8.90E+05	1.96E+06	7.86E+05	2.20E+08	2.15E+06	0.00E+00	4.20E+05
I-131	6.80E+08	8.02E+08	3.53E+08	2.63E+11	9.36E+08	0.00E+00	2.86E+07
Te-131m	8.45E+05	3.40E+05	2.81E+05	6.90E+05	2.34E+06	0.00E+00	5.73E+06
Te-131	9.40E-33	3.47E-33	2.64E-33	8.38E-33	2.40E-32	0.00E+00	3.80E-31
I-132	3.63E-01	7.38E-01	2.63E-01	3.46E+01	8.23E-01	0.00E+00	5.98E-01
Te-132	5.28E+06	2.61E+06	2.44E+06	3.86E+06	1.63E+07	0.00E+00	9.67E+06
I-133	9.08E+06	1.32E+07	3.87E+06	2.40E+09	1.55E+07	0.00E+00	2.24E+06
Cs-134m	3.87E-01	6.44E-01	3.25E-01	0.00E+00	2.48E-01	5.72E-02	5.10E-01
Cs-134	1.79E+10	3.34E+10	3.38E+09	0.00E+00	8.61E+09	3.53E+09	9.08E+07
I-134	4.60E-12	9.42E-12	3.35E-12	2.20E-10	1.05E-11	0.00E+00	9.73E-12
I-135	2.82E+04	5.62E+04	2.05E+04	5.03E+06	6.26E+04	0.00E+00	2.03E+04
Cs-135	6.73E+09	6.12E+09	3.19E+08	0.00E+00	1.74E+09	6.63E+08	2.21E+07
Cs-136	4.99E+08	1.47E+09	5.47E+08	0.00E+00	5.84E+08	1.19E+08	2.23E+07
Cs-137	2.63E+10	3.08E+10	2.18E+09	0.00E+00	8.26E+09	3.35E+09	9.62E+07
Cs-138	2.25E-23	3.66E-23	1.78E-23	0.00E+00	1.83E-23	2.85E-24	5.85E-23
Cs-139	2.10E-89	2.87E-89	1.10E-89	0.00E+00	1.48E-89	2.23E-90	1.80E-90
Ba-139	1.10E-07	7.28E-11	3.18E-09	0.00E+00	4.38E-11	4.41E-11	6.96E-06
Ba-140	6.07E+07	6.07E+04	3.13E+06	0.00E+00	1.44E+04	3.73E+04	1.49E+07
La-140	1.01E+01	4.00E+00	1.03E+00	0.00E+00	0.00E+00	0.00E+00	4.70E+04
Ba-141	1.12E-45	7.64E-49	3.52E-47	0.00E+00	4.59E-49	4.65E-49	1.36E-44
La-141	7.41E-05	2.15E-05	3.74E-06	0.00E+00	0.00E+00	0.00E+00	2.46E+00
Ce-141	1.25E+04	7.63E+03	8.98E+02	0.00E+00	2.35E+03	0.00E+00	3.94E+06
Ba-142	7.58E-80	6.31E-83	3.73E-81	0.00E+00	3.63E-83	3.82E-83	3.13E-79
La-142	4.35E-11	1.60E-11	3.83E-12	0.00E+00	0.00E+00	0.00E+00	2.72E-06
Ce-143	9.93E+01	6.59E+04	7.52E+00	0.00E+00	1.92E+01	0.00E+00	3.85E+05
Pr-143	3.75E+02	1.40E+02	1.86E+01	0.00E+00	5.22E+01	0.00E+00	1.98E+05
Ce-144	1.07E+06	4.39E+05	6.00E+04	0.00E+00	1.77E+05	0.00E+00	6.15E+07
Pr-144	1.63E-53	6.29E-54	8.19E-55	0.00E+00	2.28E-54	0.00E+00	2.92E-49
Nd-147	2.21E+02	2.27E+02	1.39E+01	0.00E+00	8.76E+01	0.00E+00	1.44E+05
Pm-147	7.79E+03	6.57E+02	3.19E+02	0.00E+00	9.80E+02	0.00E+00	1.86E+05
Pm-148m	1.51E+03	3.82E+02	3.00E+02	0.00E+00	4.39E+02	0.00E+00	4.98E+05
Pm-148	1.39E+02	2.01E+01	1.01E+01	0.00E+00	2.40E+01	0.00E+00	2.15E+05
Pm-149	1.03E+01	1.36E+00	5.92E-01	0.00E+00	1.65E+00	0.00E+00	3.64E+04
Pm-151	1.53E+00	2.24E-01	1.13E-01	0.00E+00	2.66E-01	0.00E+00	1.04E+04
Sm-151	6.11E+03	1.40E+03	3.03E+02	0.00E+00	9.54E+02	0.00E+00	1.17E+05
Sm-153	4.75E+00	3.67E+00	2.82E-01	0.00E+00	7.69E-01	0.00E+00	1.92E+04

Table 4-32 (Page 3 of 3)
Grass-Cow-Milk Pathway Factors for Infant (R_i^C)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	1.41E+04	3.74E+03	3.15E+03	0.00E+00	1.05E+04	0.00E+00	3.32E+05
Eu-154	5.48E+04	7.62E+03	4.57E+03	0.00E+00	2.07E+04	0.00E+00	9.52E+05
Eu-155	1.11E+04	1.28E+03	6.64E+02	0.00E+00	2.88E+03	0.00E+00	1.72E+06
Eu-156	5.66E+02	3.51E+02	5.57E+01	0.00E+00	1.62E+02	0.00E+00	3.31E+05
Tb-160	3.16E+03	0.00E+00	3.95E+02	0.00E+00	8.99E+02	0.00E+00	4.21E+05
Ho-166m	2.64E+04	5.67E+03	4.49E+03	0.00E+00	7.53E+03	0.00E+00	5.61E+05
W-181	1.31E+05	4.03E+04	4.51E+03	0.00E+00	0.00E+00	0.00E+00	5.66E+05
W-185	4.49E+06	1.40E+06	1.60E+05	0.00E+00	0.00E+00	0.00E+00	2.01E+07
W-187	1.52E+04	1.06E+04	3.66E+03	0.00E+00	0.00E+00	0.00E+00	6.22E+05
Np-239	9.12E+00	8.16E-01	4.61E-01	0.00E+00	1.63E+00	0.00E+00	2.36E+04
U-232	5.09E+10	0.00E+00	4.55E+09	0.00E+00	4.99E+09	0.00E+00	1.48E+08
U-233	1.07E+10	0.00E+00	8.16E+08	0.00E+00	2.28E+09	0.00E+00	1.37E+08
U-234	1.03E+10	0.00E+00	8.01E+08	0.00E+00	2.23E+09	0.00E+00	1.34E+08
U-235	9.85E+09	0.00E+00	7.51E+08	0.00E+00	2.09E+09	0.00E+00	1.71E+08
U-236	9.85E+09	0.00E+00	7.67E+08	0.00E+00	2.13E+09	0.00E+00	1.26E+08
U-237	1.35E+05	0.00E+00	3.60E+04	0.00E+00	3.35E+05	0.00E+00	5.75E+06
U-238	9.42E+09	0.00E+00	7.02E+08	0.00E+00	1.96E+09	0.00E+00	1.20E+08
Np-237	5.06E+07	3.35E+06	2.21E+06	0.00E+00	1.34E+07	0.00E+00	1.74E+06
Np-238	8.70E+01	2.19E+00	1.35E+00	0.00E+00	4.78E+00	0.00E+00	2.93E+04
Pu-238	1.08E+07	1.26E+06	2.86E+05	0.00E+00	1.02E+06	0.00E+00	6.37E+05
Pu-239	1.16E+07	1.31E+06	2.99E+05	0.00E+00	1.08E+06	0.00E+00	5.83E+05
Pu-240	1.16E+07	1.31E+06	2.99E+05	0.00E+00	1.08E+06	0.00E+00	5.94E+05
Pu-241	3.55E+05	1.47E+04	7.37E+03	0.00E+00	2.65E+04	0.00E+00	1.21E+04
Pu-242	1.08E+07	1.26E+06	2.88E+05	0.00E+00	1.04E+06	0.00E+00	5.71E+05
Pu-244	1.26E+07	1.44E+06	3.30E+05	0.00E+00	1.19E+06	0.00E+00	8.52E+05
Am-241	3.08E+07	2.68E+07	2.30E+06	0.00E+00	1.38E+07	0.00E+00	1.62E+06
Am-242m	3.18E+07	2.57E+07	2.38E+06	0.00E+00	1.40E+07	0.00E+00	2.04E+06
Am-243	3.04E+07	2.59E+07	2.23E+06	0.00E+00	1.34E+07	0.00E+00	1.90E+06
Cm-242	2.21E+06	2.05E+06	1.47E+05	0.00E+00	4.22E+05	0.00E+00	1.33E+06
Cm-243	2.94E+07	2.41E+07	1.88E+06	0.00E+00	6.86E+06	0.00E+00	1.70E+06
Cm-244	2.47E+07	2.03E+07	1.59E+06	0.00E+00	5.67E+06	0.00E+00	1.64E+06
Cm-245	3.77E+07	3.06E+07	2.38E+06	0.00E+00	9.11E+06	0.00E+00	1.54E+06
Cm-246	3.73E+07	3.06E+07	2.38E+06	0.00E+00	9.09E+06	0.00E+00	1.51E+06
Cm-247	3.65E+07	3.01E+07	2.34E+06	0.00E+00	8.94E+06	0.00E+00	1.99E+06
Cm-248	3.01E+08	2.49E+08	1.93E+07	0.00E+00	7.38E+07	0.00E+00	3.20E+07
Cf-252	2.45E+07	0.00E+00	5.93E+05	0.00E+00	0.00E+00	0.00E+00	6.01E+06

Units of mrem/yr per µCi/m³ for H-3 and C-14
Units of m²mrem/yr per µCi/sec for all other nuclides

Table 4-33 (Page 1 of 3)
Grass-Cow-Meat Pathway Factors for Adult (R_i^M)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.85E+02	1.85E+02	1.85E+02	1.85E+02	1.85E+02	1.85E+02
C-14	3.33E+05	6.66E+04	6.66E+04	6.66E+04	6.66E+04	6.66E+04	6.66E+04
Na-22	6.89E+08	6.89E+08	6.89E+08	6.89E+08	6.89E+08	6.89E+08	6.89E+08
Na-24	3.48E-04	3.48E-04	3.48E-04	3.48E-04	3.48E-04	3.48E-04	3.48E-04
P-32	1.18E+09	7.34E+07	4.56E+07	0.00E+00	0.00E+00	0.00E+00	1.33E+08
Ca-41	1.04E+09	0.00E+00	1.12E+08	0.00E+00	0.00E+00	0.00E+00	1.03E+06
Sc-46	6.58E+04	1.28E+05	3.71E+04	0.00E+00	1.19E+05	0.00E+00	6.22E+08
Cr-51	0.00E+00	0.00E+00	1.96E+03	1.17E+03	4.31E+02	2.60E+03	4.92E+05
Mn-54	0.00E+00	4.27E+06	8.15E+05	0.00E+00	1.27E+06	0.00E+00	1.31E+07
Fe-55	1.46E+08	1.01E+08	2.35E+07	0.00E+00	0.00E+00	5.61E+07	5.77E+07
Mn-56	0.00E+00	4.40E-54	7.80E-55	0.00E+00	5.59E-54	0.00E+00	1.40E-52
Co-57	0.00E+00	2.58E+06	4.30E+06	0.00E+00	0.00E+00	0.00E+00	6.56E+07
Co-58	0.00E+00	6.54E+06	1.47E+07	0.00E+00	0.00E+00	0.00E+00	1.33E+08
Fe-59	8.36E+07	1.97E+08	7.54E+07	0.00E+00	0.00E+00	5.49E+07	6.55E+08
Co-60	0.00E+00	3.79E+07	8.36E+07	0.00E+00	0.00E+00	0.00E+00	7.12E+08
Ni-59	7.27E+07	2.50E+07	1.21E+07	0.00E+00	0.00E+00	0.00E+00	5.14E+06
Ni-63	9.67E+08	6.70E+07	3.24E+07	0.00E+00	0.00E+00	0.00E+00	1.40E+07
Cu-64	0.00E+00	6.99E-08	3.28E-08	0.00E+00	1.76E-07	0.00E+00	5.96E-06
Ni-65	6.54E-54	8.50E-55	3.88E-55	0.00E+00	0.00E+00	0.00E+00	2.16E-53
Zn-65	1.61E+08	5.13E+08	2.32E+08	0.00E+00	3.43E+08	0.00E+00	3.23E+08
Zn-69m	4.31E-06	1.03E-05	9.45E-07	0.00E+00	6.26E-06	0.00E+00	6.31E-04
Zn-69	6.86E-154	1.31E-153	9.12E-155	0.00E+00	8.52E-154	0.00E+00	1.97E-154
Se-79	0.00E+00	5.54E+07	9.26E+06	0.00E+00	9.59E+07	0.00E+00	1.13E+07
Br-82	0.00E+00	0.00E+00	3.09E+02	0.00E+00	0.00E+00	0.00E+00	3.54E+02
Br-83	0.00E+00	0.00E+00	1.76E-57	0.00E+00	0.00E+00	0.00E+00	2.54E-57
Br-84	0.00E+00	0.00E+00	3.42E-270	0.00E+00	0.00E+00	0.00E+00	2.69E-275
Br-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.26E+08	5.89E+07	0.00E+00	0.00E+00	0.00E+00	2.49E+07
Rb-87	0.00E+00	5.36E+08	1.86E+08	0.00E+00	0.00E+00	0.00E+00	2.51E+07
Rb-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-89	9.85E+07	0.00E+00	2.83E+06	0.00E+00	0.00E+00	0.00E+00	1.58E+07
Sr-90	7.30E+09	0.00E+00	1.47E+08	0.00E+00	0.00E+00	0.00E+00	1.84E+08
Y-90	2.71E+01	0.00E+00	7.26E-01	0.00E+00	0.00E+00	0.00E+00	2.87E+05
Sr-91	3.95E-11	0.00E+00	1.60E-12	0.00E+00	0.00E+00	0.00E+00	1.88E-10
Y-91m	2.78E-175	0.00E+00	1.08E-176	0.00E+00	0.00E+00	0.00E+00	8.15E-175
Y-91	3.85E+05	0.00E+00	1.03E+04	0.00E+00	0.00E+00	0.00E+00	2.12E+08
Sr-92	3.39E-50	0.00E+00	1.47E-51	0.00E+00	0.00E+00	0.00E+00	6.73E-49
Y-92	4.23E-40	0.00E+00	1.24E-41	0.00E+00	0.00E+00	0.00E+00	7.41E-36
Y-93	1.22E-12	0.00E+00	3.36E-14	0.00E+00	0.00E+00	0.00E+00	3.86E-08
Nb-93m	9.92E+06	3.24E+06	7.98E+05	0.00E+00	3.72E+06	0.00E+00	1.49E+09
Nb-95	6.76E+05	3.76E+05	2.02E+05	0.00E+00	3.72E+05	0.00E+00	2.28E+09
Nb-97	2.03E-119	5.14E-120	1.88E-120	0.00E+00	5.99E-120	0.00E+00	1.90E-116
Zr-93	2.00E+06	1.12E+05	5.21E+04	0.00E+00	4.24E+05	0.00E+00	1.16E+08
Zr-95	6.54E+05	2.10E+05	1.42E+05	0.00E+00	3.29E+05	0.00E+00	6.65E+08
Zr-97	5.29E-06	1.07E-06	4.88E-07	0.00E+00	1.61E-06	0.00E+00	3.30E-01
Mo-93	0.00E+00	8.44E+07	2.28E+06	0.00E+00	2.39E+07	0.00E+00	1.37E+07
Mo-99	0.00E+00	2.51E+04	4.78E+03	0.00E+00	5.69E+04	0.00E+00	5.83E+04
Tc-99	7.03E+07	1.05E+08	2.82E+07	0.00E+00	1.32E+09	8.88E+06	3.42E+09
Tc-99m	1.19E-21	3.35E-21	4.27E-20	0.00E+00	5.09E-20	1.64E-21	1.98E-18
Tc-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru-103	3.20E+07	0.00E+00	1.38E+07	0.00E+00	1.22E+08	0.00E+00	3.73E+09
Ru-105	1.57E-28	0.00E+00	6.22E-29	0.00E+00	2.03E-27	0.00E+00	9.63E-26
Rh-105	9.71E-01	7.10E-01	4.68E-01	0.00E+00	3.02E+00	0.00E+00	1.13E+02
Ru-106	1.32E+09	0.00E+00	1.67E+08	0.00E+00	2.55E+09	0.00E+00	8.54E+10
Pd-107	0.00E+00	8.26E+05	5.28E+04	0.00E+00	7.42E+06	0.00E+00	5.12E+06

Table 4-33 (Page 2 of 3)
Grass-Cow-Meat Pathway Factors for Adult (R_i^M)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	3.39E-07	7.65E-08	0.00E+00	1.94E-06	0.00E+00	3.76E-05
Ag-110m	3.04E+06	2.81E+06	1.67E+06	0.00E+00	5.52E+06	0.00E+00	1.15E+09
Ag-111	3.67E+04	1.54E+04	7.65E+03	0.00E+00	4.95E+04	0.00E+00	2.82E+07
Cd-113m	0.00E+00	2.34E+06	7.51E+04	0.00E+00	2.58E+06	0.00E+00	1.88E+07
Cd-115m	0.00E+00	4.70E+05	1.50E+04	0.00E+00	3.73E+05	0.00E+00	1.98E+07
Sn-123	2.28E+09	3.77E+07	5.56E+07	3.21E+07	0.00E+00	0.00E+00	4.64E+09
Sn-125	4.43E+07	8.93E+05	2.01E+06	7.39E+05	0.00E+00	0.00E+00	5.53E+08
Sn-126	9.50E+09	1.88E+08	2.70E+08	5.53E+07	0.00E+00	0.00E+00	2.73E+09
Sb-124	6.79E+06	1.28E+05	2.69E+06	1.65E+04	0.00E+00	5.29E+06	1.93E+08
Sb-125	9.49E+06	1.06E+05	2.26E+06	9.65E+03	0.00E+00	7.32E+06	1.04E+08
Sb-126	4.88E+05	9.92E+03	1.76E+05	2.99E+03	0.00E+00	2.99E+05	3.99E+07
Sb-127	4.17E+03	9.12E+01	1.60E+03	5.01E+01	0.00E+00	2.47E+03	9.53E+05
Te-125m	1.22E+08	4.42E+07	1.63E+07	3.67E+07	4.96E+08	0.00E+00	4.87E+08
Te-127m	4.44E+08	1.59E+08	5.41E+07	1.13E+08	1.80E+09	0.00E+00	1.49E+09
Te-127	5.53E-11	1.98E-11	1.20E-11	4.10E-11	2.25E-10	0.00E+00	4.36E-09
Te-129m	3.30E+08	1.23E+08	5.23E+07	1.13E+08	1.38E+09	0.00E+00	1.66E+09
Te-129	1.56E-121	5.85E-122	3.79E-122	1.19E-121	6.54E-121	0.00E+00	1.17E-121
Te-133m	2.15E-153	1.26E-153	1.21E-153	1.82E-153	1.24E-152	0.00E+00	4.31E-154
Te-134	1.38E-204	9.05E-205	5.55E-205	1.21E-204	8.75E-204	0.00E+00	1.53E-207
I-129	6.66E+07	5.73E+07	1.88E+08	1.47E+11	1.23E+08	0.00E+00	9.05E+06
I-130	5.44E-07	1.60E-06	6.33E-07	1.36E-04	2.50E-06	0.00E+00	1.38E-06
I-131	2.69E+06	3.85E+06	2.21E+06	1.26E+09	6.60E+06	0.00E+00	1.02E+06
Te-131m	1.14E+02	5.59E+01	4.65E+01	8.85E+01	5.66E+02	0.00E+00	5.55E+03
Te-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-132	2.06E-59	5.51E-59	1.93E-59	1.93E-57	8.77E-59	0.00E+00	1.03E-59
Te-132	3.57E+05	2.31E+05	2.17E+05	2.55E+05	2.22E+06	0.00E+00	1.09E+07
I-133	9.30E-02	1.62E-01	4.93E-02	2.38E+01	2.82E-01	0.00E+00	1.45E-01
Cs-134m	7.47E-48	1.57E-47	8.03E-48	0.00E+00	8.52E-48	1.34E-48	5.54E-48
Cs-134	3.23E+08	7.69E+08	6.29E+08	0.00E+00	2.49E+08	8.27E+07	1.35E+07
I-134	4.13E-162	1.12E-161	4.01E-162	1.94E-160	1.78E-161	0.00E+00	9.77E-165
I-135	1.17E-17	3.07E-17	1.13E-17	2.03E-15	4.92E-17	0.00E+00	3.47E-17
Cs-135	1.10E+08	1.01E+08	4.49E+07	0.00E+00	3.83E+07	1.15E+07	2.37E+06
Cs-136	3.04E+06	1.20E+07	8.65E+06	0.00E+00	6.69E+06	9.17E+05	1.37E+06
Cs-137	4.46E+08	6.09E+08	3.99E+08	0.00E+00	2.07E+08	6.88E+07	1.18E+07
Cs-138	1.38E-267	2.72E-267	1.35E-267	0.00E+00	2.00E-267	1.97E-268	1.16E-272
Cs-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba-139	4.10E-102	2.92E-105	1.20E-103	0.00E+00	2.73E-105	1.66E-105	7.28E-102
Ba-140	7.25E+06	9.11E+03	4.75E+05	0.00E+00	3.10E+03	5.21E+03	1.49E+07
La-140	9.36E-03	4.72E-03	1.25E-03	0.00E+00	0.00E+00	0.00E+00	3.46E+02
Ba-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La-141	1.07E-37	3.34E-38	5.46E-39	0.00E+00	0.00E+00	0.00E+00	3.98E-33
Ce-141	4.05E+03	2.74E+03	3.11E+02	0.00E+00	1.27E+03	0.00E+00	1.05E+07
Ba-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La-142	1.10E-92	4.99E-93	1.24E-93	0.00E+00	0.00E+00	0.00E+00	3.64E-89
Ce-143	5.08E-03	3.75E+00	4.15E-04	0.00E+00	1.65E-03	0.00E+00	1.40E+02
Pr-143	5.30E+03	2.13E+03	2.63E+02	0.00E+00	1.23E+03	0.00E+00	2.32E+07
Ce-144	6.72E+05	2.81E+05	3.61E+04	0.00E+00	1.67E+05	0.00E+00	2.27E+08
Pr-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nd-147	1.78E+03	2.05E+03	1.23E+02	0.00E+00	1.20E+03	0.00E+00	9.85E+06
Pm-147	4.78E+05	4.50E+04	1.82E+04	0.00E+00	8.50E+04	0.00E+00	5.66E+07
Pm-148m	6.64E+04	1.72E+04	1.32E+04	0.00E+00	2.60E+04	0.00E+00	1.46E+08
Pm-148	4.95E+02	8.21E+01	4.13E+01	0.00E+00	1.55E+02	0.00E+00	6.45E+06
Pm-149	1.29E+00	1.83E-01	7.47E-02	0.00E+00	3.46E-01	0.00E+00	3.43E+04
Pm-151	1.46E-03	2.45E-04	1.24E-04	0.00E+00	4.38E-04	0.00E+00	6.75E+01
Sm-151	4.84E+05	8.35E+04	2.00E+04	0.00E+00	9.33E+04	0.00E+00	3.68E+07
Sm-153	2.89E-01	2.41E-01	1.76E-02	0.00E+00	7.78E-02	0.00E+00	8.59E+03

Table 4-33 (Page 3 of 3)
Grass-Cow-Meat Pathway Factors for Adult (R_i^M)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	1.30E+06	2.96E+05	2.60E+05	0.00E+00	1.83E+06	0.00E+00	1.71E+08
Eu-154	4.07E+06	5.01E+05	3.56E+05	0.00E+00	2.40E+06	0.00E+00	3.63E+08
Eu-155	5.61E+05	7.96E+04	5.14E+04	0.00E+00	3.68E+05	0.00E+00	6.27E+07
Eu-156	9.58E+03	7.41E+03	1.20E+03	0.00E+00	4.95E+03	0.00E+00	5.08E+07
Tb-160	1.42E+05	0.00E+00	1.76E+04	0.00E+00	5.84E+04	0.00E+00	1.30E+08
Ho-166m	1.67E+06	5.21E+05	3.96E+05	0.00E+00	7.79E+05	0.00E+00	1.58E+08
W-181	1.15E+04	3.74E+03	4.01E+02	0.00E+00	0.00E+00	0.00E+00	4.26E+05
W-185	3.69E+05	1.23E+05	1.29E+04	0.00E+00	0.00E+00	0.00E+00	1.42E+07
W-187	5.25E-03	4.39E-03	1.53E-03	0.00E+00	0.00E+00	0.00E+00	1.44E+00
Np-239	6.52E-02	6.41E-03	3.54E-03	0.00E+00	2.00E-02	0.00E+00	1.32E+03
U-232	1.97E+09	0.00E+00	1.41E+08	0.00E+00	2.13E+08	0.00E+00	3.23E+07
U-233	4.16E+08	0.00E+00	2.52E+07	0.00E+00	9.70E+07	0.00E+00	3.00E+07
U-234	4.00E+08	0.00E+00	2.47E+07	0.00E+00	9.51E+07	0.00E+00	2.93E+07
U-235	3.83E+08	0.00E+00	2.32E+07	0.00E+00	8.94E+07	0.00E+00	3.73E+07
U-236	3.83E+08	0.00E+00	2.37E+07	0.00E+00	9.13E+07	0.00E+00	2.75E+07
U-237	5.37E+02	0.00E+00	1.43E+02	0.00E+00	2.21E+03	0.00E+00	1.89E+05
U-238	3.67E+08	0.00E+00	2.17E+07	0.00E+00	8.36E+07	0.00E+00	2.63E+07
Np-237	3.54E+08	2.52E+07	1.56E+07	0.00E+00	1.16E+08	0.00E+00	2.23E+07
Np-238	3.53E-01	9.52E-03	5.50E-03	0.00E+00	3.22E-02	0.00E+00	8.85E+02
Pu-238	1.24E+07	1.57E+06	3.36E+05	0.00E+00	1.44E+06	0.00E+00	1.43E+06
Pu-239	1.43E+07	1.71E+06	3.76E+05	0.00E+00	1.60E+06	0.00E+00	1.31E+06
Pu-240	1.42E+07	1.71E+06	3.76E+05	0.00E+00	1.59E+06	0.00E+00	1.33E+06
Pu-241	3.05E+05	1.45E+04	6.46E+03	0.00E+00	2.98E+04	0.00E+00	2.72E+04
Pu-242	1.32E+07	1.65E+06	3.62E+05	0.00E+00	1.54E+06	0.00E+00	1.28E+06
Pu-244	1.54E+07	1.89E+06	4.15E+05	0.00E+00	1.76E+06	0.00E+00	1.91E+06
Am-241	2.12E+08	1.98E+08	1.52E+07	0.00E+00	1.14E+08	0.00E+00	2.08E+07
Am-242m	2.14E+08	1.86E+08	1.52E+07	0.00E+00	1.14E+08	0.00E+00	2.62E+07
Am-243	2.12E+08	1.94E+08	1.49E+07	0.00E+00	1.12E+08	0.00E+00	2.45E+07
Cm-242	4.10E+06	4.36E+06	2.73E+05	0.00E+00	1.24E+06	0.00E+00	1.58E+07
Cm-243	1.67E+08	1.53E+08	1.05E+07	0.00E+00	4.89E+07	0.00E+00	2.18E+07
Cm-244	1.27E+08	1.19E+08	8.00E+06	0.00E+00	3.73E+07	0.00E+00	2.10E+07
Cm-245	2.64E+08	2.30E+08	1.62E+07	0.00E+00	7.56E+07	0.00E+00	1.98E+07
Cm-246	2.61E+08	2.29E+08	1.62E+07	0.00E+00	7.53E+07	0.00E+00	1.94E+07
Cm-247	2.55E+08	2.26E+08	1.59E+07	0.00E+00	7.42E+07	0.00E+00	2.56E+07
Cm-248	2.12E+09	1.86E+09	1.31E+08	0.00E+00	6.13E+08	0.00E+00	4.13E+08
Cf-252	6.90E+07	0.00E+00	1.66E+06	0.00E+00	0.00E+00	0.00E+00	7.61E+07

Units of mrem/yr per μCi/m³ for H-3 and C-14
Units of m²mrem/yr per μCi/sec for all other nuclides

Table 4-34 (Page 1 of 3)
Grass-Cow-Meat Pathway Factors for Teenager (R_i^M)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.10E+02	1.10E+02	1.10E+02	1.10E+02	1.10E+02	1.10E+02
C-14	2.81E+05	5.62E+04	5.62E+04	5.62E+04	5.62E+04	5.62E+04	5.62E+04
Na-22	5.48E+08	5.48E+08	5.48E+08	5.48E+08	5.48E+08	5.48E+08	5.48E+08
Na-24	2.78E-04	2.78E-04	2.78E-04	2.78E-04	2.78E-04	2.78E-04	2.78E-04
P-32	9.98E+08	6.18E+07	3.87E+07	0.00E+00	0.00E+00	0.00E+00	8.39E+07
Ca-41	6.54E+08	0.00E+00	7.08E+07	0.00E+00	0.00E+00	0.00E+00	6.48E+05
Sc-46	5.11E+04	9.95E+04	2.95E+04	0.00E+00	9.53E+04	0.00E+00	3.39E+08
Cr-51	0.00E+00	0.00E+00	1.57E+03	8.70E+02	3.43E+02	2.24E+03	2.63E+05
Mn-54	0.00E+00	3.26E+06	6.46E+05	0.00E+00	9.72E+05	0.00E+00	6.68E+06
Fe-55	1.18E+08	8.38E+07	1.96E+07	0.00E+00	0.00E+00	5.32E+07	3.63E+07
Mn-56	0.00E+00	3.57E-54	6.35E-55	0.00E+00	4.52E-54	0.00E+00	2.35E-52
Co-57	0.00E+00	2.08E+06	3.48E+06	0.00E+00	0.00E+00	0.00E+00	3.87E+07
Co-58	0.00E+00	5.04E+06	1.16E+07	0.00E+00	0.00E+00	0.00E+00	6.95E+07
Fe-59	6.68E+07	1.56E+08	6.02E+07	0.00E+00	0.00E+00	4.92E+07	3.69E+08
Co-60	0.00E+00	2.94E+07	6.63E+07	0.00E+00	0.00E+00	0.00E+00	3.83E+08
Ni-59	5.81E+07	2.05E+07	9.86E+06	0.00E+00	0.00E+00	0.00E+00	3.22E+06
Ni-63	7.78E+08	5.49E+07	2.64E+07	0.00E+00	0.00E+00	0.00E+00	8.75E+06
Cu-64	0.00E+00	5.70E-08	2.68E-08	0.00E+00	1.44E-07	0.00E+00	4.42E-06
Ni-65	5.48E-54	7.01E-55	3.19E-55	0.00E+00	0.00E+00	0.00E+00	3.80E-53
Zn-65	1.13E+08	3.94E+08	1.84E+08	0.00E+00	2.52E+08	0.00E+00	1.67E+08
Zn-69m	3.59E-06	8.47E-06	7.77E-07	0.00E+00	5.15E-06	0.00E+00	4.66E-04
Zn-69	5.78E-154	1.10E-153	7.71E-155	0.00E+00	7.20E-154	0.00E+00	2.03E-153
Se-79	0.00E+00	4.65E+07	7.81E+06	0.00E+00	8.10E+07	0.00E+00	7.10E+06
Br-82	0.00E+00	0.00E+00	2.46E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	1.49E-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	2.80E-270	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.05E+08	4.96E+07	0.00E+00	0.00E+00	0.00E+00	1.56E+07
Rb-87	0.00E+00	4.51E+08	1.57E+08	0.00E+00	0.00E+00	0.00E+00	1.57E+07
Rb-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-89	8.31E+07	0.00E+00	2.38E+06	0.00E+00	0.00E+00	0.00E+00	9.90E+06
Sr-90	5.05E+09	0.00E+00	1.01E+08	0.00E+00	0.00E+00	0.00E+00	1.15E+08
Y-90	2.28E+01	0.00E+00	6.14E-01	0.00E+00	0.00E+00	0.00E+00	1.88E+05
Sr-91	3.33E-11	0.00E+00	1.32E-12	0.00E+00	0.00E+00	0.00E+00	1.51E-10
Y-91m	2.33E-175	0.00E+00	8.90E-177	0.00E+00	0.00E+00	0.00E+00	1.10E-173
Y-91	3.25E+05	0.00E+00	8.71E+03	0.00E+00	0.00E+00	0.00E+00	1.33E+08
Sr-92	2.85E-50	0.00E+00	1.21E-51	0.00E+00	0.00E+00	0.00E+00	7.25E-49
Y-92	3.58E-40	0.00E+00	1.03E-41	0.00E+00	0.00E+00	0.00E+00	9.82E-36
Y-93	1.03E-12	0.00E+00	2.82E-14	0.00E+00	0.00E+00	0.00E+00	3.14E-08
Nb-93m	7.91E+06	2.60E+06	6.51E+05	0.00E+00	3.04E+06	0.00E+00	9.36E+08
Nb-95	5.28E+05	2.93E+05	1.61E+05	0.00E+00	2.84E+05	0.00E+00	1.25E+09
Nb-97	1.69E-119	4.21E-120	1.54E-120	0.00E+00	4.92E-120	0.00E+00	1.00E-115
Zr-93	1.56E+06	7.71E+05	4.21E+05	0.00E+00	2.72E+06	0.00E+00	7.29E+08
Zr-95	5.24E+05	1.65E+05	1.14E+05	0.00E+00	2.43E+05	0.00E+00	3.81E+08
Zr-97	4.41E-06	8.72E-07	4.02E-07	0.00E+00	1.32E-06	0.00E+00	2.36E-01
Mo-93	0.00E+00	7.04E+07	1.93E+06	0.00E+00	2.02E+07	0.00E+00	8.57E+06
Mo-99	0.00E+00	2.08E+04	3.96E+03	0.00E+00	4.76E+04	0.00E+00	3.72E+04
Tc-99	5.95E+07	8.74E+07	2.38E+07	0.00E+00	1.11E+09	9.04E+06	2.14E+09
Tc-99m	9.42E-22	2.63E-21	3.40E-20	0.00E+00	3.91E-20	1.46E-21	1.72E-18
Tc-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru-103	2.60E+07	0.00E+00	1.11E+07	0.00E+00	9.18E+07	0.00E+00	2.18E+09
Ru-105	1.32E-28	0.00E+00	5.11E-29	0.00E+00	1.66E-27	0.00E+00	1.06E-25
Rh-105	8.20E-01	5.93E-01	3.89E-01	0.00E+00	2.52E+00	0.00E+00	7.54E+01
Ru-106	1.11E+09	0.00E+00	1.40E+08	0.00E+00	2.14E+09	0.00E+00	5.33E+10
Pd-107	0.00E+00	6.91E+05	4.45E+04	0.00E+00	6.25E+06	0.00E+00	3.21E+06

Table 4-34 (Page 2 of 3)
Grass-Cow-Meat Pathway Factors for Teenager (R_i^M)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	2.84E-07	6.46E-08	0.00E+00	1.64E-06	0.00E+00	2.87E-05
Ag-110m	2.30E+06	2.18E+06	1.32E+06	0.00E+00	4.15E+06	0.00E+00	6.11E+08
Ag-111	3.10E+04	1.28E+04	6.46E+03	0.00E+00	4.18E+04	0.00E+00	1.79E+07
Cd-113m	0.00E+00	1.96E+06	6.31E+04	0.00E+00	2.17E+06	0.00E+00	1.18E+07
Cd-115m	0.00E+00	3.92E+05	1.27E+04	0.00E+00	3.14E+05	0.00E+00	1.24E+07
Sn-123	1.92E+09	3.16E+07	4.67E+07	2.53E+07	0.00E+00	0.00E+00	2.90E+09
Sn-125	3.74E+07	7.45E+05	1.69E+06	5.84E+05	0.00E+00	0.00E+00	3.52E+08
Sn-126	7.71E+09	1.44E+08	2.19E+08	3.78E+07	0.00E+00	0.00E+00	1.71E+09
Sb-124	5.55E+06	1.02E+05	2.16E+06	1.26E+04	0.00E+00	4.84E+06	1.12E+08
Sb-125	7.77E+06	8.49E+04	1.82E+06	7.43E+03	0.00E+00	6.83E+06	6.05E+07
Sb-126	3.98E+05	8.14E+03	1.43E+05	2.25E+03	0.00E+00	2.86E+05	2.36E+07
Sb-127	3.46E+03	7.41E+01	1.31E+03	3.89E+01	0.00E+00	2.36E+03	5.88E+05
Te-125m	1.03E+08	3.71E+07	1.38E+07	2.88E+07	0.00E+00	0.00E+00	3.04E+08
Te-127m	3.75E+08	1.33E+08	4.46E+07	8.92E+07	1.52E+09	0.00E+00	9.34E+08
Te-127	4.69E-11	1.66E-11	1.01E-11	3.24E-11	1.90E-10	0.00E+00	3.62E-09
Te-129m	2.77E+08	1.03E+08	4.38E+07	8.92E+07	1.16E+09	0.00E+00	1.04E+09
Te-129	1.31E-121	4.89E-122	3.19E-122	9.37E-122	5.50E-121	0.00E+00	7.17E-121
Te-133m	1.77E-153	1.01E-153	9.80E-154	1.41E-153	9.96E-153	0.00E+00	4.07E-153
Te-134	1.13E-204	7.24E-205	7.56E-205	9.25E-205	6.91E-204	0.00E+00	4.19E-206
I-129	5.61E+07	4.72E+07	7.88E+07	5.74E+10	8.44E+07	0.00E+00	5.50E+06
I-130	4.38E-07	1.27E-06	5.06E-07	1.03E-04	1.95E-06	0.00E+00	9.73E-07
I-131	2.24E+06	3.13E+06	1.68E+06	9.14E+08	5.39E+06	0.00E+00	6.19E+05
Te-131m	9.52E+01	4.56E+01	3.81E+01	6.87E+01	4.76E+02	0.00E+00	3.66E+03
Te-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-132	1.67E-59	4.38E-59	1.57E-59	1.47E-57	6.89E-59	0.00E+00	1.91E-59
Te-132	2.92E+05	1.85E+05	1.74E+05	1.95E+05	1.77E+06	0.00E+00	5.85E+06
I-133	7.78E-02	1.32E-01	4.03E-02	1.84E+01	2.31E-01	0.00E+00	9.99E-02
Cs-134m	6.09E-48	1.26E-47	6.48E-48	0.00E+00	7.02E-48	1.23E-48	8.39E-48
Cs-134	2.57E+08	6.05E+08	2.81E+08	0.00E+00	1.92E+08	7.34E+07	7.53E+06
I-134	3.36E-162	8.90E-162	3.20E-162	1.48E-160	1.40E-161	0.00E+00	1.17E-163
I-135	9.54E-18	2.46E-17	9.11E-18	1.58E-15	3.88E-17	0.00E+00	2.72E-17
Cs-135	9.24E+07	8.47E+07	1.98E+07	0.00E+00	3.23E+07	1.17E+07	1.48E+06
Cs-136	2.37E+06	9.34E+06	6.27E+06	0.00E+00	5.08E+06	8.01E+05	7.52E+05
Cs-137	3.70E+08	4.92E+08	1.71E+08	0.00E+00	1.68E+08	6.51E+07	7.00E+06
Cs-138	1.14E-267	2.19E-267	1.10E-267	0.00E+00	1.62E-267	1.88E-268	9.95E-271
Cs-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba-139	3.48E-102	2.45E-105	1.01E-103	0.00E+00	2.31E-105	1.69E-105	3.10E-101
Ba-140	5.99E+06	7.34E+03	3.86E+05	0.00E+00	2.49E+03	4.94E+03	9.24E+06
La-140	7.70E-03	3.78E-03	1.01E-03	0.00E+00	0.00E+00	0.00E+00	2.17E+02
Ba-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La-141	9.06E-38	2.79E-38	4.60E-39	0.00E+00	0.00E+00	0.00E+00	4.94E-33
Ce-141	3.40E+03	2.27E+03	2.61E+02	0.00E+00	1.07E+03	0.00E+00	6.50E+06
Ba-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La-142	9.07E-93	4.03E-93	1.00E-93	0.00E+00	0.00E+00	0.00E+00	1.23E-88
Ce-143	4.27E-03	3.11E+00	3.47E-04	0.00E+00	1.39E-03	0.00E+00	9.35E+01
Pr-143	4.46E+03	1.78E+03	2.22E+02	0.00E+00	1.04E+03	0.00E+00	1.47E+07
Ce-144	5.66E+05	2.34E+05	3.04E+04	0.00E+00	1.40E+05	0.00E+00	1.42E+08
Pr-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nd-147	1.57E+03	1.70E+03	1.02E+02	0.00E+00	9.99E+02	0.00E+00	6.14E+06
Pm-147	3.94E+05	3.73E+04	1.52E+04	0.00E+00	7.12E+04	0.00E+00	3.55E+07
Pm-148m	5.29E+04	1.34E+04	1.05E+04	0.00E+00	2.03E+04	0.00E+00	8.45E+07
Pm-148	4.16E+02	6.77E+01	3.41E+01	0.00E+00	1.22E+02	0.00E+00	4.04E+06
Pm-149	1.09E+00	1.53E-01	6.29E-02	0.00E+00	2.92E-01	0.00E+00	2.26E+04
Pm-151	1.22E-03	2.02E-04	1.02E-04	0.00E+00	3.63E-04	0.00E+00	4.53E+01
Sm-151	3.62E+05	6.96E+04	1.63E+04	0.00E+00	7.63E+04	0.00E+00	2.36E+07
Sm-153	2.43E-01	2.01E-01	1.48E-02	0.00E+00	6.57E-02	0.00E+00	5.67E+03

Table 4-34 (Page 3 of 3)
Grass-Cow-Meat Pathway Factors for Teenager (R_i^M)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	9.65E+05	2.32E+05	2.05E+05	0.00E+00	1.08E+06	0.00E+00	8.55E+07
Eu-154	3.10E+06	3.99E+05	2.81E+05	0.00E+00	1.78E+06	0.00E+00	2.11E+08
Eu-155	6.71E+05	6.48E+04	4.01E+04	0.00E+00	2.53E+05	0.00E+00	3.72E+08
Eu-156	7.93E+03	5.95E+03	9.71E+02	0.00E+00	4.00E+03	0.00E+00	3.04E+07
Tb-160	1.15E+05	0.00E+00	1.44E+04	0.00E+00	4.55E+04	0.00E+00	7.45E+07
Ho-166m	1.30E+06	4.02E+05	2.91E+05	0.00E+00	5.88E+05	0.00E+00	9.90E+07
W-181	9.72E+03	3.14E+03	3.28E+02	0.00E+00	0.00E+00	0.00E+00	2.67E+05
W-185	3.11E+05	1.03E+05	1.09E+04	0.00E+00	0.00E+00	0.00E+00	8.88E+06
W-187	4.40E-03	3.59E-03	1.26E-03	0.00E+00	0.00E+00	0.00E+00	9.70E-01
Np-239	5.70E-02	5.38E-03	2.99E-03	0.00E+00	1.69E-02	0.00E+00	8.65E+02
U-232	1.66E+09	0.00E+00	1.19E+08	0.00E+00	1.80E+08	0.00E+00	2.03E+07
U-233	3.50E+08	0.00E+00	2.13E+07	0.00E+00	8.19E+07	0.00E+00	1.88E+07
U-234	3.36E+08	0.00E+00	2.09E+07	0.00E+00	8.05E+07	0.00E+00	1.84E+07
U-235	3.22E+08	0.00E+00	1.96E+07	0.00E+00	7.54E+07	0.00E+00	2.34E+07
U-236	3.22E+08	0.00E+00	2.00E+07	0.00E+00	7.71E+07	0.00E+00	1.73E+07
U-237	4.53E+02	0.00E+00	1.21E+02	0.00E+00	1.86E+03	0.00E+00	1.20E+05
U-238	3.08E+08	0.00E+00	1.83E+07	0.00E+00	7.06E+07	0.00E+00	1.65E+07
Np-237	2.21E+08	1.59E+07	9.72E+06	0.00E+00	7.19E+07	0.00E+00	1.40E+07
Np-238	2.97E-01	7.96E-03	4.63E-03	0.00E+00	2.73E-02	0.00E+00	5.84E+02
Pu-238	7.78E+06	9.96E+05	2.11E+05	0.00E+00	9.05E+05	0.00E+00	8.97E+05
Pu-239	8.89E+06	1.08E+06	2.34E+05	0.00E+00	9.96E+05	0.00E+00	8.21E+05
Pu-240	8.88E+06	1.08E+06	2.34E+05	0.00E+00	9.95E+05	0.00E+00	8.36E+05
Pu-241	2.01E+05	9.66E+03	4.24E+03	0.00E+00	1.97E+04	0.00E+00	1.70E+04
Pu-242	8.24E+06	1.04E+06	2.26E+05	0.00E+00	9.59E+05	0.00E+00	8.05E+05
Pu-244	9.63E+06	1.19E+06	2.58E+05	0.00E+00	1.10E+06	0.00E+00	1.20E+06
Am-241	1.33E+08	1.25E+08	9.55E+06	0.00E+00	7.16E+07	0.00E+00	1.31E+07
Am-242m	1.34E+08	1.18E+08	9.62E+06	0.00E+00	7.13E+07	0.00E+00	1.64E+07
Am-243	1.32E+08	1.22E+08	9.33E+06	0.00E+00	7.01E+07	0.00E+00	1.53E+07
Cm-242	3.46E+06	3.65E+06	2.29E+05	0.00E+00	1.05E+06	0.00E+00	9.88E+06
Cm-243	1.07E+08	9.96E+07	6.75E+06	0.00E+00	3.15E+07	0.00E+00	1.37E+07
Cm-244	8.30E+07	7.85E+07	5.25E+06	0.00E+00	2.45E+07	0.00E+00	1.32E+07
Cm-245	1.64E+08	1.45E+08	1.01E+07	0.00E+00	4.73E+07	0.00E+00	1.24E+07
Cm-246	1.63E+08	1.45E+08	1.01E+07	0.00E+00	4.72E+07	0.00E+00	1.22E+07
Cm-247	1.59E+08	1.42E+08	9.97E+06	0.00E+00	4.65E+07	0.00E+00	1.60E+07
Cm-248	1.32E+09	1.17E+09	8.22E+07	0.00E+00	3.84E+08	0.00E+00	2.57E+08
Cf-252	5.42E+07	0.00E+00	1.31E+06	0.00E+00	0.00E+00	0.00E+00	4.76E+07

Units of mrem/yr per µCi/m³ for H-3 and C-14
Units of m²mrem/yr per µCi/sec for all other nuclides

Table 4-35 (Page 1 of 3)
Grass-Cow-Meat Pathway Factors for Child (R_i^M)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.34E+02	1.34E+02	1.34E+02	1.34E+02	1.34E+02	1.34E+02
C-14	5.29E+05	1.06E+05	1.06E+05	1.06E+05	1.06E+05	1.06E+05	1.06E+05
Na-22	8.68E+08	8.68E+08	8.68E+08	8.68E+08	8.68E+08	8.68E+08	8.68E+08
Na-24	4.42E-04	4.42E-04	4.42E-04	4.42E-04	4.42E-04	4.42E-04	4.42E-04
P-32	1.88E+09	8.80E+07	7.25E+07	0.00E+00	0.00E+00	0.00E+00	5.20E+07
Ca-41	7.27E+08	0.00E+00	7.94E+07	0.00E+00	0.00E+00	0.00E+00	3.98E+05
Sc-46	8.77E+04	1.20E+05	4.63E+04	0.00E+00	1.06E+05	0.00E+00	1.76E+08
Cr-51	0.00E+00	0.00E+00	2.44E+03	1.36E+03	3.70E+02	2.47E+03	1.29E+05
Mn-54	0.00E+00	3.73E+06	9.92E+05	0.00E+00	1.04E+06	0.00E+00	3.13E+06
Fe-55	2.27E+08	1.20E+08	3.73E+07	0.00E+00	0.00E+00	6.81E+07	2.23E+07
Mn-56	0.00E+00	4.76E-54	1.08E-54	0.00E+00	5.76E-54	0.00E+00	6.90E-52
Co-57	0.00E+00	2.71E+06	5.49E+06	0.00E+00	0.00E+00	0.00E+00	2.22E+07
Co-58	0.00E+00	5.89E+06	1.80E+07	0.00E+00	0.00E+00	0.00E+00	3.44E+07
Fe-59	1.19E+08	1.92E+08	9.55E+07	0.00E+00	0.00E+00	5.56E+07	2.00E+08
Co-60	0.00E+00	3.49E+07	1.03E+08	0.00E+00	0.00E+00	0.00E+00	1.93E+08
Ni-59	1.12E+08	2.97E+07	1.89E+07	0.00E+00	0.00E+00	0.00E+00	1.97E+06
Ni-63	1.49E+09	7.98E+07	5.07E+07	0.00E+00	0.00E+00	0.00E+00	5.38E+06
Cu-64	0.00E+00	7.66E-08	4.63E-08	0.00E+00	1.85E-07	0.00E+00	3.60E-06
Ni-65	1.03E-53	9.65E-55	5.63E-55	0.00E+00	0.00E+00	0.00E+00	1.18E-52
Zn-65	1.70E+08	4.53E+08	2.82E+08	0.00E+00	2.86E+08	0.00E+00	7.96E+07
Zn-69m	6.71E-06	1.14E-05	1.35E-06	0.00E+00	6.64E-06	0.00E+00	3.72E-04
Zn-69	1.09E-153	1.57E-153	1.45E-154	0.00E+00	9.53E-154	0.00E+00	9.90E-152
Se-79	0.00E+00	6.62E+07	1.47E+07	0.00E+00	1.08E+08	0.00E+00	4.35E+06
Br-82	0.00E+00	0.00E+00	3.85E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	2.80E-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	4.85E-270	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.50E+08	9.20E+07	0.00E+00	0.00E+00	0.00E+00	9.62E+06
Rb-87	0.00E+00	6.41E+08	2.97E+08	0.00E+00	0.00E+00	0.00E+00	9.61E+06
Rb-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-89	1.57E+08	0.00E+00	4.49E+06	0.00E+00	0.00E+00	0.00E+00	6.09E+06
Sr-90	8.00E+09	0.00E+00	1.61E+08	0.00E+00	0.00E+00	0.00E+00	7.16E+07
Y-90	4.31E+01	0.00E+00	1.15E+00	0.00E+00	0.00E+00	0.00E+00	1.23E+05
Sr-91	6.24E-11	0.00E+00	2.36E-12	0.00E+00	0.00E+00	0.00E+00	1.38E-10
Y-91m	4.35E-175	0.00E+00	1.58E-176	0.00E+00	0.00E+00	0.00E+00	8.51E-172
Y-91	6.13E+05	0.00E+00	1.64E+04	0.00E+00	0.00E+00	0.00E+00	8.17E+07
Sr-92	5.31E-50	0.00E+00	2.13E-51	0.00E+00	0.00E+00	0.00E+00	1.01E-48
Y-92	6.71E-40	0.00E+00	1.92E-41	0.00E+00	0.00E+00	0.00E+00	1.94E-35
Y-93	1.93E-12	0.00E+00	5.30E-14	0.00E+00	0.00E+00	0.00E+00	2.88E-08
Nb-93m	1.52E+07	3.80E+06	1.25E+06	0.00E+00	4.10E+06	0.00E+00	5.73E+08
Nb-95	9.12E+05	3.55E+05	2.54E+05	0.00E+00	3.34E+05	0.00E+00	6.57E+08
Nb-97	3.15E-119	5.69E-120	2.65E-120	0.00E+00	6.31E-120	0.00E+00	1.76E-114
Zr-93	2.97E+06	1.11E+06	7.93E+05	0.00E+00	4.31E+06	0.00E+00	4.22E+08
Zr-95	9.30E+05	2.04E+05	1.82E+05	0.00E+00	2.93E+05	0.00E+00	2.13E+08
Zr-97	8.20E-06	1.18E-06	6.99E-07	0.00E+00	1.70E-06	0.00E+00	1.79E-01
Mo-93	0.00E+00	1.01E+08	3.63E+06	0.00E+00	2.66E+07	0.00E+00	5.11E+06
Mo-99	0.00E+00	2.89E+04	7.15E+03	0.00E+00	6.18E+04	0.00E+00	2.39E+04
Tc-99	1.12E+08	1.25E+08	4.48E+07	0.00E+00	1.47E+09	1.10E+07	1.31E+09
Tc-99m	1.65E-21	3.24E-21	5.37E-20	0.00E+00	4.71E-20	1.64E-21	1.84E-18
Tc-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru-103	4.71E+07	0.00E+00	1.81E+07	0.00E+00	1.19E+08	0.00E+00	1.22E+09
Ru-105	2.46E-28	0.00E+00	8.92E-29	0.00E+00	2.16E-27	0.00E+00	1.60E-25
Rh-105	1.54E+00	8.26E-01	7.06E-01	0.00E+00	3.29E+00	0.00E+00	5.12E+01
Ru-106	2.09E+09	0.00E+00	2.61E+08	0.00E+00	2.83E+09	0.00E+00	3.26E+10
Pd-107	0.00E+00	9.89E+05	8.40E+04	0.00E+00	8.28E+06	0.00E+00	1.96E+06

Table 4-35 (Page 2 of 3)
Grass-Cow-Meat Pathway Factors for Child (R_i^M)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	4.05E-07	1.22E-07	0.00E+00	2.17E-06	0.00E+00	2.39E-05
Ag-110m	3.81E+06	2.58E+06	2.06E+06	0.00E+00	4.80E+06	0.00E+00	3.06E+08
Ag-111	5.84E+04	1.83E+04	1.21E+04	0.00E+00	5.51E+04	0.00E+00	1.12E+07
Cd-113m	0.00E+00	2.80E+06	1.19E+05	0.00E+00	2.88E+06	0.00E+00	7.22E+06
Cd-115m	0.00E+00	5.60E+05	2.39E+04	0.00E+00	4.17E+05	0.00E+00	7.62E+06
Sn-123	3.63E+09	4.50E+07	8.85E+07	4.78E+07	0.00E+00	0.00E+00	1.78E+09
Sn-125	7.04E+07	1.06E+06	3.15E+06	1.10E+06	0.00E+00	0.00E+00	2.18E+08
Sn-126	1.40E+10	1.74E+08	3.96E+08	4.78E+07	0.00E+00	0.00E+00	1.05E+09
Sb-124	1.00E+07	1.30E+05	3.52E+06	2.22E+04	0.00E+00	5.57E+06	6.27E+07
Sb-125	1.42E+07	1.09E+05	2.96E+06	1.31E+04	0.00E+00	7.89E+06	3.38E+07
Sb-126	6.95E+05	1.06E+04	2.50E+05	4.08E+03	0.00E+00	3.32E+05	1.40E+07
Sb-127	6.38E+03	9.87E+01	2.22E+03	7.10E+01	0.00E+00	2.77E+03	3.59E+05
Te-125m	1.93E+08	5.24E+07	2.58E+07	5.42E+07	0.00E+00	0.00E+00	1.86E+08
Te-127m	7.07E+08	1.90E+08	8.39E+07	1.69E+08	2.01E+09	0.00E+00	5.72E+08
Te-127	8.82E-11	2.38E-11	1.89E-11	6.11E-11	2.51E-10	0.00E+00	3.45E-09
Te-129m	5.21E+08	1.46E+08	8.09E+07	1.68E+08	1.53E+09	0.00E+00	6.36E+08
Te-129	2.47E-121	6.91E-122	5.87E-122	1.77E-121	7.24E-121	0.00E+00	1.54E-119
Te-133m	3.25E-153	1.31E-153	1.63E-153	2.52E-153	1.25E-152	0.00E+00	1.00E-151
Te-134	2.05E-204	9.22E-205	1.23E-204	1.62E-204	8.54E-204	0.00E+00	9.37E-204
I-129	1.06E+08	6.48E+07	5.79E+07	4.24E+10	1.09E+08	0.00E+00	3.26E+06
I-130	7.83E-07	1.58E-06	8.15E-07	1.74E-04	2.36E-06	0.00E+00	7.40E-07
I-131	4.15E+06	4.17E+06	2.37E+06	1.38E+09	6.85E+06	0.00E+00	3.71E+05
Te-131m	1.77E+02	6.13E+01	6.52E+01	1.26E+02	5.93E+02	0.00E+00	2.49E+03
Te-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-132	3.02E-59	5.56E-59	2.56E-59	2.58E-57	8.51E-59	0.00E+00	6.54E-59
Te-132	5.33E+05	2.36E+05	2.85E+05	3.43E+05	2.19E+06	0.00E+00	2.37E+06
I-133	1.45E-01	1.79E-01	6.76E-02	3.32E+01	2.98E-01	0.00E+00	7.20E-02
Cs-134m	1.10E-47	1.63E-47	1.07E-47	0.00E+00	8.61E-48	1.42E-48	2.06E-47
Cs-134	4.53E+08	7.44E+08	1.57E+08	0.00E+00	2.31E+08	8.27E+07	4.01E+06
I-134	6.08E-162	1.13E-161	5.19E-162	2.60E-160	1.73E-161	0.00E+00	7.49E-162
I-135	1.73E-17	3.11E-17	1.47E-17	2.75E-15	4.77E-17	0.00E+00	2.37E-17
Cs-135	1.74E+08	1.21E+08	1.24E+07	0.00E+00	4.27E+07	1.43E+07	9.07E+05
Cs-136	4.10E+06	1.13E+07	7.29E+06	0.00E+00	6.00E+06	8.94E+05	3.96E+05
Cs-137	6.82E+08	6.52E+08	9.63E+07	0.00E+00	2.13E+08	7.65E+07	4.08E+06
Cs-138	2.12E-267	2.94E-267	1.87E-267	0.00E+00	2.07E-267	2.23E-268	1.36E-267
Cs-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba-139	6.53E-102	3.49E-105	1.89E-103	0.00E+00	3.04E-105	2.05E-105	3.77E-100
Ba-140	1.11E+07	9.69E+03	6.46E+05	0.00E+00	3.15E+03	5.78E+03	5.60E+06
La-140	1.41E-02	4.93E-03	1.66E-03	0.00E+00	0.00E+00	0.00E+00	1.37E+02
Ba-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La-141	1.71E-37	3.98E-38	8.64E-39	0.00E+00	0.00E+00	0.00E+00	8.85E-33
Ce-141	6.41E+03	3.20E+03	4.75E+02	0.00E+00	1.40E+03	0.00E+00	3.99E+06
Ba-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La-142	1.67E-92	5.34E-93	1.67E-93	0.00E+00	0.00E+00	0.00E+00	1.06E-87
Ce-143	8.02E-03	4.35E+00	6.30E-04	0.00E+00	1.82E-03	0.00E+00	6.36E+01
Pr-143	8.44E+03	2.53E+03	4.19E+02	0.00E+00	1.37E+03	0.00E+00	9.11E+06
Ce-144	1.07E+06	3.35E+05	5.69E+04	0.00E+00	1.85E+05	0.00E+00	8.72E+07
Pr-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nd-147	2.94E+03	2.38E+03	1.84E+02	0.00E+00	1.31E+03	0.00E+00	3.77E+06
Pm-147	7.52E+05	5.37E+04	2.88E+04	0.00E+00	9.48E+04	0.00E+00	2.17E+07
Pm-148m	8.31E+04	1.65E+04	1.65E+04	0.00E+00	2.45E+04	0.00E+00	4.66E+07
Pm-148	7.77E+02	9.34E+01	6.05E+01	0.00E+00	1.59E+02	0.00E+00	2.50E+06
Pm-149	2.06E+00	2.19E-01	1.19E-01	0.00E+00	3.87E-01	0.00E+00	1.49E+04
Pm-151	2.28E-03	2.77E-04	1.80E-04	0.00E+00	4.70E-04	0.00E+00	3.15E+01
Sm-151	6.69E+05	9.96E+04	3.14E+04	0.00E+00	1.03E+05	0.00E+00	1.45E+07
Sm-153	4.58E-01	2.85E-01	2.75E-02	0.00E+00	8.67E-02	0.00E+00	3.79E+03

Table 4-35 (Page 3 of 3)
Grass-Cow-Meat Pathway Factors for Child (R_i^M)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	1.53E+06	2.78E+05	3.30E+05	0.00E+00	1.18E+06	0.00E+00	4.57E+07
Eu-154	5.68E+06	5.11E+05	4.67E+05	0.00E+00	2.24E+06	0.00E+00	1.19E+08
Eu-155	1.17E+06	8.44E+04	6.62E+04	0.00E+00	3.16E+05	0.00E+00	2.11E+08
Eu-156	1.47E+04	7.85E+03	1.62E+03	0.00E+00	5.06E+03	0.00E+00	1.78E+07
Tb-160	1.86E+05	0.00E+00	2.31E+04	0.00E+00	5.54E+04	0.00E+00	4.13E+07
Ho-166m	2.49E+06	5.21E+05	4.40E+05	0.00E+00	7.42E+05	0.00E+00	6.06E+07
W-181	1.83E+04	4.49E+03	6.18E+02	0.00E+00	0.00E+00	0.00E+00	1.64E+05
W-185	5.87E+05	1.47E+05	2.05E+04	0.00E+00	0.00E+00	0.00E+00	5.46E+06
W-187	8.15E-03	4.83E-03	2.17E-03	0.00E+00	0.00E+00	0.00E+00	6.78E-01
Np-239	1.07E-01	7.70E-03	5.41E-03	0.00E+00	2.23E-02	0.00E+00	5.70E+02
U-232	3.13E+09	0.00E+00	2.24E+08	0.00E+00	2.38E+08	0.00E+00	1.24E+07
U-233	6.63E+08	0.00E+00	4.01E+07	0.00E+00	1.09E+08	0.00E+00	1.15E+07
U-234	6.36E+08	0.00E+00	3.94E+07	0.00E+00	1.07E+08	0.00E+00	1.13E+07
U-235	6.09E+08	0.00E+00	3.69E+07	0.00E+00	9.99E+07	0.00E+00	1.43E+07
U-236	6.09E+08	0.00E+00	3.78E+07	0.00E+00	1.02E+08	0.00E+00	1.05E+07
U-237	8.56E+02	0.00E+00	2.27E+02	0.00E+00	2.47E+03	0.00E+00	7.54E+04
U-238	5.82E+08	0.00E+00	3.46E+07	0.00E+00	9.33E+07	0.00E+00	1.01E+07
Np-237	2.34E+08	1.54E+07	1.03E+07	0.00E+00	6.34E+07	0.00E+00	8.55E+06
Np-238	5.61E-01	1.13E-02	8.73E-03	0.00E+00	3.62E-02	0.00E+00	3.88E+02
Pu-238	8.71E+06	1.01E+06	2.31E+05	0.00E+00	8.42E+05	0.00E+00	5.49E+05
Pu-239	9.46E+06	1.01E+06	2.43E+05	0.00E+00	8.95E+05	0.00E+00	5.02E+05
Pu-240	9.39E+06	1.05E+06	2.43E+05	0.00E+00	8.95E+05	0.00E+00	5.12E+05
Pu-241	2.81E+05	1.15E+04	5.83E+03	0.00E+00	2.15E+04	0.00E+00	1.04E+04
Pu-242	8.73E+06	1.01E+06	2.34E+05	0.00E+00	8.58E+05	0.00E+00	4.92E+05
Pu-244	1.02E+07	1.16E+07	2.68E+05	0.00E+00	9.90E+05	0.00E+00	7.33E+05
Am-241	1.42E+08	1.23E+08	1.07E+07	0.00E+00	6.52E+07	0.00E+00	8.00E+06
Am-242m	1.47E+08	1.17E+08	1.09E+07	0.00E+00	6.59E+07	0.00E+00	1.01E+07
Am-243	1.40E+08	1.18E+08	1.03E+07	0.00E+00	6.35E+07	0.00E+00	9.38E+06
Cm-242	6.52E+06	5.20E+06	4.33E+05	0.00E+00	1.39E+06	0.00E+00	6.06E+06
Cm-243	1.33E+08	1.08E+08	8.58E+06	0.00E+00	3.21E+07	0.00E+00	8.37E+06
Cm-244	1.12E+08	9.07E+07	7.20E+06	0.00E+00	2.64E+07	0.00E+00	8.07E+06
Cm-245	1.75E+08	1.40E+08	1.10E+07	0.00E+00	4.31E+07	0.00E+00	7.59E+06
Cm-246	1.73E+08	1.40E+08	1.10E+07	0.00E+00	4.30E+07	0.00E+00	7.45E+06
Cm-247	1.69E+08	1.38E+08	1.08E+07	0.00E+00	4.23E+07	0.00E+00	9.80E+06
Cm-248	1.40E+09	1.14E+09	8.93E+07	0.00E+00	3.49E+08	0.00E+00	1.58E+08
Cf-252	1.03E+08	0.00E+00	2.50E+06	0.00E+00	0.00E+00	0.00E+00	2.92E+07

Units of mrem/yr per µCi/m^3 for H-3 and C-14
Units of m^{2}mrem/yr per µCi/sec for all other nuclides

Table 4-36 (Page 1 of 3)
Grass-Cow-Meat Pathway Factors for Infant (R_i^M)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
P-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ca-41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sc-46	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cr-51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mn-54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mn-56	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni-59	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cu-64	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-69m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Se-79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-93m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mo-93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mo-99	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tc-99	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tc-99m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tc-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru-105	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rh-105	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pd-107	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 4-36 (Page 2 of 3)
Grass-Cow-Meat Pathway Factors for Infant (R_i^M)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ag-110m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ag-111	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cd-113m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cd-115m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-123	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-126	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-126	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-127	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-125m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-127m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-127	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-129m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-133m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-130	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-131m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-132	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-132	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-135	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-136	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba-140	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La-140	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ce-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ce-143	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pr-143	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ce-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pr-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nd-147	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pm-147	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pm-148m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pm-148	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pm-149	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pm-151	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sm-151	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sm-153	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 4-36 (Page 3 of 3)
Grass-Cow-Meat Pathway Factors for Infant (R_i^M)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Eu-154	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Eu-155	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Eu-156	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tb-160	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ho-166m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W-181	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W-185	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W-187	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Np-239	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-232	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-233	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-234	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-235	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-236	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-237	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-238	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Np-237	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Np-238	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-238	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-239	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-240	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-241	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-242	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-244	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Am-241	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Am-242m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Am-243	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-242	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-243	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-244	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-245	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-246	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-247	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-248	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cf-252	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Units of mrem/yr per μCi/m^3 for H-3 and C-14
Units of m^{2}mrem/yr per μCi/sec for all other nuclides

Table 4-37 (Page 1 of 3)
Vegetation Pathway Factors for Adult (R_i^V)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.29E+03	1.29E+03	1.29E+03	1.29E+03	1.29E+03	1.29E+03
C-14	8.97E+05	1.79E+05	1.79E+05	1.79E+05	1.79E+05	1.79E+05	1.79E+05
Na-22	1.32E+09	1.32E+09	1.32E+09	1.32E+09	1.32E+09	1.32E+09	1.32E+09
Na-24	2.68E+05	2.68E+05	2.68E+05	2.68E+05	2.68E+05	2.68E+05	2.68E+05
P-32	1.40E+09	8.73E+07	5.42E+07	0.00E+00	0.00E+00	0.00E+00	1.58E+08
Ca-41	1.48E+10	0.00E+00	1.60E+09	0.00E+00	0.00E+00	0.00E+00	1.47E+07
Sc-46	2.51E+05	4.87E+05	1.41E+05	0.00E+00	4.54E+05	0.00E+00	2.37E+09
Cr-51	0.00E+00	0.00E+00	4.64E+04	2.77E+04	1.02E+04	6.16E+04	1.17E+07
Mn-54	0.00E+00	3.13E+08	5.97E+07	0.00E+00	9.31E+07	0.00E+00	9.58E+08
Fe-55	2.10E+08	1.45E+08	3.38E+07	0.00E+00	0.00E+00	8.08E+07	8.31E+07
Mn-56	0.00E+00	1.54E+01	2.74E+00	0.00E+00	1.96E+01	0.00E+00	4.93E+02
Co-57	0.00E+00	1.17E+07	1.95E+07	0.00E+00	0.00E+00	0.00E+00	2.97E+08
Co-58	0.00E+00	3.07E+07	6.89E+07	0.00E+00	0.00E+00	0.00E+00	6.23E+08
Fe-59	1.26E+08	2.96E+08	1.14E+08	0.00E+00	0.00E+00	8.28E+07	9.88E+08
Co-60	0.00E+00	1.67E+08	3.69E+08	0.00E+00	0.00E+00	0.00E+00	3.14E+09
Ni-59	7.82E+08	2.68E+08	1.31E+08	0.00E+00	0.00E+00	0.00E+00	5.53E+07
Ni-63	1.04E+10	7.21E+08	3.49E+08	0.00E+00	0.00E+00	0.00E+00	1.50E+08
Cu-64	0.00E+00	9.15E+03	4.29E+03	0.00E+00	2.31E+04	0.00E+00	7.79E+05
Ni-65	5.96E+01	7.75E+00	3.54E+00	0.00E+00	0.00E+00	0.00E+00	1.97E+02
Zn-65	3.17E+08	1.01E+09	4.56E+08	0.00E+00	6.75E+08	0.00E+00	6.36E+08
Zn-69m	2.23E+04	5.35E+04	4.89E+03	0.00E+00	3.24E+04	0.00E+00	3.26E+06
Zn-69	5.06E-06	9.67E-06	6.72E-07	0.00E+00	6.28E-06	0.00E+00	1.45E-06
Se-79	0.00E+00	2.11E+08	3.52E+07	0.00E+00	3.65E+08	0.00E+00	4.31E+07
Br-82	0.00E+00	0.00E+00	1.50E+06	0.00E+00	0.00E+00	0.00E+00	1.72E+06
Br-83	0.00E+00	0.00E+00	3.01E+00	0.00E+00	0.00E+00	0.00E+00	4.33E+00
Br-84	0.00E+00	0.00E+00	2.14E-11	0.00E+00	0.00E+00	0.00E+00	1.68E-16
Br-85	0.00E+00	0.00E+00	2.07E-151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	2.19E+08	1.02E+08	0.00E+00	0.00E+00	0.00E+00	4.32E+07
Rb-87	0.00E+00	9.86E+08	3.43E+08	0.00E+00	0.00E+00	0.00E+00	4.62E+07
Rb-88	0.00E+00	2.64E-22	1.40E-22	0.00E+00	0.00E+00	0.00E+00	3.65E-33
Rb-89	0.00E+00	2.88E-26	2.03E-26	0.00E+00	0.00E+00	0.00E+00	1.67E-39
Sr-89	9.96E+09	0.00E+00	2.86E+08	0.00E+00	0.00E+00	0.00E+00	1.60E+09
Sr-90	6.95E+11	0.00E+00	1.40E+10	0.00E+00	0.00E+00	0.00E+00	1.75E+10
Y-90	1.33E+04	0.00E+00	3.56E+02	0.00E+00	0.00E+00	0.00E+00	1.41E+08
Sr-91	3.02E+05	0.00E+00	1.22E+04	0.00E+00	0.00E+00	0.00E+00	1.44E+06
Y-91m	4.76E-09	0.00E+00	1.84E-10	0.00E+00	0.00E+00	0.00E+00	1.40E-08
Y-91	5.11E+06	0.00E+00	1.37E+05	0.00E+00	0.00E+00	0.00E+00	2.81E+09
Sr-92	4.15E+02	0.00E+00	1.79E+01	0.00E+00	0.00E+00	0.00E+00	8.21E+03
Y-92	8.96E-01	0.00E+00	2.62E-02	0.00E+00	0.00E+00	0.00E+00	1.57E+04
Y-93	1.68E+02	0.00E+00	4.65E+00	0.00E+00	0.00E+00	0.00E+00	5.34E+06
Nb-93m	2.02E+06	6.61E+05	1.63E+05	0.00E+00	7.60E+05	0.00E+00	3.05E+08
Nb-95	1.42E+05	7.92E+04	4.26E+04	0.00E+00	7.82E+04	0.00E+00	4.80E+08
Nb-97	2.02E-06	5.11E-07	1.87E-07	0.00E+00	5.96E-07	0.00E+00	1.88E-03
Zr-93	3.35E+06	1.88E+05	8.74E+04	0.00E+00	7.11E+05	0.00E+00	1.95E+08
Zr-95	1.17E+06	3.77E+05	2.55E+05	0.00E+00	5.91E+05	0.00E+00	1.19E+09
Zr-97	3.36E+02	6.78E+01	3.10E+01	0.00E+00	1.02E+02	0.00E+00	2.10E+07
Mo-93	0.00E+00	6.02E+08	1.63E+07	0.00E+00	1.71E+08	0.00E+00	9.78E+07
Mo-99	0.00E+00	6.14E+06	1.17E+06	0.00E+00	1.39E+07	0.00E+00	1.42E+07
Tc-99	1.00E+07	1.49E+07	4.02E+06	0.00E+00	1.88E+08	1.27E+06	4.87E+08
Tc-99m	3.06E+00	8.66E+00	1.10E+02	0.00E+00	1.31E+02	4.24E+00	5.12E+03
Tc-101	5.93E-31	8.55E-31	8.39E-30	0.00E+00	1.54E-29	4.37E-31	2.57E-42
Ru-103	4.77E+06	0.00E+00	2.05E+06	0.00E+00	1.82E+07	0.00E+00	5.57E+08
Ru-105	5.29E+01	0.00E+00	2.09E+01	0.00E+00	6.84E+02	0.00E+00	3.24E+04
Rh-105	8.04E+04	5.88E+04	3.87E+04	0.00E+00	2.50E+05	0.00E+00	9.37E+06
Ru-106	1.93E+08	0.00E+00	2.44E+07	0.00E+00	3.72E+08	0.00E+00	1.25E+10
Pd-107	0.00E+00	1.18E+07	7.53E+05	0.00E+00	1.06E+08	0.00E+00	7.30E+07

Table 4-37 (Page 2 of 3)
Vegetation Pathway Factors for Adult (R_i^V)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	2.21E+04	4.98E+03	0.00E+00	1.26E+05	0.00E+00	2.45E+06
Ag-110m	1.05E+07	9.74E+06	5.79E+06	0.00E+00	1.92E+07	0.00E+00	3.98E+09
Ag-111	2.11E+05	8.82E+04	4.39E+04	0.00E+00	2.85E+05	0.00E+00	1.62E+08
Cd-113m	0.00E+00	2.52E+08	8.09E+06	0.00E+00	2.78E+08	0.00E+00	2.03E+09
Cd-115m	0.00E+00	5.34E+07	1.70E+06	0.00E+00	4.24E+07	0.00E+00	2.25E+09
Sn-123	1.71E+09	2.84E+07	4.18E+07	2.41E+07	0.00E+00	0.00E+00	3.49E+09
Sn-125	3.84E+07	7.75E+05	1.74E+06	6.41E+05	0.00E+00	0.00E+00	4.80E+08
Sn-126	6.77E+09	1.34E+08	1.92E+08	3.94E+07	0.00E+00	0.00E+00	1.95E+09
Sb-124	1.04E+08	1.96E+06	4.11E+07	2.51E+05	0.00E+00	8.07E+07	2.94E+09
Sb-125	1.37E+08	1.53E+06	3.25E+07	1.39E+05	0.00E+00	1.05E+08	1.50E+09
Sb-126	7.01E+06	1.43E+05	2.53E+06	4.29E+04	0.00E+00	4.30E+06	5.73E+08
Sb-127	5.19E+05	1.14E+04	1.99E+05	6.24E+03	0.00E+00	3.08E+05	1.19E+08
Te-125m	9.65E+07	3.50E+07	1.29E+07	2.90E+07	3.93E+08	0.00E+00	3.85E+08
Te-127m	3.49E+08	1.25E+08	4.25E+07	8.92E+07	1.42E+09	0.00E+00	1.17E+09
Te-127	5.61E+03	2.02E+03	1.21E+03	4.16E+03	2.29E+04	0.00E+00	4.43E+05
Te-129m	2.51E+08	9.37E+07	3.98E+07	8.63E+07	1.05E+09	0.00E+00	1.26E+09
Te-129	7.13E-04	2.68E-04	1.74E-04	5.48E-04	3.00E-03	0.00E+00	5.38E-04
Te-133m	2.12E-05	1.24E-05	1.19E-05	1.79E-05	1.22E-04	0.00E+00	4.24E-06
Te-134	3.19E-08	2.09E-08	1.28E-08	2.79E-08	2.02E-07	0.00E+00	3.54E-11
I-129	1.31E+09	1.13E+09	3.69E+09	2.90E+12	2.42E+09	0.00E+00	1.78E+08
I-130	3.90E+05	1.15E+06	4.54E+05	9.75E+07	1.79E+06	0.00E+00	9.90E+05
I-131	8.07E+07	1.15E+08	6.62E+07	3.78E+10	1.98E+08	0.00E+00	3.05E+07
Te-131m	9.10E+05	4.45E+05	3.71E+05	7.05E+05	4.51E+06	0.00E+00	4.42E+07
Te-131	1.25E-15	5.21E-16	3.94E-16	1.03E-15	5.47E-15	0.00E+00	1.77E-16
I-132	5.57E+01	1.49E+02	5.21E+01	5.21E+03	2.37E+02	0.00E+00	2.80E+01
Te-132	4.30E+06	2.78E+06	2.61E+06	3.07E+06	2.68E+07	0.00E+00	1.31E+08
I-133	2.08E+06	3.61E+06	1.10E+06	5.31E+08	6.31E+06	0.00E+00	3.25E+06
Cs-134m	6.57E+00	1.38E+01	7.06E+00	0.00E+00	7.49E+00	1.18E+00	4.87E+00
Cs-134	4.67E+09	1.11E+10	9.08E+09	0.00E+00	3.59E+09	1.19E+09	1.94E+08
I-134	8.84E-05	2.40E-04	8.59E-05	4.16E-03	3.82E-04	0.00E+00	2.09E-07
I-135	3.85E+04	1.01E+05	3.72E+04	6.65E+06	1.62E+05	0.00E+00	1.14E+05
Cs-135	1.56E+09	1.44E+09	6.40E+08	0.00E+00	5.46E+08	1.63E+08	3.37E+07
Cs-136	4.27E+07	1.68E+08	1.21E+08	0.00E+00	9.37E+07	1.28E+07	1.91E+07
Cs-137	6.36E+09	8.70E+09	5.70E+09	0.00E+00	2.95E+09	9.81E+08	1.68E+08
Cs-138	3.39E-11	6.70E-11	3.32E-11	0.00E+00	4.92E-11	4.86E-12	2.86E-16
Cs-139	1.36E-44	2.03E-44	7.39E-45	0.00E+00	1.62E-44	1.48E-45	4.39E-67
Ba-139	2.70E-02	1.92E-05	7.91E-04	0.00E+00	1.80E-05	1.09E-05	4.79E-02
Ba-140	1.28E+08	1.61E+05	8.41E+06	0.00E+00	5.48E+04	9.23E+04	2.64E+08
La-140	1.97E+03	9.95E+02	2.63E+02	0.00E+00	0.00E+00	0.00E+00	7.30E+07
Ba-141	8.94E-22	6.76E-25	3.02E-23	0.00E+00	6.28E-25	3.83E-25	4.21E-31
La-141	6.06E-01	1.88E-01	3.08E-02	0.00E+00	0.00E+00	0.00E+00	2.24E+04
Ce-141	1.97E+05	1.33E+05	1.51E+04	0.00E+00	6.19E+04	0.00E+00	5.09E+08
Ba-142	3.88E-39	3.99E-42	2.44E-40	0.00E+00	3.37E-42	2.26E-42	5.46E-57
La-142	1.92E-04	8.75E-05	2.18E-05	0.00E+00	0.00E+00	0.00E+00	6.39E-01
Ce-143	9.95E+02	7.36E+05	8.14E+01	0.00E+00	3.24E+02	0.00E+00	2.75E+07
Pr-143	6.26E+04	2.51E+04	3.10E+03	0.00E+00	1.45E+04	0.00E+00	2.74E+08
Ce-144	3.29E+07	1.38E+07	1.77E+06	0.00E+00	8.16E+06	0.00E+00	1.11E+10
Pr-144	2.36E-26	9.81E-27	1.20E-27	0.00E+00	5.53E-27	0.00E+00	3.40E-33
Nd-147	3.33E+04	3.85E+04	2.30E+03	0.00E+00	2.25E+04	0.00E+00	1.85E+08
Pm-147	5.74E+06	5.39E+05	2.18E+05	0.00E+00	1.02E+06	0.00E+00	6.79E+08
Pm-148m	8.30E+05	2.15E+05	1.64E+05	0.00E+00	3.24E+05	0.00E+00	1.82E+09
Pm-148	1.96E+04	3.25E+03	1.64E+03	0.00E+00	6.14E+03	0.00E+00	2.55E+08
Pm-149	1.69E+03	2.39E+02	9.78E+01	0.00E+00	4.52E+02	0.00E+00	4.49E+07
Pm-151	3.38E+02	5.67E+01	2.86E+01	0.00E+00	1.01E+02	0.00E+00	1.56E+07
Sm-151	5.52E+06	9.52E+05	2.28E+05	0.00E+00	1.06E+06	0.00E+00	4.20E+08
Sm-153	8.18E+02	6.82E+02	4.98E+01	0.00E+00	2.20E+02	0.00E+00	2.43E+07

Table 4-37 (Page 3 of 3)
Vegetation Pathway Factors for Adult (R_i^V)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	1.55E+07	3.52E+06	3.09E+06	0.00E+00	2.18E+07	0.00E+00	2.03E+09
Eu-154	4.85E+07	5.97E+06	4.25E+06	0.00E+00	2.86E+07	0.00E+00	4.32E+09
Eu-155	6.71E+06	9.51E+05	6.14E+05	0.00E+00	4.39E+06	0.00E+00	7.48E+08
Eu-156	1.08E+05	8.35E+04	1.35E+04	0.00E+00	5.58E+04	0.00E+00	5.72E+08
Tb-160	1.96E+06	0.00E+00	2.45E+05	0.00E+00	8.10E+05	0.00E+00	1.81E+09
Ho-166m	2.16E+07	6.76E+06	5.13E+06	0.00E+00	1.01E+07	0.00E+00	2.05E+09
W-181	5.33E+05	1.74E+05	1.86E+04	0.00E+00	0.00E+00	0.00E+00	1.98E+07
W-185	1.73E+07	5.77E+06	6.07E+05	0.00E+00	0.00E+00	0.00E+00	6.67E+08
W-187	3.79E+04	3.17E+04	1.11E+04	0.00E+00	0.00E+00	0.00E+00	1.04E+07
Np-239	1.43E+03	1.40E+02	7.73E+01	0.00E+00	4.37E+02	0.00E+00	2.88E+07
U-232	3.30E+11	0.00E+00	2.36E+10	0.00E+00	3.58E+10	0.00E+00	5.42E+09
U-233	6.98E+10	0.00E+00	4.23E+09	0.00E+00	1.63E+10	0.00E+00	5.02E+09
U-234	6.70E+10	0.00E+00	4.14E+09	0.00E+00	1.59E+10	0.00E+00	4.92E+09
U-235	6.42E+10	0.00E+00	3.89E+09	0.00E+00	1.50E+10	0.00E+00	6.26E+09
U-236	6.42E+10	0.00E+00	3.97E+09	0.00E+00	1.53E+10	0.00E+00	4.62E+09
U-237	1.84E+05	0.00E+00	4.89E+04	0.00E+00	7.55E+05	0.00E+00	6.45E+07
U-238	6.15E+10	0.00E+00	3.64E+09	0.00E+00	1.40E+10	0.00E+00	4.41E+09
Np-237	1.01E+11	7.18E+09	4.44E+09	0.00E+00	3.30E+10	0.00E+00	6.36E+09
Np-238	1.45E+04	3.90E+02	2.25E+02	0.00E+00	1.32E+03	0.00E+00	3.63E+07
Pu-238	5.04E+10	6.39E+09	1.37E+09	0.00E+00	5.86E+09	0.00E+00	5.84E+09
Pu-239	5.81E+10	6.98E+09	1.53E+09	0.00E+00	6.50E+09	0.00E+00	5.34E+09
Pu-240	5.80E+10	6.97E+09	1.53E+09	0.00E+00	6.49E+09	0.00E+00	5.43E+09
Pu-241	1.25E+09	5.91E+07	2.64E+07	0.00E+00	1.21E+08	0.00E+00	1.11E+08
Pu-242	5.39E+10	6.72E+09	1.47E+09	0.00E+00	6.26E+09	0.00E+00	5.23E+09
Pu-244	6.28E+10	7.70E+09	1.69E+09	0.00E+00	7.17E+09	0.00E+00	7.80E+09
Am-241	6.05E+10	5.65E+10	4.33E+09	0.00E+00	3.26E+10	0.00E+00	5.94E+09
Am-242m	6.09E+10	5.31E+10	4.35E+09	0.00E+00	3.24E+10	0.00E+00	7.48E+09
Am-243	6.04E+10	5.53E+10	4.25E+09	0.00E+00	3.20E+10	0.00E+00	6.97E+09
Cm-242	1.23E+09	1.30E+09	8.15E+07	0.00E+00	3.70E+08	0.00E+00	4.71E+09
Cm-243	4.78E+10	4.38E+10	2.99E+09	0.00E+00	1.40E+10	0.00E+00	6.23E+09
Cm-244	3.63E+10	3.40E+10	2.28E+09	0.00E+00	1.07E+10	0.00E+00	6.01E+09
Cm-245	7.52E+10	6.55E+10	4.62E+09	0.00E+00	2.16E+10	0.00E+00	5.64E+09
Cm-246	7.45E+10	6.54E+10	4.61E+09	0.00E+00	2.15E+10	0.00E+00	5.54E+09
Cm-247	7.27E+10	6.44E+10	4.54E+09	0.00E+00	2.12E+10	0.00E+00	7.28E+09
Cm-248	6.04E+11	5.31E+11	3.74E+10	0.00E+00	1.75E+11	0.00E+00	1.18E+11
Cf-252	1.99E+10	0.00E+00	4.79E+08	0.00E+00	0.00E+00	0.00E+00	2.19E+10

Units of mrem/yr per µCi/m^3 for H-3 and C-14
Units of m^{2}mrem/yr per µCi/sec for all other nuclides

Table 4-38 (Page 1 of 3)
Vegetation Pathway Factors for Teenager (R_i^V)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.47E+03	1.47E+03	1.47E+03	1.47E+03	1.47E+03	1.47E+03
C-14	1.45E+06	2.91E+05	2.91E+05	2.91E+05	2.91E+05	2.91E+05	2.91E+05
Na-22	2.01E+09	2.01E+09	2.01E+09	2.01E+09	2.01E+09	2.01E+09	2.01E+09
Na-24	2.38E+05	2.38E+05	2.38E+05	2.38E+05	2.38E+05	2.38E+05	2.38E+05
P-32	1.61E+09	9.96E+07	6.23E+07	0.00E+00	0.00E+00	0.00E+00	1.35E+08
Ca-41	1.79E+10	0.00E+00	1.94E+09	0.00E+00	0.00E+00	0.00E+00	1.77E+07
Sc-46	3.61E+05	7.03E+05	2.08E+05	0.00E+00	6.73E+05	0.00E+00	2.39E+09
Cr-51	0.00E+00	0.00E+00	6.16E+04	3.42E+04	1.35E+04	8.80E+04	1.04E+07
Mn-54	0.00E+00	4.54E+08	9.01E+07	0.00E+00	1.36E+08	0.00E+00	9.32E+08
Fe-55	3.26E+08	2.31E+08	5.39E+07	0.00E+00	0.00E+00	1.47E+08	1.00E+08
Mn-56	0.00E+00	1.39E+01	2.47E+00	0.00E+00	1.76E+01	0.00E+00	9.16E+02
Co-57	0.00E+00	1.79E+07	3.00E+07	0.00E+00	0.00E+00	0.00E+00	3.33E+08
Co-58	0.00E+00	4.36E+07	1.00E+08	0.00E+00	0.00E+00	0.00E+00	6.01E+08
Fe-59	1.79E+08	4.18E+08	1.62E+08	0.00E+00	0.00E+00	1.32E+08	9.90E+08
Co-60	0.00E+00	2.49E+08	5.60E+08	0.00E+00	0.00E+00	0.00E+00	3.24E+09
Ni-59	1.20E+09	4.24E+08	2.04E+08	0.00E+00	0.00E+00	0.00E+00	6.64E+07
Ni-63	1.61E+10	1.13E+09	5.45E+08	0.00E+00	0.00E+00	0.00E+00	1.81E+08
Cu-64	0.00E+00	8.29E+03	3.90E+03	0.00E+00	2.10E+04	0.00E+00	6.43E+05
Ni-65	5.55E+01	7.09E+00	3.23E+00	0.00E+00	0.00E+00	0.00E+00	3.85E+02
Zn-65	4.24E+08	1.47E+09	6.86E+08	0.00E+00	9.42E+08	0.00E+00	6.23E+08
Zn-69m	2.06E+04	4.87E+04	4.46E+03	0.00E+00	2.96E+04	0.00E+00	2.68E+06
Zn-69	4.73E-06	9.02E-06	6.31E-07	0.00E+00	5.89E-06	0.00E+00	1.66E-05
Se-79	0.00E+00	3.39E+08	5.70E+07	0.00E+00	5.91E+08	0.00E+00	5.18E+07
Br-82	0.00E+00	0.00E+00	1.32E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	2.82E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	1.95E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	1.94E-151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	2.73E+08	1.28E+08	0.00E+00	0.00E+00	0.00E+00	4.05E+07
Rb-87	0.00E+00	1.59E+09	5.55E+08	0.00E+00	0.00E+00	0.00E+00	5.55E+07
Rb-88	0.00E+00	2.44E-22	1.30E-22	0.00E+00	0.00E+00	0.00E+00	2.09E-29
Rb-89	0.00E+00	2.59E-26	1.83E-26	0.00E+00	0.00E+00	0.00E+00	3.98E-35
Sr-89	1.51E+10	0.00E+00	4.33E+08	0.00E+00	0.00E+00	0.00E+00	1.80E+09
Sr-90	9.22E+11	0.00E+00	1.84E+10	0.00E+00	0.00E+00	0.00E+00	2.11E+10
Y-90	1.24E+04	0.00E+00	3.34E+02	0.00E+00	0.00E+00	0.00E+00	1.02E+08
Sr-91	2.82E+05	0.00E+00	1.12E+04	0.00E+00	0.00E+00	0.00E+00	1.28E+06
Y-91m	4.43E-09	0.00E+00	1.69E-10	0.00E+00	0.00E+00	0.00E+00	2.09E-07
Y-91	7.83E+06	0.00E+00	2.10E+05	0.00E+00	0.00E+00	0.00E+00	3.21E+09
Sr-92	3.86E+02	0.00E+00	1.65E+01	0.00E+00	0.00E+00	0.00E+00	9.83E+03
Y-92	8.42E-01	0.00E+00	2.43E-02	0.00E+00	0.00E+00	0.00E+00	2.31E+04
Y-93	1.58E+02	0.00E+00	4.33E+00	0.00E+00	0.00E+00	0.00E+00	4.82E+06
Nb-93m	3.10E+06	1.02E+06	2.55E+05	0.00E+00	1.19E+06	0.00E+00	3.66E+08
Nb-95	1.92E+05	1.07E+05	5.87E+04	0.00E+00	1.03E+05	0.00E+00	4.56E+08
Nb-97	1.87E-06	4.65E-07	1.70E-07	0.00E+00	5.43E-07	0.00E+00	1.11E-02
Zr-93	5.03E+06	2.48E+06	1.35E+06	0.00E+00	8.77E+06	0.00E+00	2.34E+09
Zr-95	1.72E+06	5.43E+05	3.73E+05	0.00E+00	7.98E+05	0.00E+00	1.25E+09
Zr-97	3.11E+02	6.15E+01	2.83E+01	0.00E+00	9.33E+01	0.00E+00	1.67E+07
Mo-93	0.00E+00	9.63E+08	2.64E+07	0.00E+00	2.76E+08	0.00E+00	1.17E+08
Mo-99	0.00E+00	5.64E+06	1.08E+06	0.00E+00	1.29E+07	0.00E+00	1.01E+07
Tc-99	1.63E+07	2.39E+07	6.52E+06	0.00E+00	3.04E+08	2.47E+06	5.85E+08
Tc-99m	2.70E+00	7.54E+00	9.77E+01	0.00E+00	1.12E+02	4.18E+00	4.95E+03
Tc-101	5.52E-31	7.85E-31	7.71E-30	0.00E+00	1.42E-29	4.78E-31	1.34E-37
Ru-103	6.82E+06	0.00E+00	2.91E+06	0.00E+00	2.40E+07	0.00E+00	5.69E+08
Ru-105	4.92E+01	0.00E+00	1.91E+01	0.00E+00	6.20E+02	0.00E+00	3.97E+04
Rh-105	7.54E+04	5.45E+04	3.58E+04	0.00E+00	2.32E+05	0.00E+00	6.93E+06
Ru-106	3.09E+08	0.00E+00	3.90E+07	0.00E+00	5.97E+08	0.00E+00	1.48E+10
Pd-107	0.00E+00	1.89E+07	1.22E+06	0.00E+00	1.71E+08	0.00E+00	8.78E+07

Table 4-38 (Page 2 of 3)
Vegetation Pathway Factors for Teenager (R_i^V)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	2.06E+04	4.67E+03	0.00E+00	1.19E+05	0.00E+00	2.07E+06
Ag-110m	1.52E+07	1.43E+07	8.72E+06	0.00E+00	2.73E+07	0.00E+00	4.03E+09
Ag-111	2.02E+05	8.37E+04	4.21E+04	0.00E+00	2.72E+05	0.00E+00	1.17E+08
Cd-113m	0.00E+00	4.06E+08	1.30E+07	0.00E+00	4.49E+08	0.00E+00	2.44E+09
Cd-115m	0.00E+00	7.94E+07	2.56E+06	0.00E+00	6.35E+07	0.00E+00	2.51E+09
Sn-123	2.72E+09	4.46E+07	6.61E+07	3.58E+07	0.00E+00	0.00E+00	4.11E+09
Sn-125	3.85E+07	7.67E+05	1.74E+06	6.02E+05	0.00E+00	0.00E+00	3.63E+08
Sn-126	1.05E+10	1.96E+08	3.00E+08	5.17E+07	0.00E+00	0.00E+00	2.34E+09
Sb-124	1.54E+08	2.84E+06	6.02E+07	3.50E+05	0.00E+00	1.35E+08	3.11E+09
Sb-125	2.14E+08	2.34E+06	5.01E+07	2.05E+05	0.00E+00	1.88E+08	1.67E+09
Sb-126	7.36E+06	1.50E+05	2.64E+06	4.16E+04	0.00E+00	5.27E+06	4.35E+08
Sb-127	4.79E+05	1.02E+04	1.81E+05	5.39E+03	0.00E+00	3.26E+05	8.14E+07
Te-125m	1.48E+08	5.34E+07	1.98E+07	4.14E+07	0.00E+00	0.00E+00	4.37E+08
Te-127m	5.51E+08	1.96E+08	6.56E+07	1.31E+08	2.23E+09	0.00E+00	1.37E+09
Te-127	5.29E+03	1.88E+03	1.14E+03	3.65E+03	2.14E+04	0.00E+00	4.09E+05
Te-129m	3.61E+08	1.34E+08	5.72E+07	1.17E+08	1.51E+09	0.00E+00	1.36E+09
Te-129	6.68E-04	2.49E-04	1.63E-04	4.77E-04	2.80E-03	0.00E+00	3.65E-03
Te-133m	1.94E-05	1.10E-05	1.07E-05	1.54E-05	1.09E-04	0.00E+00	4.45E-05
Te-134	2.89E-08	1.85E-08	1.94E-08	2.37E-08	1.77E-07	0.00E+00	1.07E-09
I-129	2.12E+09	1.78E+09	2.97E+09	2.17E+12	3.19E+09	0.00E+00	2.08E+08
I-130	3.49E+05	1.01E+06	4.03E+05	8.22E+07	1.55E+06	0.00E+00	7.75E+05
I-131	7.68E+07	1.08E+08	5.78E+07	3.14E+10	1.85E+08	0.00E+00	2.13E+07
Te-131m	8.42E+05	4.04E+05	3.37E+05	6.07E+05	4.21E+06	0.00E+00	3.24E+07
Te-131	1.16E-15	4.78E-16	3.62E-16	8.93E-16	5.07E-15	0.00E+00	9.52E-17
I-132	5.02E+01	1.31E+02	4.72E+01	4.43E+03	2.07E+02	0.00E+00	5.72E+01
Te-132	3.90E+06	2.47E+06	2.33E+06	2.61E+06	2.37E+07	0.00E+00	7.83E+07
I-133	1.93E+06	3.27E+06	9.99E+05	4.57E+08	5.74E+06	0.00E+00	2.48E+06
Cs-134m	5.95E+00	1.23E+01	6.33E+00	0.00E+00	6.86E+00	1.20E+00	8.20E+00
Cs-134	7.10E+09	1.67E+10	7.75E+09	0.00E+00	5.31E+09	2.03E+09	2.08E+08
I-134	7.99E-05	2.12E-04	7.61E-05	3.53E-03	3.34E-04	0.00E+00	2.79E-06
I-135	3.48E+04	8.96E+04	3.32E+04	5.76E+06	1.42E+05	0.00E+00	9.93E+04
Cs-135	2.53E+09	2.32E+09	5.42E+08	0.00E+00	8.84E+08	3.20E+08	4.05E+07
Cs-136	4.37E+07	1.72E+08	1.15E+08	0.00E+00	9.36E+07	1.48E+07	1.38E+07
Cs-137	1.01E+10	1.35E+10	4.69E+09	0.00E+00	4.59E+09	1.78E+09	1.92E+08
Cs-138	3.13E-11	6.01E-11	3.00E-11	0.00E+00	4.44E-11	5.16E-12	2.73E-14
Cs-139	1.28E-44	1.88E-44	6.89E-45	0.00E+00	1.52E-44	1.66E-45	8.72E-60
Ba-139	2.54E-02	1.79E-05	7.40E-04	0.00E+00	1.69E-05	1.23E-05	2.27E-01
Ba-140	1.38E+08	1.69E+05	8.89E+06	0.00E+00	5.73E+04	1.14E+05	2.13E+08
La-140	1.80E+03	8.86E+02	2.36E+02	0.00E+00	0.00E+00	0.00E+00	5.09E+07
Ba-141	8.36E-22	6.24E-25	2.79E-23	0.00E+00	5.79E-25	4.27E-25	1.78E-27
La-141	5.67E-01	1.74E-01	2.88E-02	0.00E+00	0.00E+00	0.00E+00	3.09E+04
Ce-141	2.83E+05	1.89E+05	2.17E+04	0.00E+00	8.89E+04	0.00E+00	5.40E+08
Ba-142	3.57E-39	3.57E-42	2.20E-40	0.00E+00	3.02E-42	2.38E-42	1.10E-50
La-142	1.77E-04	7.84E-05	1.95E-05	0.00E+00	0.00E+00	0.00E+00	2.39E+00
Ce-143	9.30E+02	6.77E+05	7.56E+01	0.00E+00	3.04E+02	0.00E+00	2.04E+07
Pr-143	7.00E+04	2.79E+04	3.48E+03	0.00E+00	1.62E+04	0.00E+00	2.30E+08
Ce-144	5.27E+07	2.18E+07	2.83E+06	0.00E+00	1.30E+07	0.00E+00	1.33E+10
Pr-144	2.22E-26	9.07E-27	1.12E-27	0.00E+00	5.20E-27	0.00E+00	2.44E-29
Nd-147	3.62E+04	3.93E+04	2.36E+03	0.00E+00	2.31E+04	0.00E+00	1.42E+08
Pm-147	9.04E+06	8.57E+05	3.49E+05	0.00E+00	1.64E+06	0.00E+00	8.15E+08
Pm-148m	1.17E+06	2.96E+05	2.31E+05	0.00E+00	4.48E+05	0.00E+00	1.86E+09
Pm-148	1.83E+04	2.98E+03	1.50E+03	0.00E+00	5.39E+03	0.00E+00	1.78E+08
Pm-149	1.59E+03	2.23E+02	9.14E+01	0.00E+00	4.25E+02	0.00E+00	3.28E+07
Pm-151	3.14E+02	5.18E+01	2.62E+01	0.00E+00	9.32E+01	0.00E+00	1.16E+07
Sm-151	7.92E+06	1.52E+06	3.58E+05	0.00E+00	1.67E+06	0.00E+00	5.17E+08
Sm-153	7.64E+02	6.33E+02	4.65E+01	0.00E+00	2.07E+02	0.00E+00	1.79E+07

Table 4-38 (Page 3 of 3)
Vegetation Pathway Factors for Teenager (R_i^V)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	2.20E+07	5.31E+06	4.68E+06	0.00E+00	2.46E+07	0.00E+00	1.95E+09
Eu-154	7.07E+07	9.12E+06	6.43E+06	0.00E+00	4.08E+07	0.00E+00	4.82E+09
Eu-155	1.54E+07	1.48E+06	9.18E+05	0.00E+00	5.80E+06	0.00E+00	8.50E+09
Eu-156	1.24E+05	9.30E+04	1.52E+04	0.00E+00	6.26E+04	0.00E+00	4.75E+08
Tb-160	2.94E+06	0.00E+00	3.67E+05	0.00E+00	1.16E+06	0.00E+00	1.90E+09
Ho-166m	3.24E+07	1.00E+07	7.23E+06	0.00E+00	1.46E+07	0.00E+00	2.46E+09
W-181	8.47E+05	2.73E+05	2.86E+04	0.00E+00	0.00E+00	0.00E+00	2.33E+07
W-185	2.70E+07	8.90E+06	9.41E+05	0.00E+00	0.00E+00	0.00E+00	7.69E+08
W-187	3.53E+04	2.87E+04	1.01E+04	0.00E+00	0.00E+00	0.00E+00	7.78E+06
Np-239	1.38E+03	1.31E+02	7.25E+01	0.00E+00	4.10E+02	0.00E+00	2.10E+07
U-232	5.34E+11	0.00E+00	3.82E+10	0.00E+00	5.79E+10	0.00E+00	6.52E+09
U-233	1.13E+11	0.00E+00	6.85E+09	0.00E+00	2.64E+10	0.00E+00	6.04E+09
U-234	1.08E+11	0.00E+00	6.72E+09	0.00E+00	2.59E+10	0.00E+00	5.92E+09
U-235	1.04E+11	0.00E+00	6.31E+09	0.00E+00	2.43E+10	0.00E+00	7.53E+09
U-236	1.04E+11	0.00E+00	6.44E+09	0.00E+00	2.48E+10	0.00E+00	5.55E+09
U-237	1.74E+05	0.00E+00	4.64E+04	0.00E+00	7.16E+05	0.00E+00	4.62E+07
U-238	9.91E+10	0.00E+00	5.90E+09	0.00E+00	2.27E+10	0.00E+00	5.30E+09
Np-237	1.21E+11	8.68E+09	5.32E+09	0.00E+00	3.94E+10	0.00E+00	7.64E+09
Np-238	1.35E+04	3.62E+02	2.11E+02	0.00E+00	1.24E+03	0.00E+00	2.66E+07
Pu-238	6.08E+10	7.79E+09	1.65E+09	0.00E+00	7.08E+09	0.00E+00	7.01E+09
Pu-239	6.95E+10	8.44E+09	1.83E+09	0.00E+00	7.79E+09	0.00E+00	6.42E+09
Pu-240	6.94E+10	8.43E+09	1.83E+09	0.00E+00	7.78E+09	0.00E+00	6.53E+09
Pu-241	1.57E+09	7.56E+07	3.32E+07	0.00E+00	1.54E+08	0.00E+00	1.33E+08
Pu-242	6.44E+10	8.13E+09	1.76E+09	0.00E+00	7.50E+09	0.00E+00	6.29E+09
Pu-244	7.53E+10	9.27E+09	2.02E+09	0.00E+00	8.59E+09	0.00E+00	9.36E+09
Am-241	7.25E+10	6.84E+10	5.22E+09	0.00E+00	3.92E+10	0.00E+00	7.15E+09
Am-242m	7.33E+10	6.46E+10	5.27E+09	0.00E+00	3.90E+10	0.00E+00	8.99E+09
Am-243	7.23E+10	6.68E+10	5.11E+09	0.00E+00	3.84E+10	0.00E+00	8.39E+09
Cm-242	1.95E+09	2.06E+09	1.29E+08	0.00E+00	5.90E+08	0.00E+00	5.57E+09
Cm-243	5.88E+10	5.45E+10	3.70E+09	0.00E+00	1.73E+10	0.00E+00	7.49E+09
Cm-244	4.54E+10	4.30E+10	2.88E+09	0.00E+00	1.34E+10	0.00E+00	7.21E+09
Cm-245	9.00E+10	7.92E+10	5.54E+09	0.00E+00	2.59E+10	0.00E+00	6.78E+09
Cm-246	8.93E+10	7.91E+10	5.54E+09	0.00E+00	2.58E+10	0.00E+00	6.66E+09
Cm-247	8.70E+10	7.79E+10	5.45E+09	0.00E+00	2.54E+10	0.00E+00	8.75E+09
Cm-248	7.23E+11	6.42E+11	4.50E+10	0.00E+00	2.10E+11	0.00E+00	1.41E+11
Cf-252	2.99E+10	0.00E+00	7.21E+08	0.00E+00	0.00E+00	0.00E+00	2.63E+10

Units of mrem/yr per μCi/m^3 for H-3 and C-14
Units of m^{2}mrem/yr per μCi/sec for all other nuclides

Table 4-39 (Page 1 of 3)
Vegetation Pathway Factors for Child (R_i^V)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	2.29E+03	2.29E+03	2.29E+03	2.29E+03	2.29E+03	2.29E+03
C-14	3.50E+06	7.01E+05	7.01E+05	7.01E+05	7.01E+05	7.01E+05	7.01E+05
Na-22	4.09E+09	4.09E+09	4.09E+09	4.09E+09	4.09E+09	4.09E+09	4.09E+09
Na-24	3.71E+05	3.71E+05	3.71E+05	3.71E+05	3.71E+05	3.71E+05	3.71E+05
P-32	3.37E+09	1.58E+08	1.30E+08	0.00E+00	0.00E+00	0.00E+00	9.30E+07
Ca-41	2.55E+10	0.00E+00	2.79E+09	0.00E+00	0.00E+00	0.00E+00	1.40E+07
Sc-46	7.85E+05	1.08E+06	4.14E+05	0.00E+00	9.52E+05	0.00E+00	1.57E+09
Cr-51	0.00E+00	0.00E+00	1.17E+05	6.50E+04	1.78E+04	1.19E+05	6.21E+06
Mn-54	0.00E+00	6.65E+08	1.77E+08	0.00E+00	1.86E+08	0.00E+00	5.58E+08
Fe-55	8.01E+08	4.25E+08	1.32E+08	0.00E+00	0.00E+00	2.40E+08	7.87E+07
Mn-56	0.00E+00	1.82E+01	4.11E+00	0.00E+00	2.20E+01	0.00E+00	2.64E+03
Co-57	0.00E+00	2.99E+07	6.04E+07	0.00E+00	0.00E+00	0.00E+00	2.45E+08
Co-58	0.00E+00	6.44E+07	1.97E+08	0.00E+00	0.00E+00	0.00E+00	3.75E+08
Fe-59	3.97E+08	6.43E+08	3.20E+08	0.00E+00	0.00E+00	1.86E+08	6.69E+08
Co-60	0.00E+00	3.78E+08	1.12E+09	0.00E+00	0.00E+00	0.00E+00	2.10E+09
Ni-59	2.96E+09	7.87E+08	5.01E+08	0.00E+00	0.00E+00	0.00E+00	5.22E+07
Ni-63	3.95E+10	2.11E+09	1.34E+09	0.00E+00	0.00E+00	0.00E+00	1.42E+08
Cu-64	0.00E+00	1.09E+04	6.60E+03	0.00E+00	2.64E+04	0.00E+00	5.13E+05
Ni-65	1.02E+02	9.59E+00	5.60E+00	0.00E+00	0.00E+00	0.00E+00	1.17E+03
Zn-65	8.12E+08	2.16E+09	1.35E+09	0.00E+00	1.36E+09	0.00E+00	3.80E+08
Zn-69m	3.78E+04	6.44E+04	7.61E+03	0.00E+00	3.74E+04	0.00E+00	2.10E+06
Zn-69	8.73E-06	1.26E-05	1.17E-06	0.00E+00	7.66E-06	0.00E+00	7.96E-04
Se-79	0.00E+00	6.20E+08	1.37E+08	0.00E+00	1.01E+09	0.00E+00	4.06E+07
Br-82	0.00E+00	0.00E+00	2.03E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	5.20E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	3.30E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	3.59E-151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	4.52E+08	2.78E+08	0.00E+00	0.00E+00	0.00E+00	2.91E+07
Rb-87	0.00E+00	2.90E+09	1.35E+09	0.00E+00	0.00E+00	0.00E+00	4.35E+07
Rb-88	0.00E+00	3.37E-22	2.34E-22	0.00E+00	0.00E+00	0.00E+00	1.65E-23
Rb-89	0.00E+00	3.42E-26	3.04E-26	0.00E+00	0.00E+00	0.00E+00	2.98E-28
Sr-89	3.59E+10	0.00E+00	1.03E+09	0.00E+00	0.00E+00	0.00E+00	1.39E+09
Sr-90	1.87E+12	0.00E+00	3.77E+10	0.00E+00	0.00E+00	0.00E+00	1.67E+10
Y-90	2.30E+04	0.00E+00	6.17E+02	0.00E+00	0.00E+00	0.00E+00	6.56E+07
Sr-91	5.20E+05	0.00E+00	1.96E+04	0.00E+00	0.00E+00	0.00E+00	1.15E+06
Y-91m	8.12E-09	0.00E+00	2.95E-10	0.00E+00	0.00E+00	0.00E+00	1.59E-05
Y-91	1.86E+07	0.00E+00	4.98E+05	0.00E+00	0.00E+00	0.00E+00	2.48E+09
Sr-92	7.07E+02	0.00E+00	2.84E+01	0.00E+00	0.00E+00	0.00E+00	1.34E+04
Y-92	1.55E+00	0.00E+00	4.43E-02	0.00E+00	0.00E+00	0.00E+00	4.48E+04
Y-93	2.91E+02	0.00E+00	7.98E+00	0.00E+00	0.00E+00	0.00E+00	4.34E+06
Nb-93m	7.64E+06	1.91E+06	6.27E+05	0.00E+00	2.06E+06	0.00E+00	2.87E+08
Nb-95	4.10E+05	1.60E+05	1.14E+05	0.00E+00	1.50E+05	0.00E+00	2.95E+08
Nb-97	3.41E-06	6.16E-07	2.88E-07	0.00E+00	6.84E-07	0.00E+00	1.90E-01
Zr-93	1.23E+07	4.59E+06	3.27E+06	0.00E+00	1.78E+07	0.00E+00	1.74E+09
Zr-95	3.86E+06	8.48E+05	7.55E+05	0.00E+00	1.21E+06	0.00E+00	8.84E+08
Zr-97	5.68E+02	8.20E+01	4.84E+01	0.00E+00	1.18E+02	0.00E+00	1.24E+07
Mo-93	0.00E+00	1.77E+09	6.36E+07	0.00E+00	4.67E+08	0.00E+00	8.97E+07
Mo-99	0.00E+00	7.70E+06	1.91E+06	0.00E+00	1.64E+07	0.00E+00	6.37E+06
Tc-99	3.93E+07	4.38E+07	1.57E+07	0.00E+00	5.16E+08	3.87E+06	4.59E+08
Tc-99m	4.65E+00	9.12E+00	1.51E+02	0.00E+00	1.32E+02	4.63E+00	5.19E+03
Tc-101	1.02E-30	1.06E-30	1.35E-29	0.00E+00	1.81E-29	5.62E-31	3.38E-30
Ru-103	1.53E+07	0.00E+00	5.89E+06	0.00E+00	3.86E+07	0.00E+00	3.96E+08
Ru-105	9.01E+01	0.00E+00	3.27E+01	0.00E+00	7.92E+02	0.00E+00	5.88E+04
Rh-105	1.39E+05	7.45E+04	6.37E+04	0.00E+00	2.97E+05	0.00E+00	4.62E+06
Ru-106	7.45E+08	0.00E+00	9.30E+07	0.00E+00	1.01E+09	0.00E+00	1.16E+10
Pd-107	0.00E+00	3.47E+07	2.95E+06	0.00E+00	2.90E+08	0.00E+00	6.89E+07

Table 4-39 (Page 2 of 3)
Vegetation Pathway Factors for Child (R_i^V)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	2.88E+04	8.62E+03	0.00E+00	1.54E+05	0.00E+00	1.70E+06
Ag-110m	3.21E+07	2.17E+07	1.73E+07	0.00E+00	4.04E+07	0.00E+00	2.58E+09
Ag-111	3.79E+05	1.19E+05	7.82E+04	0.00E+00	3.58E+05	0.00E+00	7.26E+07
Cd-113m	0.00E+00	7.42E+08	3.16E+07	0.00E+00	7.64E+08	0.00E+00	1.91E+09
Cd-115m	0.00E+00	1.42E+08	6.04E+06	0.00E+00	1.05E+08	0.00E+00	1.93E+09
Sn-123	6.54E+09	8.11E+07	1.59E+08	8.61E+07	0.00E+00	0.00E+00	3.21E+09
Sn-125	7.45E+07	1.12E+06	3.34E+06	1.16E+06	0.00E+00	0.00E+00	2.31E+08
Sn-126	2.45E+10	3.05E+08	6.95E+08	8.38E+07	0.00E+00	0.00E+00	1.84E+09
Sb-124	3.52E+08	4.56E+06	1.23E+08	7.76E+05	0.00E+00	1.95E+08	2.20E+09
Sb-125	4.99E+08	3.85E+06	1.05E+08	4.63E+05	0.00E+00	2.78E+08	1.19E+09
Sb-126	1.38E+07	2.12E+05	4.97E+06	8.12E+04	0.00E+00	6.61E+06	2.79E+08
Sb-127	8.67E+05	1.34E+04	3.01E+05	9.65E+03	0.00E+00	3.76E+05	4.88E+07
Te-125m	3.50E+08	9.50E+07	4.67E+07	9.84E+07	0.00E+00	0.00E+00	3.38E+08
Te-127m	1.32E+09	3.56E+08	1.57E+08	3.16E+08	3.77E+09	0.00E+00	1.07E+09
Te-127	9.76E+03	2.63E+03	2.09E+03	6.76E+03	2.78E+04	0.00E+00	3.81E+05
Te-129m	8.40E+08	2.35E+08	1.30E+08	2.71E+08	2.47E+09	0.00E+00	1.03E+09
Te-129	1.24E-03	3.45E-04	2.94E-04	8.82E-04	3.62E-03	0.00E+00	7.70E-02
Te-133m	3.48E-05	1.41E-05	1.74E-05	2.70E-05	1.34E-04	0.00E+00	1.07E-03
Te-134	5.16E-08	2.32E-08	3.10E-08	4.08E-08	2.15E-07	0.00E+00	2.36E-07
I-129	5.11E+09	3.14E+09	2.80E+09	2.05E+12	5.29E+09	0.00E+00	1.58E+08
I-130	6.12E+05	1.24E+06	6.37E+05	1.36E+08	1.85E+06	0.00E+00	5.78E+05
I-131	1.43E+08	1.44E+08	8.16E+07	4.75E+10	2.36E+08	0.00E+00	1.28E+07
Te-131m	1.54E+06	5.32E+05	5.66E+05	1.09E+06	5.15E+06	0.00E+00	2.16E+07
Te-131	2.14E-15	6.51E-16	6.35E-16	1.63E-15	6.46E-15	0.00E+00	1.12E-14
I-132	8.91E+01	1.64E+02	7.53E+01	7.60E+03	2.51E+02	0.00E+00	1.93E+02
Te-132	6.99E+06	3.10E+06	3.74E+06	4.51E+06	2.87E+07	0.00E+00	3.12E+07
I-133	3.52E+06	4.35E+06	1.65E+06	8.08E+08	7.25E+06	0.00E+00	1.75E+06
Cs-134m	1.06E+01	1.57E+01	1.02E+01	0.00E+00	8.26E+00	1.37E+00	1.98E+01
Cs-134	1.60E+10	2.63E+10	5.55E+09	0.00E+00	8.15E+09	2.93E+09	1.42E+08
I-134	1.42E-04	2.64E-04	1.21E-04	6.07E-03	4.03E-04	0.00E+00	1.75E-04
I-135	6.18E+04	1.11E+05	5.26E+04	9.86E+06	1.71E+05	0.00E+00	8.48E+04
Cs-135	6.10E+09	4.25E+09	4.36E+08	0.00E+00	1.50E+09	5.01E+08	3.18E+07
Cs-136	8.23E+07	2.26E+08	1.46E+08	0.00E+00	1.21E+08	1.80E+07	7.95E+06
Cs-137	2.39E+10	2.29E+10	3.38E+09	0.00E+00	7.46E+09	2.68E+09	1.43E+08
Cs-138	5.69E-11	7.91E-11	5.02E-11	0.00E+00	5.57E-11	5.99E-12	3.64E-11
Cs-139	2.35E-44	2.61E-44	1.26E-44	0.00E+00	1.96E-44	1.98E-45	2.35E-48
Ba-139	4.69E-02	2.50E-05	1.36E-03	0.00E+00	2.18E-05	1.47E-05	2.70E+00
Ba-140	2.76E+08	2.42E+05	1.61E+07	0.00E+00	7.88E+04	1.44E+05	1.40E+08
La-140	3.24E+03	1.13E+03	3.82E+02	0.00E+00	0.00E+00	0.00E+00	3.16E+07
Ba-141	1.54E-21	8.64E-25	5.02E-23	0.00E+00	7.47E-25	5.07E-24	8.79E-22
La-141	1.05E+00	2.44E-01	5.31E-02	0.00E+00	0.00E+00	0.00E+00	5.44E+04
Ce-141	6.56E+05	3.27E+05	4.85E+04	0.00E+00	1.43E+05	0.00E+00	4.08E+08
Ba-142	6.46E-39	4.65E-42	3.61E-40	0.00E+00	3.76E-42	2.74E-42	8.43E-41
La-142	3.20E-04	1.02E-04	3.19E-05	0.00E+00	0.00E+00	0.00E+00	2.02E+01
Ce-143	1.71E+03	9.29E+05	1.35E+02	0.00E+00	3.90E+02	0.00E+00	1.36E+07
Pr-143	1.45E+05	4.37E+04	7.22E+03	0.00E+00	2.37E+04	0.00E+00	1.57E+08
Ce-144	1.27E+08	3.98E+07	6.78E+06	0.00E+00	2.21E+07	0.00E+00	1.04E+10
Pr-144	4.11E-26	1.27E-26	2.07E-27	0.00E+00	6.73E-27	0.00E+00	2.74E-23
Nd-147	7.14E+04	5.78E+04	4.48E+03	0.00E+00	3.17E+04	0.00E+00	9.16E+07
Pm-147	2.21E+07	1.58E+06	8.49E+05	0.00E+00	2.79E+06	0.00E+00	6.39E+08
Pm-148m	2.28E+06	4.54E+05	4.54E+05	0.00E+00	6.73E+05	0.00E+00	1.28E+09
Pm-148	3.36E+04	4.04E+03	2.62E+03	0.00E+00	6.87E+03	0.00E+00	1.08E+08
Pm-149	2.94E+03	3.12E+02	1.69E+02	0.00E+00	5.52E+02	0.00E+00	2.13E+07
Pm-151	5.75E+02	6.99E+01	4.55E+01	0.00E+00	1.19E+02	0.00E+00	7.93E+06
Sm-151	1.88E+07	2.80E+06	8.81E+05	0.00E+00	2.89E+06	0.00E+00	4.06E+08
Sm-153	1.42E+03	8.80E+02	8.49E+01	0.00E+00	2.68E+02	0.00E+00	1.17E+07

Table 4-39 (Page 3 of 3)
Vegetation Pathway Factors for Child (R_i^V)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	4.47E+07	8.15E+06	9.67E+06	0.00E+00	3.44E+07	0.00E+00	1.34E+09
Eu-154	1.66E+08	1.50E+07	1.37E+07	0.00E+00	6.57E+07	0.00E+00	3.48E+09
Eu-155	3.44E+07	2.48E+06	1.94E+06	0.00E+00	9.28E+06	0.00E+00	6.20E+09
Eu-156	2.57E+05	1.38E+05	2.85E+04	0.00E+00	8.88E+04	0.00E+00	3.13E+08
Tb-160	6.02E+06	0.00E+00	7.47E+05	0.00E+00	1.79E+06	0.00E+00	1.33E+09
Ho-166m	7.94E+07	1.66E+07	1.40E+07	0.00E+00	2.37E+07	0.00E+00	1.93E+09
W-181	2.02E+06	4.98E+05	6.85E+04	0.00E+00	0.00E+00	0.00E+00	1.81E+07
W-185	6.44E+07	1.61E+07	2.25E+06	0.00E+00	0.00E+00	0.00E+00	5.99E+08
W-187	6.41E+04	3.80E+04	1.70E+04	0.00E+00	0.00E+00	0.00E+00	5.34E+06
Np-239	2.56E+03	1.84E+02	1.29E+02	0.00E+00	5.31E+02	0.00E+00	1.36E+07
U-232	1.29E+12	0.00E+00	9.24E+10	0.00E+00	9.83E+10	0.00E+00	5.12E+09
U-233	2.73E+11	0.00E+00	1.65E+10	0.00E+00	4.48E+10	0.00E+00	4.74E+09
U-234	2.62E+11	0.00E+00	1.62E+10	0.00E+00	4.40E+10	0.00E+00	4.65E+09
U-235	2.51E+11	0.00E+00	1.52E+10	0.00E+00	4.12E+10	0.00E+00	5.90E+09
U-236	2.51E+11	0.00E+00	1.56E+10	0.00E+00	4.21E+10	0.00E+00	4.35E+09
U-237	3.26E+05	0.00E+00	8.65E+04	0.00E+00	9.39E+05	0.00E+00	2.87E+07
U-238	2.40E+11	0.00E+00	1.43E+10	0.00E+00	3.85E+10	0.00E+00	4.16E+09
Np-237	1.64E+11	1.08E+10	7.20E+09	0.00E+00	4.45E+10	0.00E+00	6.00E+09
Np-238	2.50E+04	5.07E+02	3.90E+02	0.00E+00	1.62E+03	0.00E+00	1.74E+07
Pu-238	8.73E+10	1.01E+10	2.32E+09	0.00E+00	8.44E+09	0.00E+00	5.50E+09
Pu-239	9.48E+10	1.01E+10	2.43E+09	0.00E+00	8.97E+09	0.00E+00	5.04E+09
Pu-240	9.41E+10	1.05E+10	2.43E+09	0.00E+00	8.97E+09	0.00E+00	5.13E+09
Pu-241	2.82E+09	1.15E+08	5.85E+07	0.00E+00	2.15E+08	0.00E+00	1.05E+08
Pu-242	8.75E+10	1.01E+10	2.34E+09	0.00E+00	8.60E+09	0.00E+00	4.93E+09
Pu-244	1.02E+11	1.16E+11	2.68E+09	0.00E+00	9.92E+09	0.00E+00	7.35E+09
Am-241	9.99E+10	8.60E+10	7.50E+09	0.00E+00	4.58E+10	0.00E+00	5.61E+09
Am-242m	1.03E+11	8.23E+10	7.64E+09	0.00E+00	4.63E+10	0.00E+00	7.06E+09
Am-243	9.85E+10	8.31E+10	7.23E+09	0.00E+00	4.45E+10	0.00E+00	6.58E+09
Cm-242	4.69E+09	3.74E+09	3.12E+08	0.00E+00	9.98E+08	0.00E+00	4.36E+09
Cm-243	9.36E+10	7.61E+10	6.03E+09	0.00E+00	2.25E+10	0.00E+00	5.87E+09
Cm-244	7.88E+10	6.37E+10	5.05E+09	0.00E+00	1.85E+10	0.00E+00	5.67E+09
Cm-245	1.23E+11	9.85E+10	7.72E+09	0.00E+00	3.02E+10	0.00E+00	5.32E+09
Cm-246	1.21E+11	9.85E+10	7.72E+09	0.00E+00	3.01E+10	0.00E+00	5.23E+09
Cm-247	1.18E+11	9.70E+10	7.57E+09	0.00E+00	2.97E+10	0.00E+00	6.87E+09
Cm-248	9.85E+11	8.01E+11	6.26E+10	0.00E+00	2.45E+11	0.00E+00	1.11E+11
Cf-252	7.31E+10	0.00E+00	1.77E+09	0.00E+00	0.00E+00	0.00E+00	2.06E+10

Units of mrem/yr per μCi/m^3 for H-3 and C-14
Units of m^{2}mrem/yr per μCi/sec for all other nuclides

Table 4-40 (Page 1 of 3)
Vegetation Pathway Factors for Infant (R_i^V)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
P-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ca-41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sc-46	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cr-51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mn-54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mn-56	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni-59	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cu-64	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-69m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Se-79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-83	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-93m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mo-93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mo-99	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tc-99	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tc-99m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tc-101	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru-103	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru-105	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rh-105	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ru-106	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pd-107	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 4-40 (Page 2 of 3)
Vegetation Pathway Factors for Infant (R_i^V)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Pd-109	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ag-110m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ag-111	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cd-113m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cd-115m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-123	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-126	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-126	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-127	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-125m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-127m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-127	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-129m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-133m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-129	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-130	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-131m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-131	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-132	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-132	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-135	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-136	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-138	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba-140	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La-140	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ce-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
La-142	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ce-143	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pr-143	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ce-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pr-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nd-147	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pm-147	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pm-148m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pm-148	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pm-149	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pm-151	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sm-151	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sm-153	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 4-40 (Page 3 of 3)
Vegetation Pathway Factors for Infant (R_i^V)

Nuclide	Bone	Liver	T Body	Thyroid	Kidney	Lung	GI-LLI
Eu-152	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Eu-154	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Eu-155	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Eu-156	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tb-160	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ho-166m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W-181	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W-185	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W-187	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Np-239	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-232	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-233	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-234	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-235	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-236	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-237	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-238	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Np-237	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Np-238	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-238	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-239	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-240	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-241	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-242	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-244	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Am-241	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Am-242m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Am-243	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-242	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-243	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-244	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-245	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-246	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-247	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-248	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cf-252	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Units of mrem/yr per µCi/m^3 for H-3 and C-14
Units of m^{2}mrem/yr per µCi/sec for all other nuclides

Table 4-41
Atmospheric Stability Classes

Description	Pasquill Stability Class	[a]σ_θ (degrees)	Temperature Change with Height (°C/100 m)
Extremely Unstable	A	>22.5	<-1.9
Moderately Unstable	B	17.5 to 22.5	-1.9 to -1.7
Slightly Unstable	C	12.5 to 17.5	-1.7 to -1.5
Neutral	D	7.5 to 12.5	-1.5 to -0.5
Slightly Stable	E	3.8 to 7.5	-0.5 to 1.5
Moderately Stable	F	2.1 to 3.8	1.5 to 4.0
Extremely Stable	G	0 to 2.1	>4.0

[a]σ_θ is the standard deviation of horizontal wind direction fluctuation over a period of 15 minutes to 1 hour.

From Regulatory Guide 1.21, Table 4B.

Table 4-42
Vertical Dispersion Parameters

Section 1

Vertical Dispersion Parameters σ_z

σ_z (meters) = aR^b+c with σ_z limited to a maximum of 1000 meters
R = downwind radius (meters)
a, b, and c have the values listed below:

Stability Class	100 < R < 1000 a	b	c	R > 1000 a	b	c
A	*	*	*	0.00024	2.094	-9.6
B	*	*	*	*	*	*
C	0.113	0.911	0.0	*	*	*
D	0.222	0.725	-1.7	1.26	0.516	-13.0
E	0.211	0.678	-1.3	6.73	0.305	-34.0
F	0.086	0.74	-0.35	18.05	0.18	-48.6
G	0.052	0.74	-0.21	10.83	0.18	-29.2

Basis: Reference 53, except for cases denoted by an asterisk. In these cases, the value of σ_z is obtained by a polynomial approximation to the data from Reference 53 (see Section 2 of this table). The functions given in Reference 50 are not used because they are discontinuous at 1000 meters.

Section 2

Polynomial Approximation for σ_z:
σ_z (meters) = $\exp [a_0 + a_1P + a_2P^2 + a_3P^3]$ with σ_z limited to a maximum of 1000 meters
$P = \log_e [R(\text{meters})]$

a_0, a_1, a_2 and a_3 have the values listed below:

Stability Class	Radius	Coefficients	
A	$100 \leq R \leq 1000$	a_0 =	-10.50
		a_1 =	6.879
		a_2 =	-1.309
		a_3 =	0.0957
B	$100 \leq R \leq 1000$	a_0 =	-0.449
		a_1 =	0.218
		a_2 =	0.112
		a_3 =	-0.00517
B	R > 1000	a_0 =	319.148
		a_1 =	-127.806
		a_2 =	17.093
		a_3 =	-0.750
C	R > 1000	a_0 =	5.300
		a_1 =	-1.866
		a_2 =	0.3509
		a3 =	-0.01514

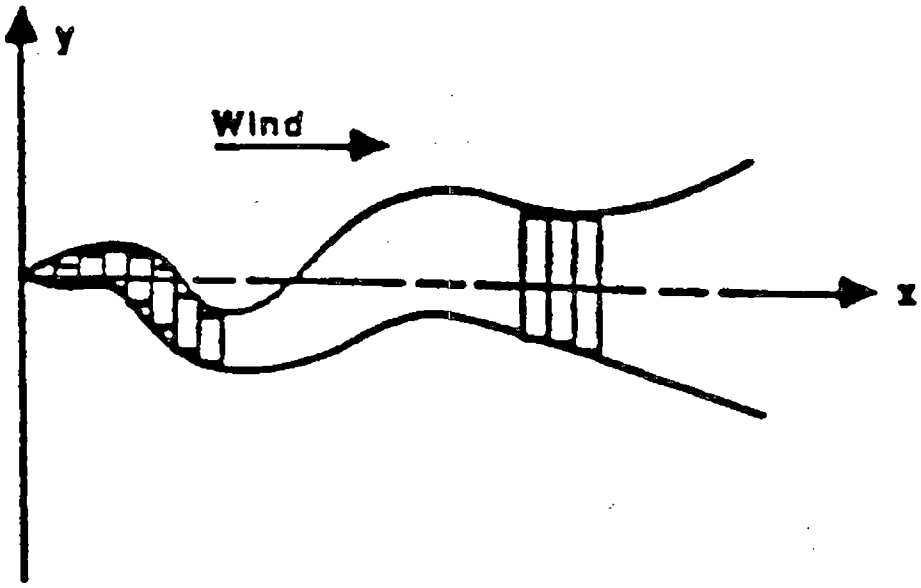
Table 4-43
Radionuclide Types Considered For Airborne Effluent Exposure Pathways

	External Radiation		Internal Radiation	
Category	Plume	Ground	Inhalation	Ingestion
Noble Gases	X			
Tritium (^{3}H)			X	X
Carbon-14 (^{14}C)[a]			X	X
Iodine[b]		X	X	X
Particulate[b]		X	X	X

a Carbon-14 releases should be estimated until a suitable measurement scheme is implemented. See 4.1.9 for more information.

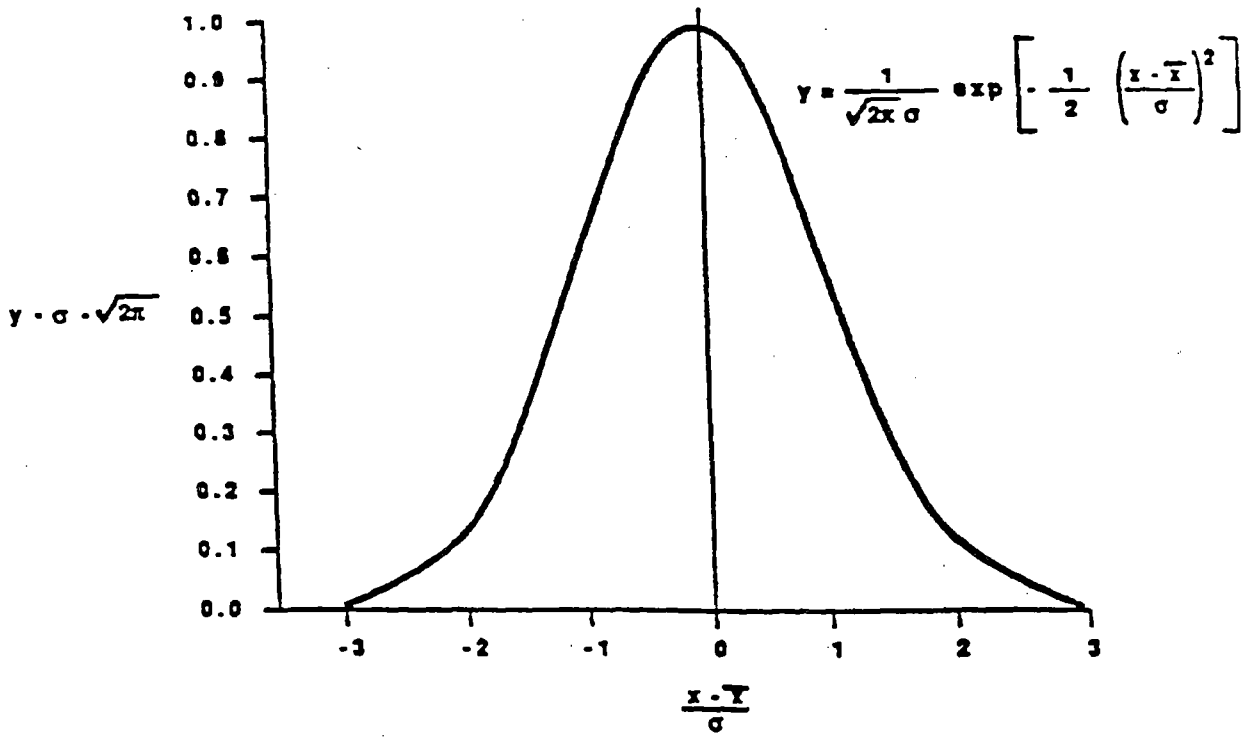
b Dresden is not required to consider all iodine and particulate radionuclides. For details, see Generic Letter 89-01 and the RECs.

Figure 4-1
Instantaneous View of Plume



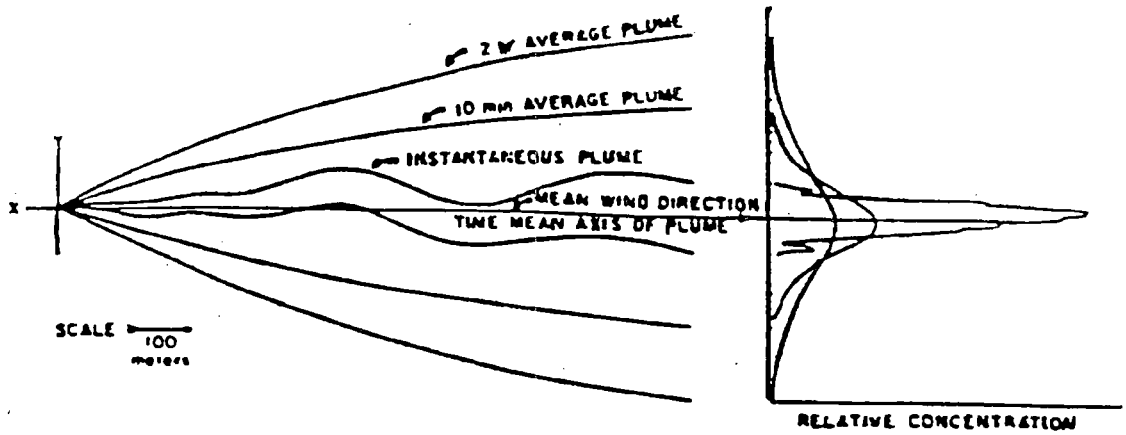
This figure represents a snapshot of a projection of a plume on the horizontal plane. As it moves downwind, the plume meanders about the average wind direction and broadens (adapted from Reference 18).

Figure 4-2
A Gaussian Curve



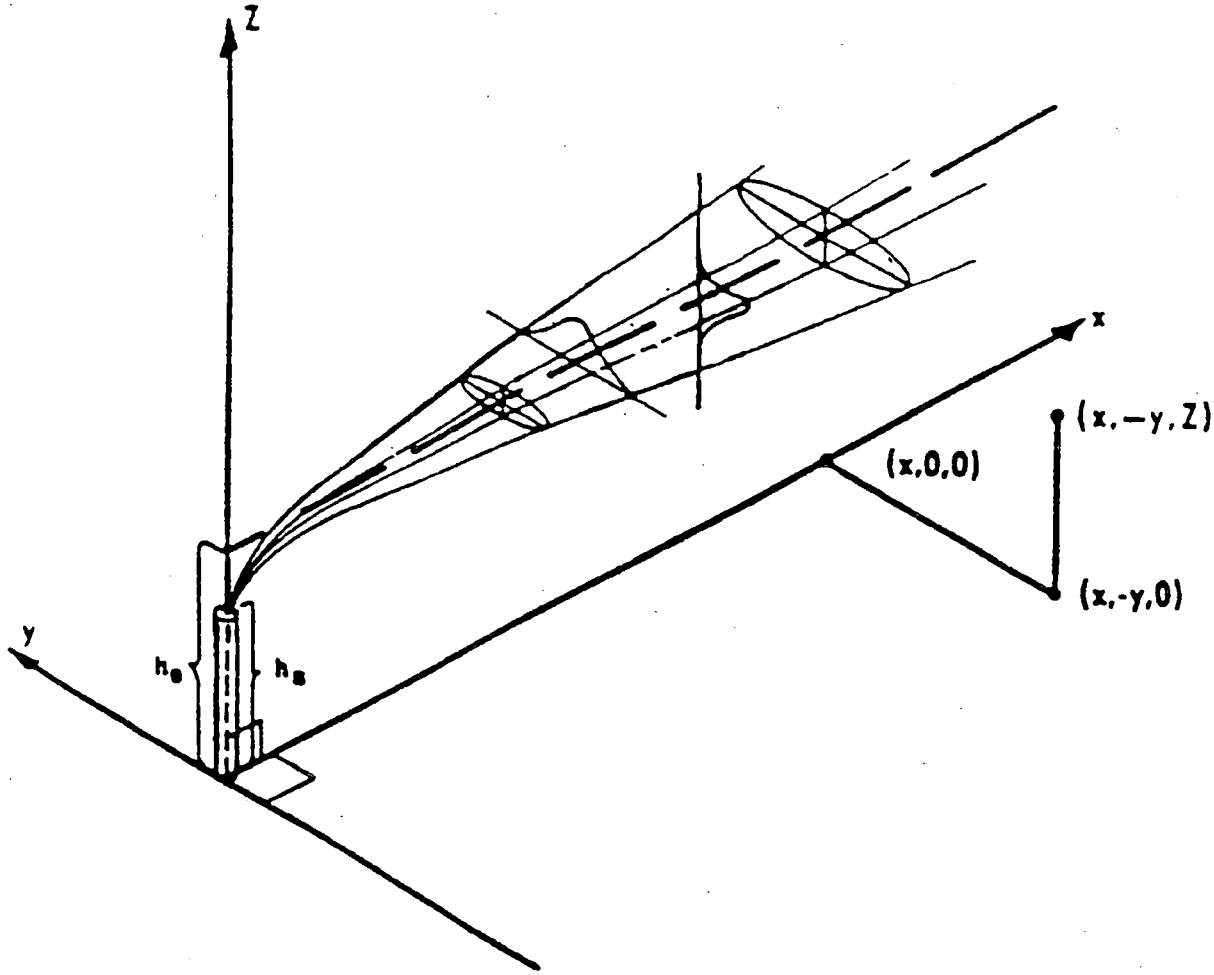
(Adapted from Reference 24 of Chapter 9, Page 61.)

Figure 4-3
Effect of Observation Period on Plume Shape



This sketch represents the approximate outlines of a smoke plume observed instataneously and averaged over periods of 10 minutes and 2 hours. The diagram on the right shows the corresponding cross plume distribution patterns. The plume width increases as the period of observation increases (from Reference 18).

Figure 4-4
A Gaussian Plume



This sketch illsutrates a plume characterized by Equation 4-36. The plume is moving downwind in the x direction. Both the horizontal dispersion parameter σ_z increases as x increases. The reflected component has been omitted in this illustration (adapted from Reference 24).

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5.0 Total Dose

Radioactivity contained within tanks, pipes, or other systems and contained radioactive material or waste stored on site can produce radiation at offsite locations. Annual offsite radiation doses near the station due to such sources were judged to be negligible in comparison with applicable limits except for doses due to BWR turbine skyshine and potential doses due to radioactive waste storage facilities (excludes radioactive material storage). Changes or modifications to the power station that may impact the offsite dose through increases to the direct radiation levels need to be evaluated on a case-by-case basis and added to the ODCM when applicable.

5.1 Total Dose Calculation Requirements

5.1.1 Total Effective Dose Equivalent Limits; 10CFR20 and 40CFR190

Dresden is required to determine the total dose to a member of the public due to all uranium fuel cycle sources in order to assess compliance with 40CFR190 as part of demonstrating compliance with 10CFR20.

The total dose for the uranium fuel cycle is the sum of doses due to radioactivity in airborne and liquid effluents and the doses due to direct radiation from contained sources at the nuclear power station and from sources outside the station associated with the uranium fuel cycle. When evaluation of total dose is required for a location near the station, the following contributions are summed:

- Doses due to airborne and liquid effluents from the station.
- Doses due to liquid effluents from nuclear power stations upstream.
- Doses due to ^{16}N skyshine.
- Doses due to any onsite radioactive waste storage facilities, if applicable.
- Doses from nearby facilities that are also part of the uranium fuel cycle (e.g., General Electric Morris Operations)

10CFR20 requires compliance to dose limits expressed as "Total Effective Dose Equivalent" (TEDE). Although annual dose limits in 10CFR20 are now expressed in terms of TEDE, 40CFR190 limits remain stated as organ dose. The NRC continues to require 10CFR50 Appendix I and 40CFR190 doses to be reported in terms of organ dose and not TEDE. Due to the fact that organ dose limits set forth in 40CFR190 are substantially lower than those of 10CFR20 (25 mrem/yr vs. 100 mrem/yr), the NRC has stated that demonstration of compliance with the dose limits in 40CFR190 will be deemed as demonstration of compliance with the dose limits of 10CFR20 for most facilities (Reference 104). In addition to compliance with 40CFR190, it may be necessary for a nuclear power plant to address dose from on-site activity by members of the public.

5.1.2 Independent Spent Fuel Storage Installation (ISFSI)

10CFR72.104 dose limits are the same as those specified by 40CFR190.

Even a fully loaded ISFSI is not expected to become the prominent contributor to the limits in this section. ISFSI dose contribution is in the form of direct radiation as no liquid or gas releases are expected to occur. The 10CFR72.212 report prepared in accordance with ISFSI requirements assumes a certain array of casks exists on the pad. The dose contribution from this array of casks in combination with historical uranium fuel cycle operations prior to ISFSI operations was analyzed to be within the 40CFR190 and 10CFR72.104 limits.

If the dose limits of 40CFR190 or 10CFR72.104 are exceeded, a special report to the NRC as well as an appropriate request for exemption/variance is required to be submitted to the NRC.

5.1.3 Total Dose Calculation Methodology

There are presently two types of contained sources of radioactivity that are of concern in Dresden Station's offsite radiological dose assessments. The first source is that due to gamma rays from nitrogen-16 (^{16}N) carried over to the turbine in boiling water reactor (BWR) steam. The second potential source is that due to gamma rays associated with radioactive material resident in onsite radwaste storage facilities, which is added to the calculation methodology if found to be significant (see Section 5.3).

Gamma radiation from these sources contributes to the total body dose. In addition to the total body, skin, and single organ dose assessments previously described, an additional assessment is required. The additional assessment addresses radiation dose due to radioactivity contained within the nuclear power station and its structures.

5.1.4 BWR Skyshine

The most significant dose component to members of the public produced by "contained sources" is nitrogen-16 (^{16}N) within the turbine buildings of BWRs. Although primary side shielding is around the turbine and its piping, ^{16}N gamma rays scattered by air molecules in the overhead air space above the turbine and piping cause a measurable "skyshine" radiation dose in the local power plant environs.

Equation 5-1 is used to evaluate skyshine dose. A complicating factor in the calculation is the practice at some stations of adding hydrogen to reactor coolant to improve coolant chemistry. The addition of hydrogen can increase the dose rate due to skyshine up to a factor of 10 times expected levels depending on injection rates and power levels (Reference 39). Increasing the hydrogen injection rate will increase the dose rates even further (See Reference 102). The skyshine dose determined by Equation 5-1 depends on the following factors:

- The distance of the dose recipient location from the turbine.
- The hours per year that the location is occupied by a dose recipient.
- The total energy [MWe-hr] generated by the station with hydrogen addition.
- The total energy [MWe-hr] generated by the station without hydrogen addition.

5.2 BWR Skyshine Calculation

The contained onsite radioactivity source that results in the most significant offsite radiation levels at Dresden Station is skyshine resulting from ^{16}N decay inside turbines and steam piping.

The ^{16}N that produces the skyshine effect is formulated through neutron activation of the oxygen atoms (oxygen-16, or ^{16}O) in reactor coolant as the coolant passes through the operating reactor core. The ^{16}N travels with the steam produced in the reactor to the steam-driven turbine. While the ^{16}N is in transport, it radioactively decays with a half-life of about 7 seconds and produces 6 to 7 MeV gamma rays. Typically, offsite dose points are shielded from a direct view of components containing ^{16}N, but there can be skyshine radiation at offsite locations due to scattering of gamma rays off the mass of air above the steam lines and turbine.

The offsite dose rate due to skyshine has been found to have the following dependencies:

- The dose rate decreases as distance from the station increases.
- The dose rate increases non-linearly as the power production level increases.
- The dose rate increases when hydrogen is added to the reactor coolant, an action taken to improve reactor coolant chemistry characteristics (see Reference 39).

To calculate offsite dose due to skyshine in a given time period due to skyshine, Dresden Station must track the following parameters:

- The total gross energy E_h produced with hydrogen being added.
- The total gross energy E_o produced without hydrogen being added.

The turbines at the site are sufficiently close to each other that energy generated by the two operating units may be summed. Because the hydrogen addition system is normally in service during plant operation, the conservative assumption that all power is generated during hydrogen addition can be used.

An initial estimate of skyshine dose is calculated per the following equation:

$$D^{sky} = (K)(E_o + M_h E_h)\sum_k \left(OF_k\, SF_k\, e^{-0.007 R_k}\right) \qquad (5\text{-}1)$$

The summation is over all locations k occupied by a hypothetical maximally exposed member of the public characterized by the parameters specified in Table 5-1. The parameters in Equation 5-1 are defined as follows:

D^{sky}	Dose Due to ^{16}N Skyshine - Gamma External direct gamma dose (deep dose equivalent) due to ^{16}N skyshine for the time period of interest.	[mrem]
K	Empirical Constant - A constant determined by fitting data measured at the Dresden station. See Table 5-1.	[mrem/(MWe-hr)]
E_o	Electrical Energy Generated Without Hydrogen Addition - Total gross electrical energy generated without hydrogen addition in the time period of interest.	[MWe-hr]
E_h	Electrical Energy Generated with Hydrogen Addition - Total gross electrical energy generated with hydrogen addition in the period of interest.	[MWe-hr]
M_h	Multiplication Factor for Hydrogen Addition - Factor applied to offsite dose rate when skyshine is present. Hydrogen addition increases main steam line radiation levels typically up to a factor of approximately 5 (see Page 8-1 of Reference 39). M_h is station specific and is given in Table 5-1, dimensionless.	
OF_k	Occupancy Factor - The fraction of time that the dose recipient spends at location **k** during the period of interest. See Table 5-1, dimensionless.	
SF_k	Shielding Factor - A dimensionless factor that accounts for shielding due to occupancy of structures, where:	
	SF_k = 0.7 if there is a structure at location **k**; 1.0 otherwise. See Table 5-1.	
0.007	Empirical Constant - A constant determined by fitting data measured at the Dresden station (see Reference 45).	[m^{-1}]
R_k	Distance - Distance from the turbine to location **k**. See Table 5-1.	[m]

5.3 Onsite Radwaste and Radioactive Material Storage Facilities

Low-level radwaste may be stored at Dresden in the following types of storage facilities:

- Process Waste Storage Facilities
  - Interim Radwaste Storage Facility (IRSF) structure
  - Concrete vaults containing radwaste liners (aka, 48-pack)
- DAW Storage Facilities
  - Dry Active Waste (DAW) facilities (may include Butler buildings / warehouses)
  - Seavans or other temporary warehouses
- Replaced Steam Dryer Storage Facilities
- Independent spent fuel storage installation (ISFSI) Facilities

The "48-Pack" is a shielded concrete vault, which is designed to hold three tiers of radwaste liners in a four by four array. The outer shell of the "48-Pack" is a three-foot thick concrete wall and a two and one-half foot thick concrete cover slab. The vault is placed on a poured concrete slab. The liners may have an average surface dose rate of fifteen (15) rem per hour (or up to 380 rem/hr if a 10CFR50.59 evaluation has been completed).

The DAW facility will contain low-level radioactive waste that would result in dose rates less than the 10CFR20 requirements.

The dose rates resulting from these radwaste and spent fuel storage facilities will be monitored frequently as they are being utilized, and if necessary, a dose calculation model similar to that of Equation 5-1 will be developed and placed in the ODCM.

Administrative controls are implemented to ensure compliance to applicable regulations. The impact to the offsite dose will be evaluated on a case-by-case basis and added to the ODCM when applicable. A 10CFR50.59 analysis may be required for radwaste storage facilities.

5.4 Methodology

5.4.1 Total Body Dose

Total Body Dose, D_{TB}, is comprised of up to five parts:

- Total body dose due to liquid effluents (Section 3.4.1), and
- Total body dose due to noble gas radionuclides in gaseous effluents (Section 4.2.2.3),
- Total body dose due to non-noble gas radionuclides in gaseous effluents (Section 4.2.3),
- Dose due to ^{16}N skyshine (Section 5.2),
- Other contained sources (Section 5.3), if applicable.

$$D_{TB} = D_{TB}^{LIQ} + D_{TB}^{NG} + D_{TB}^{NNG} + D^{sky} + D^{OSF} \qquad (5\text{-}2)$$

where:		(units)
D_{TB}	Total Body Dose - Dose to the total body at the location of interest due to all pathways.	[mrem]
D_{TB}^{LIQ}	Total Body Dose, Liquid Effluents - Dose to the total body due to all radionuclides released in liquid effluents. See Equation 3-3.	[mrem]
D_{TB}^{NG}	Total Body Dose, Noble Gas Effluents - Dose to the total body at the location of interest due to gamma radiation from noble gas radionuclides released in gaseous effluents. See Equation 4-11.	[mrem]
D_{TB}^{NNG}	Total Body Dose, Non-Noble Gas Effluents - Dose to the total body at the location of interest due to non-noble gas radionuclides released in gaseous effluents. See Equation 4-13.	[mrem]
D^{sky}	Dose Due to ^{16}N Skyshine - External dose due to ^{16}N skyshine for the period and location of interest. See Equation 5-1.	[mrem]
D^{OSF}	Dose From On-Site Storage Facilities - External dose at the location of interest due to gamma radiation from on-site storage facilities, if applicable. See Section 5.3.	[mrem]

Conservatively, the maximum total body dose for each exposure type is used for this calculation, regardless of location. In the event that Total Dose approaches or exceeds 10CFR20 limits for TEDE, further study should be conducted to consider determining total body doses at specific locations.

5.4.2 Organ Dose

Organ Dose is comprised of two parts, organ dose from liquid effluents and organ dose from non-noble gas radionuclides in gaseous effluents:

$$D_{ja} = D_{\tau}^{LIQ} + D_{ja}^{NNG} \qquad (5\text{-}3)$$

where:		(units)
D_{ja}	Organ Dose - The maximum dose to any organ j of any age group a due to all pathways.	[mrem]
D_{τ}^{LIQ}	Organ Dose, Liquid Effluents - The maximum dose to any organ τ due to all radionuclides released in liquid effluents. See Equation 3-3.	[mrem]
D_{ja}^{NNG}	Organ Dose, Non-Noble Gas Radionuclides - The maximum dose to any organ j (not including total body or skin) of any age group a due to non-noble gas radionuclides released in gaseous effluents. See Equation 4-14.	[mrem]

Skin dose from gaseous (both noble and non-noble gas) effluents is not used in this calculation because it is excluded from 10CFR20 Total Effective Dose Equivalent (TEDE) calculations and is not considered an organ under 40CFR190.

5.4.3 Total Dose

For a conservative comparison to 10CFR20 limits, the above relationships can be combined into a single equation for Total Dose as follows:

$$D_{Total} = D_{TB} + D_{ja} \qquad (5\text{-}4)$$

where:		(units)
D_{Total}	Total Dose - The sum of the maximum total body and organ doses from all effluent pathways.	[mrem]

The remaining parameters are defined in Sections 5.4.1 and 5.4.2.

Conservatively, weighting factors are not used to calculate Total Dose. In the event that Total Dose approaches or exceeds 10CFR20 limits for TEDE, further study should be conducted to consider the use of weighting factors per 10CFR20.

5.5 COMPLIANCE TO TOTAL DOSE LIMITS

5.5.1 Total Effective Dose Equivalent Limit - 10CFR20 Compliance

Dresden RECs limit the Total Effective Dose Equivalent (TEDE) to an annual limit of 100 mrem, as required by 10CFR20.1301 (a)(1). The regulations offer licensees the option of demonstrating compliance with one of two methods, 10CFR20.1302(b)(1) or 10CFR20.1302(b)(2). The RECs state that the 10CFR20.1302(b)(1) methodology has been selected to demonstrate compliance to 10CFR20.1301 (a)(1).

The general methodology for calculating Total Dose for comparison to the Total Effective Dose Equivalent is given in Section 5.4.3.

In August of 1995, a revision to 10CFR20 was implemented that changed the definition of a member of the public. As a result, for each nuclear station, estimated doses were calculated for a member of the public who enters the site boundary, but is not authorized for unescorted access to the protected area of the site and does not enter any radiologically posted areas on the site. Realistic assumptions were made for occupancy times and locations visited while within the site boundary. These evaluations indicate that the doses estimated for these members of the public are well within the 10CFR20 limits.

This evaluation dose is used to demonstrate compliance to 10CFR20 and satisfy station RECs and Technical Specifications (see ODCM Part I).

5.5.2 Total Dose due to the Uranium Fuel Cycle (40CFR190)

RECs and 40CFR190 limit the annual (calendar year) dose or dose commitment to any member of the public due to releases of radioactivity and to radiation from uranium fuel cycle sources to the following:

- Less than or equal to 25 mrem to the total body.
- Less than or equal to 25 mrem to any organ except the thyroid.
- Less than or equal to 75 mrem to the thyroid.

Total Dose Components

This requirement includes the total dose from operations at Dresden. This includes doses due to radioactive effluents (airborne and liquid) and dose due to direct radiation from non-effluent sources (e.g., sources contained in systems on site). It also includes dose due to plants under consideration, neighboring plants and dose due to other facilities in the uranium fuel cycle.

The operations comprising the uranium fuel cycle are specified in 40CFR190.02(b). The following are included to the extent that they directly support the production of electrical power for public use utilizing nuclear energy:

- Milling of uranium ore.
- Chemical conversion of uranium.
- Isotopic enrichment of uranium.
- Fabrication of uranium fuel.
- Generation of electricity by a light-watered-cooled nuclear power plant using uranium fuel.
- Reprocessing of spent uranium fuel.

Excluded are:

- Mining operations.
- Operations at waste disposal sites.
- Transportation of any radioactive material in support of these operations.
- The re-use of recovered non-uranium special nuclear and by-product materials from the cycle.

5.5.3 When Compliance Assessment is Required

Compliance with the 40CFR190 regulations is now required as part of demonstration of compliance to 10CFR20 regulations per 10CFR20.1301(e).

The dose due to the uranium fuel cycle is determined by equations 5-2 and 5-3, sections 5.4.1 and 5.4.2 respectively.

5.6 Summary of Compliance Methodology

The required compliance is given in Tables 1-1, 1-2, and 1-3. In Table 1-1, the dose components are itemized and referenced, and an indication of their regulatory application is noted. A more detailed compliance matrix is given in Table 1-3. The locations of dose receivers for each dose component are given in Table 1-2.

Further, Table 1-2 states the location of the receiver and occupancy factors, if applicable. In general, the receiver spends time in locations that result in maximum direct dose exposure and inhales and ingests radioactivity from sites that yield maximum pathway doses. Thus, the dose calculated is a very conservative one compared to the "average" receiver who does not go out of his way to maximize radioactivity uptakes. Finally, the connection between regulations, the ODCM equations, and the station RECs and Technical Specifications is given in Table 1-4.

Table 5-1
Parameters for Calculations of ^{16}N Skyshine Radiation
from Dresden Units 2 and 3

Location Number K	Activity	Occupancy Hours OH_k[a]	Occupancy Factor OF_k	Shielding Factor SF_k	Distance R_k (m)
1	Living at home (nearest resident)	8344	0.95	0.7	868[b]
2	Fishing	416	0.05	1.0	610[c]

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$M_h = 5$
K = 3.60E-05 mrem/(MWe-hr)

These parameters are used to obtain an initial estimate of skyshine dose to the maximally exposed member of the public using Equation 5-1. If desired, more realistic parameters could be used in place of these to refine the estimate. For example, one could determine whether the nearest resident really fishes the specified number of hours at the specified location.

a The amount of time in a year that a maximally exposed fisherman would spend fishing near the site is estimated as 12 hours per week for 8 months per year. This yields an estimate of:

[12 hours/week] x [(8 months/yr)/(12 months/yr)] x [52 weeks/yr] = 416 hours/yr

The remaining time is assumed to be spent at the nearest residence.

b Distance to nearest residence (See ODCM Table 4-1).

c Estimated from a drawing of the site.

d The OF_k is the quotient of the number of hours a location is occupied and the number of hours in a year. Thus OH_k/8760 hours = OF_k rounded to the 0.01 digit.

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6.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM LOCATIONS

6.1 The Radiological Environmental Monitoring Program monitoring locations for the environs around Dresden Station are given in Table 6-1. Figures 6-1 through 6-5 show general sampling and monitoring locations. See RECs Table 12.6-1 for sampling and analysis requirements. LCM 6/21

6.1.1 Distances provided for sampling/monitor locations are approximate.

6.1.2 The fish monitoring locations are not identified exactly on the map. The points, D-28 and D-46, represent the general area where the samples are taken.

6.1.3 Airborne sampling stations D-01, D-02, and D-03 are not REMP samples, but are special samples required per Section 11.5.1.10 of the UFSAR. They may be discontinued pending revision of the aforementioned section.

6.1.4 Individual areas where Illinois River dredge spoils are deposited do not require sampling if no additions were made to that area since last sample collection.

6.1.5 Broadleaf vegetation is only required if there is no milking animal sample within 5 km of the site. LCM 6/21

Table 6-1 (Page 1 of 4)
Radiological Environmental Monitoring Program Locations

Exposure Pathway and/or Sample	Direction / Sector		Designator	Distance		Designator	Distance	
1. Direct Radiation			a. Indicators - Inner Ring			b. Indicators - Outer Ring		
	N	A	D-101	1.0 mi	1.6 km	D-201	4.8 mi	7.7 km
	NNE	B	D-102	1.4 mi	2.2 km	D-202	5.1 mi	8.2 km
	NE	C	D-103	1.2 mi	1.9 km	D-203	4.7 mi	7.6 km
	ENE	D	D-104	1.7 mi	2.7 km	D-204	5.1 mi	8.1 km
	E	E	D-105	1.5 mi	2.4 km	D-205	4.0 mi	6.5 km
	ESE	F	D-106	1.1 mi	1.8 km	D-206	3.5 mi	5.6 km
	SE	G	D-107	1.4 mi	2.3 km	D-207	4.2 mi	6.8 km
	SSE	H	D-108	1.9 mi	3.0 km	D-208	4.9 mi	7.8 km
	S	J	D-109	0.8 mi	1.3 km	D-209	4.1 mi	6.6 km
	SSW	K	D-110	0.9 mi	1.4 km	D-210	4.9 mi	7.9 km
	SW	L	D-111	0.6 mi	1.0 km	D-211	4.8 mi	7.7 km
	WSW	M	D-112	0.7 mi	1.1 km	D-212	6.0 mi	9.6 km
	W	N	D-113	0.9 mi	1.4 km	D-213	4.6 mi	7.4 km
	WNW	P	D-114	0.9 mi	1.5 km	D-214	5.0 mi	8.0 km
	NW	Q	D-115	0.8 mi	1.3 km	D-215	4.8 mi	7.8 km
	NNW	R	D-116	1.0 mi	1.6 km	D-216	4.9 mi	7.8 km
	c. Other Indicators - One at each of the airborne location given in part 2.a and 2.b.							
	d. Control - One at each airborne control location given in part 2.c.							

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Table 6-1 (Page 2 of 4)
Radiological Environmental Monitoring Program Locations

Exposure Pathway and/or Sample	Designator, Description	Direction / Sector		Distance	
2. Airborne					
Radioiodine and Particulates	a. Indicators-Near Field				
	D-04, Collins Road, on station property	W	N	0.8 mi	1.3 km
	D-07, Clay Products, Dresden Road	S	J	2.6 mi	4.2 km
	D-45, McKinley Woods Rd, Channahon	ENE	D	1.7 mi	2.7 km
	D-53, Will Road at Hollyhock	SSE	H	2.1 mi	3.4 km
	D-56, Will Road, Wildfeather	SE	G	1.7 mi	2.8 km
	D-58, Will Road, Marina	ESE	F	1.1 mi	1.8 km
	b. Indicators-Far Field				
		SW	L	3.8 mi	6.1 km
	D-08, Jugtown Road, Prairie Parks	SSW	K	3.5 mi	5.7 km
	D-10, Goose Lake Road, Goose Lake Village	NE	C	3.7 mi	5.9 km
	D-14, Center Street, Channahon	N	A	4.3 mi	7.0 km
	D-55, Ridge Road, Minooka				
	c. Controls				
		NW	Q	10.5 mi	16.9 km
	D-12, Quarry Road, Lisbon				
	d. Special				
	D-01, Onsite Station 1	NW	Q	0.8 mi	1.3 km
	D-02, Onsite Station 2	NNE	B	0.3 mi	0.5 km
	D-03, Onsite Station 3	S	J	0.4 mi	0.7 km

Table 6-1 (Page 3 of 4)
Radiological Environmental Monitoring Program Locations

Exposure Pathway and/or Sample	Designator, Description	Direction / Sector		Distance		
3. Waterborne						
a. Surface Water	a. Indicator					
	D-21, Illinois River at EJ&E bridge	WNW	P	1.4 mi	2.3 km	
	b. Control					
	D-52, DesPlaines River at Will Road	ESE	F	1.1 mi	1.8 km	
	D-57, Kankakee River at Will Road	SE	G	2.0 mi	3.2 km	
b. Ground/Well	a. Indicators					
	D-22, 8150 N. Thorsen Rd	SSE	H	0.8 mi	1.3 km	LCM 6/21
	D-24, 8177 N. Thorsen Rd	SSE	H	0.6 mi	1.0 km	
	D-35, Dresden Lock & Dam	NW	Q	0.8 mi	1.3 km	
c. Drinking Water	Currently there are no community drinking water supplies that could be affected by the station discharge within 10 km (6.2 mi) of the station discharge.					
d. Sediment from Shoreline	a. Indicator					
	D-27, Illinois River at Dresden Lock & Dam	NW	Q	0.8 mi	1.3 km	
e. Dredging Spoils	a. Indicator					
	One sample from each major dredging of Illinois River within 1 mile downstream of station discharge point.					

Table 6-1 (Page 4 of 4)
Radiological Environmental Monitoring Program Locations

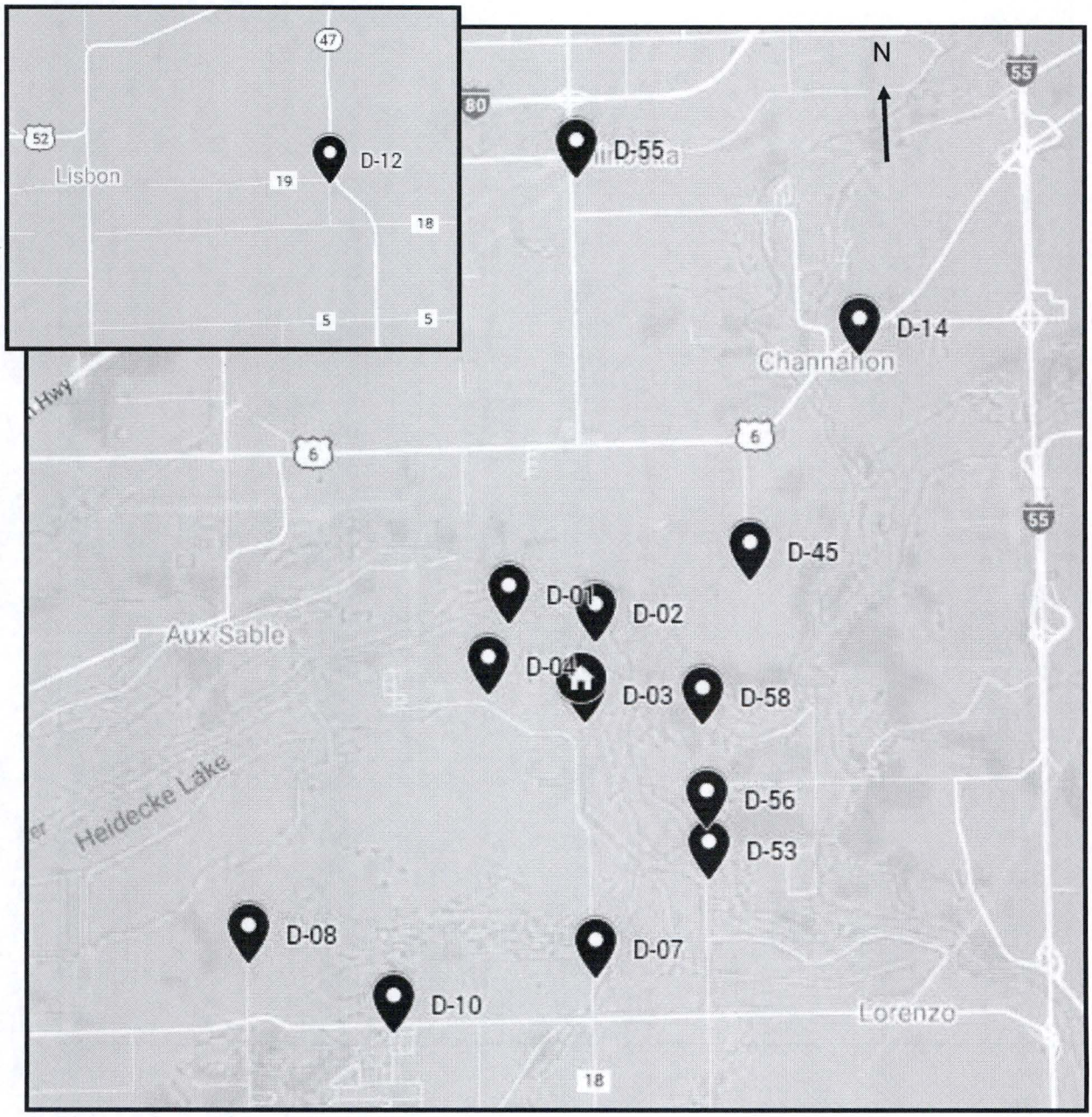
Exposure Pathway and/or Sample	Designator, Description	Direction / Sector		Distance		
4. Ingestion						
a. Milk	a. Indicator					
	Currently there are no milking animals within 5 km of the station.					
	b. Control					
	N/A					LCM 6/21
b. Fish	a. Indicator					
	D-28, Dresden Pool of Illinois River	NNW	R	0.9 mi	1.4 km	
	b. Control					
	D-46, DesPlaines River upstream of discharge	ESE	F	1.2 mi	1.9 km	
c. Food Products	a. Indicators					
	Currently there are no crops being irrigated by water in which liquid plant wastes have been discharged.					
d. Broadleaf	a. Indicators					LCM 6/21
	D-40, 7715 E. Hansel Rd	NNW	R	0.9 mi	1.4 km	
	D-41, 8100 E. Blanchard Circ	SSE	H	0.5 mi	0.9 km	
	D-42, Dresden site garden	N	A	0.4 mi	0.6 km	
	D-43, 25158 W. Elm St.	NE	Q	3.3 mi	5.4 km	
	D-44, 9980 Ridge Rd.	N	A	3.0 mi	4.8 km	
	b. Control					
	D-25, Vince Biros Farm, Reed Road	SW	L	11.3 mi	18.2 km	

Table 6-2

Sector Code Definitions

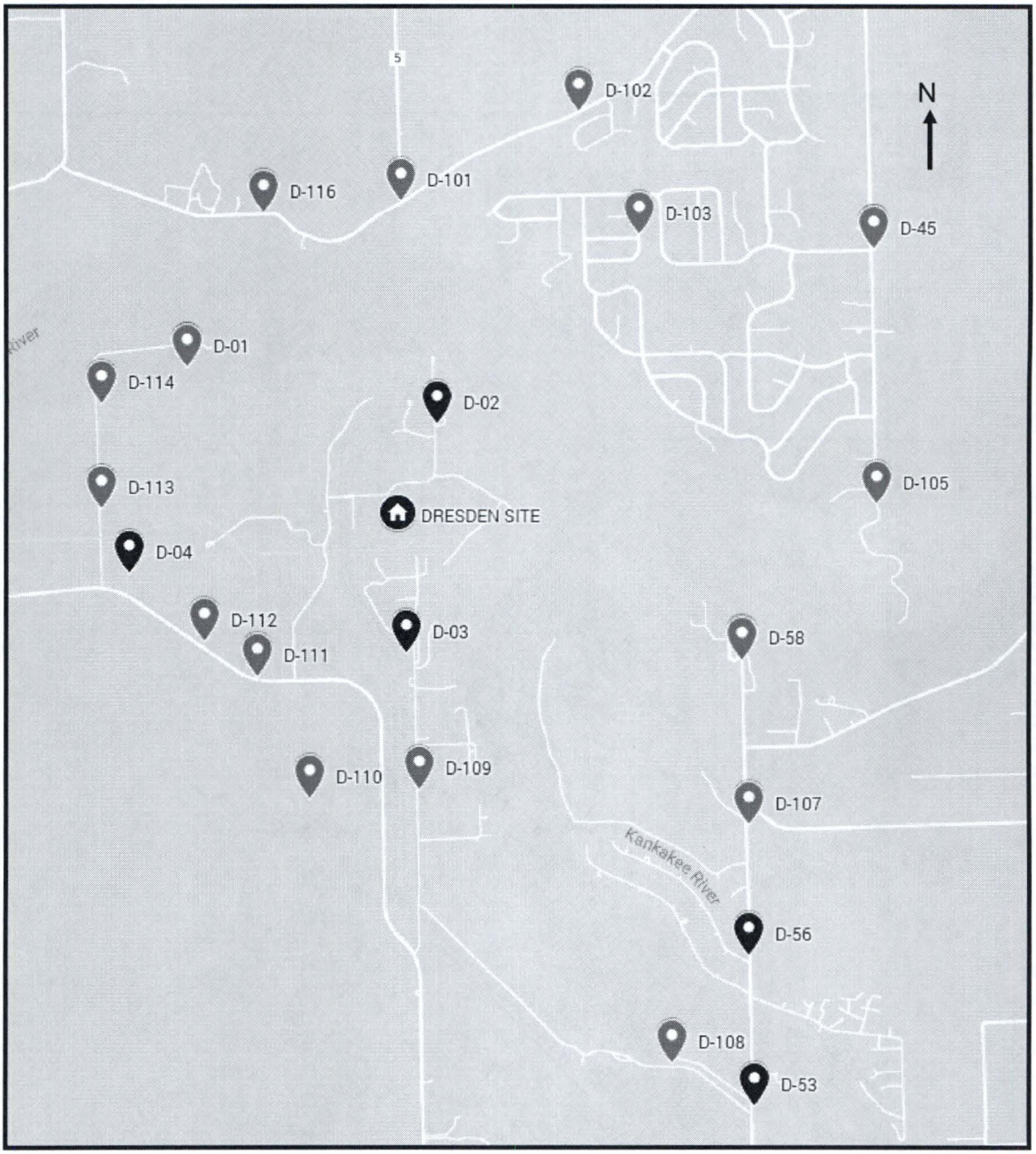
Sector Code	Sector Direction	Angle from North (degrees)
A	N	$348.75 < \theta \leq 11.25$
B	NNE	$11.25 < \theta \leq 33.75$
C	NE	$33.75 < \theta \leq 56.25$
D	ENE	$56.25 < \theta \leq 78.75$
E	E	$78.75 < \theta \leq 101.25$
F	ESE	$101.25 < \theta \leq 123.75$
G	SE	$123.75 < \theta \leq 146.25$
H	SSE	$146.25 < \theta \leq 168.75$
J	S	$168.75 < \theta \leq 191.25$
K	SSW	$191.25 < \theta \leq 213.75$
L	SW	$213.75 < \theta \leq 236.25$
M	WSW	$236.25 < \theta \leq 258.75$
N	W	$258.75 < \theta \leq 281.25$
P	WNW	$281.25 < \theta \leq 303.75$
Q	NW	$303.75 < \theta \leq 326.25$
R	NNW	$326.25 < \theta \leq 348.75$

Figure 6-1



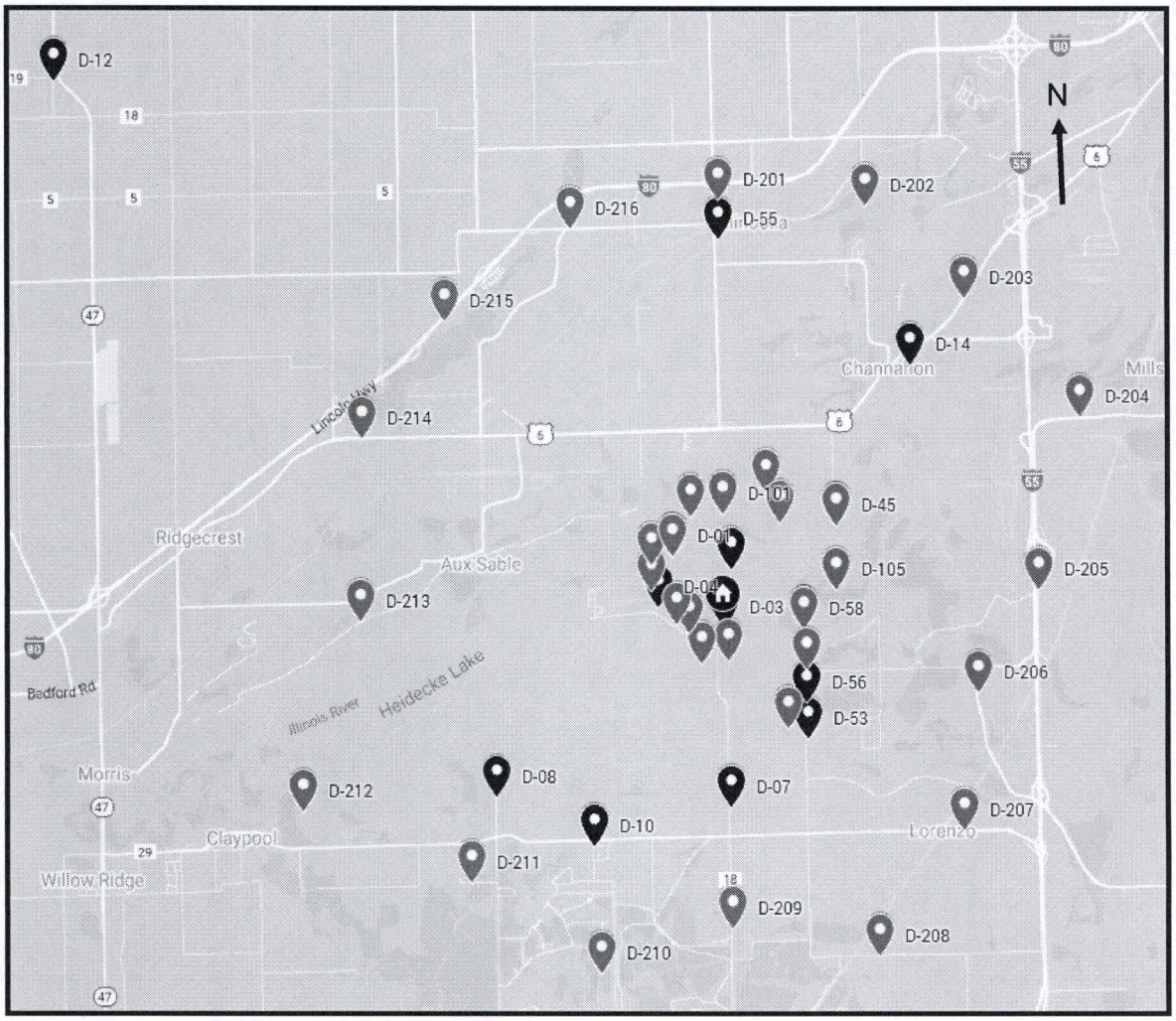
Dresden REMP Air Sampling Locations

Figure 6-2



Dresden OSLD Inner Ring Locations

Figure 6-3

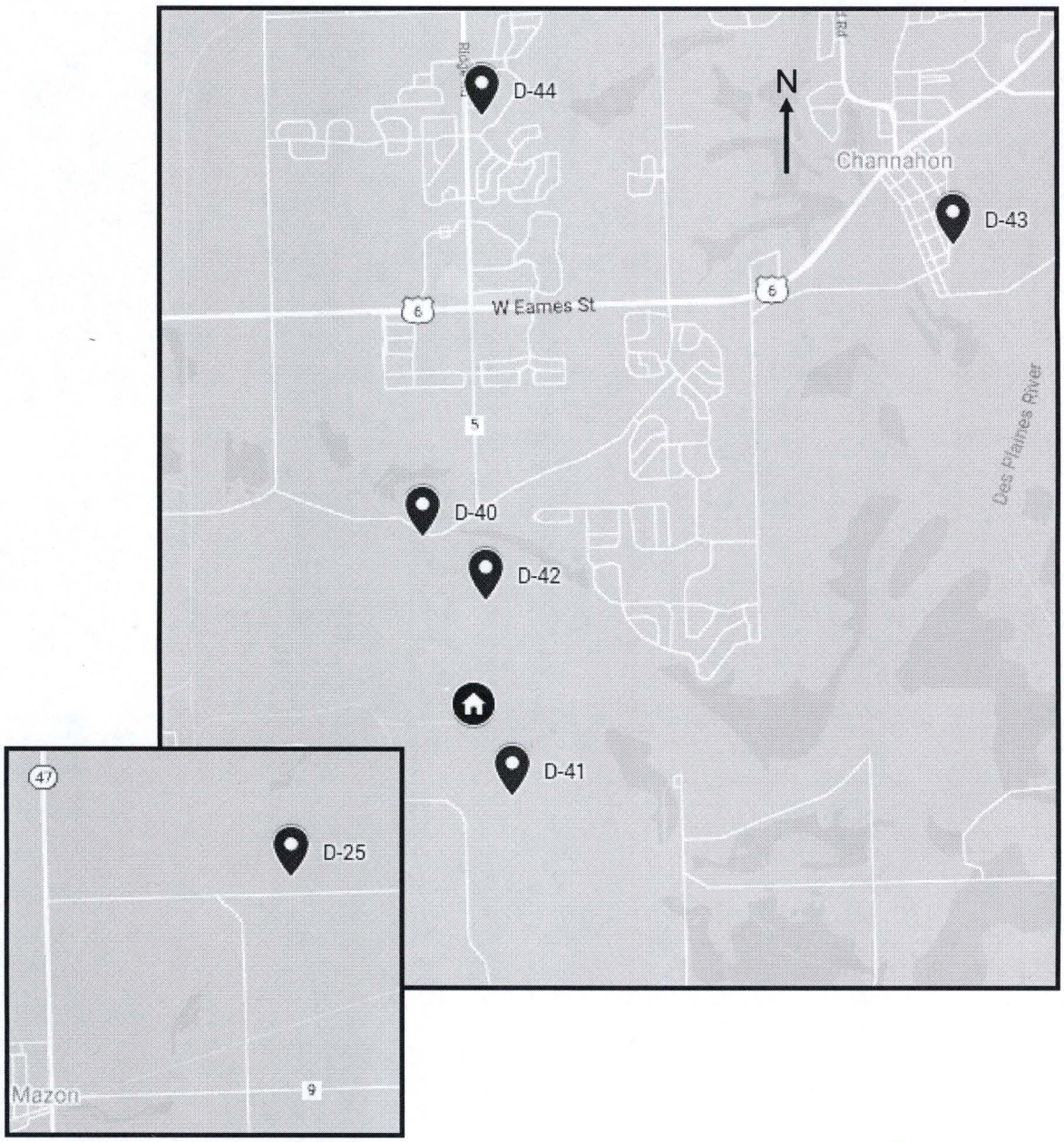


Dresden OSLD Outer Ring Locations

Figure 6-4

Dresden Water, Sediment and Fish Sampling Locations

Figure 6-5



Dresden Broadleaf Vegetation Sampling Locations