ENCLOSURE

NUCLEAR MANAGEMENT COMPANY, LLC
PALISADES PLANT
DOCKET 50-255

2002 ANNUAL RADIOACTIVE EFFLUENT RELEASE AND WASTE DISPOSAL REPORT

March 24, 2003

187 Pages follow

PALISADES NUCLEAR PLANT
ANNUAL RADIOACTIVE EFFLUENT RELEASE AND WASTE DISPOSAL REPORT

JANUARY - DECEMBER 2002

This report provides information relating to radioactive effluent releases and solid radioactive waste shipments at the Palisades Nuclear Plant during the period of January 1, 2002 through December 31, 2002. The report is required by 10 CFR 50.36a(a)(2) and Plant Technical Specification 5.6.3. The report format is detailed in the Offsite Dose Calculation Manual (ODCM), Appendix A.

Plant Operating History

Palisades was off line at the start of 2002, as part of the control rod drive upper housing replacement project. The unit returned to service on January 21, 2002, and remained in service until December 1, 2002, when the unit went out of service due to a fault in the switchyard. The Plant returned to service on December 5, 2002, and remained in service for the rest of the year.

1. Supplemental Information

A. Batch Releases

Information relating to batch release of gaseous and liquid effluents is provided in Attachment 1.

B. Abnormal releases

None

C. Lower Limits of Detection (LLD's) for gaseous and liquid effluents are provided in Attachment 5.

D. Results of the 2002 Radiochemistry Cross Check Program with Analytics are shown in Attachment 6. Results were in agreement for all isotopes on all three detectors. There were a total of 272 measurements made.

E. Radioactive Effluent Monitoring Instrumentation

The Offsite Dose Calculation Manual (ODCM), Appendix A, requires that any Gaseous or Liquid Effluent Monitor out of service for greater than 30 days be included in this effluent report. There were no radioactive effluent monitoring instrument channels inoperable for more than 30 days. RIA-2327, High Range Noble Gas Channel (one of the channels associated with the Stack Gas Effluent System) was out of service for 21 days in 2002. As a result of this inoperability, a special report was submitted to the NRC detailing the cause of the event. This report was submitted on September 20, 2002.

2. Gaseous Effluents

Attachment 2 lists and summarizes all gaseous radioactive effluents released during the reporting period. The unidentified beta was 1.91E-05% of the total release.

Gaseous effluents (noble gasses) and resultant beta and gamma doses to site boundaries in 2002 were approximately six times higher than 2001. The total fission and activation gasses released in 2002 were six times higher than 2001. Organ dose (long lived particulates and iodine) was also slightly higher (10%) than 2001. The increases are attributed to the long production run in 2002, as compared with the extended outage Palisades experienced in 2001.

3. Liquid Effluents

Attachment 3 lists and summarizes all liquid radioactive effluents released during the reporting period. The unidentified beta was 3.23E-05% of the total release.

No liquid batch releases occurred during the 2nd quarter of 2002, therefore the total release (not including tritium) was zero. Since only tritium was released in the second quarter, the resultant calculated organ dose was the same value as calculated for the whole body dose.

Overall, whole body dose from liquid effluents released during 2002 were 92% lower than 2001. Organ dose was approximately 60% lower in 2002 compared to 2001. Total liquid release volumes and release curies were nearly identical for both years. The reduction of dose for 2002 is a function of the total dilution water. The dilution water volume in 2002 was 85% higher than that of 2001.

Release tanks continue to be recirculated through the demineralizers prior to release to further reduce activity concentration.

4. Estimate of Uncertainty

Both the Gaseous and Liquid Summation of Release data sheets include an estimate of the uncertainty associated with the measurement of radioactive effluents. These estimates are based on a statistical analysis of a series of sample results as described in the ODCM, Appendix A. These results are listed in the "Est Total Error %" columns on the Gaseous and Liquid Summation Report.

5. Solid Waste

Attachment 4 summarizes all solid radwaste classification, sources, volume shipped, curie and nuclide content. Radwaste shipments were made either to Barnwell Waste Management Facility in Barnwell, South Carolina, or to Envirocare of Utah, Inc. In 2002, the waste volume was slightly lower than 2001, and the curies shipped were higher than that of the previous year. The higher curies in 2002 was due to a resin shipment, which made up 97% of the total curies shipped.

6. <u>Summary of Radiological Impact on Man</u>

Potential doses to individuals and populations were calculated using GASPAR and LADTAP computer program codes. The quarterly values for curies released were input for each nuclide and summarized as follows:

A. The maximum total body dose to an individual in unrestricted water-related exposure pathways was:

First Quarter -	8.47 E-05 millirem (adult)
Second Quarter-	5.36 E-08 millirem (adult)
Third Quarter -	1.73 E-04 millirem (adult)
Fourth Quarter -	9.72 E-05 millirem (adult)

The maximum organ dose was

First Quarter -	1.13 E-04 millirem (adult bone)
Second Quarter-	5.36 E-08 millirem (adult thyroid)
Third Quarter -	2.55 E-04 millirem(teenage liver)
Fourth Quarter -	9.69 E-05 millirem (adult gi-tract)

B. The offsite air dose at site boundary (0.48 mi SSE) due to noble gases was:

First Quarter -	3.55 E-05 millirad beta and 1.22 E-05 millirad gamma
Second Quarter -	2.32 E-04 millirad beta and 7.45 E-05 millirad gamma
Third Quarter -	1.38 E-04 millirad beta and 3.17 E-05 millirad gamma
Fourth Quarter -	2.33 E-03 millirad beta and 7.68 E-04 millirad gamma

The maximum noble gas offsite air dose to the nearest residence (0.50 mi S) for beta and gamma occurred during the fourth quarter; 1.51 E-03 millirad and 4.99 E-04 millirad, respectively.

C. The most restrictive organ dose to an individual in an unrestricted area (based on identified critical receptors) from gaseous effluent releases were:

First Quarter -	5.70 E-03 millirem (child thyroid)
Second Quarter -	5.36 E-03 millirem (child thyroid)
Third Quarter	5.66 E-03 millirem (child thyroid
Fourth Quarter -	1.94 E-02 millirem (infant thyroid)

D. Integrated total body dose to the general population and average dose to individuals within the population from liquid effluent release pathways to a distance of 50-miles from the site boundary were:

First Quarter -	7.76 E-04 person-rem and 5.83 E-07 millirem
Second Quarter-	6.26 E-07 person-rem and 4.71 E-10 millirem
Third Quarter -	1.19 E-03 person-rem and 8.95 E-07 millirem
Fourth Quarter -	1.13 E-03 person-rem and 8.50 E-07 millirem

E. Integrated total body dose to the general population and average dose to individuals within the population from gaseous effluent release pathways to a distance of 50 miles from the site boundary were:

First Quarter -	1.96 E-02 person-rem and 1.47 E-05 millirem
Second Quarter-	1.88 E-02 person-rem and 1.41 E-05 millirem
Third Quarter -	1.86 E-02 person-rem and 1.36 E-05 millirem
Fourth Quarter -	2.11 E-02 person-rem and 1.59 E-05 millirem

7. Process Control Program

Attachment 7 contains the Process Control Program (PCP), Revision 9.

Summary of Changes:

Old section 2 was deleted. This level of detail is not necessary in the PCP, as the description exists in the Final Safety Analysis Report (FSAR). The retained section, re-titled "Processing Evaporator Bottoms," describes the system in considerable detail, including methodology for meeting waste form requirements for elimination of freestanding water.

Section 4.1: Revised the description of waste sampling frequency and waste streams to reflect current program implementation.

Section 4.2: Updated waste stream descriptions to current program implementation.

Section 4.10: Improved description of waste processing for hazardous, biological, pathogenic or infectious waste. This material would be processed offsite rather than sent directly to burial.

Section 6.0: Updated reference to Technical Specifications, CTS/ITS distinction no longer applicable.

Appendix B, Surveillance Requirements, paragraph b: Updated reference to Technical Specifications, CTS/ITS distinction no longer applicable.

The changes herein comply with Technical Specification 5.5.15b.1.b, which states that changes to the PCP will maintain conformance of the solidified waste product to existing requirements of Federal, State or other applicable regulations.

8. Offsite Dose Calculation Manual

Attachment 8 contains the Offsite Dose Calculation Manual (ODCM), Revision 17, along with the safety evaluation per the requirements of Technical Specification 5.5.1.c.3.

Revision 17 to the ODCM involved changes as a result of use of the 2001 Land Use Survey. The Land Use Survey ensures that effluent dose is accurately calculated. These changes maintain the level of radioactive effluent control required by 10 CFR 20.1302, 40 CFR Part 190, and Appendix I to 10 CFR Part 50, and do not affect any monitor or release set point calculations.

1) Update of Table 1.4, 2001 Palisades Land Use Census
2) Update of Table 1.4a, 2001 Palisades Land Use Census - Critical Receptor Items

ATTACHMENT 1

Nuclear Management Company, LLC
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RADIOACTIVE EFFLUENT RELEASE REPORT
BATCH RELEASES

January - December 2002

1 Page Follows

TABLE HP 10.5-1

PALISADES PLANT RADIOACTIVE EFFLUENT REPORT

BATCH RELEASES

January 1, 2002 to December 31, 2002

GASEOUS	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
Number of Releases		5	4	6	5
Total Release Time	Minutes	628	400	602	411
Maximum Release Time	Minutes	175	140	145	139
Average Release Time	Minutes	126	100	100	82
Minimum Release Time	Minutes	50	62	40	54

LIQUID	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
Number of Releases		1	0	2	1
Total Release Time	Minutes	627	N/A	702	540
Maximum Release Time	Minutes	627	N/A	446	540
Average Release Time	Minutes	627	N/A	351	540
Minimum Release Time	Minutes	627	N/A	256	540

ATTACHMENT 2

Nuclear Management Company, LLC
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RADIOACTIVE EFFLUENT RELEASE REPORT
GASEOUS EFFLUENTS - SUMMATION OF RELEASES

January - December 2002

3 Pages Follow

TABLE HP 10.5-2

PALISADES PLANT RADIOACTIVE EFFLUENT REPORT

GASEOUS EFFLUENTS - SUMMATION OF RELEASES
January 1, 2002 to December 31, 2002

A. FISSION & ACTIVATION GASES	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Est Total Error %
1. TOTAL RELEASE	Ci	5.01E-01	3.20E+00	1.65E+00	3.26E+01	
2. Average release rate for Period	uCi/sec	6.44E-02	4.07E-01	2.08E-01	4.10E+00	8.41
3. Percent of annual ave EC	%	2.90E-05	1.71E-04	8.49E-05	1.71E-03	
B. IODINES						
1. Total Iodine *	Ci	2.61E-04	4.55E-04	6.81E-04	1.20E-03	
2. Average release rate for Period	uCi/sec	3.35E-05	5.79E-05	8.57E-05	1.50E-04	9.88
3. Percent of annual ave EC	%	1.60E-05	2.98E-05	4.31E-05	1.31E-04	
C. PARTICULATES						
1. Particulates with half-life > than 8 days	Ci	1.94E-04	4.88E-06	2.82E-06	8.32E-07	
2. Average release rate for Period	uCi/sec	2.50E-05	6.21E-07	3.55E-07	1.05E-07	15.97
3. Percent of annual ave EC	%	6.00E-05	2.22E-05	1.27E-05	3.75E-06	
4. Gross Alpha radioactivity	Ci	8.23E-07	1.75E-06	1.42E-06	7.17E-07	
D. TRITIUM						
1. Total release	Ci	4.87E+00	4.73E+00	4.79E+00	5.23E+00	
2. Average release rate for Period	uCi/sec	6.26E-01	6.02E-01	6.03E-01	6.58E-01	
3. Percent of annual ave EC	%	1.33E-03	1.28E-03	1.28E-03	1.40E-03	
E. SITE BOUNDARY DOSE						
1. Beta Airdose at Site Boundary Due to Noble Gases 2. (ODCM App A III.C)	mrads	3.55E-05	2.32E-04	1.38E-04	2.33E-03	
2. Percent limit	%	3.55E-04	2.32E-03	1.38E-03	2.33E-02	
3. Gamma Airdose at Site Boundary Due to Noble Gases (ODCM App A III.C)	mrads	1.22E-05	7.45E-05	3.17E-05	7.68E-04	
4. Percent limit	%	3.10E-04	1.49E-03	6.34E-04	1.54E-02	
F. ORGAN DOSE						
1. Maximum Organ Dose to Public Based on Critical Receptors (ODCM App A III.D)	mrem	5.70E-03	5.36E-03	5.66E-03	1.94E-02	
2. Percent limit	%	7.60E-02	7.15E-02	7.55E-02	2.59E-01	

* **NOTE**: Data is reported for I-131 and I-133 only.

TABLE HP 10.5-2

PALISADES PLANT RADIOACTIVE EFFLUENT REPORT

GASEOUS EFFLUENTS

January 1, 2002 to December 31, 2002

1. FISSION GASES	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
Argon-41	Ci	<LLD	<LLD	<LLD	8.68E-04
Krypton-85	Ci	<LLD	9.20E-02	3.56E-01	3.93E-01
Krypton-85m	Ci	<LLD	<LLD	9.85E-05	2.72E-04
Xenon-131m	Ci	<LLD	1.27E-03	6.54E-03	5.08E-03
Xenon-133	Ci	4.97E-01	3.10E+00	1.28E+00	3.22E+01
Xenon-135	Ci	1.46E-03	2.19E-03	2.55E-03	2.65E-03
Xenon-135m	Ci	2.72E-03	3.72E-03	4.65E-03	5.36E-03
Total for Period	Ci	5.01E-01	3.20E+00	1.65E+00	3.26E+01

2. IODINES	Units	1st Qtr	2nd Qtr	3rrd Qtr	4th Qtr
Iodine-131	Ci	8.11E-05	1.61E-04	2.32E-04	9.30E-04
Iodine-132	Ci	<LLD	<LLD	<LLD	<LLD
Iodine-133	Ci	1.80E-04	2.94E-04	4.49E-04	2.65E-04
Iodine-134	Ci	<LLD	<LLD	<LLD	<LLD
Iodine-135	Ci	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	2.61E-04	4.55E-04	6.81E-04	1.20E-03

TABLE HP 10.5-2

PALISADES PLANT RADIOACTIVE EFFLUENT REPORT

GASEOUS EFFLUENTS

January 1, 2002 to December 31, 2002

*PARTICULATES	Units	1st Qtr	2nd Qtr	3rrd Qtr	4th Qtr
Chromium-51	Ci	<LLD	<LLD	<LLD	<LLD
Cobalt-58	Ci	1.06E-04	<LLD	<LLD	<LLD
Cobalt-60	Ci	8.35E-05	<LLD	<LLD	<LLD
Cobalt-57	Ci	6.53E-07	<LLD	<LLD	<LLD
Zinc-65	Ci	<LLD	<LLD	<LLD	<LLD
Strontium-89	Ci	<LLD	<LLD	<LLD	<LLD
Strontium-90	Ci	<LLD	<LLD	<LLD	<LLD
Cesium-134	Ci	<LLD	<LLD	<LLD	<LLD
Cesium-137	Ci	<LLD	<LLD	<LLD	<LLD
Net unidentified beta	Ci	2.45E-06	4.88E-06	2.82E-06	8.32E-07
Total for Period	Ci	1.94E-04	4.88E-06	2.82E-06	8.32E-07

* Particulates with half-lives > 8 days

ATTACHMENT 3

Nuclear Management Company, LLC
Palisades Plant
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RADIOACTIVE EFFLUENT RELEASE REPORT
LIQUID EFFLUENTS - SUMMATION OF RELEASES

January - December 2002

2 Pages Follow

TABLE HP 10.5-3

PALISADES PLANT RADIOACTIVE EFFLUENT REPORT

LIQUID EFFLUENTS - SUMMATION OF RELEASES

January 1, 2002 to December 31, 2002

A. FISSION & ACTIVATION PRODUCTS	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Est Total Error %
1. Total release (not including tritium, gases, alpha)	Ci	9.59E-05	0.000	1.83E-04	7.48E-07	17.31
2. Average release rate for Period	uCi/ml	2.45E-12	N/A	4.93E-12	1.89E-14	
3. Percent of EC	%	3.13E-04	N/A	2.90E-04	3.78E-06	
B. TRITIUM						4.01
1. Total Release	Ci	4.17E+01	4.09E-02	4.90E+01	7.27E+01	
2. Average diluted concentration during period	uCi/ml	1.06E-06	1.03E-09	1.32E-06	1.84E-06	
3. Percent of EC	%	1.06E-01	1.03E-04	1.32E-01	1.84E-01	
C. DISSOLVED & ENTRAINED GASES						N/A
1. Total Release	Ci	0.000	0.000	0.000	0.000	
2. Average diluted concentration during period	uCi/ml	N/A	N/A	N/A	N/A	
3. Percent of EC	%	N/A	N/A	N/A	N/A	
D. GROSS ALPHA RADIOACTIVITY (Total Release)	Ci	3.09E-08	0.000	2.74E-06	3.74E-07	
E. VOLUME OF WASTE RELEASED (Prior to Dillution)	Liters	1.93E+05	0.000	2.10E+05	2.20E+05	
F. VOLUME OF DILLUTION WATER USED DURING PERIOD	Liters	3.92E+10	3.97E+10	3.71E+10	3.95E+10	
G. MAXIMUM DOSE COMMITTMENT – WHOLE BODY	mrem	8.47E-05	5.36E-08	1.73E-04	9.72E-05	
Percent of ODCM App A III. H limit	%	5.65E-03	3.57E-06	1.15E-02	6.48E-03	
H. MAXIMUM DOSE COMMITMENT - ORGAN	mrem	1.13E-04	5.36E-08	2.55E-04	9.69E-05	
Percent of ODCM App A III. H limit	%	2.26E-03	1.07E-06	5.10E-03	1.94E-03	

TABLE HP 10.5-3

PALISADES PLANT RADIOACTIVE EFFLUENT REPORT

LIQUID EFFLUENTS

January 1, 2002 to December 31, 2002

NUCLIDES RELEASED	Units	1st Qtr	2nd Qtr	3rrd Qtr	4th Qtr
Manganese-54	Ci	<LLD	<LLD	<LLD	<LLD
Cobalt-58	Ci	<LLD	<LLD	<LLD	<LLD
Cobalt-60	Ci	4.15E-05	<LLD	1.12E-04	<LLD
Zirconium-95	Ci	<LLD	<LLD	<LLD	<LLD
Silver-110m	Ci	<LLD	<LLD	<LLD	<LLD
Strontium-89	Ci	<LLD	<LLD	<LLD	<LLD
Strontium-90	Ci	6.95E-07	<LLD	7.35E-07	7.48E-07
Cesium-134	Ci	<LLD	<LLD	<LLD	<LLD
Cesium-137	Ci	<LLD	<LLD	6.87E-05	<LLD
Iodine-131	Ci	<LLD	<LLD	<LLD	<LLD
Antimony-125	Ci	<LLD	<LLD	<LLD	<LLD
Net unidentified beta	Ci	5.37E-05	<LLD	<LLD	<LLD
Fission & Activation Products Total	Ci	9.59E-05	0.00	1.83E-04	7.48E-07
Tritium	Ci	4.17E+01	4.09E-02	4.90E+01	7.27E+01
Grand Total	Ci	4.17E+01	4.09E-02	4.90E+01	7.27E+01

ATTACHMENT 4

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RADIOACTIVE EFFLUENT RELEASE REPORT
SOLID WASTE

January - December 2002

1 Page Follows

SOLID WASTE

January 1, 2002 To December 31, 2002

Waste Class	Source of Waste	Solidification Agent	Container Type	Volume (ft^3)	*Total Curies	Principal Radionuclides
AS	Evap Bottoms	NA	HIC	256	1.493	Co-60, Cs-137 Sb-125, Ni-63 Cs-134, Mn-54 Co-58, Fe-55
AS	DAW	NA	HIC	194.1	0.555	Co-60, Cs-137 Sb-125, Ni-63 Sr-90, Mn-54 Co-58, Fe-55 Ru-106, Pu-241
B	Resin	NA	HIC	145.8	75.100	Co-60, Cs-137 Sb-125, Ni-63 Sr-90, Mn-54 Co-58, Fe-55 Cs-134, Zn-65 H-3
AU	DAW	NA	LSA	1334.6	0.291	Co-60, Cs-137 Sb-125, Ni-63 Sr-90, Mn-54 Co-58, Fe-55 Ru-106, Pu-241
			TOTAL	1930.5 ft^3	77.439 Ci	

ATTACHMENT 5

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RADIOACTIVE EFFLUENT RELEASE REPORT
LOWER LIMITS OF DETECTION FOR PALISADES EFFLUENTS

January - December 2002

1 Page Follows

LOWER LIMITS OF DETECTION (LLDs) FOR PALISADES EFFLUENTS

Gaseous Effluents	Nuclide	LLD (uci/cc)*
	Mn-54	1.97E-14
	Co-58	1.92E-14
	Fe-59	4.70E-14
	Co-60	6.49E-14
	Zn-65	9.61E-14
02-002-St	Zr-95	4.58E-14
02-011-St	Mo-99	2.03E-13
02-002-G	I-131	6.01E-14
	I-133	3.70E-13
	Cs-134	3.11E-14
	Cs-137	3.70E-14
	Ce-141	2.34E-14
	Ce-144	1.30E-13
	Kr-87	7.25E-07
	Kr-88	1.11E-06
	Xe-133	8.11E-07
	Xe-133m	2.93E-06
	Xe-135	3.14E-07
	Xe-138	2.97E-06

Liquid Effluents	Nuclide	LLD (uci/ml)**
	Mn-54	1.15E-07
	Fe-59	2.61E-07
	Co-58	3.54E-08
	Co-60	3.48E-07
	Zn-65	5.08E-07
Liquid Batch Release	Mo-99	8.51E-07
02-024-R	I-131	8.85E-08
	Cs-134	1.82E-07
	Cs-137	2.16E-07
	Ce-141	1.56E-07
	Ce-144	6.84E-07

* From a typical Stack release analysis.
** From a typical Liquid release analysis.

ATTACHMENT 6

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RADIOACTIVE EFFLUENT RELEASE REPORT
RESULTS OF 2002 RADIOCHEMISTRY CROSS CHECK PROGRAM

14 Pages Follow

ANALYTICS

1380 Seaboard Industrial Blvd
Atlanta, Georgia 30318 · U.S A.

Phone (404) 352-8677
Fax (404) 352-2837

RESULTS OF RADIOCHEMISTRY

CROSS CHECK PROGRAM

CONSUMER ENERGY

PALISADES PLANT

SECOND QUARTER 2002

8-12-02

Daniel M. Montgomery, QA Manager

SAMPLE	ANALYSIS	PALISADES VALUE microCi/cc	ANALYTICS VALUE microCi/cc	RATIO PALISADES: ANALYTICS	RESOLUTION	COMPARISON
A15758-66	Ce-141	3.51E-05	3.37E-05	1.04	20	AGREEMENT
SOLID	Cr-51	9.65E-05	9.99E-05	0.97	20	AGREEMENT
1 LITER	Cs-134	2.26E-05	2.25E-05	1.00	20	AGREEMENT
DET. 1	Cs-137	1.72E-05	1.66E-05	1.04	20	AGREEMENT
	Co-58	2.58E-05	2.53E-05	1.02	21	AGREEMENT
	Mn-54	1.87E-05	1.86E-05	1.00	20	AGREEMENT
	Fe-59	2.54E-05	2.48E-05	1.02	20	AGREEMENT
	Zn-65	3.59E-05	3.58E-05	1.00	20	AGREEMENT
	Co-60	2.29E-05	2.29E-05	1.00	20	AGREEMENT
A15758-66	Ce-141	3.26E-05	3.37E-05	0.97	20	AGREEMENT
SOLID	Cr-51	9.97E-05	9.99E-05	1.00	20	AGREEMENT
1 LITER	Cs-134	2.04E-05	2.25E-05	0.91	20	AGREEMENT
DET. 2	Cs-137	1.62E-05	1.66E-05	0.98	20	AGREEMENT
	Co-58	2.41E-05	2.53E-05	0.95	21	AGREEMENT
	Mn-54	1.86E-05	1.86E-05	1.00	20	AGREEMENT
	Fe-59	2.40E-05	2.48E-05	0.97	20	AGREEMENT
	Zn-65	3.33E-05	3.58E-05	0.93	20	AGREEMENT
	Co-60	2.14E-05	2.29E-05	0.94	20	AGREEMENT
A15758-66	Ce-141	3.23E-05	3.37E-05	0.96	20	AGREEMENT
SOLID	Cr-51	9.22E-05	9.99E-05	0.92	20	AGREEMENT
1 LITER	Cs-134	2.20E-05	2.25E-05	0.98	20	AGREEMENT
DET. 3	Cs-137	1.72E-05	1.66E-05	1.04	20	AGREEMENT
	Co-58	2.46E-05	2.53E-05	0.97	21	AGREEMENT
	Mn-54	1.95E-05	1.86E-05	1.05	20	AGREEMENT
	Fe-59	2.54E-05	2.48E-05	1.02	20	AGREEMENT
	Zn-65	3.53E-05	3.58E-05	0.99	20	AGREEMENT
	Co-60	2.31E-05	2.29E-05	1.01	20	AGREEMENT

SAMPLE	ANALYSIS	PALISADES VALUE microCi/cc	ANALYTICS VALUE microCi/cc	RATIO PALISADES: ANALYTICS	RESOLUTION	COMPARISON
A15759-66✓ SIM. GAS 1 LITER DET. 1	Ce-141	3.30E-05	3.37E-05	0.98	20	AGREEMENT
	Cr-51	9.63E-05	9.98E-05	0.96	20	AGREEMENT
	Cs-134	2.15E-05	2.25E-05	0.96	20	AGREEMENT
	Cs-137	1.63E-05	1.66E-05	0.98	20	AGREEMENT
	Co-58	2.47E-05	2.53E-05	0.98	20	AGREEMENT
	Mn-54	1.90E-05	1.86E-05	1.02	20	AGREEMENT
	Fe-59	2.50E-05	2.48E-05	1.01	20	AGREEMENT
	Zn-65	3.60E-05	3.58E-05	1.01	20	AGREEMENT
	Co-60	2.31E-05	2.29E-05	1.01	20	AGREEMENT
A15759-66 SIM. GAS 1 LITER DET. 2	Ce-141	3.24E-05	3.37E-05	0.96	20	AGREEMENT
	Cr-51	9.21E-05	9.98E-05	0.92	20	AGREEMENT
	Cs-134	2.12E-05	2.25E-05	0.94	20	AGREEMENT
	Cs-137	1.67E-05	1.66E-05	1.01	20	AGREEMENT
	Co-58	2.58E-05	2.53E-05	1.02	21	AGREEMENT
	Mn-54	1.91E-05	1.86E-05	1.03	20	AGREEMENT
	Fe-59	2.20E-05	2.48E-05	0.89	20	AGREEMENT
	Zn-65	3.53E-05	3.58E-05	0.99	20	AGREEMENT
	Co-60	2.18E-05	2.29E-05	0.95	20	AGREEMENT
A15759-66 SIM. GAS 1 LITER DET. 3	Ce-141	3.21E-05	3.37E-05	0.95	20	AGREEMENT
	Cr-51	9.29E-05	9.98E-05	0.93	20	AGREEMENT
	Cs-134	2.16E-05	2.25E-05	0.96	20	AGREEMENT
	Cs-137	1.72E-05	1.66E-05	1.04	20	AGREEMENT
	Co-58	2.43E-05	2.53E-05	0.96	21	AGREEMENT
	Mn-54	1.88E-05	1.86E-05	1.01	20	AGREEMENT
	Fe-59	2.48E-05	2.48E-05	1.00	20	AGREEMENT
	Zn-65	3.55E-05	3.58E-05	0.99	20	AGREEMENT
	Co-60	2.23E-05	2.29E-05	0.98	20	AGREEMENT

SAMPLE	ANALYSIS	PALISADES VALUE microCi/cc	ANALYTICS VALUE microCi/cc	RATIO PALISADES: ANALYTICS	RESOLUTION	COMPARISON
A15760-66	Ce-141	2.96E-04	3.05E-04	0.97	20	AGREEMENT
SOLID	Cr-51	9.02E-04	9.03E-04	1.00	20	AGREEMENT
50 ML	Cs-134	1.95E-04	2.03E-04	0.96	20	AGREEMENT
DET. 1	Cs-137	1.55E-04	1.50E-04	1.04	20	AGREEMENT
	Co-58	2.31E-04	2.28E-04	1.01	21	AGREEMENT
	Mn-54	1.80E-04	1.68E-04	1.07	20	AGREEMENT
	Fe-59	2.32E-04	2.24E-04	1.03	20	AGREEMENT
	Zn-65	3.33E-04	3.24E-04	1.03	20	AGREEMENT
	Co-60	2.04E-04	2.07E-04	0.99	20	AGREEMENT
A15760-66	Ce-141	2.96E-04	3.05E-04	0.97	20	AGREEMENT
SOLID	Cr-51	9.31E-04	9.03E-04	1.03	20	AGREEMENT
50 ML	Cs-134	1.95E-04	2.03E-04	0.96	20	AGREEMENT
DET. 2	Cs-137	1.49E-04	1.50E-04	1.00	20	AGREEMENT
	Co-58	2.28E-04	2.28E-04	1.00	21	AGREEMENT
	Mn-54	1.67E-04	1.68E-04	0.99	20	AGREEMENT
	Fe-59	2.20E-04	2.24E-04	0.98	20	AGREEMENT
	Zn-65	3.10E-04	3.24E-04	0.96	20	AGREEMENT
	Co-60	1.93E-04	2.07E-04	0.93	20	AGREEMENT
A15760-66	Ce-141	2.80E-04	3.05E-04	0.92	20	AGREEMENT
SOLID	Cr-51	8.65E-04	9.03E-04	0.96	20	AGREEMENT
50 ML	Cs-134	1.95E-04	2.03E-04	0.96	20	AGREEMENT
DET. 3	Cs-137	1.55E-04	1.50E-04	1.04	20	AGREEMENT
	Co-58	2.21E-04	2.28E-04	0.97	21	AGREEMENT
	Mn-54	1.72E-04	1.68E-04	1.02	20	AGREEMENT
	Fe-59	2.23E-04	2.24E-04	0.99	20	AGREEMENT
	Zn-65	3.37E-04	3.24E-04	1.04	20	AGREEMENT
	Co-60	2.03E-04	2.07E-04	0.98	20	AGREEMENT

SAMPLE	ANALYSIS	PALISADES VALUE microCi/cc	ANALYTICS VALUE microCi/cc	RATIO PALISADES: ANALYTICS	RESOLUTION	COMPARISON
A15761-66	Ce-141	3.39E-02	3.11E-02	1.09	20	AGREEMENT
FILTER	Cr-51	9.60E-02	9.22E-02	1.04	20	AGREEMENT
DET. 1	Cs-134	2.02E-02	2.08E-02	0.97	20	AGREEMENT
	Cs-137	1.66E-02	1.53E-02	1.09	20	AGREEMENT
	Co-58	2.54E-02	2.33E-02	1.09	21	AGREEMENT
	Mn-54	1.98E-02	1.72E-02	1.15	20	AGREEMENT
	Fe-59	2.59E-02	2.29E-02	1.13	20	AGREEMENT
	Zn-65	3.84E-02	3.31E-02	1.16	20	AGREEMENT
	Co-60	2.23E-02	2.11E-02	1.06	20	AGREEMENT
A15761-66	Ce-141	3.21E-02	3.11E-02	1.03	20	AGREEMENT
FILTER	Cr-51	9.36E-02	9.22E-02	1.02	20	AGREEMENT
DET. 2	Cs-134	2.01E-02	2.08E-02	0.97	20	AGREEMENT
	Cs-137	1.66E-02	1.53E-02	1.09	20	AGREEMENT
	Co-58	2.48E-02	2.33E-02	1.06	21	AGREEMENT
	Mn-54	1.92E-02	1.72E-02	1.12	20	AGREEMENT
	Fe-59	2.54E-02	2.29E-02	1.11	20	AGREEMENT
	Zn-65	3.63E-02	3.31E-02	1.10	20	AGREEMENT
	Co-60	2.14E-02	2.11E-02	1.01	20	AGREEMENT
A15761-66	Ce-141	3.19E-02	3.11E-02	1.03	20	AGREEMENT
FILTER	Cr-51	9.58E-02	9.22E-02	1.04	20	AGREEMENT
DET. 3	Cs-134	2.04E-02	2.08E-02	0.98	20	AGREEMENT
	Cs-137	1.68E-02	1.53E-02	1.10	20	AGREEMENT
	Co-58	2.52E-02	2.33E-02	1.08	21	AGREEMENT
	Mn-54	1.96E-02	1.72E-02	1.14	20	AGREEMENT
	Fe-59	2.63E-02	2.29E-02	1.15	20	AGREEMENT
	Zn-65	3.76E-02	3.31E-02	1.14	20	AGREEMENT
	Co-60	2.26E-02	2.11E-02	1.07	20	AGREEMENT

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RESULTS OF RADIOCHEMISTRY

CROSS CHECK PROGRAM

CONSUMERS POWER

PALISADES PLANT

THIRD QUARTER 2002

12-10-02

Daniel M. Montgomery, QA Manager

SAMPLE	ANALYSIS	PALISADES VALUE microCi	ANALYTICS VALUE microCi	RATIO PALISADES: ANALYTICS	RESOLUTION	COMPARISON
A16096-66	Ce-141	5.27E-02	5.04E-02	1.05	20	AGREEMENT
SCOTT	Cr-51	7.95E-02	8.12E-02	0.98	20	AGREEMENT
CARTRIDGE	Cs-134	1.96E-02	2.07E-02	0.95	20	AGREEMENT
DET. 1	Cs-137	2.08E-02	1.94E-02	1.07	20	AGREEMENT
	Co-58	2.21E-02	2.07E-02	1.07	20	AGREEMENT
	Mn-54	2.78E-02	2.51E-02	1.11	20	AGREEMENT
	Fe-59	2.50E-02	2.30E-02	1.09	20	AGREEMENT
	Zn-65	3.44E-02	3.16E-02	1.09	20	AGREEMENT
	Co-60	2.30E-02	2.30E-02	1.00	20	AGREEMENT
A16096-66	Ce-141	4.97E-02	5.04E-02	0.99	20	AGREEMENT
SCOTT	Cr-51	7.72E-02	8.12E-02	0.95	20	AGREEMENT
CARTRIDGE	Cs-134	1.81E-02	2.07E-02	0.88	20	AGREEMENT
DET. 2	Cs-137	1.91E-02	1.94E-02	0.99	20	AGREEMENT
	Co-58	2.04E-02	2.07E-02	0.99	20	AGREEMENT
	Mn-54	2.56E-02	2.51E-02	1.02	20	AGREEMENT
	Fe-59	2.27E-02	2.30E-02	0.99	20	AGREEMENT
	Zn-65	3.18E-02	3.16E-02	1.01	20	AGREEMENT
	Co-60	2.10E-02	2.30E-02	0.91	20	AGREEMENT
A16096-66	Ce-141	4.88E-02	5.04E-02	0.97	20	AGREEMENT
SCOTT	Cr-51	7.77E-02	8.12E-02	0.96	20	AGREEMENT
CARTRIDGE	Cs-134	1.90E-02	2.07E-02	0.92	20	AGREEMENT
DET. 3	Cs-137	1.99E-02	1.94E-02	1.03	20	AGREEMENT
	Co-58	2.15E-02	2.07E-02	1.04	20	AGREEMENT
	Mn-54	2.68E-02	2.51E-02	1.07	20	AGREEMENT
	Fe-59	2.48E-02	2.30E-02	1.08	20	AGREEMENT
	Zn-65	3.32E-02	3.16E-02	1.05	20	AGREEMENT
	Co-60	2.19E-02	2.30E-02	0.95	20	AGREEMENT

SAMPLE	ANALYSIS	PALISADES VALUE microCi/cc	ANALYTICS VALUE microCi/cc	RATIO PALISADES: ANALYTICS	RESOLUTION	COMPARISON
A16097-66	Ce-141	1.03E-03	9.97E-04	1.03	20	AGREEMENT
SIMULATED	Cr-51	1.59E-03	1.61E-03	0.99	20	AGREEMENT
GAS	Cs-134	3.87E-04	4.10E-04	0.94	20	AGREEMENT
DET. 1	Cs-137	4.02E-04	3.83E-04	1.05	20	AGREEMENT
	Co-58	4.30E-04	4.09E-04	1.05	20	AGREEMENT
	Mn-54	5.35E-04	4.97E-04	1.08	20	AGREEMENT
	Fe-59	4.92E-04	4.55E-04	1.08	20	AGREEMENT
	Zn-65	6.74E-04	6.25E-04	1.08	20	AGREEMENT
	Co-60	4.47E-04	4.55E-04	0.98	20	AGREEMENT
A16097-66	Ce-141	9.97E-04	9.97E-04	1.00	20	AGREEMENT
SIMULATED	Cr-51	1.56E-03	1.61E-03	0.97	20	AGREEMENT
GAS	Cs-134	3.73E-04	4.10E-04	0.91	20	AGREEMENT
DET. 2	Cs-137	3.80E-04	3.83E-04	0.99	20	AGREEMENT
	Co-58	4.10E-04	4.09E-04	1.00	20	AGREEMENT
	Mn-54	5.19E-04	4.97E-04	1.04	20	AGREEMENT
	Fe-59	4.56E-04	4.55E-04	1.00	20	AGREEMENT
	Zn-65	6.38E-04	6.25E-04	1.02	20	AGREEMENT
	Co-60	4.28E-04	4.55E-04	0.94	20	AGREEMENT
A16097-66	Ce-141	9.83E-04	9.97E-04	0.99	20	AGREEMENT
SIMULATED	Cr-51	1.60E-03	1.61E-03	1.00	20	AGREEMENT
GAS	Cs-134	3.89E-04	4.10E-04	0.95	20	AGREEMENT
DET. 3	Cs-137	3.98E-04	3.83E-04	1.04	20	AGREEMENT
	Co-58	4.26E-04	4.09E-04	1.04	20	AGREEMENT
	Mn-54	5.38E-04	4.97E-04	1.08	20	AGREEMENT
	Fe-59	5.03E-04	4.55E-04	1.11	20	AGREEMENT
	Zn-65	6.63E-04	6.25E-04	1.06	20	AGREEMENT
	Co-60	4.41E-04	4.55E-04	0.97	20	AGREEMENT

SAMPLE	ANALYSIS	PALISADES VALUE microCi/cc	ANALYTICS VALUE microCi/cc	RATIO PALISADES: ANALYTICS	RESOLUTION	COMPARISON
A16098-66	Ce-141	5.48E-05	5.04E-05	1.09	20	AGREEMENT
SAND	Cr-51	9.28E-05	8.12E-05	1.14	20	AGREEMENT
DET. 1	Cs-134	2.17E-05	2.07E-05	1.05	20	AGREEMENT
	Cs-137	2.16E-05	1.94E-05	1.11	20	AGREEMENT
	Co-58	2.32E-05	2.07E-05	1.12	20	AGREEMENT
	Mn-54	2.87E-05	2.51E-05	1.14	20	AGREEMENT
	Fe-59	2.63E-05	2.30E-05	1.14	20	AGREEMENT
	Zn-65	3.47E-05	3.16E-05	1.10	20	AGREEMENT
	Co-60	2.46E-05	2.30E-05	1.07	20	AGREEMENT
A16098-66	Ce-141	5.27E-05	5.04E-05	1.05	20	AGREEMENT
SAND	Cr-51	8.95E-05	8.12E-05	1.10	20	AGREEMENT
DET. 2	Cs-134	2.04E-05	2.07E-05	0.99	20	AGREEMENT
	Cs-137	1.90E-05	1.94E-05	0.98	20	AGREEMENT
	Co-58	2.05E-05	2.07E-05	0.99	20	AGREEMENT
	Mn-54	2.55E-05	2.51E-05	1.02	20	AGREEMENT
	Fe-59	2.40E-05	2.30E-05	1.04	20	AGREEMENT
	Zn-65	2.95E-05	3.16E-05	0.93	20	AGREEMENT
	Co-60	2.11E-05	2.30E-05	0.92	20	AGREEMENT
A16098-66	Ce-141	5.13E-05	5.04E-05	1.02	20	AGREEMENT
SAND	Cr-51	8.16E-05	8.12E-05	1.00	20	AGREEMENT
DET. 3	Cs-134	2.00E-05	2.07E-05	0.97	20	AGREEMENT
	Cs-137	2.06E-05	1.94E-05	1.06	20	AGREEMENT
	Co-58	2.24E-05	2.07E-05	1.08	20	AGREEMENT
	Mn-54	2.74E-05	2.51E-05	1.09	20	AGREEMENT
	Fe-59	2.52E-05	2.30E-05	1.10	20	AGREEMENT
	Zn-65	3.23E-05	3.16E-05	1.02	20	AGREEMENT
	Co-60	2.31E-05	2.30E-05	1.01	20	AGREEMENT

SAMPLE	ANALYSIS	PALISADES VALUE microCi	ANALYTICS VALUE microCi	RATIO PALISADES: ANALYTICS	RESOLUTION	COMPARISON
A16099-66	Ce-141	4.88E-02	5.04E-02	0.97	20	AGREEMENT
LAPEL	Cr-51	7.77E-02	8.13E-02	0.96	20	AGREEMENT
CARTRIDGE	Cs-134	1.90E-02	2.07E-02	0.92	20	AGREEMENT
DET. 1	Cs-137	2.02E-02	1.94E-02	1.04	20	AGREEMENT
	Co-58	2.18E-02	2.07E-02	1.05	20	AGREEMENT
	Mn-54	2.74E-02	2.51E-02	1.09	20	AGREEMENT
	Fe-59	2.45E-02	2.30E-02	1.07	20	AGREEMENT
	Zn-65	3.43E-02	3.16E-02	1.08	20	AGREEMENT
	Co-60	2.26E-02	2.30E-02	0.98	20	AGREEMENT
A16099-66	Ce-141	4.86E-02	5.04E-02	0.96	20	AGREEMENT
LAPEL	Cr-51	7.67E-02	8.13E-02	0.94	20	AGREEMENT
CARTRIDGE	Cs-134	1.79E-02	2.07E-02	0.86	20	AGREEMENT
DET. 2	Cs-137	1.90E-02	1.94E-02	0.98	20	AGREEMENT
	Co-58	2.02E-02	2.07E-02	0.98	20	AGREEMENT
	Mn-54	2.52E-02	2.51E-02	1.00	20	AGREEMENT
	Fe-59	2.31E-02	2.30E-02	1.00	20	AGREEMENT
	Zn-65	3.15E-02	3.16E-02	1.00	20	AGREEMENT
	Co-60	2.07E-02	2.30E-02	0.90	20	AGREEMENT
A16099-66	Ce-141	4.74E-02	5.04E-02	0.94	20	AGREEMENT
LAPEL	Cr-51	7.77E-02	8.13E-02	0.96	20	AGREEMENT
CARTRIDGE	Cs-134	1.88E-02	2.07E-02	0.91	20	AGREEMENT
DET. 3	Cs-137	1.96E-02	1.94E-02	1.01	20	AGREEMENT
	Co-58	2.09E-02	2.07E-02	1.01	20	AGREEMENT
	Mn-54	2.64E-02	2.51E-02	1.05	20	AGREEMENT
	Fe-59	2.41E-02	2.30E-02	1.05	20	AGREEMENT
	Zn-65	3.29E-02	3.16E-02	1.04	20	AGREEMENT
	Co-60	2.20E-02	2.30E-02	0.96	20	AGREEMENT

SAMPLE	ANALYSIS	PALISADES VALUE microCi/cc	ANALYTICS VALUE microCi/cc	RATIO PALISADES: ANALYTICS	RESOLUTION	COMPARISON
A16094-66 LIQUID	Gross Beta	1.88E-03	2.16E-03	0.87	17	AGREEMENT
A16095-66 LIQUID	Tritium	1.90E-03	2.00E-03	0.95	12.5	AGREEMENT

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RESULTS OF RADIOCHEMISTRY

CROSS CHECK PROGRAM

CONSUMERS POWER COMPANY

PALISADES

FOURTH QUARTER 2002

Daniel M. Montgomery, QA Manager

SAMPLE	ANALYSIS	PALISADES VALUE microCi	ANALYTICS VALUE microCi	RATIO PALISADES: ANALYTICS	RESOLUTION	COMPARISON
A16152-66 CARTRIDGE DET. 1	Ce-141	2.89E-02	2.76E-02	1.05	20	AGREEMENT
	Cr-51	9.85E-02	9.50E-02	1.04	20	AGREEMENT
	Cs-134	1.34E-02	1.42E-02	0.95	20	AGREEMENT
	Cs-137	3.46E-02	3.08E-02	1.13	20	AGREEMENT
	Co-58	2.68E-02	2.52E-02	1.06	20	AGREEMENT
	Mn-54	2.33E-02	2.11E-02	1.11	20	AGREEMENT
	Fe-59	1.74E-02	1.53E-02	1.13	20	AGREEMENT
	Zn-65	3.06E-02	2.68E-02	1.14	20	AGREEMENT
	Co-60	2.38E-02	2.32E-02	1.03	20	AGREEMENT
A16152-66 CARTRIDGE DET. 2	Ce-141	2.76E-02	2.76E-02	1.00	20	AGREEMENT
	Cr-51	9.36E-02	9.50E-02	0.98	20	AGREEMENT
	Cs-134	1.27E-02	1.42E-02	0.90	20	AGREEMENT
	Cs-137	3.20E-02	3.08E-02	1.04	20	AGREEMENT
	Co-58	2.58E-02	2.52E-02	1.02	20	AGREEMENT
	Mn-54	2.58E-02	2.11E-02	1.22	20	AGREEMENT
	Fe-59	1.74E-02	1.53E-02	1.13	20	AGREEMENT
	Zn-65	2.78E-02	2.68E-02	1.04	20	AGREEMENT
	Co-60	2.18E-02	2.32E-02	0.94	20	AGREEMENT
A16152-66 CARTRIDGE DET. 3	Ce-141	2.61E-02	2.76E-02	0.95	20	AGREEMENT
	Cr-51	9.14E-02	9.50E-02	0.96	20	AGREEMENT
	Cs-134	1.30E-02	1.42E-02	0.92	20	AGREEMENT
	Cs-137	3.22E-02	3.08E-02	1.05	20	AGREEMENT
	Co-58	2.54E-02	2.52E-02	1.01	20	AGREEMENT
	Mn-54	2.18E-02	2.11E-02	1.03	20	AGREEMENT
	Fe-59	1.62E-02	1.53E-02	1.06	20	AGREEMENT
	Zn-65	2.80E-02	2.68E-02	1.04	20	AGREEMENT
	Co-60	2.23E-02	2.32E-02	0.96	20	AGREEMENT

SAMPLE	ANALYSIS	PALISADES VALUE microCi/cc	ANALYTICS VALUE microCi/cc	RATIO PALISADES: ANALYTICS	RESOLUTION	COMPARISON
A16153-66	Ce-141	9.19E-04	9.01E-04	1.02	20	AGREEMENT
SOLID	Cr-51	3.19E-03	3.10E-03	1.03	20	AGREEMENT
7 ML	Cs-134	4.42E-04	4.63E-04	0.96	20	AGREEMENT
DET. 1	Cs-137	1.03E-03	1.00E-03	1.03	20	AGREEMENT
	Co-58	8.18E-04	8.22E-04	0.99	20	AGREEMENT
	Mn-54	7.06E-04	6.87E-04	1.03	20	AGREEMENT
	Fe-59	5.42E-04	5.00E-04	1.08	20	AGREEMENT
	Zn-65	8.58E-04	8.75E-04	0.98	20	AGREEMENT
	Co-60	7.28E-04	7.57E-04	0.96	20	AGREEMENT
A16153-66	Ce-141	7.94E-04	9.01E-04	0.88	20	AGREEMENT
SOLID	Cr-51	2.64E-03	3.10E-03	0.85	20	AGREEMENT
7 ML	Cs-134	4.26E-04	4.63E-04	0.92	20	AGREEMENT
DET. 2	Cs-137	9.69E-04	1.00E-03	0.97	20	AGREEMENT
	Co-58	6.83E-04	8.22E-04	0.83	20	AGREEMENT
	Mn-54	6.14E-04	6.87E-04	0.89	20	AGREEMENT
	Fe-59	5.24E-04	5.00E-04	1.05	20	AGREEMENT
	Zn-65	6.64E-04	8.75E-04	0.76	20	AGREEMENT
	Co-60	6.18E-04	7.57E-04	0.82	20	AGREEMENT
A16153-66	Ce-141	8.28E-04	9.01E-04	0.92	20	AGREEMENT
SOLID	Cr-51	2.72E-03	3.10E-03	0.88	20	AGREEMENT
7 ML	Cs-134	4.24E-04	4.63E-04	0.92	20	AGREEMENT
DET. 3	Cs-137	9.84E-04	1.00E-03	0.98	20	AGREEMENT
	Co-58	7.98E-04	8.22E-04	0.97	20	AGREEMENT
	Mn-54	6.29E-04	6.87E-04	0.92	20	AGREEMENT
	Fe-59	4.10E-04	5.00E-04	0.82	20	AGREEMENT
	Zn-65	8.82E-04	8.75E-04	1.01	20	AGREEMENT
	Co-60	7.05E-04	7.57E-04	0.93	20	AGREEMENT

ATTACHMENT 7

Nuclear Management Company, LLC
Palisades Plant
Docket 50-255

RADIOACTIVE EFFLUENT RELEASE REPORT
PROCESS CONTROL PROGRAM (PCP)

16 Pages Follow

Consumers Energy
Palisades Nuclear Plant

PROCESS CONTROL PROGRAM (PCP)

Approved	Radiological Services Mgr	Date 4/30/02
	Technical Review	Date 4/29/02
	Plant Review Committee	Date 5-7-02
	Periodic Review	Date
	Plant General Manager	Date 5/8/02

Table of Contents

PALISADES PROCESS CONTROL PROGRAM (PCP)

1.0 INTRODUCTION

The Process Control Program contains methodology used to meet the requirements of 10CFR61 for land disposal of radioactive waste. Palisades only available burial ground is located near Barnwell, SC. South Carolina has Agreement State status from the Nuclear Regulatory Commission (NRC) and radioactive waste has to meet SC license conditions as well as the NRC requirements.

2.0 PROCESSING EVAPORATOR CONCENTRATES

Palisades uses the VECTRA Radwaste Volume Reduction System (RVR-200) to reduce the volume of radioactive liquid concentrates (evaporator concentrates) to the minimum amount practicable for storage and burial purposes. The end product will meet South Carolina burial requirements.

The Blender/Dryer (B/D) steam jacket is heated by a steam boiler. The plant evaporator concentrates are introduced to the B/D via a waste slurry supply line through the waste supply valves. When the liquid level in the B/D reaches a predetermined level (approximately 3" from the top of the B/D) the waste supply valve is closed by the operator or will automatically close when a high level is achieved. The agitator/scraper then mixes the heated waste liquids under a vacuum of approximately 24-30" Hg Steam vapors are produced by the heating of the steam jacket surrounding the Blender/Dryer. These steam vapors are then drawn through a demister filter to a condensing heat exchanger (HX-1). This condenser is cooled by the chilled water system and its 50 ton chiller skid.

After the level in the Blender/Dryer boils down to a low level or the boil off rate significantly decreases as determined by the system operator, the waste supply valve is opened to refill the B/D. The process of boiling off the liquid in the form of steam vapor is repeated. This sequence of operations continues until the appropriate amount of concentrates have been transferred to the B/D for a batch cycle.

Once the last transfer has been achieved, the dry out phase begins. The dry out phase is the time it takes from the last transfer to the time when all of the free standing liquid has been removed. The dryness of the material is verified by monitoring several system parameters, as well as a visual observation of the product. Upon verification of the removal of free standing liquid, the material is ready for binder addition.

Between 50 and 70 pounds of binder (20-30% of the dried material by weight) will be used to bind the waste solids. This binding agent, which is added at the beginning of the process in solid form, is melted using steam heat from the steam generator in the binder addition tank. The binder takes approximately 2-4 hours to melt completely.

The binding agent is introduced to the B/D through a chemical addition valve (CA-1) and allowed to throughly blend with the dry waste product for approximately 20 minutes. This changes the waste product to a near liquid form to allow for free passage through the discharge valve (DV-1). Using the binder will result in a free standing billet with a compressive strength of up to 250 psi. The material is now ready for discharge into a container.

5-13-02

2.1 PACKAGING

The binder and waste product mixture is discharged from the unit through a six inch pneumatically operated ball valve (DV-1) into a burial container. The burial container is kept at a slight negative pressure and vented through a HEPA system. A sonic level indicator, as well as a remote visual display, allows for the operator to monitor the filling of the container. The sonic level indicator can be programmed for automatic closure of the dump valve at a predetermined level to prevent overfilling.

5-13-02

2.2 ALARA CONSIDERATIONS

Construction of the RVR-200 employs several concepts to permit operation without significant exposure to operating personnel. Some of these will greatly reduce the accumulated dose received by those personnel working on or around the area in which the RVR-200 is located.

- A remotely operated control panel allows for the control of major pumps and valves associated with the operation of the RVR without being near the unit during the process.
- Lead blankets can be used to shield the operator from the processing Blender/Dryer.
- All filling and dumping operations are viewed remotely at the control panel, using a CCTV monitor, which permits the operator to be shielded from direct exposure.

- A 1" steel process shield or shipping cask can be used to contain the HIC while it is being filled. A cart is used to move it out from under the RVR.

- A HEPA system is installed to filter out potential of airborne contaminants.

The major portion of radiation exposure is received by personnel during maintenance and radwaste handling. This exposure may be reduced by performing preventive maintenance on the unit after processing and removing of the waste from the system. The units are also skid mounted, permitting them to be removed from the area for maintenance or work away from the unit and reduce exposure to the personnel.

2.3 SYSTEM PARAMETERS

There are no critical chemistry parameters for the system to work as designed for acceptable waste form. However other requirements need to be addressed. Waste below 2 pH and above 12 pH is characteristically classified hazardous waste which would make the package mixed waste which must be avoided as no burial site is presently available. Palisades also wants to operate in a pH range to keep iodine in solution and in the waste matrix rather than offgassed which would be counter to good ALARA practices. The required parameters are contained in Chemistry Operating Procedure COP-17, "Radwaste System Chemistry."

Waste form Absence of Liquid will be controlled by System Operating Procedure SOP-18D, "Operating the VECTRA RVR-200 System," and visual observation of material. The visual inspection and quality control requirements will be documented on form HP 6.18-3 as required by procedure Health Physics Procedure HP 6.18, "Low-Level Radwaste Packaging."

The system produces a dry powder which meets the "free liquid" determination of Barnwell License 097. This does not meet the Barnwell License 097, condition 45 unless using wax as a binder to make the waste undispersable. The binder addition is documented in the VECTRA procedure process sheets. A letter from the South Carolina DHEC is attached to document their approval of the wax as a binder.

South Carolina

DHEC

Department of Health and Environmental Control

2600 Bull Street, Columbia, SC 29201

July 30, 1992

William B. House
Corporate Director of Licensing
Chem-Nuclear Systems, Inc.
140 Stoneridge Drive
Columbia, SC 29210

Dear Mr. House:

Enclosed is information on the Pacific Nuclear Systems, Inc. RVR waste forms. The system produces a dry powder which is processed using wax as a binding matrix. The waste forms meet the intent of License 097, Condition 45 to render the powder non-dispersible. The system has been approved by the Department for processing Class A unstable waste only. Waste processed using this system may be disposed of in Type A unstable waste trenches.

If you have any additional questions concerning these waste forms, please contact our office.

Very truly yours,

Virgil R. Autry, Director
Division of Radioactive Materials
Licensing and Compliance
Bureau of Radiological Health

HJP/em
wbh72992/0792

cc: R. L. Williams, Pacific Nuclear Systems, Inc.

Meeting the above referenced procedure requirements will demonstrate that the system product is acceptable for burial at the Barnwell SC Burial Facility.

3.0 DEWATERING SOLIDS IN HIGH INTEGRITY CONTAINERS (HIC) 5-13-02

3.1 Solids such as bead resin, filter cartridges, and powdered resin (Powdex) may be dewatered and shipped in HICs per approved procedures and the HIC certificate of compliance.

3.2 High integrity containers are approved by the individual burial ground agreement states as meeting 10CFR61 waste form stability requirements.

3.3 Free water determination shall be verified by the successful completion and documentation of an approved dewatering procedure.

4.0 10 CFR 61 REQUIREMENTS

4.1 10 CFR 61 classification requirements will be met using a shipping computer software program using the scaling factor methodology of AIF/NESP-027, "Methodologies for Classification of Low-Level Radioactive Waste From Nuclear Power Plants," 1983.

The scaling factors will be updated by an ongoing analysis program of actual waste streams. The program includes sampling of waste streams, typically on a fuel cycle based interval. Waste streams include: resin, filters, DAW and evaporator concentrates. 5-13-02

4.2 10 CFR 61 waste form stability requirements can be met by generic testing of the waste stream product but usually High Integrity Containers (HIC) approved by the State of South Carolina will be used.

The generic waste streams will be evaporator concentrates (boric acid), bead resin and filters. Barnwell, South Carolina is only disposal site used for direct radwaste shipments from this license. 5-13-02

4.3 Documentation of the waste stream analysis, waste form stability, and computer software scaling factor security shall be maintained by the Radiological Services Department.

4.4 No radioactive waste shall be shipped for disposal in cardboard or fiberboard packages.

4.5 Liquid waste must be solidified or packaged in sufficient absorbent material to absorb twice the volume of the liquid.

4.6 Solid waste containing liquid shall contain as little free standing noncorrosive liquid as is reasonably achievable but in no case shall the free standing liquid exceed 1% of the volume. The required parameters of Chemistry Operating Procedure COP-17, "Radwaste System Chemistry," will ensure there is no corrosive liquid potential in final waste product. Shipment procedures address free liquid determination.

4.7 Not withstanding the requirements of 4.5 and 4.6 any processed liquid waste (bead resin or filters etc) shall not contain noncorrosive free standing liquid exceed 0.5% of the waste volume. See 4.6 above.

4.8 Waste must not be readily capable of detonation or of explosive decomposition or reaction at normal pressure and temperature. Hazardous chemicals are very closely controlled by this site. The few that are required are used as lab chemicals are diluted many times in the 20,000 gallon liquid waste system tanks and then ran through an evaporator system prior to solidification or resin bed clean up and are not a potential concern.

4.9 Waste must not contain or be capable of generating, quantities of toxic gasses, vapors, or fumes harmful to persons transporting, handling, or disposing of the waste. See Step 4.8 above.

4.10 The plant only uses a minimal amount of hazardous material which has the potential to enter a waste stream. The site has minimal biological, pathogenic, or infectious waste. This material is typically sent for additional processing and the processor's acceptance criteria for incineration will be met if these waste streams are generated for disposal.

4.11 Waste must not be pyrophoric. Pyrophoric material contained in waste shall be treated, prepared, and package to be non pyrophoric. See Step 4.8 above. In addition waste packages are sealed and would not support combustion.

5.0 **<u>RADWASTE SYSTEM</u>**

5.1 A radwaste system flow diagram is included in Appendix A, A-2.

6.0 TECHNICAL SPECIFICATION REQUIREMENTS

The PCP is implemented per the requirements of the Administrative Controls section of the Technical Specification Chapter 5, Section 5.5.15. Procedural requirements included in Appendix B have been relocated from the Technical Specifications in accordance with NRC Generic Letter 89-01, dated January 31, 1989. 5-13-02

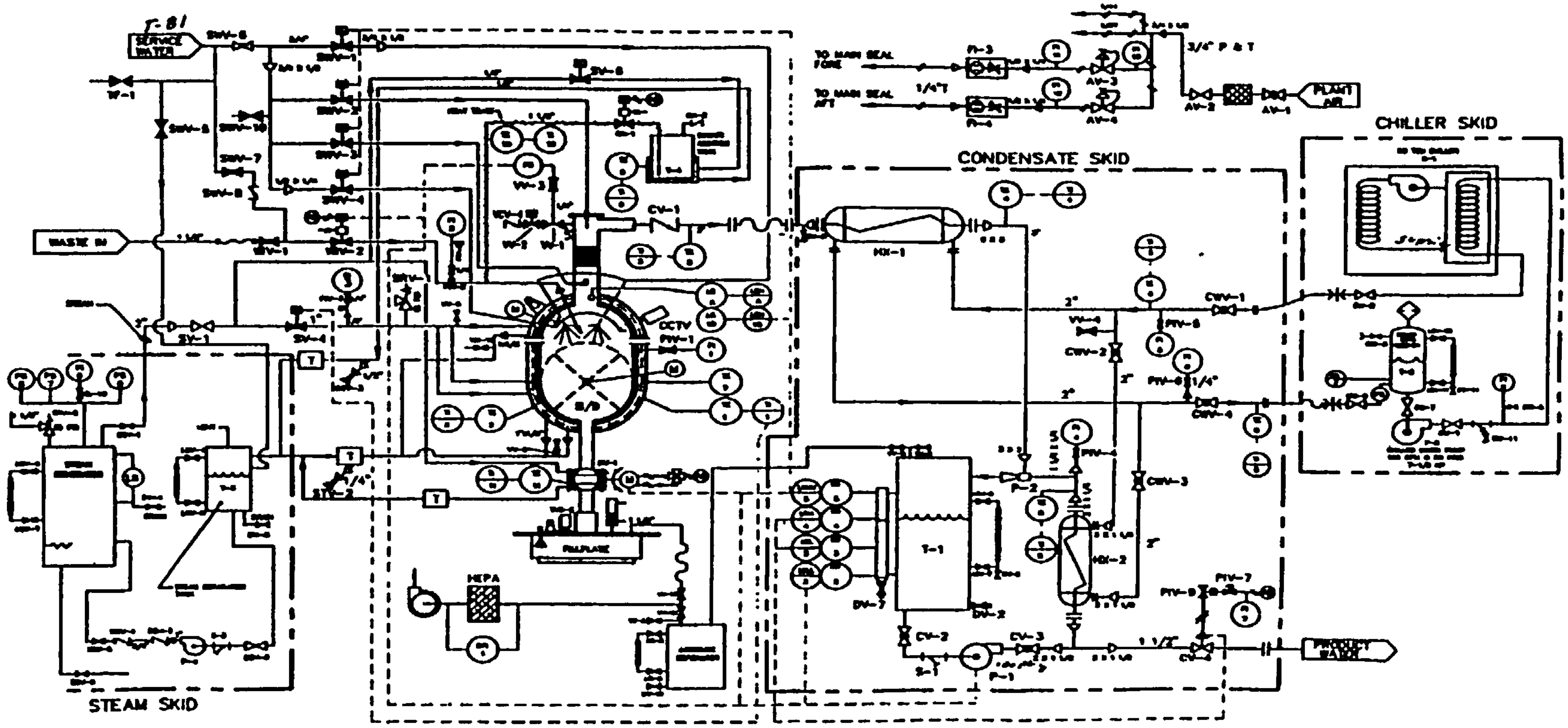
APPENDIX A

Consumers Energy
Palisades Nuclear Plant

PROCESS CONTROL PROGRAM (PCP)

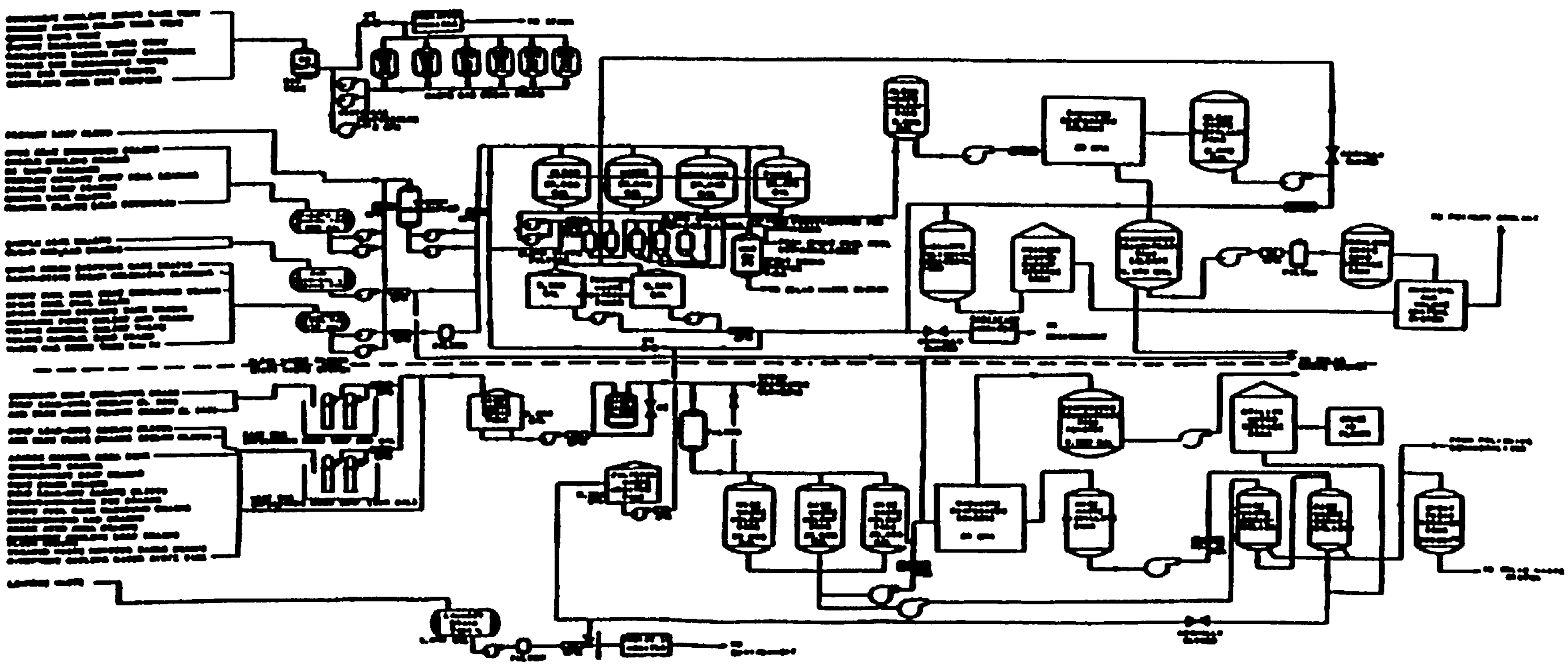
System Diagrams

APPENDIX A


SERVICE WATER
WASTE IN
PLANT AIR
CHILLER SKID
CONDENSATE SKID
STEAM SKID
HEPA
HX-1
HX-2
T-1
CCTV
PRODUCT WATER

APPENDIX A

A-2 RADWASTE SYSTEM FLOW DIAGRAM



APPENDIX B

Consumers Energy
Palisades Nuclear Plant

PROCESS CONTROL PROGRAM (PCP)

Relocated Technical Specifications
(per NRC Generic Letter 89-01)
(dated January 31, 1989)

Relocated Technical Specifications

Introduction

The NRC, through 10CFR 50.36a, requires implementation of Technical Specifications on effluents from nuclear power plants. NRC Generic Letter 89-01, dated January 31, 1989, allowed the relocation of the existing procedural requirements from the Technical Specifications (implemented in Amendment 85, November 9, 1984). The relocated procedural requirements pertaining to solid radwaste follow below. Programmatic controls are retained in the Administrative Controls section of the Technical Specifications to satisfy the regulatory requirements of 10CFR 50.36a. The Technical Specifications programmatic controls include requirements for the establishment, implementation, maintenance, and changes to the Process Control Program (PCP), as well as record retention and reporting requirements.

Definitions

The Technical Specification's definition of the PCP is:

The Process Control Program (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 10CFR Parts 20, 61, and 71, state regulations, burial ground requirements, and other requirements governing the disposal of solid radioactive waste.

Solidification shall be the conversion of radioactive wastes from liquid systems to a homogeneous (uniformly distributed), monolithic, immobilized solid with definite volume and shape, bounded by a stable surface of distinct outline on all sides (free-standing).

Requirements

The solid radwaste system shall be used in accordance with the PCP to process wet radioactive wastes to meet shipping and burial ground requirements.

Action

With the provisions of the PCP not satisfied, suspend shipments of defectively processed or defectively packaged solid radioactive wastes from the site.

Surveillance Requirements

The Process Control Program shall be used to verify the solidification of at least one representative test specimen from at least every tenth package of each type of wet radioactive waste (eg, filter sludges, spent resins, evaporator bottoms, and boric acid solutions).

a. If any test specimen fails to verify solidification, the solidification of the package under test shall be suspended until such time as additional test specimens can be obtained, alternative solidification parameters can be determined in accordance with the Process Control Program and a subsequent test verifies solidification. Solidification of the package may then be resumed using the alternative solidification parameters determined by the Process Control Program.

b. If the initial test specimen from a package of waste fails to verify solidification, the Process Control Program shall provide for the collection and testing of representative test specimens from each consecutive package of the same type of wet waste until at least 3 consecutive initial test specimens demonstrate solidification. The Process Control Program shall be modified as required, as provided in the Technical Specification Chapter 5, Section 5.5.15, to assure solidification of subsequent packages of waste.

BASES

Solid Radioactive Waste

The Process Control Program implements the requirements of 10CFR Part 50.36a and General Design Criterion 60 of Appendix A to 10CFR Part 50. The process parameters included in establishing the Process Control Program may include, but are not limited to, waste type, waste pH, waste/liquid/solidification agent/catalyst ratios, waste oil content, waste principal chemical constituents, and mixing and curing times.

Reporting Requirements

The Radiological Effluent Release Report, pursuant to the Plant Technical Specifications, shall include the following information for each class of solid waste (as defined by 10CFR Part 61) shipped offsite during the report period. (Additional details of the report are contained in the Offsite Dose Calculation Manual.)

a. Container burial volume.

b. Total curie quantity (specify whether determined by measurement or estimate).

c. Principal radionuclides (specify whether determined by measurement or estimate).

d. Source of waste and processing employed (eg, dewatered spent resin, compacted dry waste, evaporator bottoms).

e. Type of container (eg, LSA, Type A, Type B, Large Quantity).

f. Solidification agent or absorbent (eg, cement, asphalt).

g. Any changes made during the reporting period to the PCP pursuant to the Plant Technical Specifications.

Major Modifications to Radioactive Solid Waste Treatment System

Licensee initiated major modifications to the radioactive solid waste systems:

1. Shall be reported to the NRC pursuant to 10CFR 50.59. The discussion of each modification shall contain:

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

    b. A description of the equipment, components, and processes involved and the interface with other Plant systems.

    c. Documentation of the fact that the modification was reviewed and found acceptable by the PRC.

2. Shall become effective upon review and acceptance by the Plant Manager.

ATTACHMENT 8

Nuclear Management Company, LLC
Palisades Plant
Docket 50-255

RADIOACTIVE EFFLUENT RELEASE REPORT
OFFSITE DOSE CALCULATION MANUAL

133 Double-Sided Pages Follow

50.59 SCREEN

Page 1 of 2 SDR Log No 01-1254

I. **Activity/Document No** ODCM **Revision No** 17

Title Offsite Dose Calculation Manual

Brief Description of Activity (What Is Being Changed and Why) Update Tables 1.4 and 1.4a. These Tables are updated (annually) at the completion of the Land Use Census. Table 1.4 shows the location of all critical receptors, in all nine sectors out to five miles. Several critical receptor locations changed. The only change made to Table 1.4a was the date in the Table header. Continued [ ]

II. **50.59 Screening Questions (Check Correct Response)**
(See Attachment 6 for Guidance)

List the documents (UFSAR, Technical Specifications, and other documents) reviewed where relevant information was found, including section numbers: ODCM, ODCM appendix A, Technical Specification 5.5.1, 5.5.4, UFSAR sections 2.6, 2.6.5, 2.6.6 Continued [ ]

Identify relevant UFSAR design functions: 2.6, 2.6.6 operational environmental survey utilized to compare dose to man from operation of the facility to the preoperational environmental survey. The environmental survey will remain flexible so future adjustments can be made. Finding a critical food chain pathway or vector may justify the elimination or addition of samples. Continued [X]

1. Does the proposed activity involve a change to an SSC that adversely affects an UFSAR described design function? ____Yes X No
2. Does the proposed activity involve a change to a procedure that adversely affects how UFSAR described SSC design functions are performed or controlled? ____Yes X No
3. Does the proposed activity involve revising or replacing an UFSAR described evaluation methodology that is used in establishing the design bases or used in the safety analyses? ____Yes X No
4. Does the proposed activity involve a test or experiment not described in the UFSAR, where an SSC is utilized or controlled in a manner that is outside the reference bounds of the design for that SSC or is inconsistent with analyses or descriptions in the UFSAR? ____Yes X No
5. Does the proposed activity require a change to the Technical Specifications? ____Yes X No

III. If all questions are answered NO, then implement the activity without performing a 50.59 Evaluation or obtaining NRC approval.
If question 5 is answered YES, then a License Amendment must be obtained from the NRC prior to implementation of the activity.
If question 5 is answered NO and question 1, 2, 3 or 4 is answered YES, then a 50.59 Evaluation shall be performed.

IV. Provide an overall justification for the answers to the screening questions. ODCM Table 1.4 lists the results of the 2000 Land Use Census. Several receptors have changed (locations of gardens closer to the facility, the addition of beef cattle etc) since the previous census. ODCM Table 1.4a lists the critical receptors. These have not changed since the previous survey. Critical receptors (nearest residence, garden, beef cattle, dairy cow, and goats) determine the maximum doses to an individual offsite, and is reported to the NRC annually. Critical receptors determine the parameters for the maximum whole body and organ dose that an offsite individual could receive from Plant effluents. These are updated annually after a Land Use Census is conducted in an area within a 10 mile radius of the Plant site. The critical receptors determined for 2002, have not changed from those utilized in 2001. This ensures that the Continued [X]

V. **Screen Signoffs** Screen Preparer: [signature] Date: 10/30/01

Screen Reviewer: [signature] Date: 10/30/01

50.59 SCREEN

II. **50.59 Screening Questions (Check Correct Response)**
(See Attachment 6 for Guidance)

Identify relevant UFSAR design functions:(Continued) ODCM Appendix A III. J4 b, Ensure that changes in the use of areas at and beyond the site boundary are identified and that modifications to the radiological environmental program are made if required by results of the census.

IV. **Provide an overall justification for the answers to the screening questions.**
(Continued)

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, will be maintained. The accuracy of effluent, dose, or setpoint calculations are not effected.

This ODCM revision does not involve any change to an SSC, or procedure that would adversely affect an UFSAR design function, nor does it involve evaluation methodology or tests or experiments as described in the UFSAR.

ODCM
Revision 17
Issued Date 1/8/02

PALISADES NUCLEAR PLANT
OFFSITE DOSE CALCULATION MANUAL

TITLE: OFFSITE DOSE CALCULATION MANUAL

[signature] 1/2/2002
Procedure Sponsor Date

JLBeer / 10/25/01
Technical Reviewer Date

N/A /
User Reviewer Date

[signature] / 1/03/02
Plant Manager - Operations Date

PALISADES NUCLEAR PLANT
OFFSITE DOSE CALCULATION MANUAL

Revision 17

Table of Contents

PALISADES NUCLEAR PLANT
OFFSITE DOSE CALCULATION MANUAL

Revision 17

Table of Contents

I. GASEOUS EFFLUENTS

A. ALARM/TRIP SETPOINT METHOD

Appendix A, Section III.B.1 requires that 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:

- For noble gases: Less than or equal to 500 mrems/yr to the total body and less than or equal to 3000 mrems/yr to the skin, and
- For iodine-131, for iodine-133, for tritium, and for all radionuclides in particulate form with half lives greater than 8 days: Less than or equal to 1500 mrems/yr to any organ.

Appendix A, Section III.A.1 requires gaseous effluent monitors to have alarm/trip setpoints to ensure that offsite concentrations, when averaged over 1 hour, will not be greater than Appendix A, Section III.B.1. This section of the ODCM describes the methodology that will be used to determine these setpoints.

The methodology for determining alarm/trip setpoints is divided into two major parts. The first consists of calculating an allowable concentration for the nuclide mixture to be released. The second consists of determining monitor response to this mixture in order to establish the physical settings on the monitors.

1. **Allowable Concentration**

The total EC-fraction (R_k) for each release point will be calculated by the relationship defined by Note 4 of Appendix B, 10 CFR 20:

$$R_{(k)} = \left(\frac{X}{Q}\right) (F) \sum_i \frac{C_i}{EC_i} = \leq 5.0 \qquad (1.1)$$

If gaseous tritium and noble gasses are not present then:

$R_{(k)} \leq 10$

where:

C_i = Actual or measured concentration, at ambient temperature and pressure of nuclide i (μCi/cc)

EC_i = The EC of nuclide i from 10 CFR 20, Appendix B, Table 2

$R_{(k)}$ = The total EC-fraction for release point k

X/Q = Most conservative sector site boundary dispersion (sec/m^3) - Table 1.3

F' = Release flow rate (83,000 cfm = 39.2 m^3/sec) for stack monitor considerations; variable for other monitors

NOTE: If a batch release is made while a continuous release or another batch release is in progress, the sum of all values of R_k must be less than 5.0.

2. **Monitor Response**

Normal radioactivity releases consist mainly of well-decayed fission gases. Therefore, monitor response calibrations are performed to fission gas typical of normal releases (mainly Xe-133). Response of monitors used to define fission product release rates under accident conditions may vary from that of Xe-133, however. Monitor response for the two categories of monitor is determined as follows:

a. Normal Release (aged fission gasses)

Total gas concentration (μCi/cc) at the monitor is calculated. The calibration curve or constant for cpm/μCi/cc) is applied to determine cpm expected. The setting for monitor alarms is established at some factor (b) greater than 1 but less than $1/R_k$ (Equation 1.1) times the measured concentration (c):

$$s = b \times c \tag{1.2}$$

b. Accident Releases

Monitors are preset to alarm at or before precalculated offsite dose rates would be achieved under hypothetical accident conditions. These setpoints are established in accordance with Emergency Plan requirements for defining Emergency Action Levels and associated actions. Emergency Implementing Procedures contain monitor-specific curves or calibration constants for conversion between cpm and μCi/cc (or R/hr and μCi/cc), depending on monitor type, for fission product mixtures as a function of mixture decay time.

When these monitors are utilized for other than accident conditions, either an appropriately decayed "accident" conversion curve may be used, or a decayed fission gas calibration factor may be applied. In these cases, setpoints are established as in 1.A above.

Setpoints of accident monitors (if set to monitor normal releases) are reset to the accident alarm settings at the end of normal release. Setpoints of other release monitors are maintained at the level used at the latest release (well below the level which would allow 10 times EC to be exceeded at the site boundary), or are reset to approximately three times background in order to detect leakage or inadvertent releases of low level gases.

B. DOSE RATE CALCULATION

1. Dose rates are calculated for (1) noble gases and (2) iodines and particulates. Dose rates as defined in this section are based on 10 CFR 50 Appendix I limits of mrem per quarter and millirem per year. All dose pathways of major importance in the Palisades environs are considered.

   a. Equations and assumptions for calculating doses from noble gases are as follows:

      1) Assumptions

         a) Doses to be calculated are the maximum offsite point in air, total body and skin.

         b) Exposure pathway is submersion within a cloud of noble gases.

         c) Noble gas radionuclide mix is based on the historically observed source term given in Table 1.1, plus additional nuclides.

         d) Basic radionuclide data are given in Table 1.2.

         e) All releases are treated as ground-level.

         f) Meteorological data expressed as joint-frequency distribution of wind speed, wind direction, and atmospheric stability for the period resulting in X/Q's and D/Q's shown in Table 1.3.

g) Raw meteorological data consists of wind speed and direction measurements at 10m and temperature measurements at 10m and 60m.

h) Dose is to be evaluated at the offsite exposure points where maximum concentrations are expected to exist (overland sector site boundaries), and nearest residents.

i) Potential maximum population (resident) exposure points are identified in Table 1.4.

j) A semi-infinite cloud model is used.

k) For person exposures, credit is taken for shielding by residence (factor of 0.7).

l) Radioactive decay is considered for the plume.

m) Building wake effects on effluent dispersion are considered.

n) A sector-average dispersion equation is used.

o) The wind speed classes that are used are as follows:

Wind Speed Class Number	Range (m/s)	Midpoint (m/s)
1	0.0-0.4	0.2
2	0.4-1.5	0.95
3	1.5-3.0	2.25
4	3.0-5.0	4.0
5	5.0-7.5	6.25
6	7.5-10.0	8.75
7	> 10.0	--

p) The stability classes that will be used are the standard A through G classifications. The stability classes 1-7 will correspond to A=1, B=2, ..., G=7.

q) Terrain effects are not considered.

2) Equations

To calculate the dose for any one of the exposure points, the following equations are used.

For determining the air concentration of any radionuclide:

$$X_I = \sum_{j=1}^{9} \sum_{k=1}^{7} \left(\frac{2}{\pi}\right)^{1/2} \frac{fjk \quad Q_I \quad p}{\sum zkU^{J} \quad (2\pi x/n)} \left[\exp^{-} \left(\lambda i \frac{x}{u_j}\right)\right] \quad (1.3)$$

where:

X_i = Air concentration of radionuclide i, μCi/m^3.

f_{jk} = Joint relative frequency of occurrence of winds in wind speed class j, stability class k, blowing toward this exposure point, expressed as a fraction.

Q_i = Average release rate of radionuclide i, μCi/s.

p = Fraction of radionuclide remaining in plume.

Σ_{zk} = Vertical dispersion coefficient for stability class k (m).

^{u}j = Midpoint value of wind speed class interval j, m/s.

x = Downwind distance, m.

n = Number of sectors, 16.

λ_i = Radioactive decay coefficient of radionuclide i, s^{-1}.

$2\pi x/n$ = Sector width at point of interest, m.

For determining the total body dose rate:

$$D_{TB} = \sum_i X_i \; DFB_i \qquad (1.4)$$

where:

D_{TB} = Total body dose rate, mrem/y.

X_i = Air concentration of radionuclide I, $\mu Ci/m^3$.

DFB_i = Total body dose factor due to gamma radiation, mrem/y per $\mu Ci/m^3$ (Table 1.5).

For determining the skin dose rate:

$$D_s = \sum_i X_i \left(DFS_i + 1.11 \; DFY_i \right) \qquad (1.5)$$

where:

D_s = Skin dose rate, mrem/y.

X_i = Air concentration of radionuclide i, $\mu Ci/m^3$

DFS_i = Skin dose factor due to beta radiation, mrem/y per $\mu Ci/m^3$ (Table 1.5).

1.11 = The average ratio of tissue to air energy absorption coefficients, mrem/mrad.

DFY_i = Gamma-to-air dose factor for radionuclide i, mrad/y per $\mu Ci/m^3$ (Table 1.5).

For determining dose rate to a point in air:

$$D_a = \sum_i X_i \left(DFY_i \text{ or } DFB_i\right) \tag{1.6}$$

where:

D_a = Air dose rate, mrad/yr.

DFB_i = Air dose factor for beta radiation (Table 1.5).

b. Equations and assumptions for calculating doses from radioiodines and particulates are as follows:

1) Assumptions

a) Dose is to be calculated for the critical organ, thyroid, and the critical age groups (adult, teen, child, infant), infant (milk) and child (green, leafy vegetables).

b) Exposure pathways from iodines and particulates are milk ingestion, ground contamination, green leafy vegetables from home gardens, and inhalation.

c) The radioiodine and particulate mix is based on the historically observed source term given in Table 1.1.

d) Basic radionuclide data are given in Table 1.2.

e) All releases are treated as ground-level.

f) Mean annual average X/Q's are given in Table 1.3.

g) Raw meteorological data for ground-level releases consist of wind speed and direction measurements at 10m and temperature measurements at 10m and 60m.

h) Dose is to be evaluated at the potential offsite exposure points where maximum doses to man are expected to exist.

i) Real cow, goat and garden locations are considered.

j) Potential maximum exposure points (Table 1.4) considered are the nearest cow, goat, and home garden locations in each sector.

k) Terrain effects and open terrain recirculation factors are not considered.

l) Building wake effects on effluent dispersion are considered.

m) Plume depletion and radioactive decay are considered for air-concentration calculations.

n) Radioactive decay is considered for ground-concentration calculations.

o) Deposition is calculated based on the curves given in Figure 1.2.

p) Milk cows and goats obtain 100% of their food from pasture grass May through October of each year. Use default values of 0.58 for cows and 0.67 for goats for fraction of year on pasture.

q) Credit is taken for shielding by residence (factor of 0.7).

2) Equations

To calculate the dose for any one of the potential maximum-exposure points, the following equations in Section 1.2.2 are used.

a) Inhalation

Equation for calculating air concentration, X_i is the same as in the Noble Gas Section (Equation 1.3).

For determining the organ dose rate:

$$D_i = 1 \times 10^6 \sum_i X_i \, DFI_i \, BR \quad (1.7)$$

where:

D_i = Organ dose rate due to inhalation, mrem/y.

X_i = Air concentration of radionuclide i, $\mu Ci/m^3$.

DFI_i = Inhalation dose factor, mrem/pCi (Table 1.7).

BR = Breathing rate 1400 m^3/y infant; 3700 m^3/y child; or 8000 m^3/y teen and adult.

1×10^6 = pCi/μCi conversion factor.

b) Ground Contamination

For determining the ground concentration of any nuclide;

$$G_i = 3.15 \times 10^7 \sum_{k=1}^{7} \frac{f_k\, Q_i\, DR}{(2\pi x/n)\lambda_i} [1 - \exp - (\lambda_i\, t_b)]$$

(1.8)

where:

G_i = Ground concentration of radionuclide i, μCi/m^2.

k = Stability class.

f_k = Joint relative frequency of occurrence of winds in stability class k blowing toward this exposure point, expressed as a fraction.

Q_i = Average release rate of radionuclide i, μCi/s.

DR = Relative deposition rate, m^{-1} (Fig 1.2).

x = Downwind distance, m.

n = Number of sectors, 16.

$2\pi x/n$ = Sector width at point of interest, m.

λ_i = Radioactive decay coefficient of radionuclide i, y^{-1}.

t_b = Time for buildup of radionuclides on the ground, 15 y.

3.15×10^7 = s/y conversion factor.

Figure 1.2

Corrected
January 1977

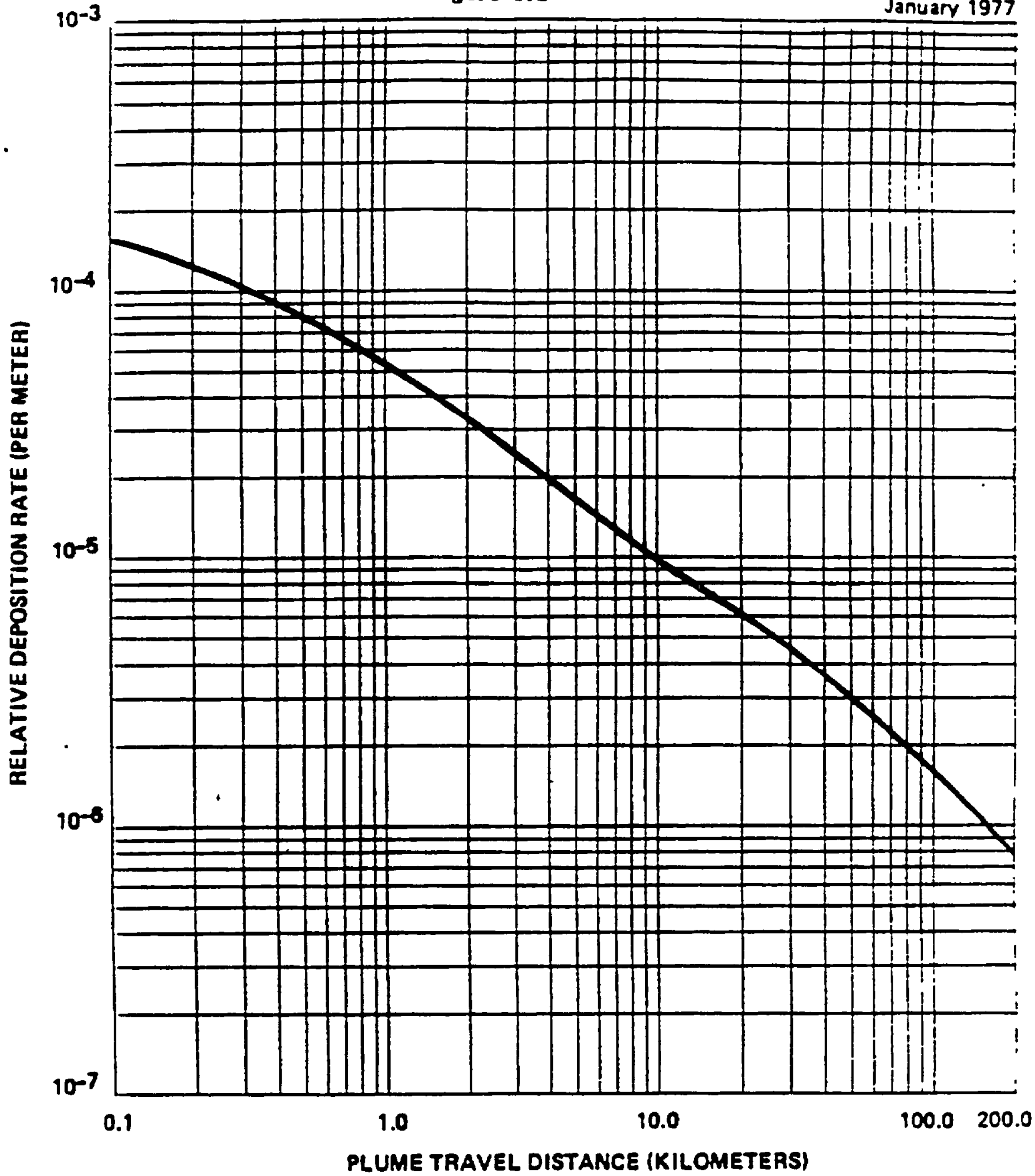


Figure 7. Relative Deposition for Ground Level Releases (All Atmospheric Stability Classes)

For determining the total body or organ dose rate from ground contamination:

$$D_G = (8{,}760)(1 \times 10^6)(0.7) \sum_i G_i \, DFG_i \qquad (1.9)$$

where:

D_G = Dose rate due to ground contamination, mrem/y.

G_i = Ground concentration of radionuclide i, μCi/m^2.

DFG_i = Dose factor for standing on contaminated ground, mrem/h per pCi/m^2 (Table 1.8).

8,760 = Occupation time, h/y.

1×10^6 = pCi/μCi conversion factor.

0.7 = Shielding factor accounting for a distance of 1.0 meter above ordinary ground, dimensionless.

c) Milk and Vegetation Ingestion

For determining the concentration of any nuclide (except C-14 and H-3) in and on vegetation:

$$CV_i = 3{,}600 \sum_{k=1}^{7} \frac{f_k \, Q_i \, DR}{(2\pi x/n)} \left(\frac{r[1 - \exp(-\lambda_{Ei} t_e)]}{Y_v \, \lambda_{Ei}} + B_{iv}\left[\frac{1 - \exp}{P\lambda_i}(-\lambda_i t_b)\right] \right) \left[\exp^{-}(\lambda_i t_h)\right] \qquad (1.10)$$

where:

CV_i = Concentration of radionuclide i in and on vegetation, μCi/kg.

k = Stability class.

f_k	=	Frequency of this stability class and wind direction combination, expressed as a fraction.
Q_i	=	Average release rate of radionuclide i, μCi/s.
DR	=	Relative deposition rate, m^{-1} (Figure 1.2).
x	=	Downwind distance, m.
n	=	Number of sectors, 16.
$2\pi x/n$	=	Sector width at point of interest, m.
r	=	Fraction of deposited activity retained on vegetation (1.0 for iodines, 0.2 for particulates).
λEi	=	Effective removal rate constant, $\lambda Ei = \lambda_i + \lambda_w$, where λ_i is the radioactive decay coefficient, h^{-1}, and λ_w is a measure of physical loss by weathering (λ_w = 0.0021 h^{-}).
t_e	=	Period over which deposition occurs, 720 h.
Y_v	=	Agricultural yield, 0.7 kg/m^2.
B_{iv}	=	Transfer factor from soil to vegetation of radionuclide i (Table 1.6).
λ_i	=	Radioactive decay coefficient of radionuclide i, h^{-1}.
t_b	=	Time for buildup of radionuclides on the ground, 1.31×10^5 h (15Y).

p = Effective surface density of soil, 240 kg/m^2.

3,600 = s/h conversion factor.

t_h = Holdup time between harvest and consumption of food (2,160 hours for stored food).

For determining the concentration of C-14 in vegetation:

$$CV_{14} = 1 \times 10^3 X_{14} (0.11/0.16) \quad (1.11)$$

where:

CV_{14} = Concentration of C-14 in vegetation, μCi/kg.

X_{14} = Air concentration of C-14, μCi/m^3.

0.11 = Fraction of total Plant mass that is natural carbon.

0.16 = Concentration of natural carbon in the atmosphere, g/m^3.

1×10^3 = g/kg conversion factor.

For determining the concentration of H-3 in vegetation:

$$CV_T = 1 \times 10^3 X_T (0.75)(0.5/H) \quad (1.12)$$

where:

CV_T = Concentration of H-3 in vegetation, μCi/m^3.

X_T = Air concentration of H-3, μCi/m^3.

0.75 = Fraction of total Plant mass that is water.

0.5 = Ratio of tritium concentration in Plant water to tritium concentration in atmospheric water.

H = Absolute humidity of the atmosphere, g/m^3.

1×10^3 = g/kg conversion factor.

For determining the concentration of any nuclide in cow's or goat's milk:

$$CM_i = CV_i \, FM_i \, Q_f \exp(-\lambda_i t_f) \qquad (1.13)$$

where:

CM_i = Concentration of radionuclide i (including C-14 and H-3) in milk, μCi/ℓ.

CV_i = Concentration of radionuclide i in and on vegetation, μCi/kg.

FM_i = Transfer factor from feed to milk for radionuclide i, d/ℓ (Table 1.6).

Q_f = Amount of feed consumed by the milk animal per day, kg/d (cow, 50 kg/d or goat 6 kg/d).

λi = Radioactive decay coefficient of radionuclide i, d^{-1}.

t_f = Transport time of activity from feed to milk to receptor, 2 days.

For determining the organ dose rate from ingestion of green leafy vegetables and milk:

$$D = 1 \times 10^6 \sum_i CM_i \, DF_i \, UM \quad (1.14)$$

where:

D = Organ dose rate due to ingestion, mrem/y.

CM_i = Concentration of radionuclide i in vegetables or milk, μCi/kg (or liters).

DF_i = Ingestion dose factor, mrem/pCi (Table 2.1).

UM = Ingestion rate for milk, 330 ℓ/y; for vegetables 26 kg/yr (child), no ingestion by infant.

1×10^6 = pCi/μCi conversion factor.

d) Meat Ingestion (Beef)

To calculate the concentration of a nuclide in animal flesh:

$$C_{fi} = F_{fi} \; CV_i \; Q_{fi} \; \exp(\lambda_i{}^t s) \quad (1.15)$$

where:

C_{fi} = Concentration of nuclide i in the animal flesh, pCi/kg.

F_{fi} = Fraction of animal's daily intake which appears in each kg of flesh, days/kg (Table 1.6).

CV_i = Concentration of radionuclide i in the animal's feed (Equation 1.10).

Q_f = Amount of feed consumed by the cow per day, 50 kg/d.

t_s = Average time from slaughter to consumption, 20 days.

To determine the organ dose from ingestion of beef:

$$D^f = \sum_i C_{fi} D_{fi} U_f \quad (1.16)$$

where:

D_{fi} = Ingestion dose factor for age group, mrem/pCi (Table 2.1) for nuclide i.

U_f = Ingestion rate of meat for age group, kg/y (child-41, teen-65, adult-110).

e) Organ Dose Rates

For determining the total body and organ dose rate from iodines and particulates:

$$D = D_I + D_G + D_M + D_V + D_F \quad (1.17)$$

where:

D = Total organ dose rate, mrem/y.

D_I = Dose rate due to inhalation, mrem/y.

D_G = Dose rate due to ground contamination, mrem/y.

D_M = Dose rate due to milk ingestion, mrem/y.

D_V = Dose rate due to vegetable ingestion, mrem/y.

D_F = Dose rate due to beef ingestion, mrem/y.

3) The maximum organ dose rate, maximum total body dose rate, and maximum skin dose rate calculated in the previous section (Sec I.B) are used to calculate design basis quantities as described in Section I.B.1.3.

c. Design Basis Quantities

The design basis quantity of a radionuclide emitted to the atmosphere is the amount of that nuclide, when released in one year, which would result in a dose not exceeding any of the following:

1) 15 millirem to any organ of an individual from iodines and particulates with half-life greater than 8 days (Appendix A, Section III.D.1).

2) 15 millirem to skin of an individual from noble gas (Appendix A, Section III.C.1.b).

3) 5 millirem to the total body of an individual from noble gas (Appendix A, Section III.C.1.a).

Design basis quantity (Ci) is the smallest value for each nuclide, calculated by dividing the dose limits (a through c above) by the appropriate dose calculated from the amount of radionuclide (Ci) used to conservatively estimate the doses of Section D, as listed in Table 1.1 (or a hypothetical 1 Ci/year); the result is then multiplied by the amount of radionuclide used.

$$DBQ = \frac{D_{AI}}{D_c}(C_c) \qquad (1.18)$$

where:

D_{AI} = Appendix I dose limit (mrem or mrad).

D_c = Calculated dose (mrem or mrad).

C_c = Quantity of nuclide resulting in dose D_c (Ci).

DBQ = Design Basis Quantity (Ci).

The limiting values for Design Basis Quantities for radionuclides released to the atmosphere are given in Table 1.9.

The inverse of the ratio C_c/D_c in the above equation (ie, D_c/C_c) is a useful value, since it represents the most limiting dose per unit quantity of each nuclide released. Use of the D_c/C_c ratio in quarterly evaluation of offsite dose is discussed in Section D. Values of D_c/C_c are given in Table 1.9.

d. Land Use Census and DBQ Changes

Appendix A, Sections J.3.b and J.3.c describe the requirements for an annual land use census and revision of the ODCM for use in the following calendar year. Areas of the ODCM which will be reviewed, and changed if appropriate, are Table 1.4 (Land Use Census Data by Sector), Table 1.4a (Critical Receptors), and Table 1.9 (Gaseous Design Basis Objective Annual Quantities). Changes will be effective on January 1 of the year following the year of the survey.

e. Gaseous Releases From the Steam Generator Blowdown Vent and Atmosphere Release Valves

Releases from the steam generator blowdown vent and atmospheric relief valves are difficult to quantify as there are no sampling capabilities on these steam release systems. However, neither system is a normal release path. The steam generator blowdown vent is normally routed to the main condenser and recirculated. Radioactive releases will be calculated by analyzing steam generator blowdown liquid and assuming that 100 percent of Noble Gases, 10 percent of the Iodines and 1 percent of the Particulates will be released to the environment in the steam phase. Volumes will be released to the environment in the steam phase. Volumes will be calculated using water balances or alternate means as available.

C. DESIGN OBJECTIVE QUANTITY (DBQ) LIMITS ON BATCH AND CONTINUOUS RELEASES

1. **Batch Releases**

Prior to each batch release (waste decay tank release or Containment purge), the quantity of each nuclide identified is summed with the quantity of that nuclide released since the first of the current calendar year. The cumulative total for each nuclide then is divided by the design objective quantity for each nuclide (from Table 1.9), and the resultant fractions are summed in order to assure that the sum fraction of all nuclides does not exceed 1.0:

$$\sum_i \frac{Ai}{(DBQ)_i} < 1.0 \qquad (1.19)$$

The amount in any calendar quarter should not exceed 0.5. This is checked by subtracting the value obtained at the end of the previous quarter from the value obtained from the cumulative total to date, including the batch to be released.

2. Continuous Releases

Low level continuous releases from the vent gas collection header and other low level sources are totaled on a weekly basis and summed with any batch releases for the week in order to establish the cumulative DBQ fraction from batch plus continuous released for the year-to-date. Calculations are performed in the same manner as for batch releases described in C.1.

3. Exceeding DBQ Limits

As discussed under B.1.3, the DBQ is a very conservative estimate of activity which could give doses at Appendix I limits. Because different organs are summed together and doses to different people are summed, the DBQ typically overestimates dose by about a factor of five. Thus, if calculations of DBQ fraction exceed 1.0 for year-to-date or 0.5 for the quarter, technical specifications probably still would not be exceeded. However, further discretionary releases should be deferred until an accurate assessment of dose is made by use of GASPAR computer code or by analysis of appropriate release data via the segment gaussian dose model used in emergency planning (inhalation dose, total body external dose, and boundary dose in air). See also Section D.1.2.

It should be noted that Palisades Plant to date (based on review of semiannual effluent data) has never exceeded the annual or quarterly DBQ fraction, despite its conservatism. Thus, it is not expected that an alternate to the DBQ method will be required unless the Plant is in a significantly off-normal condition.

4. Releasing Radionuclides Not Listed in Table 1.9

Table 1.9 contains all nuclides identified to date as routine constituents of gaseous releases at Palisades Plant, plus those common to PWRs in general, even if not previously detected at Palisades. From time to time, however, other nuclides may be detected.

If the unlisted nuclide constitutes less than 10% of the EC-fraction for the release, and all unlisted nuclides total less than 25% of the EC-fraction, the nuclide may be considered not present.

If the unlisted nuclide constitutes greater than 10% of the EC-fraction, or all unlisted nuclides together constitute greater than 25%, then each nuclide should be assigned a DBQ equal to the most conservative value listed for the physical form of the nuclide involved (noble gas, halogen, or particulate).

Should a nuclide not listed in Table 1.9 begin to appear in significant quantities on a routine basis, revision to this ODCM should be made in order to include a design basis quantity specific to that nuclide.

D. OPTIONAL QUARTERLY DOSE CALCULATIONS

1. Methodology for Optional Quarterly Dose Calculations

This option may be used in place of, or in addition to, the Design Basis Quantity (DBQ) fraction calculation described by Equation 1.19. This optional conservative calculation relates the DBQ fraction to the doses from which it was originally derived. Use of this method may assist in identification of the critical dose pathway or characteristics of the assumed critical individual (infant, child, teen, and adult), since Table 1.9 indicates these parameters.

a. Simplified Conservative Approach

This method utilizes a limiting dose concept such that the limiting dose for each nuclide is summed with the limiting dose for each other nuclide, regardless if such sum is physically possible. It also assumes critical pathways, such as milk and vegetables, are in effect even in winter when the pathway is absent.

As such, the method is highly conservative and significantly over-estimates dose. If limits appear to be exceeded by this method, Section D.1.2 (a concise method, but requiring computer support) will be utilized.

1) Assumptions

a) All assumptions of Section 1.1 are utilized.

b) Limiting doses for each gaseous nuclide are summed, regardless of limiting decay mode (gamma or beta).

c) Limiting doses for each particulate and iodine nuclide are summed, regardless of dose point location, exposure pathway, or organ affected.

d) Doses are summed for detected nuclides such that all nuclides which contribute greater than 10% individually or 25% in aggregate, to the EC of released radioactivity, are included in the dose calculation.

2) Equations

For determining gaseous effluent dose:

$$D_G = \sum_{o}^{i} A_{iG}(D_c/C_c)_{iG} < 5 \text{ millirad/quarter, } 10 \text{ mrad/yr} \quad (1.20)$$

where:

DG = Dose from gaseous effluents (mrad).

A_{iG} = Quantity of gaseous nuclide i released (Ci).

$(D_c/C_c)_{iG}$ = Dose per Ci factor for gaseous nuclide i (mrad/Ci).

The limit for this mixture is conservatively taken as that for gamma exposure (5 mrem/quarter, 10 mrem/year) although as indicated in Table 1.9, a majority of the gaseous effluents are beta-limiting and on an individual basis have the higher limit of 10 millirem/quarter and 20 millirem/year.

For determining tritium, particulate and iodine dose to organs:

$$D_{TPI} = \sum^{i} A_{TPIi} \left(D_c/C_c\right)_{TPIi} < 7.5 \text{ mrem/q, } 15 \text{ mrem/y} \quad (1.21)$$

where:

D_{TPI} = Dose from particulates and iodines (mrem).

A_{TPIi} = Quantity of particulate or iodine nuclide i released (Ci).

$(D_c/C_c)_{TPIi}$ = Dose per Ci factor for particulate or iodine nuclide i (mrad/Ci).

b. Realistic Calculation

This methodology is to be used if the highly conservative calculations described in C.1 or D.1 yield values that appear to exceed applicable limits.

Doses for released particulates, iodines and noble gases will be determined by use of the NRC GASPAR computer code. The computer run will utilize the annual average joint frequency meteorological data based on not less than 3 years of meteorological measurement, and will reflect demographic and land use information from the land use survey generated in the most recent prior year. Where appropriate, seasonal adjustments will be applied to obtain realistic dose estimates since both recreational and agricultural activities can vary greatly in relation to season of the year.

An alternative to GASPAR for offsite dose calculation is the use of the Palisades Segmented Gaussian Plume Emergency offsite dose calculation program. This dose model allows evaluation of dose under the actual meteorological conditions present at the time of release. It is anticipated that the system may be used in major short-term releases such as Containment purges are to be made under conditions which depart significantly from mean annual conditions.

E. GASEOUS RADWASTE TREATMENT SYSTEM OPERATION

The gaseous radwaste treatment system (GRTS) described below shall be maintained and operated to keep releases ALARA.

1. System Description

A flow diagram for the GRTS is given in Figure 1-1. The system consists of three waste-gas compressor packages, six gas decay tanks, and the associated piping, valves, and instrumentation. Gaseous wastes are received from the following: degassing of the reactor coolant and purging of the volume control tank prior to a cold shutdown, displacing of cover gases caused by liquid accumulation in the tanks connected to the vent header, and boron recycle process operation.

Design of the system precludes hydrogen explosion by means of ignition source elimination (diaphragm valves, low flow diaphragm compressors and system electrical grounding), and minimization of leakage outside the system. Explosive mixtures of hydrogen and oxygen have been demonstrated compatible with the system by operational experience over the past 13 years.

2. Determination of Satisfactory Operation

Design basis quantity fraction will be calculated for batch and continuous releases as described in Section I.C. These calculations will be used to ensure that the GRTS is operating as designed. Because the Plant was designed to collect and hold for decay a vast majority of the high level gases generated within the primary system, and because the 13-year operating history (to date of writing the initial ODCM) of the Plant has demonstrated the system's consistent performance well below Appendix I limits, no additional operability requirements are specified.

F. **RELEASE RATE FOR OFFSITE EC**

10 CFR 20.1302 requires radioactive effluent releases to unrestricted areas be in concentrations less than the limits specified in Appendix B, Table 2 when averaged over a period not to exceed one year. (Note: there are no unrestricted areas anywhere within the site boundary as defined by Figure 1-1.) Concentrations at this level if inhaled or ingested continuously for one year will result in a dose of 50 mrem whole body except for submersion dose isotopes (gaseous tritium and noble gasses) which will results in a dose of 100 mrem whole body. 10 CFR 50.36a requires that the release of radioactive materials be kept as low as reasonably achievable. However, the section further states that the licensee is permitted the flexibility of operation, to assure a dependable source of power even under unusual operating conditions, to release quantities of material higher than a small percentage of 10 CFR 20.1302 limits but still within those limits. Appendix I to 10 CFR 50 provides the numerical guidelines on limiting conditions for operations to meet the as low as reasonably achievable requirement.

The GASPAR code has been run to determine the dose due to external radiation and inhalation. The source term used is listed in Table 1.1. The meteorology data is given in Table 1.3. Dose using annual average meteorology, to the most limiting organ of the person assume to be residing at the site boundary with highest X/Q, is 2.15E-02 mrem (for one year). The release rate which would result in a dose rate equivalent to 50 mrem/year (using the more conservative total body limit) is the curies/year given in Table 1.1 multiplied by 50/2.15E-02 or 0.11 Ci/sec.

G. PARTICULATE AND IODINE SAMPLING

Particulate an iodine samples are obtained from the continuous sample stream pulled from the Plant stack. Samples typically are obtained to represent an integrated release from a gas batch (waste gas decay tank or Containment purge, for example), or a series of samples are obtained to follow the course of a release. In any event, sample intervals are weekly, at a minimum.

Because HEPA filters are present between most source inputs to the stack and the sample point, releases of particulates normally are significantly less than pre-release calculations indicate. This provides for conservatism in establishing setpoints and in estimation of pre-release design basis quantity fraction. However, for the sake of maintaining accurate release totals, monitor results (for gases) and sample results (for particulates and iodines) utilized rather than the pre-release estimates, for cumulative records.

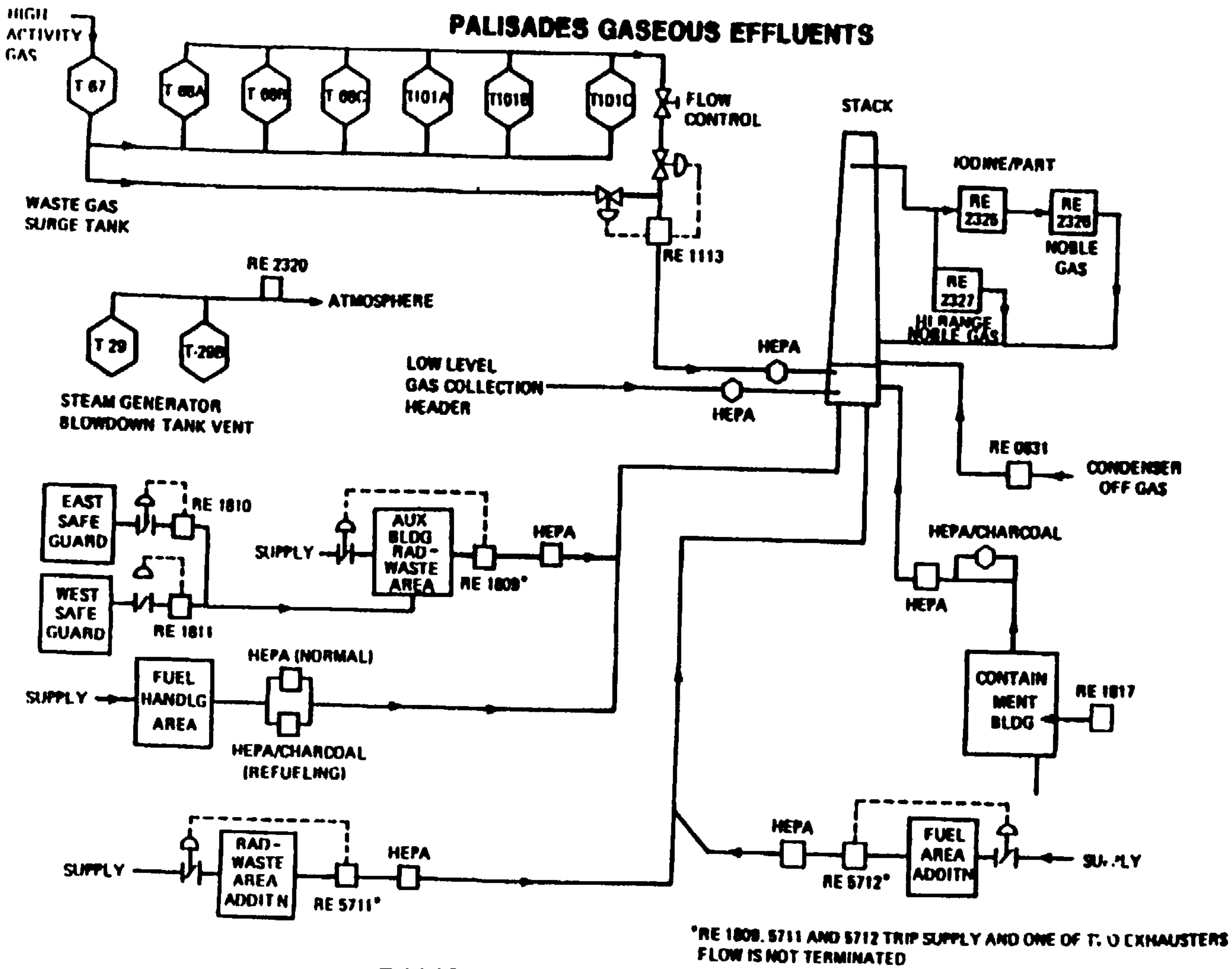
Gamma analytical results for particulate and halogen filters are combined for determination of total activity of particulates and halogens released. Beta and alpha counting also is performed on the particulate filters. Beta yields of the gamma isotopes detected on particulate filters are applied to determine "identified" beta, an the "identified" count rate is subtracted from the observed count rate to give "unidentified" beta. The "unidentified" beta is assumed to be Sr-90 until results on actual Sr-90 (chemically separated from a quarterly composite of filters) are obtained. Sampling and analysis will be performed per Appendix A, Table B-1 requirements.

H. NOBLE GAS SAMPLING

Noble gases will be sampled from Waste Gas Decay Tanks prior to release and the Containment prior to purging. Analysis of these samples will be used for accountability of noble gases. Off gas will be sampled at least weekly and used to calculate monthly noble gas releases. Nonroutine releases will be quantified from the stack noble gas monitor (RE 2326) which has a LLD of 1E-06 μCi/cc. Sampling and analysis will be performed per Appendix A, Table B-1 requirements.

I. TRITIUM SAMPLING

Tritium has a low dose consequence to the public because of low production rates. The major contributors to tritium effluents are evaporation from the fuel pool and reactor cavity (when flooded). Because of the low dose impact, gaseous tritium sampling will not be required. Tritium effluents will be estimated using conservative evaporation rate calculations from the fuel pool and reactor cavity.



PALISADES EFFLUENT FLOW PATHS
GASEOUS

TABLE 1.1
PALISADES GASEOUS AND LIQUID SOURCE TERMS, CURIES/YEAR (1)

Nuclide	Gaseous(2)	Liquid(2)
H-3	5.5	159
Kr-85	4.1	NA
Kr-85m	0.12	NA
Kr-87	8.4E-02	NA
Kr-88	2.1E-01	NA
Ar-41	3.1E-02	NA
Xe-131m	2.2	NA
Xe-133	1493	NA
Xe-133m	0.43	NA
Xe-135	1.11	NA
Xe-135m	0.3	NA
I-131	0.025	3.21E-03
I-132	2.91E-03	NA
I-133	6.5E-03	4.7E-05
I-134	4.8E-04	NA
I-135	1.84E-02	NA
Na-24	1.5E-06	NA
Cr-51	2.5E-04	3.9E-03
Mn-54	4.1E-04	7.8E-03
Co-57	2.1E-06	3.2E-05
Co-58	8.6E-04	2.9E-02
Fe-59	6.6E-06	4.1E-04
Co-60	1.1E-03	1.24E-02
Se-75	3.7E-06	NA
Nb-95	2.4E-05	4.53E-04
Zr-95	4.7E-06	1.79E-04
Mo-99	1.5E-07	NA
Ru-103	.3E-07	.1E-05
Sb-127	NA	3.5E-05
Cs-134	4.5E-05	0.7
Cs-136	NA	1.8E-06
Cs-137	2.6E-04	1.36E-02
Ba-140	2.8E-07	NA
La-140	7.5E-07	1.1E-04
Unidentified beta	3.9E-04	3.3E-03

(1) Data derived from taking the effluents released during July-December 1978 through January-June 1982 and dividing by 4.

(2) Nuclide values listed as NA have not been observed at detectable levels in these waste streams.

TABLE 1.2
BASIC RADIONUCLIDE DATA

	NUCLIDE	HALF-LIFE (days)	LAMBDA (1/s)	BETA[1] (MEV/DIS)	GAMMA[1] (MEV/DIS)
1	Tritium	4.49E 03	1.79E-09	5.68E-03	0.0
2	C-14	2.09E 06	3.84E-12	4.95E-02	0.0
3	N-13	6.94E-03	1.16E-03	4.91E-01	1.02E 00
4	O-19	3.36E-04	2.39E-02	1.02E 00	1.05E 00
5	F-18	7.62E-02	1.05E-04	2.50E-01	1.02E 00
6	NA-24	6.33E-01	1.27E-05	5.55E-01	4.12E 00
7	P-32	1.43E 01	5.61E-07	6.95E-01	0.0
8	AR-41	7.63E-02	1.05E-04	4.64E-01	1.28E 00
9	CR-51	2.78E 01	2.89E-07	3.86E-03	3.28E-02
10	MN-54	3.03E 02	2.65E-08	3.80E-03	8.36E-01
11	MN-56	1.07E-01	7.50E-05	8.29E-01	1.69E 00
12	FE-59	4.50E 01	1.78E-07	1.18E-01	1.19E 00
13	CO-58	7.13E 01	1.12E-07	3.41E-02	9.78E-01
14	CO-60	1.92E 03	4.18E-09	9.68E-02	2.50E 00
15	ZN-69m	5.75E-01	1.39E-05	2.21E-02	4.16E-01
16	ZN-69	3.96E-02	2.03E-04	3.19E-01	0.0
17	BR-84	2.21E-02	3.63E-04	1.28E 00	1.77E 00
18	BR-85	2.08E-03	3.86E-03	1.04E 00	6.60E-02
19	KR-85m	1.83E-01	4.38E-05	2.53E-01	1.59E-01
20	KR-85	3.93E 03	2.04E-09	2.51E-01	2.21E-03
21	KR-87	5.28E-02	1.52E-04	1.32E 00	7.93E-01
22	KR-88	1.17E-01	6.86E-05	3.61E-01	1.96E 00
23	KR-89	2.21E-03	3.63E-03	1.36E 00	1.83E 00
24	RB-88	1.24E-02	6.47E-04	2.06E 00	6.26E-01
25	RB-89	1.07E-02	7.50E-04	1.01E 00	2.05E-00
26	SR-89	5.20E 01	1.54E-07	5.83E-01	8.45E-05
27	SR-90	1.03E 04	7.79E-10	1.96E-01	0.0
28	SR-91	4.03E-01	1.99E-05	6.50E-01	6.95E-01
29	SR-92	1.13E-01	7.10E-05	1.95E-01	1.34E 00
30	SR-93	5.56E-03	1.44E-03	9.20E-01	2.24E 00
31	Y-90	2.67E 00	3.00E-06	9.36E-01	0.0
32	Y-91m	3.47E-02	2.31E-04	2.73E-02	5.30E-01
33	Y-91	5.88E 01	1.36E-07	6.06E-01	3.61E-03
34	Y-92	1.47E-01	5.46E-05	1.44E 00	2.50E-01
35	Y-93	4.29E-01	1.87E-05	1.17E 00	8.94E-02
36	ZR-95	6.50E 01	1.23E-07	1.16E-01	7.35E-01
37	NB-95m	3.75E 00	2.14E-06	1.81E-01	6.06E-02
38	NB-95	3.50E 01	2.29E-07	4.44E-02	7.64E-01
39	MO-99	2.79E 00	2.87E-06	3.96E-01	1.50E-01
40	TC-99m	2.50E-01	3.21E-05	1.56E-02	1.26E-01

TABLE 1.2 (continued)
BASIC RADIONUCLIDE DATA

	NUCLIDE	HALF-LIFE (days)	LAMBDA (1/s)	BETA[1] (MEV/DIS)	GAMMA[1] (MEV/DIS)
41	TC-99	7.74E 07	1.04E-13	8.46E-02	0.0
42	TC-104	1.25E-02	6.42E-04	1.60E 00	1 .95E 00
43	RU-106	3.67E 02	2.19E-08	1.01E-02	0.0
44	TE-132	3.24E 00	2.48E-06	1.00E-01	2.33E-01
45	I-129	6.21E 09	1.29E-15	5.43E-02	2.46E-02
46	I-131	8.05E 00	9.96E-07	1.94E-01	3.81E-01
47	I-132	9.58E-02	8.37E-05	4.89E-01	2.24E 00
48	I-133	8.75E-01	9.17E-06	4.08E-01	6.02E-01
49	I-134	3.61E-02	2.22E-04	6.16E-01	2.59E 00
50	I-135	2.79E-01	2.87E-05	3.68E-01	1.55E 00
51	XE-131m	1.18E 01	6.80E-07	1.43E-01	2.01E-02
52	XE-133m	2.26E 00	3.55E-06	1.90E-01	4.15E-02
53	XE-133	5.27E 00	1.52E-06	1.35E-01	4.60E-02
54	XE-135m	1.08E-02	7.43E-04	9.58E-02	4.32E-01
55	XE-135	3.83E-01	2.09E-05	3.17E-01	2.47E-01
56	XE-137	2.71E 03	2.96E-03	1.77E 00	1.88E-01
57	XE-138	9.84E-03	8.15E-04	6.65E-01	1.10E 00
58	CS-134	7.48E 02	1.07E-08	1.63E-01	1.55E 00
59	CS-135	1.10E 09	7.29E-15	5.63E-02	0.0
60	CS-136	1.30E 01	6.17E-07	1.37E-01	2.15E 00
61	CS-137	1.10E 04	7.29E-10	1.71E-01	5.97E-01
62	CS-138	2.24E-02	3.58E-04	1.20E 00	2.30E 00
63	BA-139	5.76E-02	1.39E-04	8.96E-01	3.53E-02
64	BA-140	1.28E 01	6.27E-07	3.15E-01	1.71E-01
65	LA-140	1.68E 00	4.77E-06	5.33E-01	2.31E 00
66	CE-144	2.84E 02	2.82E-08	9.13E-02	1.93E-02
67	PR-143	1.36E 01	5.90E-07	3.14E-01	0.0
68	PR-144	1.20E-02	6.68E-04	1.21E 00	3.18E 00

[1] Average energy per disintegration values were obtained from ICRP Publication No 38, Radionuclide Transformations: Energy and Intensity of Emissions 1983 and NUREG/CR-1413 (ORNL/NUREG-70), a Radionuclide Decay Data Base - Index and Summary Table, DC Kocher, May 1980.

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0   RUN DATE: 970513

***** PALISADES XOQDOQ82 ***** USING 01/01/92 - 12/31/96 MET DATA *****

GROUND LEVEL RELEASE - TOP OF CONTAINMENT BUILDING
NO DECAY, UNDEPLETED

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED)   DISTANCE IN MILES FROM THE SITE

SECTOR	0.250	0.500	0.750	1.000	1.500	2.000	2.500	3.000	3.500	4.000	4.500
S	4.208E-06	1.381E-06	7.556E-07	4.993E-07	2.782E-07	1.842E-07	1.340E-07	1.033E-07	8.298E-08	6.867E-08	5.813E-08
SSW	3.330E-06	1.086E-06	5.856E-07	3.870E-07	2.160E-07	1.437E-07	1.048E-07	8.108E-08	6.528E-08	5.413E-08	4.590E-08
SW	3.890E-06	1.242E-06	6.590E-07	4.333E-07	2.413E-07	1.614E-07	1.184E-07	9.203E-08	7.440E-08	6.191E-08	5.267E-08
WSW	4.060E-06	1.279E-06	6.715E-07	4.401E-07	2.450E-07	1.648E-07	1.215E-07	9.484E-08	7.694E-08	6.422E-08	5.477E-08
W	5.554E-06	1.759E-06	9.224E-07	6.035E-07	3.349E-07	2.249E-07	1.657E-07	1.292E-07	1.047E-07	8.735E-08	7.447E-08
WNW	7.378E-06	2.346E-06	1.235E-06	8.084E-07	4.487E-07	3.010E-07	2.216E-07	1.726E-07	1.399E-07	1.166E-07	9.937E-08
NW	9.531E-06	2.974E-06	1.551E-06	1.012E-06	5.610E-07	3.784E-07	2.800E-07	2.191E-07	1.781E-07	1.490E-07	1.273E-07
NNW	1.286E-05	3.959E-06	2.052E-06	1.339E-06	7.443E-07	5.039E-07	3.741E-07	2.935E-07	2.391E-07	2.003E-07	1.715E-07
N	1.087E-05	3.347E-06	1.739E-06	1.138E-06	6.348E-07	4.300E-07	3.192E-07	2.504E-07	2.040E-07	1.709E-07	1.462E-07
NNE	5.487E-06	1.717E-06	9.119E-07	6.000E-07	3.353E-07	2.256E-07	1.664E-07	1.299E-07	1.054E-07	8.793E-08	7.501E-08
NE	5.450E-06	1.803E-06	9.856E-07	6.476E-07	3.578E-07	2.355E-07	1.705E-07	1.310E-07	1.049E-07	8.657E-08	7.312E-08
ENE	4.258E-06	1.379E-06	7.464E-07	4.886E-07	2.697E-07	1.773E-07	1.282E-07	9.850E-08	7.885E-08	6.507E-08	5.496E-08
E	4.618E-06	1.531E-06	8.321E-07	5.438E-07	2.990E-07	1.959E-07	1.413E-07	1.082E-07	8.645E-08	7.120E-08	6.002E-08
ESE	4.436E-06	1.479E-06	8.008E-07	5.210E-07	2.848E-07	1.860E-07	1.338E-07	1.023E-07	8.153E-08	6.704E-08	5.644E-08
SE	5.091E-06	1.678E-06	9.044E-07	5.872E-07	3.207E-07	2.096E-07	1.509E-07	1.155E-07	9.217E-08	7.586E-08	6.391E-08
SSE	6.044E-06	2.000E-06	1.088E-06	7.106E-07	3.901E-07	2.557E-07	1.845E-07	1.415E-07	1.131E-07	9.317E-08	7.858E-08

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED)   DISTANCE IN MILES FROM THE SITE

SECTOR	5.000	7.500	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
S	5.010E-08	2.837E-08	1.901E-08	1.086E-08	7.328E-09	5.410E-09	4.227E-09	3.433E-09	2.869E-09	2.450E-09	2.127E-09
SSW	3.963E-08	2.257E-08	1.519E-08	8.728E-09	5.913E-09	4.379E-09	3.431E-09	2.793E-09	2.338E-09	2.000E-09	1.740E-09
SW	4.560E-08	2.627E-08	1.782E-08	1.037E-08	7.086E-09	5.284E-09	4.163E-09	3.405E-09	2.863E-09	2.458E-09	2.145E-09
WSW	4.753E-08	2.763E-08	1.886E-08	1.106E-08	7.602E-09	5.693E-09	4.501E-09	3.693E-09	3.113E-09	2.678E-09	2.342E-09
W	6.459E-08	3.749E-08	2.557E-08	1.498E-08	1.029E-08	7.706E-09	6.091E-09	4.996E-09	4.211E-09	3.623E-09	3.168E-09
WNW	8.615E-08	4.992E-08	3.400E-08	1.989E-08	1.364E-08	1.021E-08	8.059E-09	6.606E-09	5.565E-09	4.785E-09	4.183E-09
NW	1.106E-07	6.471E-08	4.436E-08	2.618E-08	1.808E-08	1.359E-08	1.077E-08	8.857E-09	7.481E-09	6.449E-09	5.649E-09
NNW	1.492E-07	8.772E-08	6.035E-08	3.579E-08	2.479E-08	1.867E-08	1.483E-08	1.221E-08	1.033E-08	8.915E-09	7.817E-09
N	1.273E-07	7.475E-08	5.139E-08	3.045E-08	2.107E-08	1.586E-08	1.259E-08	1.036E-08	8.762E-09	7.559E-09	6.625E-09
NNE	6.508E-08	3.782E-08	2.581E-08	1.513E-08	1.039E-08	7.781E-09	6.148E-09	5.042E-09	4.248E-09	3.654E-09	3.194E-09
NE	6.291E-08	3.539E-08	2.361E-08	1.342E-08	9.033E-09	6.656E-09	5.193E-09	4.213E-09	3.517E-09	3.000E-09	2.604E-09
ENE	4.729E-08	2.665E-08	1.781E-08	1.015E-08	6.847E-09	5.056E-09	3.951E-09	3.211E-09	2.684E-09	2.293E-09	1.993E-09
E	5.155E-08	2.883E-08	1.915E-08	1.083E-08	7.262E-09	5.337E-09	4.155E-09	3.366E-09	2.806E-09	2.392E-09	2.074E-09
ESE	4.843E-08	2.698E-08	1.788E-08	1.007E-08	6.742E-09	4.948E-09	3.848E-09	3.114E-09	2.594E-09	2.210E-09	1.915E-09
SE	5.488E-08	3.069E-08	2.039E-08	1.154E-08	7.748E-09	5.702E-09	4.445E-09	3.604E-09	3.008E-09	2.566E-09	2.227E-09
SSE	6.753E-08	3.785E-08	2.519E-08	1.428E-08	9.595E-09	7.064E-09	5.507E-09	4.466E-09	3.727E-09	3.179E-09	2.758E-09

VENT AND BUILDING PARAMETERS:

RELEASE HEIGHT	(METERS)	58.10	REP. WIND HEIGHT	(METERS)	10.0
DIAMETER	(METERS)	0.00	BUILDING HEIGHT	(METERS)	58.1
EXIT VELOCITY	(METERS)	0.00	BLDG MIN.CRS.SEC.AREA	(SQ.METERS)	2000.0
			HEAT EMISSION RATE	(CAL/SEC)	0.0

ALL GROUND LEVEL RELEASES.

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 970513

***** PALISADES XOQDOQ82 ***** USING 01/01/92 - 12/31/96 MET DATA *****

GROUND LEVEL RELEASE - TOP OF CONTAINMENT BUILDING
NO DECAY, UNDEPLETED

CHI/Q (SEC/METER CUBED) FOR EACH SEGMENT

DIRECTION FROM SITE	SEGMENT BOUNDARIES IN MILES FROM THE SITE									
	.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	7.808E-07	2.856E-07	1.351E-07	8.334E-08	5.828E-08	2.904E-08	1.110E-08	5.448E-09	3.445E-09	2.454E-09
SSW	6.085E-07	2.219E-07	1.057E-07	6.555E-08	4.602E-08	2.308E-08	8.912E-09	4.409E-09	2.802E-09	2.004E-09
SW	6.883E-07	2.484E-07	1.193E-07	7.468E-08	5.279E-08	2.681E-08	1.057E-08	5.316E-09	3.415E-09	2.462E-09
WSW	7.038E-07	2.527E-07	1.224E-07	7.721E-08	5.489E-08	2.815E-08	1.126E-08	5.725E-09	3.703E-09	2.683E-09
W	9.666E-07	3.457E-07	1.669E-07	1.051E-07	7.463E-08	3.821E-08	1.525E-08	7.749E-09	5.010E-09	3.629E-09
WNW	1.292E-06	4.630E-07	2.232E-07	1.404E-07	9.958E-08	5.089E-08	2.025E-08	1.026E-08	6.625E-09	4.793E-09
NW	1.627E-06	5.800E-07	2.819E-07	1.787E-07	1.276E-07	6.587E-08	2.662E-08	1.366E-08	8.879E-09	6.458E-09
NNW	2.159E-06	7.695E-07	3.765E-07	2.399E-07	1.718E-07	8.923E-08	3.636E-08	1.877E-08	1.224E-08	8.928E-09
N	1.829E-06	6.557E-07	3.212E-07	2.046E-07	1.465E-07	7.604E-08	3.093E-08	1.594E-08	1.039E-08	7.569E-09
NNE	9.521E-07	3.454E-07	1.676E-07	1.057E-07	7.516E-08	3.854E-08	1.540E-08	7.825E-09	5.056E-09	3.660E-09
NE	1.017E-06	3.678E-07	1.720E-07	1.054E-07	7.332E-08	3.627E-08	1.374E-08	6.704E-09	4.227E-09	3.006E-09
ENE	7.724E-07	2.773E-07	1.294E-07	7.922E-08	5.511E-08	2.731E-08	1.038E-08	5.092E-09	3.222E-09	2.298E-09
E	8.592E-07	3.076E-07	1.426E-07	8.686E-08	6.020E-08	2.958E-08	1.109E-08	5.378E-09	3.378E-09	2.397E-09
ESE	8.271E-07	2.934E-07	1.351E-07	8.193E-08	5.661E-08	2.770E-08	1.033E-08	4.986E-09	3.126E-09	2.214E-09
SE	9.353E-07	3.305E-07	1.524E-07	9.262E-08	6.411E-08	3.149E-08	1.182E-08	5.745E-09	3.617E-09	2.571E-09
SSE	1.123E-06	4.016E-07	1.863E-07	1.136E-07	7.881E-08	3.882E-08	1.462E-08	7.116E-09	4.482E-09	3.186E-09

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 970513

***** PALISADES XOQDOQ82 ***** USING 01/01/92 - 12/31/96 MET DATA *****

GROUND LEVEL RELEASE - TOP OF CONTAINMENT BUILDING
2 260 DAY DECAY, UNDEPLETED

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES FROM THE SITE

SECTOR	0.250	0.500	0.750	1.000	1.500	2.000	2.500	3.000	3.500	4.000	4.500
S	4.205E-06	1.379E-06	7.540E-07	4.979E-07	2.769E-07	1.831E-07	1.330E-07	1.024E-07	8.212E-08	6.785E-08	5.735E-08
SSW	3.327E-06	1.084E-06	5.842E-07	3.858E-07	2.150E-07	1.428E-07	1.040E-07	8.032E-08	6.457E-08	5.346E-08	4.526E-08
SW	3.887E-06	1.240E-06	6.575E-07	4.319E-07	2.402E-07	1.604E-07	1.175E-07	9.117E-08	7.359E-08	6.114E-08	5.193E-08
WSW	4.057E-06	1.277E-06	6.699E-07	4.388E-07	2.439E-07	1.637E-07	1.206E-07	9.394E-08	7.609E-08	6.341E-08	5.400E-08
W	5.550E-06	1.757E-06	9.203E-07	6.016E-07	3.334E-07	2.235E-07	1.644E-07	1.280E-07	1.036E-07	8.628E-08	7.344E-08
WNW	7.373E-06	2.343E-06	1.232E-06	8.062E-07	4.468E-07	2.993E-07	2.200E-07	1.712E-07	1.385E-07	1.153E-07	9.810E-08
NW	9.524E-06	2.969E-06	1.547E-06	1.009E-06	5.585E-07	3.761E-07	2.779E-07	2.171E-07	1.762E-07	1.472E-07	1.256E-07
NNW	1.285E-05	3.953E-06	2.047E-06	1.335E-06	7.408E-07	5.008E-07	3.712E-07	2.907E-07	2.365E-07	1.979E-07	1.691E-07
N	1.087E-05	3.341E-06	1.735E-06	1.134E-06	6.316E-07	4.271E-07	3.165E-07	2.478E-07	2.016E-07	1.686E-07	1.440E-07
NNE	5.483E-06	1.714E-06	9.099E-07	5.982E-07	3.338E-07	2.242E-07	1.652E-07	1.287E-07	1.042E-07	8.687E-08	7.398E-08
NE	5.447E-06	1.800E-06	9.837E-07	6.458E-07	3.563E-07	2.343E-07	1.693E-07	1.299E-07	1.039E-07	8.564E-08	7.223E-08
ENE	4.255E-06	1.377E-06	7.448E-07	4.872E-07	2.685E-07	1.763E-07	1.273E-07	9.763E-08	7.804E-08	6.431E-08	5.423E-08
E	4.615E-06	1.528E-06	8.303E-07	5.423E-07	2.977E-07	1.948E-07	1.403E-07	1.073E-07	8.559E-08	7.039E-08	5.925E-08
ESE	4.433E-06	1.477E-06	7.992E-07	5.196E-07	2.837E-07	1.850E-07	1.328E-07	1.014E-07	8.075E-08	6.631E-08	5.575E-08
SE	5.088E-06	1.676E-06	9.026E-07	5.856E-07	3.194E-07	2.085E-07	1.499E-07	1.145E-07	9.128E-08	7.502E-08	6.312E-08
SSE	6.040E-06	1.997E-06	1.086E-06	7.087E-07	3.885E-07	2.543E-07	1.833E-07	1.403E-07	1.120E-07	9.213E-08	7.760E-08

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES FROM THE SITE

SECTOR	5.000	7.500	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
S	4.936E-08	2.774E-08	1.845E-08	1.039E-08	6.911E-09	5.029E-09	3.874E-09	3.103E-09	2.557E-09	2.153E-09	1.844E-09
SSW	3.901E-08	2.204E-08	1.472E-08	8.327E-09	5.555E-09	4.051E-09	3.126E-09	2.506E-09	2.067E-09	1.742E-09	1.492E-09
SW	4.489E-08	2.566E-08	1.727E-08	9.893E-09	6.657E-09	4.889E-09	3.793E-09	3.056E-09	2.531E-09	2.140E-09	1.840E-09
WSW	4.678E-08	2.698E-08	1.827E-08	1.055E-08	7.141E-09	5.267E-09	4.101E-09	3.314E-09	2.751E-09	2.332E-09	2.009E-09
W	6.361E-08	3.664E-08	2.480E-08	1.431E-08	9.688E-09	7.147E-09	5.566E-09	4.500E-09	3.738E-09	3.170E-09	2.732E-09
WNW	8.494E-08	4.886E-08	3.304E-08	1.906E-08	1.289E-08	9.508E-09	7.405E-09	5.987E-09	4.975E-09	4.220E-09	3.639E-09
NW	1.090E-07	6.323E-08	4.301E-08	2.500E-08	1.700E-08	1.259E-08	9.836E-09	7.972E-09	6.638E-09	5.641E-09	4.872E-09
NNW	1.469E-07	8.570E-08	5.851E-08	3.417E-08	2.331E-08	1.730E-08	1.354E-08	1.099E-08	9.164E-09	7.796E-09	6.739E-09
N	1.251E-07	7.285E-08	4.966E-08	2.893E-08	1.969E-08	1.458E-08	1.139E-08	9.223E-09	7.674E-09	6.516E-09	5.622E-09
NNE	6.410E-08	3.697E-08	2.504E-08	1.446E-08	9.786E-09	7.218E-09	5.620E-09	4.541E-09	3.771E-09	3.196E-09	2.754E-09
NE	6.206E-08	3.468E-08	2.298E-08	1.289E-08	8.558E-09	6.223E-09	4.791E-09	3.836E-09	3.160E-09	2.662E-09	2.280E-09
ENE	4.659E-08	2.607E-08	1.729E-08	9.711E-09	6.459E-09	4.702E-09	3.624E-09	2.904E-09	2.395E-09	2.018E-09	1.730E-09
E	5.082E-08	2.822E-08	1.861E-08	1.037E-08	6.861E-09	4.973E-09	3.819E-09	3.051E-09	2.509E-09	2.110E-09	1.805E-09
ESE	4.776E-08	2.643E-08	1.739E-08	9.664E-09	6.380E-09	4.619E-09	3.544E-09	2.830E-09	2.327E-09	1.956E-09	1.673E-09
SE	5.413E-08	3.005E-08	1.983E-08	1.106E-08	7.329E-09	5.320E-09	4.091E-09	3.273E-09	2.695E-09	2.268E-09	1.943E-09
SSE	6.659E-08	3.706E-08	2.449E-08	1.369E-08	9.073E-09	6.588E-09	5.066E-09	4.053E-09	3.337E-09	2.808E-09	2.404E-09

VENT AND BUILDING PARAMETERS.

RELEASE HEIGHT	(METERS)	58.10	REP. WIND HEIGHT	(METERS)	10.0
DIAMETER	(METERS)	0.00	BUILDING HEIGHT	(METERS)	58.1
EXIT VELOCITY	(METERS)	0.00	BLDG.MIN.CRS.SEC.AREA	(SQ.METERS)	2000.0
			HEAT EMISSION RATE	(CAL/SEC)	0.0

ALL GROUND LEVEL RELEASES.

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 970513

***** PALISADES XOQDOQ82 ***** USING 01/01/92 - 12/31/96 MET DATA *****

GROUND LEVEL RELEASE - TOP OF CONTAINMENT BUILDING
2.260 DAY DECAY, UNDEPLETED

CHI/Q (SEC/METER CUBED) FOR EACH SEGMENT

	SEGMENT BOUNDARIES IN MILES FROM THE SITE									
DIRECTION FROM SITE	.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	7.791E-07	2.843E-07	1.341E-07	8.248E-08	5.750E-08	2.842E-08	1.064E-08	5.069E-09	3.115E-09	2.158E-09
SSW	6.072E-07	2.209E-07	1.049E-07	6.484E-08	4.537E-08	2.256E-08	8.515E-09	4.082E-09	2.516E-09	1.746E-09
SW	6.867E-07	2.473E-07	1.184E-07	7.387E-08	5.205E-08	2.621E-08	1.010E-08	4.922E-09	3.066E-09	2.145E-09
WSW	7.022E-07	2.516E-07	1.214E-07	7.636E-08	5.412E-08	2.751E-08	1.075E-08	5.300E-09	3.324E-09	2.337E-09
W	9.645E-07	3.441E-07	1.656E-07	1.040E-07	7.360E-08	3.737E-08	1.459E-08	7.192E-09	4.514E-09	3.176E-09
WNW	1.290E-06	4.611E-07	2.216E-07	1.390E-07	9.832E-08	4.985E-08	1.942E-08	9.569E-09	6.007E-09	4.229E-09
NW	1.624E-06	5.775E-07	2.798E-07	1.768E-07	1.258E-07	6.441E-08	2.545E-08	1.267E-08	7.996E-09	5.651E-09
NNW	2.154E-06	7.661E-07	3.736E-07	2.373E-07	1.694E-07	8.722E-08	3.475E-08	1.740E-08	1.102E-08	7.810E-09
N	1.825E-06	6.524E-07	3.185E-07	2.022E-07	1.443E-07	7.415E-08	2.943E-08	1.466E-08	9.251E-09	6.528E-09
NNE	9.500E-07	3.438E-07	1.663E-07	1.046E-07	7.414E-08	3.770E-08	1.473E-08	7.263E-09	4.556E-09	3.203E-09
NE	1.015E-06	3.664E-07	1.709E-07	1.044E-07	7.244E-08	3.557E-08	1.321E-08	6.272E-09	3.851E-09	2.668E-09
ENE	7.708E-07	2.761E-07	1.285E-07	7.840E-08	5.439E-08	2.673E-08	9.950E-09	4.739E-09	2.916E-09	2.023E-09
E	8.574E-07	3.063E-07	1.416E-07	8.600E-08	5.943E-08	2.897E-08	1.064E-08	5.015E-09	3.064E-09	2.115E-09
ESE	8.255E-07	2.922E-07	1.342E-07	8.115E-08	5.592E-08	2.715E-08	9.921E-09	4.659E-09	2.842E-09	1.961E-09
SE	9.335E-07	3.292E-07	1.514E-07	9.173E-08	6.332E-08	3.086E-08	1.135E-08	5.364E-09	3.286E-09	2.274E-09
SSE	1.121E-06	4.000E-07	1.850E-07	1.125E-07	7.783E-08	3.804E-08	1.404E-08	6.642E-09	4.070E-09	2.815E-09

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 970513

***** PALISADES XOQDOQ82 ***** USING 01/01/92 - 12/31/96 MET DATA *****

GROUND LEVEL RELEASE - TOP OF CONTAINMENT BUILDING
8.000 DAY DECAY, DEPLETED

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES FROM THE SITE

SECTOR	0.250	0.500	0.750	1.000	1.500	2.000	2.500	3.000	3.500	4.000	4.500
S	3.982E-06	1.261E-06	6.730E-07	4.367E-07	2.359E-07	1.523E-07	1.083E-07	8.186E-08	6.456E-08	5.254E-08	4.378E-08
SSW	3.150E-06	9.913E-07	5.215E-07	3.384E-07	1.832E-07	1.187E-07	8.473E-08	6.423E-08	5.078E-08	4.141E-08	3.457E-08
SW	3.681E-06	1.134E-06	5.869E-07	3.789E-07	2.047E-07	1.334E-07	9.572E-08	7.291E-08	5.787E-08	4.736E-08	3.966E-08
WSW	3.842E-06	1.168E-06	5.980E-07	3.849E-07	2.078E-07	1.362E-07	9.823E-08	7.513E-08	5.985E-08	4.912E-08	4.125E-08
W	5.256E-06	1.606E-06	8.215E-07	5.278E-07	2.841E-07	1.859E-07	1.339E-07	1.023E-07	8.146E-08	6.682E-08	5.608E-08
WNW	6.982E-06	2.141E-06	1.100E-06	7.071E-07	3.806E-07	2.488E-07	1.791E-07	1.368E-07	1.088E-07	8.923E-08	7.486E-08
NW	9.018E-06	2.715E-06	1.381E-06	8.848E-07	4.758E-07	3.128E-07	2.263E-07	1.736E-07	1.386E-07	1.140E-07	9.588E-08
NNW	1.217E-05	3.613E-06	1.827E-06	1.171E-06	6.312E-07	4.165E-07	3.024E-07	2.325E-07	1.860E-07	1.532E-07	1.291E-07
N	1.029E-05	3.055E-06	1.549E-06	9.954E-07	5.384E-07	3.554E-07	2.579E-07	1.983E-07	1.586E-07	1.307E-07	1.101E-07
NNE	5.192E-06	1.567E-06	8.121E-07	5.248E-07	2.844E-07	1.865E-07	1.345E-07	1.029E-07	8.196E-08	6.727E-08	5.649E-08
NE	5.157E-06	1.646E-06	8.778E-07	5.664E-07	3.035E-07	1.947E-07	1.378E-07	1.038E-07	8.162E-08	6.625E-08	5.509E-08
ENE	4.029E-06	1.259E-06	6.648E-07	4.273E-07	2.287E-07	1.466E-07	1.037E-07	7.804E-08	6.135E-08	4.978E-08	4.139E-08
E	4.370E-06	1.397E-06	7.410E-07	4.756E-07	2.536E-07	1.620E-07	1.142E-07	8.576E-08	6.727E-08	5.448E-08	4.522E-08
ESE	4.198E-06	1.350E-06	7.132E-07	4.557E-07	2.416E-07	1.538E-07	1.081E-07	8.103E-08	6.344E-08	5.130E-08	4.252E-08
SE	4.817E-06	1.532E-06	8.055E-07	5.136E-07	2.720E-07	1.733E-07	1.220E-07	9.152E-08	7.172E-08	5.805E-08	4.815E-08
SSE	5.719E-06	1.826E-06	9.691E-07	6.216E-07	3.309E-07	2.114E-07	1.492E-07	1.121E-07	8.798E-08	7.129E-08	5.920E-08

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES FROM THE SITE

SECTOR	5.000	7.500	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
S	3.719E-08	1.987E-08	1.266E-08	6.668E-09	4.208E-09	2.931E-09	2.174E-09	1.683E-09	1.345E-09	1.102E-09	9.195E-10
SSW	2.941E-08	1.580E-08	1.011E-08	5.355E-09	3.392E-09	2.370E-09	1.762E-09	1.367E-09	1.094E-09	8.973E-10	7.499E-10
SW	3.384E-08	1.840E-08	1.187E-08	6.362E-09	4.065E-09	2.860E-09	2.138E-09	1.667E-09	1.340E-09	1.103E-09	9.248E-10
WSW	3.527E-08	1.935E-08	1.256E-08	6.786E-09	4.361E-09	3.081E-09	2.311E-09	1.807E-09	1.457E-09	1.202E-09	1.010E-09
W	4.794E-08	2.626E-08	1.703E-08	9.195E-09	5.907E-09	4.173E-09	3.130E-09	2.448E-09	1.973E-09	1.628E-09	1.368E-09
WNW	6.396E-08	3.498E-08	2.266E-08	1.222E-08	7.839E-09	5.533E-09	4.148E-09	3.241E-09	2.612E-09	2.154E-09	1.810E-09
NW	8.212E-08	4.532E-08	2.954E-08	1.607E-08	1.037E-08	7.352E-09	5.531E-09	4.335E-09	3.502E-09	2.894E-09	2.436E-09
NNW	1.107E-07	6.143E-08	4.019E-08	2.196E-08	1.422E-08	1.011E-08	7.617E-09	5.980E-09	4.836E-09	4.002E-09	3.371E-09
N	9.439E-08	5.231E-08	3.419E-08	1.866E-08	1.207E-08	8.564E-09	6.449E-09	5.058E-09	4.087E-09	3.379E-09	2.844E-09
NNE	4.831E-08	2.649E-08	1.719E-08	9.289E-09	5.967E-09	4.214E-09	3.160E-09	2.470E-09	1.991E-09	1.642E-09	1.379E-09
NE	4.671E-08	2.481E-08	1.574E-08	8.249E-09	5.194E-09	3.612E-09	2.676E-09	2.070E-09	1.653E-09	1.353E-09	1.129E-09
ENE	3.510E-08	1.867E-08	1.186E-08	6.231E-09	3.932E-09	2.740E-09	2.032E-09	1.574E-09	1.259E-09	1.031E-09	8.614E-10
E	3.827E-08	2.020E-08	1.276E-08	6.651E-09	4.172E-09	2.894E-09	2.139E-09	1.652E-09	1.317E-09	1.077E-09	8.971E-10
ESE	3.596E-08	1.891E-08	1.192E-08	6.190E-09	3.875E-09	2.684E-09	1.981E-09	1.529E-09	1.219E-09	9.955E-10	8.292E-10
SE	4.075E-08	2.150E-08	1.359E-08	7.089E-09	4.453E-09	3.093E-09	2.288E-09	1.769E-09	1.413E-09	1.156E-09	9.641E-10
SSE	5.014E-08	2.653E-08	1.679E-08	8.772E-09	5.515E-09	3.831E-09	2.836E-09	2.192E-09	1.750E-09	1.432E-09	1.194E-09

VENT AND BUILDING PARAMETERS:

RELEASE HEIGHT	(METERS)	58.10
DIAMETER	(METERS)	0.00
EXIT VELOCITY	(METERS)	0.00
REP. WIND HEIGHT	(METERS)	10.0
BUILDING HEIGHT	(METERS)	58.1
BLDG.MIN.CRS.SEC.AREA	(SQ.METERS)	2000.0
HEAT EMISSION RATE	(CAL/SEC)	0.0

ALL GROUND LEVEL RELEASES.

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 970513

***** PALISADES XOQDOQ82 ***** USING 01/01/92 - 12/31/96 MET DATA *****

GROUND LEVEL RELEASE - TOP OF CONTAINMENT BUILDING
8.000 DAY DECAY, DEPLETED

CHI/Q (SEC/METER CUBED) FOR EACH SEGMENT

DIRECTION FROM SITE	SEGMENT BOUNDARIES IN MILES FROM THE SITE									
	.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	6.986E-07	2.434E-07	1.094E-07	6.492E-08	4.393E-08	2.052E-08	6.907E-09	2.969E-09	1.695E-09	1.106E-09
SSW	5.445E-07	1.891E-07	8.560E-08	5.105E-08	3.468E-08	1.630E-08	5.540E-09	2.399E-09	1.376E-09	9.011E-10
SW	6.160E-07	2.117E-07	9.664E-08	5.816E-08	3.979E-08	1.893E-08	6.565E-09	2.892E-09	1.677E-09	1.107E-09
WSW	6.299E-07	2.153E-07	9.911E-08	6.013E-08	4.137E-08	1.987E-08	6.991E-09	3.114E-09	1.818E-09	1.206E-09
W	8.653E-07	2.946E-07	1.351E-07	8.184E-08	5.625E-08	2.697E-08	9.475E-09	4.218E-09	2.462E-09	1.634E-09
WNW	1.157E-06	3.946E-07	1.808E-07	1.094E-07	7.508E-08	3.594E-08	1.259E-08	5.594E-09	3.261E-09	2.162E-09
NW	1.457E-06	4.943E-07	2.283E-07	1.392E-07	9.614E-08	4.648E-08	1.653E-08	7.429E-09	4.359E-09	2.904E-09
NNW	1.932E-06	6.557E-07	3.049E-07	1.868E-07	1.295E-07	6.295E-08	2.257E-08	1.021E-08	6.012E-09	4.016E-09
N	1.637E-06	5.586E-07	2.601E-07	1.593E-07	1.104E-07	5.361E-08	1.918E-08	8.652E-09	5.085E-09	3.391E-09
NNE	8.521E-07	2.943E-07	1.357E-07	8.234E-08	5.665E-08	2.721E-08	9.569E-09	4.260E-09	2.485E-09	1.648E-09
NE	9.101E-07	3.136E-07	1.394E-07	8.210E-08	5.529E-08	2.565E-08	8.556E-09	3.659E-09	2.084E-09	1.359E-09
ENE	6.913E-07	2.364E-07	1.049E-07	6.171E-08	4.155E-08	1.930E-08	6.461E-09	2.775E-09	1.585E-09	1.036E-09
E	7.689E-07	2.622E-07	1.156E-07	6.768E-08	4.539E-08	2.091E-08	6.908E-09	2.932E-09	1.663E-09	1.081E-09
ESE	7.403E-07	2.502E-07	1.095E-07	6.384E-08	4.269E-08	1.959E-08	6.434E-09	2.721E-09	1.540E-09	1.000E-09
SE	8.371E-07	2.818E-07	1.235E-07	7.217E-08	4.834E-08	2.226E-08	7.362E-09	3.134E-09	1.782E-09	1.161E-09
SSE	1.005E-06	3.424E-07	1.510E-07	8.852E-08	5.943E-08	2.745E-08	9.106E-09	3.882E-09	2.208E-09	1.438E-09

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 970513

***** PALISADES XOQDOQ82 ***** USING 01/01/92 - 12/31/96 MET DATA *****

GROUND LEVEL RELEASE - TOP OF CONTAINMENT BUILDING

******************** RELATIVE DEPOSITION PER UNIT AREA (M**-2) AT FIXED POINTS BY DOWNWIND SECTORS ********************

DIRECTION FROM SITE	DISTANCES IN MILES 0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
S	2.600E-08	8.794E-09	4.515E-09	2.772E-09	1.382E-09	8.383E-10	5.668E-10	4.107E-10	3.123E-10	2.460E-10	1.992E-10
SSW	1.731E-08	5.852E-09	3.005E-09	1.845E-09	9.198E-10	5.579E-10	3.772E-10	2.733E-10	2.078E-10	1.637E-10	1.325E-10
SW	1.866E-08	6.309E-09	3.239E-09	1.989E-09	9.916E-10	6.014E-10	4.066E-10	2.946E-10	2.240E-10	1.765E-10	1.429E-10
WSW	1.829E-08	6.183E-09	3.175E-09	1.949E-09	9.719E-10	5.894E-10	3.985E-10	2.888E-10	2.196E-10	1.730E-10	1.401E-10
W	2.673E-08	9.040E-09	4.641E-09	2.850E-09	1.421E-09	8.618E-10	5.826E-10	4.222E-10	3.210E-10	2.529E-10	2.048E-10
WNW	4.142E-08	1.401E-08	7.191E-09	4.416E-09	2.201E-09	1.335E-09	9.027E-10	6.541E-10	4.974E-10	3.919E-10	3.172E-10
NW	4.847E-08	1.639E-08	8.416E-09	5.168E-09	2.576E-09	1.563E-09	1.056E-09	7.656E-10	5.821E-10	4.586E-10	3.713E-10
NNW	5.897E-08	1.994E-08	1.024E-08	6.287E-09	3.135E-09	1.901E-09	1.285E-09	9.314E-10	7.082E-10	5.580E-10	4.517E-10
N	4.172E-08	1.411E-08	7.244E-09	4.448E-09	2.218E-09	1.345E-09	9.093E-10	6.589E-10	5.010E-10	3.947E-10	3.196E-10
NNE	2.423E-08	8.194E-09	4.207E-09	2.583E-09	1.288E-09	7.811E-10	5.281E-10	3.827E-10	2.910E-10	2.292E-10	1.856E-10
NE	4.208E-08	1.423E-08	7.306E-09	4.486E-09	2.237E-09	1.356E-09	9.171E-10	6.646E-10	5.053E-10	3.981E-10	3.223E-10
ENE	3.387E-08	1.145E-08	5.881E-09	3.611E-09	1.800E-09	1.092E-09	7.382E-10	5.349E-10	4.067E-10	3.204E-10	2.594E-10
E	3.926E-08	1.328E-08	6.816E-09	4.185E-09	2.087E-09	1.266E-09	8.556E-10	6.200E-10	4.715E-10	3.714E-10	3.007E-10
ESE	4.148E-08	1.403E-08	7.202E-09	4.423E-09	2.205E-09	1.337E-09	9.041E-10	6.552E-10	4.982E-10	3.925E-10	3.177E-10
SE	4.919E-08	1.663E-08	8.540E-09	5.244E-09	2.614E-09	1.586E-09	1.072E-09	7.769E-10	5.907E-10	4.654E-10	3.768E-10
SSE	5.133E-08	1.736E-08	8.913E-09	5.473E-09	2.728E-09	1.655E-09	1.119E-09	8.107E-10	6.165E-10	4.857E-10	3.932E-10

DIRECTION FROM SITE	DISTANCES IN MILES 5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
S	1.648E-10	8.074E-11	5.066E-11	2.561E-11	1.550E-11	1.039E-11	7.446E-12	5.591E-12	4.347E-12	3.473E-12	2.834E-12
SSW	1.096E-10	5.373E-11	3.371E-11	1.704E-11	1.031E-11	6.915E-12	4.955E-12	3.721E-12	2.893E-12	2.311E-12	1.886E-12
SW	1.182E-10	5.792E-11	3.634E-11	1.837E-11	1.112E-11	7.455E-12	5.342E-12	4.011E-12	3.119E-12	2.491E-12	2.033E-12
WSW	1.159E-10	5.677E-11	3.562E-11	1.801E-11	1.090E-11	7.307E-12	5.236E-12	3.931E-12	3.057E-12	2.442E-12	1.993E-12
W	1.694E-10	8.300E-11	5.208E-11	2.632E-11	1.593E-11	1.068E-11	7.654E-12	5.748E-12	4.469E-12	3.570E-12	2.914E-12
WNW	2.624E-10	1.286E-10	8.069E-11	4.078E-11	2.468E-11	1.655E-11	1.186E-11	8.905E-12	6.924E-12	5.531E-12	4.514E-12
NW	3.071E-10	1.505E-10	9.443E-11	4.773E-11	2.889E-11	1.937E-11	1.388E-11	1.042E-11	8.103E-12	6.473E-12	5.283E-12
NNW	3.736E-10	1.831E-10	1.149E-10	5.807E-11	3.515E-11	2.357E-11	1.689E-11	1.268E-11	9.859E-12	7.875E-12	6.428E-12
N	2.643E-10	1.295E-10	8.128E-11	4.108E-11	2.487E-11	1.667E-11	1.195E-11	8.970E-12	6.975E-12	5.571E-12	4.547E-12
NNE	1.535E-10	7.523E-11	4.720E-11	2.386E-11	1.444E-11	9.682E-12	6.938E-12	5.210E-12	4.051E-12	3.236E-12	2.641E-12
NE	2.666E-10	1.306E-10	8.198E-11	4.143E-11	2.508E-11	1.681E-11	1.205E-11	9.047E-12	7.034E-12	5.619E-12	4.586E-12
ENE	2.146E-10	1.052E-10	6.598E-11	3.335E-11	2.019E-11	1.353E-11	9.698E-12	7.282E-12	5.662E-12	4.523E-12	3.692E-12
E	2.487E-10	1.219E-10	7.648E-11	3.866E-11	2.340E-11	1.569E-11	1.124E-11	8.441E-12	6.563E-12	5.242E-12	4.279E-12
ESE	2.628E-10	1.288E-10	8.081E-11	4.085E-11	2.472E-11	1.658E-11	1.188E-11	8.919E-12	6.935E-12	5.539E-12	4.521E-12
SE	3.117E-10	1.527E-10	9.583E-11	4.844E-11	2.932E-11	1.966E-11	1.408E-11	1.058E-11	8.223E-12	6.569E-12	5.361E-12
SSE	3.252E-10	1.594E-10	1.000E-10	5.055E-11	3.059E-11	2.051E-11	1.470E-11	1.104E-11	8.581E-12	6.855E-12	5.595E-12

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 970513

***** PALISADES XOQDOQ82 ***** USING 01/01/92 - 12/31/96 MET DATA *****

GROUND LEVEL RELEASE - TOP OF CONTAINMENT BUILDING

************************ RELATIVE DEPOSITION PER UNIT AREA (M**-2) BY DOWNWIND SECTORS ************************

SEGMENT BOUNDARIES IN MILES

DIRECTION FROM SITE	.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	4.691E-09	1.449E-09	5.768E-10	3.152E-10	2.003E-10	8.604E-11	2.668E-11	1.057E-11	5.647E-12	3.495E-12
SSW	3.122E-09	9.645E-10	3.838E-10	2.097E-10	1.333E-10	5.726E-11	1.776E-11	7.037E-12	3.758E-12	2.326E-12
SW	3.366E-09	1.040E-09	4.138E-10	2.261E-10	1.437E-10	6.173E-11	1.914E-11	7.587E-12	4.051E-12	2.508E-12
WSW	3.299E-09	1.019E-09	4.055E-10	2.216E-10	1.409E-10	6.050E-11	1.876E-11	7.436E-12	3.971E-12	2.458E-12
W	4.823E-09	1.490E-09	5.929E-10	3.240E-10	2.059E-10	8.845E-11	2.743E-11	1.087E-11	5.805E-12	3.593E-12
WNW	7.472E-09	2.308E-09	9.186E-10	5.020E-10	3.190E-10	1.370E-10	4.249E-11	1.684E-11	8.994E-12	5.567E-12
NW	8.745E-09	2.702E-09	1.075E-09	5.875E-10	3.734E-10	1.604E-10	4.974E-11	1.971E-11	1.053E-11	6.516E-12
NNW	1.064E-08	3.287E-09	1.308E-09	7.147E-10	4.543E-10	1.951E-10	6.051E-11	2.398E-11	1.281E-11	7.927E-12
N	7.527E-09	2.325E-09	9.253E-10	5.057E-10	3.214E-10	1.380E-10	4.281E-11	1.697E-11	9.060E-12	5.608E-12
NNE	4.371E-09	1.351E-09	5.374E-10	2.937E-10	1.866E-10	8.017E-11	2.486E-11	9.853E-12	5.262E-12	3.257E-12
NE	7.591E-09	2.345E-09	9.333E-10	5.100E-10	3.241E-10	1.392E-10	4.317E-11	1.711E-11	9.138E-12	5.656E-12
ENE	6.110E-09	1.888E-09	7.512E-10	4.105E-10	2.609E-10	1.121E-10	3.475E-11	1.377E-11	7.355E-12	4.552E-12
E	7.082E-09	2.188E-09	8.707E-10	4.758E-10	3.024E-10	1.299E-10	4.028E-11	1.596E-11	8.525E-12	5.277E-12
ESE	7.484E-09	2.312E-09	9.200E-10	5.028E-10	3.195E-10	1.373E-10	4.256E-11	1.687E-11	9.008E-12	5.576E-12
SE	8.874E-09	2.742E-09	1.091E-09	5.962E-10	3.789E-10	1.628E-10	5.047E-11	2.000E-11	1.068E-11	6.612E-12
SSE	9.261E-09	2.861E-09	1.139E-09	6.222E-10	3.954E-10	1.699E-10	5.267E-11	2.088E-11	1.115E-11	6.900E-12

VENT AND BUILDING PARAMETERS:

RELEASE HEIGHT	(METERS)	58.10
DIAMETER	(METERS)	0.00
EXIT VELOCITY	(METERS)	0.00
REP. WIND HEIGHT	(METERS)	10.0
BUILDING HEIGHT	(METERS)	58.1
BLDG.MIN.CRS.SEC.AREA	(SQ.METERS)	2000.0
HEAT EMISSION RATE	(CAL/SEC)	0.0

ALL GROUND LEVEL RELEASES.

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 970513

***** PALISADES XOQDOQ82 ***** USING 01/01/92 - 12/31/96 MET DATA *****

GROUND LEVEL RELEASE - TOP OF CONTAINMENT BUILDING
SPECIFIC POINTS OF INTEREST

RELEASE ID	TYPE OF LOCATION	DIRECTION FROM SITE	DISTANCE (MILES)	DISTANCE (METERS)	X/Q (SEC/CUB.METER) NO DECAY UNDEPLETED	X/Q (SEC/CUB METER) 2.260 DAY DECAY UNDEPLETED	X/Q (SEC/CUB.METER) 8.000 DAY DECAY DEPLETED	D/Q (PER SQ.METER)
A	SITE BOUNDARY	NNE	0 50	805.	1.72E-06	1.71E-06	1.57E-06	8.19E-09
A	SITE BOUNDARY	NE	0.65	1046.	1.22E-06	1.22E-06	1.10E-06	9.30E-09
A	SITE BOUNDARY	ENE	0.87	1400.	5.99E-07	5.98E-07	5.29E-07	4.58E-09
A	SITE BOUNDARY	E	0.82	1320.	7.28E-07	7.27E-07	6.45E-07	5.86E-09
A	SITE BOUNDARY	ESE	0.76	1223.	7.85E-07	7.83E-07	6.98E-07	7.04E-09
A	SITE BOUNDARY	SE	0.63	1014.	1.18E-06	1.18E-06	1.06E-06	1.14E-08
A	SITE BOUNDARY	SSE	0.48	772.	2.13E-06	2.12E-06	1.95E-06	1.86E-08
A	SITE BOUNDARY	S	0.42	676.	1.78E-06	1.78E-06	1.64E-06	1.16E-08
A	SITE BOUNDARY	SSW	0.48	772.	1.16E-06	1.15E-06	1.06E-06	6.26E-09
A	GARDEN	NNE	1.60	2575.	3.06E-07	3.04E-07	2.58E-07	1.15E-09
A	GARDEN	NE	1.20	1931.	4.96E-07	4.95E-07	4.28E-07	3.29E-09
A	GARDEN	ENE	2.70	4345.	1.15E-07	1.14E-07	9.20E-08	6.45E-10
A	GARDEN	E	2 20	3541.	1.70E-07	1.69E-07	1.40E-07	1.07E-09
A	GARDEN	ESE	2.30	3701.	1.51E-07	1.50E-07	1.23E-07	1.05E-09
A	GARDEN	SE	1.80	2897.	2.45E-07	2.44E-07	2.04E-07	1.91E-09
A	GARDEN	SSE	1.60	2575.	3.55E-07	3.53E-07	2.99E-07	2.44E-09
A	GARDEN	S	1.50	2414.	2.78E-07	2.77E-07	2.36E-07	1.38E-09
A	BEEF COW	NE	2.90	4667.	1.38E-07	1.36E-07	1.09E-07	7.06E-10
A	BEEF COW	ENE	4.00	6437.	6.51E-08	6.43E-08	4.98E-08	3.20E-10
A	BEEF COW	E	3.50	5633.	8.64E-08	8.56E-08	6.73E-08	4.71E-10
A	BEEF COW	ESE	4.00	6437.	6.70E-08	6.63E-08	5.13E-08	3.93E-10
A	BEEF COW	SSE	3.00	4828.	1.41E-07	1.40E-07	1.12E-07	8.11E-10
A	DAIRY COW	SE	4.30	6920.	6.83E-08	6.75E-08	5.18E-08	4.09E-10
A	GOAT	NE	3.20	5150.	1.19E-07	1.18E-07	9.39E-08	5.93E-10
A	GOAT	ESE	3.00	4828.	1.02E-07	1.01E-07	8.10E-08	6.55E-10

VENT AND BUILDING PARAMETERS:

RELEASE HEIGHT	(METERS)	58.10
DIAMETER	(METERS)	0.00
EXIT VELOCITY	(METERS)	0.00

REP. WIND HEIGHT	(METERS)	10.0
BUILDING HEIGHT	(METERS)	58.1
BLDG.MIN.CRS.SEC.AREA	(SQ.METERS)	2000.0
HEAT EMISSION RATE	(CAL/SEC)	0 0

ALL GROUND LEVEL RELEASES.

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 970513

***** PALISADES XOQDOQ82 ***** USING 01/01/92 - 12/31/96 MET DATA *****

GROUND LEVEL RELEASE - TOP OF CONTAINMENT BUILDING
SPECIFIC POINTS OF INTEREST

RELEASE ID	TYPE OF LOCATION	DIRECTION FROM SITE	DISTANCE (MILES)	DISTANCE (METERS)	X/Q (SEC/CUB.METER) NO DECAY UNDEPLETED	X/Q (SEC/CUB.METER) 2.260 DAY DECAY UNDEPLETED	X/Q (SEC/CUB.METER) 8.000 DAY DECAY DEPLETED	D/Q (PER SQ.METER)
A	SITE BOUNDARY	NNE	0.50	805.	1.72E-06	1.71E-06	1.57E-06	8.19E-09
A	SITE BOUNDARY	NE	0.65	1046.	1.22E-06	1.22E-06	1.10E-06	9.30E-09
A	SITE BOUNDARY	ENE	0.87	1400.	5.99E-07	5.98E-07	5.29E-07	4.58E-09
A	SITE BOUNDARY	E	0.82	1320.	7.28E-07	7.27E-07	6.45E-07	5.86E-09
A	SITE BOUNDARY	ESE	0.76	1223.	7.85E-07	7.83E-07	6.98E-07	7.04E-09
A	SITE BOUNDARY	SE	0.63	1014.	1.18E-06	1.18E-06	1.06E-06	1.14E-08
A	SITE BOUNDARY	SSE	0.48	772.	2.13E-06	2.12E-06	1.95E-06	1.86E-08
A	SITE BOUNDARY	S	0.42	676.	1.78E-06	1.78E-06	1.64E-06	1.16E-08
A	SITE BOUNDARY	SSW	0.48	772.	1.16E-06	1.15E-06	1.06E-06	6.26E-09
A	RESIDENCE	NNE	1.10	1770.	5.23E-07	5.21E-07	4.55E-07	2.20E-09
A	RESIDENCE	NE	1.20	1931.	4.96E-07	4.95E-07	4.28E-07	3.29E-09
A	RESIDENCE	ENE	1.30	2092.	3.33E-07	3.31E-07	2.85E-07	2.30E-09
A	RESIDENCE	E	1.00	1609.	5.44E-07	5.42E-07	4.76E-07	4.19E-09
A	RESIDENCE	ESE	1.00	1609.	5.21E-07	5.20E-07	4.56E-07	4.42E-09
A	RESIDENCE	SE	1.00	1609.	5.87E-07	5.86E-07	5.14E-07	5.25E-09
A	RESIDENCE	SSE	0.70	1127.	1.21E-06	1.20E-06	1.08E-06	1.00E-08
A	RESIDENCE	S	0.50	805.	1.38E-06	1.38E-06	1.26E-06	8.79E-09
A	RESIDENCE	SSW	0.70	1127.	6.50E-07	6.49E-07	5.81E-07	3.37E-09
A	BEEF COW	NE	2.90	4667.	1.38E-07	1.36E-07	1.09E-07	7.06E-10
A	BEEF COW	ENE	4.00	6437.	6.51E-08	6.43E-08	4.98E-08	3.20E-10
A	BEEF COW	E	3.50	5633.	8.64E-08	8.56E-08	6.73E-08	4.71E-10
A	BEEF COW	ESE	4.00	6437.	6.70E-08	6.63E-08	5.13E-08	3.93E-10
A	BEEF COW	SSE	3.00	4828.	1.41E-07	1.40E-07	1.12E-07	8.11E-10
A	DAIRY COW	SE	4.30	6920.	6.83E-08	6.75E-08	5.18E-08	4.09E-10
A	GOAT	NE	3.20	5150.	1.19E-07	1.18E-07	9.39E-08	5.93E-10
A	GOAT	ESE	3.00	4828.	1.02E-07	1.01E-07	8.10E-08	6.55E-10

VENT AND BUILDING PARAMETERS:

RELEASE HEIGHT	(METERS)	58.10	REP. WIND HEIGHT	(METERS)	10.0
DIAMETER	(METERS)	0.00	BUILDING HEIGHT	(METERS)	58.1
EXIT VELOCITY	(METERS)	0.00	BLDG.MIN.CRS.SEC.AREA	(SQ.METERS)	2000.0
			HEAT EMISSION RATE	(CAL/SEC)	0.0

ALL GROUND LEVEL RELEASES.

1/8/02

TABLE 1.4

2001 PALISADES LAND USE CENSUS

Distance to the nearest residence, garden, dairy/beef cattle, and goat in each sector.

1/8/02

SECTOR	RESIDENCE	GARDEN	BEEF CATTLE	DAIRY COW	GOAT
NNE	1.1 mi	1.7 mi	>5 mi	>5 mi	>5 mi
NE	1.2 mi	1.2 mi	2.9 mi	>5 mi	3.2 mi
ENE	1.3 mi	1.6 mi	1.8 mi	>5 mi	>5 mi
E	1.0 mi	2.1 mi	3.5 mi	>5 mi	>5 mi
ESE	1.0 mi	*1.0 mi	*4.0 mi	>5 mi	*2.0 mi
SE	1.0 mi	*1.0 mi	2.2 mi	4.3 mi	*2.0 mi
SSE	0.7 mi	1.6 mi	>5 mi	>5 mi	>5 mi
S	0.5 mi	4.0 mi	>5 mi	>5 mi	4.7 mi
SSW	0.7 mi	4.9 mi	>5 mi	>5 mi	>5 mi

*Note: Garden and Farm bisected by ESE/SE sector line.

TABLE 1.4a

2001 PALISADES LAND USE CENSUS

1/8/02

Critical Receptor Items

Sector	Distance Miles	Location/Description	Item	*X/Q (sec/m3)
SSE	0.48	Site Boundary	N/A	2.13E-06
S	0.50	Residence, Palisades Park; 1/2 mile west of 29th Avenue and Blue Star intersection	Residence	1.38E-06
SE	1.0	77550 28th Avenue	Garden	5.87E-07
ENE	1.8	22595 76th Ave .3 miles N of 24th, East side of road	Beef Cattle	2.14E-07
SE	4.3	72401 36th Ave	Dairy Cow	6.83E-08
SE	2.0	SE corner of 30th and 76th	Goat	2.10E-07

*Based on Palisades 5-year composite meteorological data, 1992 - 1996.

TABLE 1.5

DOSE FACTORS FOR SUBMERSION IN NOBLE GASES*

	DFR[1]	DFY[2]	DFS[1]	DFB[2]
Kr-85m	1.17(+3)[3]	1.23(+3)	1.46(+3)	1.97(+3)
Kr-85	1.61(+1)	1.72(+1)	1.34(+3)	1.95(+3)
Kr-87	5.92(+3)	6.17(+3)	9.73(+3)	1.03(+4)
Kr-88	1.47(+4)	1.52(+4)	2.37(+3)	2.93(+3)
Kr-89	1.66(+4)	1.73(+4)	1.01(+4)	1.06(+4)
Xe-131m	9.15(+1)	1.56(+2)	4.76(+2)	1.11(+3)
Xe-133m	2.51(+2)	3.27(+2)	9.94(+2)	1.48(+3)
Xe-133	2.94(+2)	3.53(+2)	3.06(+2)	1.05(+3)
Xe-135m	3.12(+3)	3.36(+3)	7.11(+2)	7.39(+3)
Xe-135	1.81(+3)	1.92(+3)	1.86(+3)	2.46(+3)
Xe-137	1.42(+3)	1.51(+3)	1.22(+4)	1.27(+4)
Xe-138	8.83(+3)	9.21(+3)	4.13(+3)	4.75(+3)
Ar-41	8.84(+3)	9.30(+3)	2.69(+3)	3.28(+3)

1. mrem/y per μCi/m^3
2. mrad/y per μCi/m^3
3. 1.17(+3) = 1.17×10^3

*Dose factors for exposure to a semi-infinite cloud of noble gases. Values were obtained from USNRC Regulatory Guide 1.109, Revision 1 (October 1977).

TABLE 1.6

STABLE ELEMENT TRANSFER DATA

ELEMENT	F_m - MILK (COW) (DAYS/L)	F_m - MILK (GOAT) (DAYS/L)	F_f - MEAT (DAYS/KG)	B_{iv} (VEG/SOIL)
H	1.0E-02	1.7E-01	1.2E-02	4.8E-00
C	1.2E-02	1.0E-01	3.1E-02	5.5E-00
Na	4.0E-02	4.0E-02	3.0E-02	5.2E-02
P	2.5E-02	2.5E-01	4.6E-02	1.1E-00
Cr	2.2E-03	2.2E-03	2.4E-03	2.5E-04
Mn	2.5E-04	2.5E-04	8.0E-04	2.9E-02
Fe	1.2E-03	1.3E-04	4.0E-02	6.6E-04
Co	1.0E-03	1.0E-03	1.3E-02	9.4E-03
Ni	6.7E-03	6.7E-03	5.3E-02	1.9E-02
Cu	1.4E-02	1.3E-02	8.0E-03	1.2E-01
Zn	3.9E-02	3.9E-02	3.0E-02	4.0E-01
Rb	3.0E-02	3.0E-02	3.1E-02	1.3E-01
Sr	8.0E-04	1.4E-02	6.0E-04	1.7E-02
Y	1.0E-05	1.0E-05	4.6E-03	2.6E-03
Zr	5.0E-06	5.0E-06	3.4E-02	1.7E-04
Nb	2.5E-03	2.5E-03	2.8E-01	9.4E-03
Mo	7.5E-03	7.5E-03	8.0E-03	1.2E-01
Tc	2.5E-02	2.5E-02	4.0E-01	2.5E-01
Ru	1.0E-06	1.0E-06	4.0E-01	5.0E-02
Rh	1.0E-02	1.0E-02	1.5E-03	1.3E+01
Ag	5.0E-02	5.0E-02	1.7E-02	1.5E-01
Te	1.0E-03	1.0E-03	7.7E-02	1.3E-00
I	6.0E-03	6.0E-02	2.9E-03	2.0E-02
Cs	1.2E-02	3.0E-01	4.0E-03	1.0E-02
Ba	4.0E-04	4.0E-04	3.2E-03	5.0E-03
La	5.0E-06	5.0E-06	2.0E-04	2.5E-03
Ce	1.0E-04	1.0E-04	1.2E-03	2.5E-03
Pr	5.0E-06	5.0E-06	4.7E-03	2.5E-03
Nd	5.0E-06	5.0E-06	3.3E-03	2.4E-03
W	5.0E-04	5.0E-04	1.3E-03	1.8E-02
Np	5.0E-06	5.0E-06	2.0E-04	2.5E-03

TABLE 1.7

INFANT INHALATION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INHALED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
H3*	0.	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07
BE10	9.49E-04	1.25E-04	2.65E-05	0.	0.	1.49E-03	1.73E-05
C14	1.89E-05	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06
N13	4.39E-08	4.39E-08	4.39E-08	4.39E-08	4.39E-08	4.39E-08	4.39E-08
F18	3.92E-06	0.	3.33E-07	0.	0.	0.	6.10E-07
NA22	7.37E-05	7.37E-05	7.37E-05	7.37E-05	7.37E-05	7.37E-05	7.37E-05
NA24	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06
P32	1.45E-03	8.03E-05	5.53E-05	0.	0.	0.	1.15E-05
AR39	0.	0.	0.	0.	0.	1.00E-08	0.
AR41	0.	0.	0.	0.	0.	3.14E-08	0.
CA41	7.48E-05	0.	8.16E-06.	0.	0.	6.94E-02	2.96E-07
SC46	3.75E-04	5.41E-04	1.69E-04	0.	3.56E-04	0.	2.19E-05
CR51	0.	0.	6.39E-08	4.11E-08	9.45E-09	9.17E-06	2.55E-07
MN54	0.	1.81E-05	3.56E-06	0.	3.56E-06	7.14E-04	5.04E-06
MN56	0.	1.10E-09	1.58E-10	0.	7.86E-10	8.95E-06	5.12E-05
FE55	1.41E-05	8.39E-06	2.38E-06	0.	0.	6.21E-05	7.82E-07
FE59	9.69E-06	1.68E-05	6.77E-06	0.	0.	7.25E-04	1.77E-05
CO57	0.	4.65E-07	4.58E-07	0.	0.	2.71E-04	3.47E-06
CO58	0.	8.71E-07	1.30E-06	0.	0.	5.55E-04	7.95E-06
CO60	0.	5.73E-06	8.41E-06	0.	0.	3.22E-03	2.28E-05
NI59	1.81E-05	5.44E-06	3.10E-06	0.	0.	5.48E-05	6.34E-07
NI63	2.42E-04	1.46E-05	8.29E-06	0.	0.	1.49E-04	1.73E-06
NI65	1.71E-09	2.03E-10	8.79E-11	0.	0.	5.80E-06	3.58E-05
CU64	0.	1.34E-09	5.53E-10	0.	2.84E-09	6.64E-06	1.07E-05
ZN65	1.38E-05	4.47E-05	2.22E-05	0.	2.32E-05	4.62E-04	3.67E-05
ZN69M+D	8.98E-09	1.84E-08	1.67E-09	0.	7.45E-09	1.91E-05	2.92E-05
ZN69	3.85E-11	6.91E-11	5.13E-12	0.	2.87E-11	1.05E-06	9.44E-06
SE79	0.	2.25E-06	4.20E-07	0.	2.47E-06	2.99E-04	3.46E-06
BR82	0.	0.	9.49E-06	0.	0.	0.	0.
BR83+D	0.	0.	2.72E-07	0.	0.	0.	0.
BR84	0.	0.	2.86E-07	0.	0.	0.	0.
BR85	0.	0.	1.46E-08	0.	0.	0.	0.
KR83M	0.	0.	0.	0.	0.	2.50E-09	0.
KR85M	0.	0.	0.	0.	0.	1.31E-08	0.
KR85	0.	0.	0.	0.	0.	1.16E-08	0.
KR87	0.	0.	0.	0.	0.	6.59E-08	0.
KR88+D	0.	0.	0.	0.	0.	1.38E-07	0.
KR89	0.	0.	0.	0.	0.	8.67E-08	0.
RB86	0.	1.36E-04	6.30E-05	0.	0.	0.	2.17E-06
RB87	0.	7.11E-05	2.64E-05	0.	0.	0.	2.99E-07
RB88	0.	3.98E-07	2.05E-07	0.	0.	0.	2.42E-07
RB89+D	0.	2.29E-07	1.47E-07	0.	0.	0.	4.87E-08
SR89+D	2.84E-04	0.	8.15E-06	0.	0.	1.45E-03	4.57E-05
SR90+D	2.92E-02	0.	1.85E-03	0.	0.	8.03E-03	9.36E-05
SR91+D	6.83E-08	0.	2.47E-09	0.	0.	3.76E-05	5.24E-05
SR92+D	7.50E-09	0.	2.79E-10	0.	0.	1.70E-05	1.00E-04

Includes a 50% increase to account for percutaneous transpiration.

TABLE 1.7 (continued)

INFANT INHALATION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INHALED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y90	2.35E-06	0.	6.30E-08	0.	0.	1.92E-04	7.43E-05
Y91M+D	2.91E-10	0.	9.90E-12	0.	0.	1.99E-06	1.68E-06
Y91	4.20E-04	0.	1.12E-05	0.	0.	1.75E-03	5.02E-05
Y92	1.17E-08	0.	3.29E-10	0.	0.	1.75E-05	9.04E-05
Y93	1.07E-07	0.	2.91E-09	0.	0.	5.46E-05	1.19E-04
ZR93+D	2.24E-04	9.51E-05	6.18E-05	0.	3.19E-04	1.37E-03	1.48E-05
ZR95+D	8.24E-05	1.99E-05	1.45E-05	0.	2.22E-05	1.25E-03	1.55E-05
ZR97+D	1.07E-07	1.83E-08	8.36E-09	0.	1.85E-08	7.88E-05	1.00E-04
NB93M	1.38E-04	3.59E-05	1.15E-05	0.	3.68E-05	2.09E-04	2.47E-06
NB95	1.12E-05	4.59E-06	2.70E-06	0.	3.37E-06	3.42E-04	9.05E-06
NB97	2.44E-10	5.21E-11	1.88E-11	0.	4.07E-11	2.37E-06	1.92E-05
MO93	0.	6.46E-06	2.22E-07	0.	1.54E-06	3.40E-04	3.76E-06
MO99+D	0.	1.18E-07	2.31E-08	0.	1.89E-07	9.63E-05	3.48E-05
TC99M	9.98E-13	2.06E-12	2.66E-11	0.	2.22E-11	5.79E-07	1.45E-06
TC99	2.09E-07	2.68E-07	8.85E-08	0.	2.49E-06	6.77E-04	7.82E-06
TC101	4.65E-14	5.88E-14	5.80E-13	0.	6.99E-13	4.17E-07	6.03E-07
RU103+D	1.44E-06	0.	4.85E-07	0.	3.03E-06	3.94E-04	1.15E-05
RU105+D	8.74E-10	0.	2.93E-10	0.	6.42E-10	1.12E-05	3.46E-05
RU106+D	6.20E-05	0.	7.77E-06	0.	7.61E-05	8.26E-03	1.17E-04
RH105	8.26E-09	5.41E-09	3.63E-09	0.	1.50E-08	2.08E-05	1.37E-05
PD107	0.	4.92E-07	4.11E-08	0.	2.75E-06	6.34E-05	7.33E-07
PD109	0.	3.92E-09	1.05E-09	0.	1.28E-08	1.68E-05	2.85E-05
AG110M+D	7.13E-06	5.16E-06	3.57E-06	0.	7.80E-06	2.62E-03	2.36E-05
AG111	3.75E-07	1.45E-07	7.75E-08	0.	3.05E-07	2.06E-04	3.02E-05
CD113M	0.	6.67E-04	2.64E-05	0.	5.80E-04	1.40E-03	1.65E-05
CD115M	0.	1.73E-04	6.19E-06	0.	9.41E-05	1.47E-03	5.02E-05
SN123	2.09E-04	4.21E-06	7.28E-06	4.27E-06	0.	2.22E-03	4.08E-05
SN125+D	1.01E-05	2.51E-07	6.00E-07	2.47E-07	0.	6.43E-04	7.26E-05
SN126+D	8.30E-04	1.44E-05	3.52E-05	3.84E-06	0.	4.93E-03	1.65E-05
SB124	2.71E-05	3.97E-07	8.56E-06	7.18E-08	0.	1.89E-03	4.22E-05
SB125+D	3.69E-05	3.41E-07	7.78E-06	4.45E-08	0.	1.17E-03	1.05E-05
SB126	3.08E-06	6.01E-08	1.11E-06	2.35E-08	0.	6.88E-04	5.33E-05
SB127	2.82E-07	5.04E-09	8.76E-08	3.60E-09	0.	1.54E-04	3.78E-05
TE125M	3.40E-06	1.42E-06	4.70E-07	1.16E-06	0.	3.19E-04	9.22E-06
TE127M+D	1.19E-05	4.93E-06	1.48E-06	3.48E-06	2.68E-05	9.37E-04	1.95E-05
TE127	1.59E-09	6.81E-10	3.49E-10	1.32E-09	3.47E-09	7.39E-06	1.74E-05
TE129M+D	1.01E-05	4.35E-06	1.59E-06	3.91E-06	2.27E-05	1.20E-03	4.93E-05
TE129	5.63E-11	2.48E-11	1.34E-11	4.82E-11	1.25E-10	2.14E-06	1.88E-05
TE131M+D	7.62E-08	3.93E-08	2.59E-08	6.38E-08	1.89E-07	1.42E-04	8.51E-05
TE131+D	1.24E-11	5.87E-12	3.57E-12	1.13E-11	2.85E-11	1.47E-06	5.87E-06
TE132+D	2.66E-07	1.69E-07	1.26E-07	1.99E-07	7.39E-07	2.43E-04	3.15E-05
TE133M+D	6.13E-11	3.59E-11	2.74E-11	5.52E-11	1.72E-10	3.92E-06	1.59E-05
TE134+D	3.18E-11	2.04E-11	1.68E-11	2.91E-11	9.59E-11	2.93E-06	2.53E-06
I129	2.16E-05	1.59E-05	1.16E-05	1.04E-02	1.88E-05	0.	2.12E-07
I130	4.54E-06	9.91E-06	3.98E-06	1.14E-03	1.09E-05	0.	1.42E-06
I131+D	2.71E-05	3.17E-05	1.40E-05	1.06E-02	3.70E-05	0.	7.56E-07

TABLE 1.7 (continued)

INFANT INHALATION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INHALED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
I132	1.21E-06	2.53E-06	8.99E-07	1.21E-04	2.82E-06	0.	1.36E-06
I133+D	9.46E-06	1.37E-05	4.00E-06	2.54E-03	1.60E-05	0.	1.54E-06
I134	6.58E-07	1.34E-06	4.75E-07	3.18E-05	1.49E-06	0.	9.21E-07
I135+D	2.76E-06	5.43E-06	1.98E-06	4.97E-04	6.05E-06	0.	1.31E-06
XE131M	0.	0.	0.	0.	0.	6.77E-09	0.
XE133M	0.	0.	0.	0.	0.	8.89E-09	0.
XE133	0.	0.	0.	0.	0.	7.41E-09	0.
XE135M	0.	0.	0.	0.	0.	8.05E-09	0.
XE135	0.	0.	0.	0.	0.	1.80E-08	0.
XE137	0.	0.	0.	0.	0.	8.30E-08	0.
XE138+D	0.	0.	0.	0.	0.	9.78E-08	0.
CS134M+D	1.32E-07	2.10E-07	1.11E-07	0.	8.50E-08	2.00E-08	1.16E-07
CS134	2.83E-04	5.02E-04	5.32E-05	0.	1.36E-04	5.69E-05	9.53E-07
CS135	1.00E-04	8.66E-05	4.73E-06	0.	2.58E-05	1.01E-05	2.18E-07
CS136	3.45E-05	9.61E-05	3.78E-05	0.	4.03E-05	8.40E-06	1.02E-06
CS137+D	3.92E-04	4.37E-04	3.25E-05	0.	1.23E-04	5.09E-05	9.53E-07
CS138	3.61E-07	5.58E-07	2.84E-07	0.	2.93E-07	4.67E-08	6.26E-07
CS139+D	2.32E-07	3.03E-07	1.22E-07	0.	1.65E-07	2.53E-08	1.33E-08
BA139	1.06E-09	7.03E-13	3.07E-11	0.	4.23E-13	4.25E-06	3.64E-05
BA140+D	4.00E-05	4.00E-08	2.07E-06	0.	9.59E-09	1.14E-03	2.74E-05
BA141+D	1.12E-10	7.70E-14	3.55E-12	0.	4.64E-14	2.12E-06	3.39E-06
BA142+D	2.84E-11	2.36E-14	1.40E-12	0.	1.36E-14	1.11E-06	4.95E-07
LA140	3.61E-07	1.43E-07	3.68E-08	0.	0.	1.20E-04	6.06E-05
LA141	4.85E-09	1.40E-09	2.45E-10	0.	0.	1.22E-05	5.96E-05
LA142	7.36E-10	2.69E-10	6.46E-11	0.	0.	5.87E-06	4.25E-05
CE141	1.98E-05	1.19E-05	1.42E-06	0.	3.75E-06	3.69E-04	1.54E-05
CE143+D	2.09E-07	1.38E-07	1.58E-08	0.	4.03E-08	8.30E-05	3.55E-05
CE144+D	2.28E-03	8.65E-04	1.26E-04	0.	3.84E-04	7.03E-03	1.06E-04
PR143	1.00E-05	3.74E-06	4.99E-07	0.	1.41E-06	3.09E-04	2.66E-05
PR144	3.42E-11	1.32E-11	1.72E-12	0.	4.80E-12	1.15E-06	3.06E-06
ND147+D	5.67E-06	5.81E-06	3.57E-07	0.	2.25E-06	2.30E-04	2.23E-05
PM147	3.91E-04	3.07E-05	1.56E-05	0.	4.93E-05	4.55E-04	5.75E-06
PM148M+D	5.00E-05	1.24E-05	9.94E-06	0.	1.45E-05	1.22E-03	3.37E-05
PM148	3.34E-06	4.82E-07	2.44E-07	0.	5.76E-07	3.20E-04	6.04E-05
PM149	3.10E-07	4.08E-08	1.78E-08	0.	4.96E-08	6.50E-05	3.01E-05
PM151	7.52E-08	1.10E-08	5.55E-09	0.	1.30E-08	3.25E-05	2.58E-05
SM151	3.38E-04	6.45E-05	1.63E-05	0.	5.24E-05	2.98E-04	3.46E-06
SM153	1.53E-07	1.18E-07	9.06E-09	0.	2.47E-08	3.70E-05	1.93E-05
EU152	7.83E-04	1.77E-04	1.72E-04	0.	5.94E-04	1.48E-03	9.88E-06
EU154	2.96E-03	3.46E-04	2.45E-04	0.	1.14E-03	3.05E-03	2.84E-05
EU155	5.97E-04	5.72E-05	3.46E-05	0.	1.58E-04	5.20E-04	5.19E-05
EU156	1.56E-05	9.59E-06	1.54E-06	0.	4.48E-06	6.12E-04	4.14E-05
TB160	1.12E-04	0.	1.40E-05	0.	3.20E-05	1.11E-03	2.14E-05
HO166M	1.45E-03	3.07E-04	2.51E-04	0.	4.22E-04	2.05E-03	1.65E-05
W181	4.86E-08	1.46E-08	1.67E-09	0.	0.	1.33E-05	2.63E-07
W185	1.57E-06	4.83E-07	5.58E-08	0.	0.	4.48E-04	1.12E-05
W187	9.26E-09	6.44E-09	2.23E-09	0.	0.	2.83E-05	2.54E-05

TABLE 1.7 (continued)

INFANT INHALATION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INHALED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
PB210+D	8.62E-02	2.02E-02	3.43E-03	0.	6.85E-02	1.76E-01	3.79E-05
BI210+D	0.	1.33E-05	1.18E-06	0.	1.03E-04	9.96E-03	3.27E-05
PO210	2.98E-03	5.63E-03	7.12E-04	0.	1.30E-02	2.40E-01	4.36E-05
RN222+D	0.	0.	0.	0.	0.	9.88E-06	0.
RA223+D	1.56E-03	2.26E-06	3.12E-04	0.	4.16E-05	2.25E-01	3.04E-04
RA224+D	1.77E-04	4.00E-07	3.54E-05	0.	7.30E-06	7.91E-02	3.42E-04
RA225+D	2.57E-03	2.88E-06	5.13E-04	0.	5.31E-05	2.57E-01	2.87E-04
RA226+D	2.48E-01	1.46E-05	2.05E-01	0.	2.94E-04	7.83E-01	3.05E-04
RA228+D	1.60E-01	7.61E-06	1.80E-01	0.	1.53E-04	1.09E-00	5.19E-05
AC225	3.69E-03	4.72E-03	2.48E-04	0.	3.49E-04	1.96E-01	2.71E-04
AC227+D	5.29E+00	8.76E-01	3.28E-01	0.	1.86E-01	1.62E+00	5.27E-05
TH227+D	1.82E-03	3.03E-05	5.24E-05	0.	1.13E-04	3.27E-01	3.53E-04
TH228+D	8.46E-01	1.10E-02	2.86E-02	0.	5.61E-02	4.65E+00	3.62E-04
TH229	1.34E+01	1.82E-01	6.62E-01	0.	8.99E-01	1.22E+01	3.29E-04
TH230	3.46E+00	1.79E-01	9.65E-02	0.	8.82E-01	2.18E+00	3.87E-05
TH232+D	3.86E+00	1.53E-01	2.29E-01	0.	7.54E-01	2.09E+00	3.29E-05
TH234	1.33E-05	7.17E-07	3.84E-07	0.	2.70E-06	1.62E-03	7.40E-05
PA231+D	9.10E+00	3.00E-01	3.62E-01	0.	1.62E+00	3.85E-01	4.61E-05
PA233	6.84E-06	1.32E-06	1.19E-06	0.	3.68E-06	2.19E-04	9.04E-06
U232+D	2.57E-01	0.	2.13E-02	0.	2.40E-02	1.49E+00	4.36E-05
U233+D	5.44E-02	0.	3.83E-03	0.	1.09E-02	3.56E-01	4.03E-05
U234	5.22E-02	0.	3.75E-03	0.	1.07E-02	3.49E-01	3.95E-05
U235+D	5.01E-02	0.	3.52E-03	0.	1.01E-02	3.28E-01	5.02E-05
U236	5.01E-02	0.	3.60E-03	0.	1.03E-02	3.35E-01	3.71E-05
U237	3.25E-07	0.	8.65E-08	0.	8.08E-07	9.13E-05	1.31E-05
U238+D	4.79E-02	0.	3.29E-03	0.	9.40E-03	3.06E-01	3.54E-05
NP237+D	3.03E+00	2.32E-01	1.26E-01	0.	7.69E-01	3.49E-01	5.10E-05
NP238	2.67E-06	6.73E-08	4.16E-08	0.	1.47E-07	9.19E-05	2.58E-05
NP239	2.65E-07	2.37E-08	1.34E-08	0.	4.73E-08	4.25E-05	1.78E-05
PU238	5.02E+00	6.33E-01	1.27E-01	0.	4.64E-01	9.03E-01	4.69E-05
PU239	5.50E+00	6.72E-01	1.34E-01	0.	4.95E-01	8.47E-01	4.28E-05
PU240	6.49E+00	6.71E-01	1.34E-01	0.	4.94E-01	8.47E-01	4.36E-05
PU241+D	1.55E-01	6.69E-03	3.11E-03	0.	1.15E-02	7.62E-04	8.97E-07
PU242	5.09E+00	6.47E-01	1.29E-01	0.	4.77E-01	8.15E-01	4.20E-05
PU244	5.95E+00	7.40E-01	1.48E-01	0.	5.46E-01	9.33E-01	6.26E-05
AM241	1.84E+00	8.44E-01	1.31E-01	0.	7.94E-01	4.06E-01	4.78E-05
AM242M	1.90E+00	8.24E-01	1.35E-01	0.	8.03E-01	1.64E-01	6.01E-05
AM243	1.82E+00	8.10E-01	1.27E-01	0.	7.72E-01	3.85E-01	5.60E-05
CM242	8.58E-02	7.44E-02	5.70E-03	0.	1.69E-02	2.97E-01	5.10E-05
CM243	1.73E+00	7.94E-01	1.06E-01	0.	3.91E-01	4.24E-01	5.02E-05
CM244	1.43E+00	7.04E-01	8.89E-02	0.	3.21E-01	4.08E-01	4.86E-05
CM245	2.26E+00	8.80E-01	1.36E-01	0.	5.23E-01	3.92E-01	4.53E-05
CM246	2.24E+00	8.79E-01	1.36E-01	0.	5.23E-01	3.99E-01	4.45E-05
CM247+D	2.18E+00	8.64E-01	1.33E-01	0.	5.15E-01	3.92E-01	5.85E-05
CM248	1.82E+01	7.12E+00	1.10E+00	0.	4.24E+00	3.23E+00	9.43E-04
CF252	4.26E+00	0.	1.01E-01	0.	0.	1.37E+00	1.85E-04

TABLE 1.7 (continued)

CHILD INHALATION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INHALED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
H3*	0.	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07
BE10	8.43E-04	9.83E-05	2.12E-05	0.	0.	7.41E-04	1.72E-05
C14	9.70E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06
N13	2.33E-08	2.33E-08	2.33E-08	2.33E-08	2.33E-08	2.33E-08	2.33E-08
F18	1.88E-06	0.	1.85E-07	0.	0.	0.	3.37E-07
NA22	4.41E-05	4.41E-05	4.41E-05	4.41E-05	4.41E-05	4.41E-05	4.41E-05
NA24	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06
P32	7.04E-04	3.09E-05	2.67E-05	0.	0.	0.	1.14E-05
AR39	0.	0.	0.	0.	0.	4.89E-09	0.
AR41	0.	0.	0.	0.	0.	1.68E-08	0.
CA41	7.06E-05	0.	7.70E-06	0.	0.	7.21E-02	2.94E-07
SC46	1.97E-04	2.70E-04	1.04E-04	0.	2.39E-04	0.	2.45E-05
CR51	0.	0.	4.17E-08	2.31E-08	6.57E-09	4.59E-06	2.93E-07
MN54	0.	1.16E-05	2.57E-06	0.	2.71E-06	4.26E-04	6.19E-06
MN56	0.	4.48E-10	8.43E-11	0.	4.52E-10	3.55E-06	3.33E-05
FE55	1.28E-05	6.80E-06	2.10E-06	0.	0.	3.00E-05	7.75E-07
FE59	5.59E-06	9.04E-06	4.51E-06	0.	0.	3.43E-04	1.91E-05
CO57	0.	2.44E-07	2.88E-07	0.	0.	1.37E-04	3.58E-06
CO58	0.	4.79E-07	8.55E-07	0.	0.	2.99E-04	9.29E-06
CO60	0.	3.55E-06	6.12E-06	0.	0.	1.91E-03	2.60E-05
NI59	1.66E-05	4.67E-06	2.83E-06	0.	0.	2.73E-05	6.29E-07
NI63	2.22E-04	1.25E-05	7.56E-06	0.	0.	7.43E-05	1.71E-06
NI65	8.08E-10	7.99E-11	4.44E-11	0.	0.	2.21E-06	2.27E-05
CU64	0.	5.39E-10	2.90E-10	0.	1.63E-09	2.59E-06	9.92E-06
ZN65	1.15E-05	3.06E-05	1.90E-05	0.	1.93E-05	2.69E-04	4.41E-06
ZN69M+D	4.26E-09	7.28E-09	8.59E-10	0.	4.22E-09	7.36E-06	2.71E-05
ZN69	1.81E-11	2.61E-11	2.41E-12	0.	1.58E-11	3.84E-07	2.75E-06
SE79	0.	1.23E-06	2.60E-07	0.	1.71E-06	1.49E-04	3.43E-06
BR82	0.	0.	5.66E-06	0.	0.	0.	0.
BR83+D	0.	0.	1.28E-07	0.	0.	0.	0.
BR84	0.	0.	1.48E-07	0.	0.	0.	0.
BR85	0.	0.	6.84E-09	0.	0.	0.	0.
KR83M	0.	0.	0.	0.	0.	1.22E-09	0.
KR85M	0.	0.	0.	0.	0.	6.58E-09	0.
KR85	0.	0.	0.	0.	0.	5.66E-09	0.
KR87	0.	0.	0.	0.	0.	3.38E-08	0.
KR88+D	0.	0.	0.	0.	0.	6.99E-08	0.
KR89	0.	0.	0.	0.	0.	4.55E-08	0.
RB86	0.	5.36E-05	3.09E-05	0.	0.	0.	2.16E-06
RB87	0.	3.16E-05	1.37E-05	0.	0.	0.	2.96E-07
RB88	0.	1.52E-07	9.90E-08	0.	0.	0.	4.66E-09
RB89+D	0.	9.33E-08	7.83E-08	0.	0.	0.	5.11E-10
SR89+D	1.62E-04	0.	4.66E-06	0.	0.	5.83E-04	4.52E-05
SR90+D	2.73E-02	0.	1.74E-03	0.	0.	3.99E-03	9.28E-05
SR91+D	3.28E-08	0.	1.24E-09	0.	0.	1.44E-05	4.70E-05
SR92+D	3.54E-09	0.	1.42E-10	0.	0.	6.49E-06	6.55E-05

*Includes a 50% increase to account for percutaneous transpiration.

TABLE 1.7 (continued)

CHILD INHALATION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INHALED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y90	1.11E-06	0.	2.99E-08	0.	0.	7.07E-05	7.24E-05
Y91M+D	1.37E-10	0.	4.98E-12	0.	0.	7.60E-07	4.64E-07
Y91	2.47E-04	0.	6.59E-06	0.	0.	7.10E-04	4.97E-05
Y92	5.50E-09	0.	1.57E-10	0.	0.	6.46E-06	6.46E-05
Y93	5.04E-08	0.	1.38E-09	0.	0.	2.01E-05	1.05E-04
ZR93+D	2.07E-04	7.80E-05	5.55E-05	0.	3.00E-04	7.10E-04	1.47E-05
ZR95+D	5.13E-05	1.13E-05	1.00E-05	0.	1.61E-05	6.03E-04	1.65E-05
ZR97+D	5.07E-08	7.34E-09	4.32E-09	0.	1.05E-08	3.06E-05	9.49E-05
NB93M	1.27E-04	3.17E-05	1.04E-05	0.	3.44E-05	1.04E-04	2.45E-06
NB95	6.35E-06	2.48E-06	1.77E-06	0.	2.33E-06	1.66E-04	1.00E-05
NB97	1.16E-10	2.08E-11	9.74E-12	0.	2.31E-11	9.23E-07	7.52E-06
MO93	0.	3.76E-06	1.35E-07	0.	1.06E-06	1.70E-04	3.78E-06
MO99+D	0.	4.66E-08	1.15E-08	0.	1.06E-07	3.66E-05	3.42E-05
TC99M	4.81E-13	9.41E-13	1.56E-11	0.	1.37E-11	2.57E-07	1.30E-06
TC99	1.34E-07	1.49E-07	5.35E-08	0.	1.75E-06	3.37E-04	7.75E-06
TC101	2.19E-14	2.30E-14	2.91E-13	0.	3.92E-13	1.58E-07	4.41E-09
RU103+D	7.55E-07	0.	2.90E-07	0.	1.90E-06	1.79E-04	1.21E-05
RU105+D	4.13E-10	0.	1.50E-10	0.	3.63E-10	4.30E-06	2.69E-05
RU106+D	3.68E-05	0.	4.57E-06	0.	4.97E-05	3.87E-03	1.16E-04
RH105	3.91E-09	2.10E-09	1.79E-09	0.	8.39E-09	7.82E-06	1.33E-05
PD107	0.	2.65E-07	2.51E-08	0.	1.97E-06	3.16E-05	7.26E-07
PD109	0.	1.48E-09	4.95E-10	0.	7.06E-09	6.16E-06	2.59E-05
AG110M+D	4.56E-06	3.08E-06	2.47E-06	0.	5.74E-06	1.48E-03	2.71E-05
AG111	1.81E-07	5.68E-08	3.75E-08	0.	1.71E-07	7.73E-05	2.98E-05
CD113M	0.	4.93E-04	2.12E-05	0.	5.13E-04	6.94E-04	1.63E-05
CD115M	0.	7.88E-05	3.39E-06	0.	5.93E-05	5.86E-04	4.97E-05
SN123	1.29E-04	2.14E-06	4.19E-06	2.27E-06	0.	9.59E-04	4.05E-05
SN125+D	4.95E-06	9.94E-08	2.95E-07	1.03E-07	0.	2.43E-04	7.17E-05
SN126+D	6.23E-04	1.04E-05	2.36E-05	2.84E-06	0.	3.02E-03	1.63E-05
SB124	1.55E-05	2.00E-07	5.41E-06	3.41E-08	0.	8.76E-04	4.43E-05
SB125+D	2.66E-05	2.05E-07	5.59E-06	2.46E-08	0.	6.27E-04	1.09E-05
SB126	1.72E-06	2.62E-08	6.16E-07	1.00E-08	0.	2.86E-04	5.67E-05
SB127	1.36E-07	2.09E-09	4.70E-08	1.51E-09	0.	6.17E-05	3.82E-05
TE125M	1.82E-06	6.29E-07	2.47E-07	5.20E-07	0.	1.29E-04	9.13E-06
TE127M+D	6.72E-06	2.31E-06	8.16E-07	1.64E-06	1.72E-05	4.00E-04	1.93E-05
TE127	7.49E-10	2.57E-10	1.65E-10	5.30E-10	1.91E-09	2.71E-06	1.52E-05
TE129M+D	5.19E-06	1.85E-06	8.22E-07	1.71E-06	1.36E-05	4.76E-04	4.91E-05
TE129	2.64E-11	9.45E-12	6.44E-12	1.93E-11	6.94E-11	7.93E-07	6.89E-06
TE131M+D	3.63E-08	1.60E-08	1.37E-08	2.64E-08	1.08E-07	5.56E-05	8.32E-05
TE131+D	5.87E-12	2.28E-12	1.78E-12	4.59E-12	1.59E-11	5.55E-07	3.60E-07
TE132+D	1.30E-07	7.36E-08	7.12E-08	8.58E-08	4.79E-07	1.02E-04	3.72E-05
TE133M+D	2.93E-11	1.51E-11	1.50E-11	2.32E-11	1.01E-10	1.60E-06	4.77E-06
TE134+D	1.53E-11	8.81E-12	9.40E-12	1.24E-11	5.71E-11	1.23E-06	4.87E-07
I129	1.05E-05	6.40E-06	5.71E-06	4.28E-03	1.08E-05	0.	2.15E-07
I130	2.21E-06	4.43E-06	2.28E-06	4.99E-04	6.61E-06	0.	1.38E-06
I131+D	1.30E-05	1.30E-05	7.37E-06	4.39E-03	2.13E-05	0.	7.68E-07

TABLE 1.7 (continued)

CHILD INHALATION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INHALED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
I132	5.72E-07	1.10E-06	5.07E-07	5.23E-05	1.69E-06	0.	8.65E-07
I133+D	4.48E-06	5.49E-06	2.08E-06	1.04E-03	9.13E-06	0.	1.48E-06
I134	3.17E-07	5.84E-07	2.69E-07	1.37E-05	8.92E-07	0.	2.58E-07
I135+D	1.33E-06	2.36E-06	1.12E-06	2.14E-04	3.62E-06	0.	1.20E-06
XE131M	0.	0.	0.	0.	0.	3.30E-09	0.
XE133M	0.	0.	0.	0.	0.	4.36E-09	0.
XE133	0.	0.	0.	0.	0.	3.66E-09	0.
XE135M	0.	0.	0.	0.	0.	4.48E-09	0.
XE135	0.	0.	0.	0.	0.	9.09E-09	0.
XE137	0.	0.	0.	0.	0.	4.07E-08	0.
XE138+D	0.	0.	0.	0.	0.	5.17E-08	0.
CS134M+D	6.33E-08	8.92E-08	6.12E-08	0.	4.94E-08	8.35E-09	7.92E-08
CS134	1.76E-04	2.74E-04	6.07E-05	0.	8.93E-05	3.27E-05	1.04E-06
CS135	6.23E-05	4.13E-05	4.45E-06	0.	1.53E-05	5.22E-06	2.17E-07
CS136	1.76E-05	4.62E-05	3.14E-05	0.	2.58E-05	3.93E-06	1.13E-06
CS137+D	2.45E-04	2.23E-04	3.47E-05	0.	7.63E-05	2.81E-05	9.78E-07
CS138	1.71E-07	2.27E-07	1.50E-07	0.	1.68E-07	1.84E-08	7.29E-08
CS139+D	1.09E-07	1.15E-07	5.80E-08	0.	9.08E-08	9.36E-09	7.23E-12
BA139	4.98E-10	2.66E-13	1.45E-11	0.	2.33E-13	1.56E-06	1.56E-05
BA140+D	2.00E-05	1.75E-08	1.17E-06	0.	5.71E-09	4.71E-04	2.75E-05
BA141+D	5.29E-11	2.95E-14	1.72E-12	0.	2.56E-14	7.89E-07	7.44E-08
BA142+D	1.35E-11	9.73E-15	7.54E-13	0.	7.87E-15	4.44E-07	7.41E-10
LA140	1.74E-07	6.08E-08	2.04E-08	0.	0.	4.94E-05	6.10E-05
LA141	2.28E-09	5.31E-10	1.15E-10	0.	0.	4.48E-06	4.37E-05
LA142	3.50E-10	1.11E-10	3.49E-11	0.	0.	2.35E-06	2.05E-05
CE141	1.06E-05	5.28E-06	7.83E-07	0.	2.31E-06	1.47E-04	1.53E-05
CE143+D	9.89E-08	5.37E-08	7.77E-09	0.	2.26E-08	3.12E-05	3.44E-05
CE144+D	1.83E-03	5.72E-04	9.77E-05	0.	3.17E-04	3.23E-03	1.05E-04
PR143	4.99E-06	1.50E-06	2.47E-07	0.	8.11E-07	1.17E-04	2.63E-05
PR144	1.61E-11	4.99E-12	8.10E-13	0.	2.64E-12	4.23E-07	5.32E-08
ND147+D	2.92E-06	2.36E-06	1.84E-07	0.	1.30E-06	8.87E-05	2.22E-05
PM147	3.52E-04	2.52E-05	1.36E-05	0.	4.45E-05	2.20E-04	5.70E-06
PM148M+D	3.31E-05	6.55E-06	6.55E-06	0.	9.74E-06	5.72E-04	3.58E-05
PM148	1.61E-06	1.94E-07	1.25E-07	0.	3.30E-07	1.24E-04	6.01E-05
PM149	1.47E-07	1.56E-08	8.45E-09	0.	2.75E-08	2.40E-05	2.92E-05
PM151	3.57E-08	4.33E-09	2.82E-09	0.	7.35E-09	1.24E-05	2.50E-05
SM151	3.14E-04	4.75E-05	1.49E-05	0.	4.89E-05	1.48E-04	3.43E-06
SM153	7.24E-08	4.51E-08	4.35E-09	0.	1.37E-08	1.37E-05	1.87E-05
EU152	7.42E-04	1.37E-04	1.61E-04	0.	5.73E-04	9.00E-04	1.14E-05
EU154	2.74E-03	2.49E-04	2.27E-04	0.	1.09E-03	1.66E-03	2.98E-05
EU155	5.60E-04	4.05E-05	3.18E-05	0.	1.51E-04	2.79E-04	5.39E-05
EU156	7.89E-06	4.23E-06	8.75E-07	0.	2.72E-06	2.54E-04	4.24E-05
TB160	7.79E-05	0.	9.67E-06	0.	2.32E-05	5.34E-04	2.28E-05
HO166M	1.34E-03	2.81E-04	2.37E-04	0.	4.01E-04	1.13E-03	1.63E-05
W181	2.66E-08	6.52E-09	8.99E-10	0.	0.	5.71E-06	2.61E-07
W185	8.31E-07	2.08E-07	2.91E-08	0.	0.	1.86E-04	1.11E-05
W187	4.41E-09	2.61E-09	1.17E-09	0.	0.	1.11E-05	2.46E-05

TABLE 1.7 (continued)

CHILD INHALATION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INHALED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
PB210+D	8.03E-02	1.85E-02	3.18E-03	0.	6.31E-02	8.74E-02	3.75E-05
BI210+D	0.	5.11E-06	5.65E-07	0.	5.76E-05	3.70E-03	3.21E-05
PO210	1.70E-03	2.76E-03	4.09E-04	0.	8.85E-03	1.05E-01	4.32E-05
RN222+D	0.	0.	0.	0.	0.	4.82E-06	0.
RA223+D	7.69E-04	8.89E-07	1.54E-04	0.	2.36E-05	8.48E-02	3.00E-04
RA224+D	8.44E-05	1.53E-07	1.69E-05	0.	4.06E-06	2.92E-02	3.34E-04
RA225+D	1.28E-03	1.14E-06	2.56E-04	0.	3.02E-05	9.74E-02	2.84E-04
RA226+D	2.34E-01	7.66E-06	1.92E-01	0.	2.03E-04	3.90E-01	3.02E-04
RA228+D	1.49E-01	3.94E-06	1.68E-01	0.	1.04E-04	5.37E-01	5.14E-05
AC225	1.81E-03	1.87E-03	1.21E-04	0.	1.99E-04	7.37E-02	2.67E-04
AC227+D	4.96E+00	8.05E-01	3.07E-01	0.	1.77E-01	8.04E-01	5.22E-05
TH227+D	9.24E-04	1.26E-05	2.67E-05	0.	6.67E-05	1.26E-01	3.49E-04
TH228+D	8.06E-01	1.04E-02	2.72E-02	0.	5.41E-02	3.34E+00	3.59E-04
TH229	1.28E+01	1.76E-01	6.31E-01	0.	8.68E-01	1.04E+01	3.27E-04
TH230	3.30E+00	1.73E-01	9.20E-02	0.	8.52E-01	1.85E+00	3.84E-05
TH232+D	3.68E+00	1.47E-01	1.28E-01	0.	7.28E-01	1.77E+00	3.27E-05
TH234	6.94E-06	3.07E-07	2.00E-07	0.	1.62E-06	6.31E-04	7.32E-05
PA231+D	8.62E+00	2.86E-01	3.43E-01	0.	1.56E+00	1.92E-01	4.57E-05
PA233	4.14E-06	6.48E-07	7.25E-07	0.	2.38E-06	9.77E-05	8.95E-06
U232+D	2.19E-01	0.	1.56E-02	0.	1.67E-02	7.42E-01	4.33E-05
U233+D	4.64E-02	0.	2.82E-03	0.	7.62E-03	1.77E-01	4.00E-05
U234	4.46E-02	0.	2.76E-03	0.	7.47E-03	1.74E-01	3.92E-05
U235+D	4.27E-02	0.	2.59E-03	0.	7.01E-03	1.63E-01	4.98E-05
U236	4.27E-02	0.	2.65E-03	0.	7.16E-03	1.67E-01	3.67E-05
U237	1.57E-07	0.	4.17E-08	0.	4.53E-07	3.40E-05	1.29E-05
U238+D	4.09E-02	0.	2.42E-03	0.	6.55E-03	1.53E-01	3.51E-05
NP237+D	2.88E+00	2.21E-01	1.19E-01	0.	7.41E-01	1.74E-01	5.06E-05
NP238	1.26E-06	2.56E-08	1.97E-08	0.	8.16E-08	3.39E-05	2.50E-05
NP239	1.26E-07	9.04E-09	6.35E-09	0.	2.63E-08	1.57E-05	1.73E-05
PU238	4.77E+00	6.05E-01	1.21E-01	0.	4.47E-01	6.08E-01	4.65E-05
PU239	5.24E+00	6.44E-01	1.28E-01	0.	4.78E-01	5.72E-01	4.24E-05
PU240	5.23E+00	6.43E-01	1.27E-01	0.	4.77E-01	5.71E-01	4.33E-05
PU241+D	1.46E-01	6.33E-03	2.93E-03	0.	1.10E-02	5.06E-04	8.90E-07
PU242	4.85E+00	6.20E-01	1.23E-01	0.	4.60E-01	5.50E-01	4.16E-05
PU244	5.67E+00	7.10E-01	1.41E-01	0.	5.27E-01	6.30E-01	6.20E-05
AM241	1.74E+00	7.85E-01	1.24E-01	0.	7.63E-01	2.02E-01	4.73E-05
AM242M	1.79E+00	7.65E-01	1.27E-01	0.	7.71E-01	8.14E-02	5.96E-05
AM243	1.72E+00	7.53E-01	1.20E-01	0.	7.42E-01	1.92E-01	5.55E-05
CM242	6.33E-02	4.84E-02	4.20E-03	0.	1.34E-02	1.31E-01	5.06E-05
CM243	1.61E+00	7.33E-01	9.95E-02	0.	3.74E-01	2.10E-01	4.98E-05
CM244	1.33E+00	6.48E-01	8.31E-02	0.	3.06E-01	2.02E-01	4.82E-05
CM245	2.14E+00	8.16E-01	1.28E-01	0.	5.03E-01	1.95E-01	4.49E-05
CM246	2.13E+00	8.15E-01	1.28E-01	0.	5.03E-01	1.99E-01	4.41E-05
CM247+D	2.07E+00	8.02E-01	1.26E-01	0.	4.95E-01	1.95E-01	5.80E-05
CM248	1.72E+01	6.61E+00	1.04E+00	0.	4.08E+00	1.61E+00	9.35E-04
CF252	3.92E+00	0.	9.33E-02	0.	0.	6.62E-01	1.84E-04

TABLE 1.7 (continued)

TEEN INHALATION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INHALED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
H3*	0.	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07
BE10	2.78E-04	4.33E-05	7.09E-06	0.	0.	3.84E-04	1.77E-05
C14	3.25E-06	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07
N13	8.65E-09	8.65E-09	8.65E-09	8.65E-09	8.65E-09	8.65E-09	8.65E-09
F18	6.52E-07	0.	7.10E-08	0.	0.	0.	3.89E-08
NA22	1.76E-05	1.76E-05	1.76E-05	1.76E-05	1.76E-05	1.76E-05	1.76E-05
NA24	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06
P32	2.36E-04	1.37E-05	8.95E-06	0.	0.	0.	1.16E-05
AR39	0.	0.	0.	0.	0.	4.00E-09	0.
AR41	0.	0.	0.	0.	0.	1.44E-08	0.
CA41	4.05E-05	0.	4.38E-06	0.	0.	1.01E-01	3.03E-07
SC46	7.24E-05	1.41E-04	4.18E-05	0.	1.35E-04	0.	2.98E-05
CR51	0.	0.	1.69E-08	9.37E-09	3.84E-09	2.62E-06	3.75E-07
MN54	0.	6.39E-06	1.05E-06	0.	1.59E-06	2.48E-04	8.35E-06
MN56	0.	2.12E-10	3.15E-11	0.	2.24F-10	1.90E-06	7.18E-06
FE55	4.18E-06	2.98E-06	6.93E-07	0.	0.	1.55E-05	7.99E-07
FE59	1.99E-06	4.62E-06	1.79E-06	0.	0.	1.91E-04	2.23E-05
CO57	0.	1.18E-07	1.15E-07	0.	0.	7.33E-05	3.93E-06
CO58	0.	2.59E-07	3.47E-07	0.	0.	1.68E-04	1.19E-05
CO60	0.	1.89E-06	2.48E-06	0.	0.	1.09E-03	3.24E-05
NI59	5.44E-06	2.02E-06	9.24E-07	0.	0.	1.41E-05	6.48E-07
NI63	7.25E-05	5.43E-06	2.47E-06	0.	0.	3.84E-05	1.77E-06
NI65	2.73E-10	3.66E-11	1.59E-11	0.	0.	1.17E-06	4.59E-06
CU64	0.	2.54E-10	1.06E-10	0.	8.01E-10	1.39E-06	7.68E-06
ZN65	4.82E-06	1.67E-05	7.80E-06	0.	1.08E-05	1.55E-04	5.83E-06
ZN69M+D	1.44E-09	3.39E-09	3.11E-10	0.	2.06E-09	3.92E-06	2.14E-05
ZN69	6.04E-12	1.15E-11	8.07E-13	0.	7.53E-12	1.98E-07	3.56E-08
SE79	0.	5.43E-07	8.71E-08	0.	8.13E-07	7.71E-05	3.53E-06
BR82	0.	0.	2.28E-06	0.	0.	0.	0.
BR83+D	0.	0.	4.30E-08	0.	0.	0.	0.
BR84	0.	0.	5.41E-08	0.	0.	0.	0.
BR85	0.	0.	2.29E-09	0.	0.	0.	0.
KR83M	0.	0.	0.	0.	0.	9.97E-10	0.
KR85M	0.	0.	0.	0.	0.	5.46E-09	0.
KR85	0.	0.	0.	0.	0.	4.63E-09	0.
KR87	0.	0.	0.	0.	0.	2.82E-08	0.
KR88+D	0.	0.	0.	0.	0.	5.81E-08	0.
KR89	0.	0.	0.	0.	0.	3.85E-08	0.
RB86	0.	2.38E-05	1.05E-05	0.	0.	0.	2.21E-06
RB87	0.	1.40E-05	4.58E-06	0.	0.	0.	3.05E-07
RB88	0.	6.82E-08	3.40E-08	0.	0.	0.	3.65E-15
RB89+D	0.	4.40E-08	2.91E-08	0.	0.	0.	4.22E-17
SR89+D	5.43E-05	0.	1.56E-06	0.	0.	3.02E-04	4.64E-05
SR90+D	1.35E-02	0.	8.35E-04	0.	0.	2.06E-03	9.56E-05
SR91+D	1.10E-08	0.	4.39E-10	0.	0.	7.59E-06	3.24E-05
SR92+D	1.19E-09	0.	5.08E-11	0.	0.	3.43E-06	1.49E-05

*Includes a 50% increase to account for percutaneous transpiration.

TABLE 1.7 (continued)

TEEN INHALATION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INHALED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y90	3.73E-07	0.	1.00E-08	0.	0.	3.66E-05	6.99E-05
Y91M+D	4.63E-11	0.	1.77E-12	0.	0.	4.00E-07	3.77E-09
Y91	8.26E-05	0.	2.21E-06	0.	0.	3.67E-04	5.11E-05
Y92	1.84E-09	0.	5.36E-11	0.	0.	3.35E-06	2.06E-05
Y93	1.69E-08	0.	4.65E-10	0.	0.	1.04E-05	7.24E-05
ZR93+D	6.83E-05	3.38E-05	1.84E-05	0.	1.16E-04	3.67E-04	1.60E-05
ZR95+D	1.82E-05	5.73E-06	3.94E-06	0.	8.42E-06	3.36E-04	1.86E-05
ZR97+D	1.72E-08	3.40E-09	1.57E-09	0.	5.15E-09	1.62E-05	7.88E-05
NB93M	4.14E-05	1.36E-05	3.41E-06	0.	1.59E-05	5.36E-05	2.52E-06
NB95	2.32E-06	1.29E-06	7.08E-07	0.	1.25E-06	9.39E-05	1.21E-05
NB97	3.92E-11	9.72E-12	3.55E-12	0.	1.14E-11	4.91E-07	2.71E-07
MO93	0.	1.66E-06	4.52E-08	0.	5.06E-07	8.81E-05	3.99E-06
MO99+D	0.	2.11E-08	4.03E-09	0.	5.14E-08	1.92E-05	3.36E-05
TC99M	1.73E-13	4.83E-13	6.24E-12	0.	7.20E-12	1.44E-07	7.66E-07
TC99	4.48E-08	6.58E-08	1.79E-08	0.	8.35E-07	1.74E-04	7.99E-06
TC101	7.40E-15	1.05E-14	1.03E-13	0.	1.90E-13	8.34E-08	1.09E-16
RU103+D	2.63E-07	0.	1.12E-07	0.	9.29E-07	9.79E-05	1.36E-05
RU105+D	1.40E-10	0.	5.42E-11	0.	1.76E-10	2.27E-06	1.13E-05
RU106+D	1.23E-05	0.	1.55E-06	0.	2.38E-05	2.01E-03	1.20E-04
RH105	1.32E-09	9.48E-10	6.24E-10	0.	4.04E-09	4.09E-06	1.23E-05
PD107	0.	1.17E-07	8.39E-09	0.	9.39E-07	1.63E-05	7.49E-07
PD109	0.	6.56E-10	1.66E-10	0.	3.36E-09	3.19E-06	1.96E-05
AG110M+D	1.73E-06	1.64E-06	9.99E-07	0.	3.13E-06	8.44E-04	3.41E-05
AG111	6.07E-08	2.52E-08	1.26E-08	0.	8.17E-08	4.00E-05	3.00E-05
CD113M	0.	2.17E-04	7.10E-06	0.	2.43E-04	3.59E-04	1.68E-05
CD115M	0.	3.48E-05	1.14E-06	0.	2.82E-05	3.03E-04	5.10E-05
SN123	4.31E-05	9.44E-07	1.40E-06	7.55E-07	0.	4.96E-04	4.16E-05
SN125+D	1.66E-06	4.42E-08	9.99E-08	3.45E-08	0.	1.26E-04	7.29E-05
SN126+D	2.18E-04	5.39E-06	8.24E-06	1.42E-06	0.	1.72E-03	1.68E-05
SB124	5.38E-06	9.92E-08	2.10E-06	1.22E-08	0.	4.81E-04	4.98E-05
SB125+D	9.23E-06	1.01E-07	2.15E-06	8.80E-09	0.	3.42E-04	1.24E-05
SB126	6.19E-07	1.27E-08	2.23E-07	3.50E-09	0.	1.55E-04	6.01E-05
SB127	4.64E-08	9.92E-10	1.75E-08	5.21E-10	0.	3.31E-05	3.94E-05
TE125M	6.10E-07	2.80E-07	8.34E-08	1.75E-07	0.	6.70E-05	9.38E-06
TE127M+D	2.25E-06	1.02E-06	2.73E-07	5.48E-07	8.17E-06	2.07E-04	1.99E-05
TE127	2.51E-10	1.14E-10	5.52E-11	1.77E-10	9.10E-10	1.40E-06	1.01E-05
TE129M+D	1.74E-06	8.23E-07	2.81E-07	5.72E-07	6.49E-06	2.47E-04	5.06E-05
TE129	8.87E-12	4.22E-12	2.20E-12	6.48E-12	3.32E-11	4.12E-07	2.02E-07
TE131M+D	1.23E-08	7.51E-09	5.03E-09	9.06E-09	5.49E-08	2.97E-05	7.76E-05
TE131+D	1.97E-12	1.04E-12	6.30E-13	1.55E-12	7.72E-12	2.92E-07	1.89E-09
TE132+D	4.50E-08	3.63E-08	2.74E-08	3.07E-08	2.44E-07	5.61E-05	5.79E-05
TE133M+D	1.01E-11	7.33E-12	5.71E-12	8.18E-12	5.07E-11	8.71E-07	1.23E-07
TE134+D	5.31E-12	4.35E-12	3.64E-12	4.46E-12	2.91E-11	6.75E-07	1.37E-09
I129	3.53E-06	2.94E-06	4.90E-06	3.66E-03	5.26E-06	0.	2.29E-07
I130	7.80E-07	2.24E-06	8.96E-07	1.86E-04	3.44E-06	0.	1.14E-06
I131+D	4.43E-06	6.14E-06	3.30E-06	1.83E-03	1.05E-05	0.	8.11E-07

TABLE 1.7 (continued)

TEEN INHALATION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INHALED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
I132	1.99E-07	5.47E-07	1.97E-07	1.89E-05	8.65E-07	0.	1.59E-07
I133+D	1.52E-06	2.56E-06	7.78E-07	3.65E-04	4.49E-06	0.	1.29E-06
I134	1.11E-07	2.90E-07	1.05E-07	4.94E-06	4.58E-07	0.	2.55E-09
I135+D	4.62E-07	1.18E-06	4.36E-07	7.76E-05	1.86E-06	0.	8.69E-07
XE131M	0.	0.	0.	0.	0.	2.70E-09	0.
XE133M	0.	0.	0.	0.	0.	3.59E-09	0.
XE133	0.	0.	0.	0.	0.	2.99E-09	0.
XE135M	0.	0.	0.	0.	0.	3.88E-09	0.
XE135	0.	0.	0.	0.	0.	7.55E-09	0.
XE137	0.	0.	0.	0.	0.	3.33E-08	0.
XE138+D	0.	0.	0.	0.	0.	4.38E-08	0.
CS134M+D	2.20E-08	4.35E-08	2.35E-08	0.	2.54E-08	4.56E-09	2.02E-08
CS134	6.28E-05	1.41E-04	6.86E-05	0.	4.69E-05	1.83E-05	1.22E-06
CS135	2.08E-05	1.82E-05	4.47E-06	0.	7.30E-06	2.70E-06	2.23E-07
CS136	6.44E-06	2.42E-05	1.71E-05	0.	1.38E-05	2.22E-06	1.36E-06
CS137+D	8.38E-05	1.06E-04	3.89E-05	0.	3.80E-05	1.51E-05	1.06E-06
CS138	5.82E-08	1.07E-07	5.58E-08	0.	8.28E-08	9.84E-09	3.38E-11
CS139+D	3.65E-08	5.12E-08	1.97E-08	0.	4.34E-08	4.86E-09	1.66E-23
BA139	1.67E-10	1.18E-13	4.87E-12	0.	1.11E-13	8.08E-07	8.06E-07
BA140+D	6.84E-06	8.38E-09	4.40E-07	0.	2.85E-09	2.54E-04	2.86E-05
BA141+D	1.78E-11	1.32E-14	5.93E-13	0.	1.23E-14	4.11E-07	9.33E-14
BA142+D	4.62E-12	4.63E-15	2.84E-13	0.	3.92E-15	2.39E-07	5.99E-20
LA140	5.99E-08	2.95E-08	7.82E-09	0.	0.	2.68E-05	6.09E-05
LA141	7.63E-10	2.35E-10	3.87E-11	0.	0.	2.31E-06	1.54E-05
LA142	1.20E-10	5.31E-11	1.32E-11	0.	0.	1.27E-06	1.50E-06
CE141	3.55E-06	2.37E-06	2.71E-07	0.	1.11E-06	7.67E-05	1.58E-05
CE143+D	3.32E-08	2.42E-08	2.70E-09	0.	1.08E-08	1.63E-05	3.19E-05
CE144+D	6.11E-04	2.53E-04	3.28E-05	0.	1.51E-04	1.67E-03	1.08E-04
PR143	1.67E-06	6.64E-07	8.28E-08	0.	3.86E-07	6.04E-05	2.67E-05
PR144	5.37E-12	2.20E-12	2.72E-13	0.	1.26E-12	2.19E-07	2.94E-14
ND147+D	9.83E-07	1.07E-06	6.41E-08	0.	6.28E-07	4.65E-05	2.28E-05
PM147	1.15E-04	1.10E-05	4.50E-06	0.	2.10E-05	1.14E-04	5.87E-06
PM148M+D	1.32E-05	3.35E-06	2.62E-06	0.	5.07E-06	3.20E-04	4.10E-05
PM148	5.44E-07	8.88E-08	4.48E-08	0.	1.60E-07	6.52E-05	6.14E-05
PM149	4.91E-08	6.89E-09	2.84E-09	0.	1.31E-08	1.24E-05	2.79E-05
PM151	1.20E-08	1.99E-09	1.01E-09	0.	3.57E-09	6.56E-06	2.27E-05
SM151	1.07E-04	2.10E-05	4.86E-06	0.	2.27E-05	7.68E-05	3.53E-06
SM153	2.43E-08	2.01E-08	1.47E-09	0.	6.56E-09	7.11E-06	1.77E-05
EU152	2.96E-04	7.19E-05	6.30E-05	0.	3.34E-04	5.01E-04	1.35E-05
EU154	9.43E-04	1.23E-04	8.60E-05	0.	5.44E-04	9.12E-04	3.34E-05
EU155	2.00E-04	1.96E-05	1.21E-05	0.	7.65E-05	1.51E-03	5.97E-05
EU156	2.70E-06	2.03E-06	3.30E-07	0.	1.36E-06	1.37E-04	4.56E-05
TB160	3.04E-05	0.	3.79E-06	0.	1.20E-05	2.97E-04	2.60E-05
HO166M	4.40E-04	1.36E-04	9.87E-05	0.	2.00E-04	6.24E-04	1.68E-05
W181	8.90E-09	2.88E-09	3.01E-10	0.	0.	2.95E-06	2.69E-07
W185	2.78E-07	9.17E-08	9.73E-09	0.	0.	9.60E-05	1.14E-05
W187	1.50E-09	1.22E-09	4.29E-10	0.	0.	5.92E-06	2.21E-05

TABLE 1.7 (continued)

TEEN INHALATION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INHALED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
PB210+D	3.09E-02	8.28E-03	1.07E-03	0.	2.95E-02	4.52E-02	3.87E-05
BI210+D	0.	2.26E-06	1.89E-07	0.	2.74E-05	1.91E-03	3.19E-05
PO210	5.68E-04	1.22E-03	1.37E-04	0.	4.21E-03	5.41E-02	4.45E-05
RN222+D	0.	0.	0.	0.	0.	3.94E-06	0.
RA223+D	2.57E-04	3.93E-07	5.14E-05	0.	1.12E-05	4.39E-02	3.04E-04
RA224+D	2.83E-05	6.77E-08	5.65E-06	0.	1.93E-06	1.51E-02	3.29E-04
RA225+D	4.28E-04	5.04E-07	8.56E-05	0.	1.44E-05	5.04E-02	2.89E-04
RA226+D	1.33E-01	3.38E-06	9.87E-02	0.	9.67E-05	2.02E-01	3.11E-04
RA228+D	5.34E-02	1.74E-06	5.88E-02	0.	4.97E-05	2.78E-01	5.30E-05
AC225	6.04E-04	8.25E-04	4.06E-05	0.	9.47E-05	3.81E-02	2.70E-04
AC227+D	2.49E+00	3.69E-01	1.48E-01	0.	1.07E-01	4.16E-01	5.38E-05
TH227+D	3.09E-04	5.56E-06	8.93E-06	0.	3.18E-05	6.50E-02	3.57E-04
TH228+D	2.60E-01	4.37E-03	8.78E-03	0.	2.45E-02	1.69E+00	3.70E-04
TH229	9.06E+00	1.36E-01	4.45E-01	0.	6.67E-01	5.05E+00	3.36E-04
TH230	2.34E+00	1.34E-01	6.49E-02	0.	6.55E-01	8.98E-01	3.95E-05
TH232+D	2.61E+00	1.14E-01	9.21E-02	0.	5.60E-01	8.60E-01	3.36E-05
TH234	2.32E-06	1.35E-07	6.71E-08	0.	7.73E-07	3.26E-04	7.49E-05
PA231+D	5.32E+00	2.00E-01	2.07E-01	0.	1.12E+00	9.91E-02	4.71E-05
PA233	1.68E-06	3.24E-07	2.89E-07	0.	1.22E-06	5.39E-05	1.00E-05
U232+D	7.31E-02	0.	5.23E-03	0.	7.94E-03	3.84E-01	4.46E-05
U233+D	1.55E-02	0.	9.42E-04	0.	3.63E-03	9.18E-02	4.12E-05
U234	1.48E-02	0.	9.23E-04	0.	3.55E-03	8.99E-02	4.04E-05
U235+D	1.42E-02	0.	8.67E-04	0.	3.34E-03	8.44E-02	5.13E-05
U236	1.42E-02	0.	8.86E-04	0.	3.41E-03	8.62E-02	3.79E-05
U237	5.25E-08	0.	1.40E-08	0.	2.16E-07	1.76E-05	1.29E-05
U238+D	1.36E-02	0.	8.10E-04	0.	3.12E-03	7.89E-02	3.62E-05
NP237+D	1.77E+00	1.54E-01	7.21E-02	0.	5.35E-01	8.99E-02	5.22E-05
NP238	4.23E-07	1.13E-08	6.59E-09	0.	3.88E-08	1.75E-05	2.38E-05
NP239	4.23E-08	3.99E-09	2.21E-09	0.	1.25E-08	8.11E-06	1.65E-05
PU238	2.86E+00	4.06E-01	7.22E-02	0.	3.10E-01	3.12E-01	4.79E-05
PU239	3.31E+00	4.50E-01	8.05E-02	0.	3.44E-01	2.93E-01	4.37E-05
PU240	3.31E+00	4.49E-01	8.04E-02	0.	3.43E-01	2.93E-01	4.46E-05
PU241+D	6.97E-02	3.57E-03	1.40E-03	0.	6.47E-03	2.60E-04	9.17E-07
PU242	3.07E+00	4.33E-01	7.75E-02	0.	3.31E-01	2.82E-01	4.29E-05
PU244	3.59E+00	4.96E-01	8.88E-02	0.	3.79E-01	3.23E-01	6.39E-05
AM241	1.06E+00	4.07E-01	7.10E-02	0.	5.32E-01	1.05E-01	4.88E-05
AM242M	1.07E+00	3.93E-01	7.15E-02	0.	5.30E-01	4.21E-02	6.14E-05
AM243	1.06E+00	3.92E-01	6.95E-02	0.	5.21E-01	9.91E-02	5.72E-05
CM242	2.12E-02	2.14E-02	1.41E-03	0.	6.40E-03	6.76E-02	5.21E-05
CM243	8.45E-01	3.50E-01	5.00E-02	0.	2.34E-01	1.09E-01	5.13E-05
CM244	6.46E-01	3.03E-01	3.88E-02	0.	1.81E-01	1.05E-01	4.96E-05
CM245	1.32E+00	4.11E-01	7.53E-02	0.	3.52E-01	1.01E-01	4.63E-05
CM246	1.31E+00	4.11E-01	7.52E-02	0.	3.51E-01	1.03E-01	4.54E-05
CM247+D	1.28E+00	4.04E-01	7.41E-02	0.	3.46E-01	1.01E-01	5.97E-05
CM248	1.06E+01	3.33E+00	6.11E-01	0.	2.85E+00	8.32E-01	9.63E-04
CF252	1.29E+00	0.	3.07E-02	0.	0.	3.43E-01	1.89E-04

TABLE 1.7 (continued)

ADULT INHALATION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INHALED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
H3*	0.	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07
BE10	1.98E-04	3.06E-05	4.96E-06	0.	0.	2.22E-04	1.67E-05
C14	2.27E-06	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07
N13	6.27E-09	6.27E-09	6.27E-09	6.27E-09	6.27E-09	6.27E-09	6.27E-09
F18	4.71E-07	0.	5.19E-08	0.	0.	0.	9.24E-09
NA22	1.30E-05	1.30E-05	1.30E-05	1.30E-05	1.30E-05	1.30E-05	1.30E-05
NA24	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06
P32	1.65E-04	9.64E-06	6.26E-06	0.	0.	0.	1.08E-05
AR39	0.	0.	0.	0.	0.	2.08E-09	0.
AR41	0.	0.	0.	0.	0.	8.06E-09	0.
CA41	3.83E-05	0.	4.13E-06	0.	0.	3.83E-06	2.86E-07
SC46	5.51E-05	1.07E-04	3.11E-05	0.	9.99E-05	0.	3.23E-05
CR51	0.	0.	1.25E-08	7.44E-09	2.85E-09	1.80E-06	4.15E-07
MN54	0.	4.95E-06	7.87E-07	0.	1.23E-06	1.75E-04	9.67E-06
MN56	0.	1.55E-10	2.29E-11	0.	1.63E-10	1.18E-06	2.53E-06
FE55	3.07E-06	2.12E-06	4.93E-07	0.	0.	9.01E-06	7.54E-07
FE59	1.47E-06	3.47E-06	1.32E-06	0.	0.	1.27E-04	2.35E-05
CO57	0.	8.65E-08	8.39E-08	0.	0.	4.62E-05	3.93E-06
CO58	0.	1.98E-07	2.59E-07	0.	0.	1.16E-04	1.33E-05
CO60	0.	1.44E-06	1.85E-06	0.	0.	7.46E-04	3.56E-05
NI59	4.06E-06	1.46E-06	6.77E-07	0.	0.	8.20E-06	6.11E-07
NI63	5.40E-05	3.93E-06	1.81E-06	0.	0.	2.23E-05	1.67E-06
NI65	1.92E-10	2.62E-11	1.14E-11	0.	0.	7.00E-07	1.54E-06
CU64	0.	1.83E-10	7.69E-11	0.	5.78E-10	8.48E-07	6.12E-06
ZN65	4.05E-06	1.29E-05	5.82E-06	0.	8.62E-06	1.08E-04	6.68E-06
ZN69M+D	1.02E-09	2.45E-09	2.24E-10	0.	1.48E-09	2.38E-06	1.71E-05
ZN69	4.23E-12	8.14E-12	5.65E-13	0.	5.27E-12	1.15E-07	2.04E-09
SE79	0.	3.83E-07	6.09E-08	0.	5.69E-07	4.47E-05	3.33E-06
BR82	0.	0.	1.69E-06	0.	0.	0.	1.30E-06
BR83+D	0.	0.	3.01E-08	0.	0.	0.	2.90E-08
BR84	0.	0.	3.91E-08	0.	0.	0.	2.05E-13
BR85	0.	0.	1.60E-09	0.	0.	0.	0.
KR83M	0.	0.	0.	0.	0.	5.19E-10	0.
KR85M	0.	0.	0.	0.	0.	2.91E-09	0.
KR85	0.	0.	0.	0.	0.	2.41E-09	0.
KR87	0.	0.	0.	0.	0.	1.53E-08	0.
KR88+D	0.	0.	0.	0.	0.	3.13E-08	0.
KR89	0.	0.	0.	0.	0.	2.13E-08	0.
RB86	0.	1.69E-05	7.37E-06	0.	0.	0.	2.08E-06
RB87	0.	9.86E-06	3.21E-06	0.	0.	0.	2.88E-07
RB88	0.	4.84E-08	2.41E-08	0.	0.	0.	4.18E-19
RB89+D	0.	3.20E-08	2.12E-08	0.	0.	0.	1.16E-21
SR89+D	3.80E-05	0.	1.09E-06	0.	0.	1.75E-04	4.37E-05
SR90+D	1.24E-02	0.	7.62E-04	0.	0.	1.20E-03	9.02E-05
SR91+D	7.74E-09	0.	3.13E-10	0.	0.	4.56E-06	2.39E-05
SR92+D	8.43E-10	0.	3.64E-11	0.	0.	2.06E-06	5.38E-06

*Includes a 50% increase to account for percutaneous transpiration.

TABLE 1.7 (continued)

ADULT INHALATION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INHALED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y90	2.61E-07	0.	7.01E-09	0.	0.	2.12E-05	6.32E-05
Y91M+D	3.26E-11	0.	1.27E-12	0.	0.	2.40E-07	1.66E-10
Y91	5.78E-05	0.	1.55E-06	0.	0.	2.13E-04	4.81E-05
Y92	1.29E-09	0.	3.77E-11	0.	0.	1.96E-06	9.19E-06
Y93	1.18E-08	0.	3.26E-10	0.	0.	6.06E-06	5.27E-05
ZR93+D	5.22E-05	2.92E-06	1.37E-06	0.	1.11E-05	2.13E-05	1.51E-06
ZR95+D	1.34E-05	4.30E-06	2.91E-06	0.	6.77E-06	2.21E-04	1.88E-05
ZR97+D	1.21E-08	2.45E-09	1.13E-09	0.	3.71E-09	9.84E-06	6.54E-05
NB93M	3.10E-05	1.01E-05	2.49E-06	0.	1.16E-05	3.11E-05	2.38E-06
NB95	1.76E-06	9.77E-07	5.26E-07	0.	9.67E-07	6.31E-05	1.30E-05
NB97	2.78E-11	7.03E-12	2.56E-12	0.	8.18E-12	3.00E-07	3.02E-08
MO93	0.	1.17E-06	3.17E-08	0.	3.55E-07	5.11E-05	3.79E-06
MO99+D	0.	1.51E-08	2.87E-09	0.	3.64E-08	1.14E-05	3.10E-05
TC99M	1.29E-13	3.64E-13	4.63E-12	0.	5.52E-12	9.55E-08	5.20E-07
TC99	3.13E-08	4.64E-08	1.25E-08	0.	5.85E-07	1.01E-04	7.54E-06
TC101	5.22E-15	7.52E-15	7.38E-14	0.	1.35E-13	4.99E-08	1.36E-21
RU103+D	1.91E-07	0.	8.23E-08	0.	7.29E-07	6.31E-05	1.38E-05
RU105+D	9.88E-11	0.	3.89E-11	0.	1.27E-10	1.37E-06	6.02E-06
RU106+D	8.64E-06	0.	1.09E-06	0.	1.67E-05	1.17E-03	1.14E-04
RH105	9.24E-10	6.73E-10	4.43E-10	0.	2.86E-09	2.41E-06	1.09E-05
PD107	0.	8.27E-08	5.87E-09	0.	6.57E-07	9.47E-06	7.06E-07
PD109	0.	4.63E-10	1.16E-10	0.	2.35E-09	1.85E-06	1.52E-05
AG110M+D	1.35E-06	1.25E-06	7.43E-07	0.	2.46E-06	5.79E-04	3.78E-05
AG111	4.25E-08	1.78E-08	8.87E-09	0.	5.74E-08	2.33E-05	2.79E-05
CD113M	0.	1.54E-04	4.97E-06	0.	1.71E-04	2.08E-04	1.59E-05
CD115M	0.	2.46E-05	7.95E-07	0.	1.98E-05	1.76E-04	4.80E-05
SN123	3.02E-05	6.67E-07	9.82E-07	5.67E-07	0.	2.88E-04	3.92E-05
SN125+D	1.16E-06	3.12E-08	7.03E-08	2.59E-08	0.	7.37E-05	6.81E-05
SN126+D	1.58E-04	4.18E-06	6.00E-06	1.23E-06	0.	1.17E-03	1.59E-05
SB124	3.90E-06	7.36E-08	1.55E-06	9.44E-09	0.	3.10E-04	5.08E-05
SB125+D	6.67E-06	7.44E-08	1.58E-06	6.75E-09	0.	2.18E-04	1.26E-05
SB126	4.50E-07	9.13E-09	1.62E-07	2.75E-09	0.	9.57E-05	6.01E-05
SB127	3.30E-08	7.22E-10	1.27E-08	3.97E-10	0.	2.05E-05	3.77E-05
TE125M	4.27E-07	1.98E-07	5.84E-08	1.31E-07	1.55E-06	3.92E-05	8.83E-06
TE127M+D	1.58E-06	7.21E-07	1.96E-07	4.11E-07	5.72E-06	1.20E-04	1.87E-05
TE127	1.75E-10	8.03E-11	3.87E-11	1.32E-10	6.37E-10	8.14E-07	7.17E-06
TE129M+D	1.22E-06	5.84E-07	1.98E-07	4.30E-07	4.57E-06	1.45E-04	4.79E-05
TE129	6.22E-12	2.99E-12	1.55E-12	4.87E-12	2.34E-11	2.42E-07	1.96E-08
TE131M+D	8.74E-09	5.45E-09	3.63E-09	6.88E-09	3.86E-08	1.82E-05	6.95E-05
TE131+D	1.39E-12	7.44E-13	4.49E-13	1.17E-12	5.46E-12	1.74E-07	2.30E-09
TE132+D	3.25E-08	2.69E-08	2.02E-08	2.37E-08	1.82E-07	3.60E-05	6.37E-05
TE133M+D	7.24E-12	5.40E-12	4.17E-12	6.27E-12	3.74E-11	5.51E-07	5.49E-08
TE134+D	3.84E-12	3.22E-12	1.57E-12	3.44E-12	2.18E-11	4.343-07	2.97E-11
I129	2.48E-06	2.11E-06	6.91E-06	5.54E-03	4.53E-06	0.	2.22E-07
I130	5.72E-07	1.68E-06	6.60E-07	1.42E-04	2.61E-06	0.	9.61E-07
I131+D	3.15E-06	4.47E-06	2.56E-06	1.49E-03	7.66E-06	0.	7.85E-07

TABLE 1.7 (continued)

ADULT INHALATION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INHALED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
I132	1.45E-07	4.07E-07	1.45E-07	1.43E-05	6.48E-07	0.	5.08E-08
I133+D	1.08E-06	1.85E-06	5.65E-07	2.69E-04	3.23E-06	0.	1.11E-06
I134	8.05E-08	2.16E-07	7.69E-08	3.73E-06	3.44E-07	0.	1.26E-10
I135+D	3.35E-07	8.73E-07	3.21E-07	5.60E-05	1.39E-06	0.	6.56E-07
XE131M	0.	0.	0.	0.	0.	1.40E-09	0.
XE133M	0.	0.	0.	0.	0.	1.89E-09	0.
XE133	0.	0.	0.	0.	0.	1.57E-09	0.
XE135M	0.	0.	0.	0.	0.	2.22E-09	0.
XE135	0.	0.	0.	0.	0.	4.05E-09	0.
XE137	0.	0.	0.	0.	0.	1.74E-08	0.
XE138+D	0.	0.	0.	0.	0.	2.44E-08	0.
CS134M+D	1.59E-08	3.20E-08	1.72E-08	0.	1.83E-08	2.93E-09	7.92E-09
CS134	4.66E-05	1.06E-04	9.10E-05	0.	3.59E-05	1.22E-05	1.30E-06
CS135	1.46E-05	1.29E-05	5.99E-06	0.	5.11E-06	1.57E-06	2.11E-07
CS136	4.88E-06	1.83E-05	1.38E-05	0.	1.07E-05	1.50E-06	1.46E-06
CS137+D	5.98E-05	7.76E-05	5.35E-05	0.	2.78E-05	9.40E-06	1.05E-06
CS138	4.14E-08	7.76E-08	4.05E-08	0.	6.00E-08	6.07E-09	2.33E-13
CS139+D	2.56E-08	3.63E-08	1.39E-08	0.	3.05E-08	2.84E-09	5.49E-31
BA139	1.17E-10	8.32E-14	3.42E-12	0.	7.78E-14	4.70E-07	1.12E-07
BA140+D	4.88E-06	6.13E-09	3.21E-07	0.	2.09E-09	1.59E-04	2.73E-05
BA141+D	1.25E-11	9.41E-15	4.20E-13	0.	8.75E-15	2.42E-07	1.45E-17
BA142+D	3.29E-12	3.38E-15	2.07E-13	0.	2.86E-15	1.49E-07	1.96E-26
LA140	4.30E-08	2.17E-08	5.73E-09	0.	0.	1.70E-05	5.73E-05
LA141	5.34E-10	1.66E-10	2.71E-11	0.	0.	1.35E-06	7.31E-06
LA142	8.54E-11	3.88E-11	9.65E-12	0.	0.	7.91E-07	2.64E-07
CE141	2.49E-06	1.69E-06	1.91E-07	0.	7.83E-07	4.52E-05	1.50E-05
CE143+D	2.33E-08	1.72E-08	1.91E-09	0.	7.60E-09	9.97E-06	2.83E-05
CE144+D	4.29E-04	1.79E-04	2.30E-05	0.	1.06E-04	9.72E-04	1.02E-04
PR143	1.17E-06	4.69E-07	5.80E-08	0.	2.70E-07	3.51E-05	2.50E-05
PR144	3.76E-12	1.56E-12	1.91E-13	0.	8.81E-13	1.27E-07	2.69E-18
ND147+D	6.59E-07	7.62E-07	4.56E-08	0.	4.45E-07	2.76E-05	2.16E-05
PM147	8.37E-05	7.87E-06	3.19E-06	0.	1.49E-05	6.60E-05	5.54E-06
PM148M+D	9.82E-06	2.54E-06	1.94E-06	0.	3.85E-06	2.14E-04	4.18E-05
PM148	3.84E-07	6.37E-08	3.20E-08	0.	1.20E-07	3.91E-05	5.80E-05
PM149	3.44E-08	4.87E-09	1.99E-09	0.	9.19E-09	7.21E-06	2.50E-05
PM151	8.50E-09	1.42E-09	7.21E-10	0.	2.55E-09	3.94E-06	2.00E-05
SM151	8.59E-05	1.48E-05	3.55E-06	0.	1.66E-05	4.45E-05	3.25E-06
SM153	1.70E-08	1.42E-08	1.04E-09	0.	4.59E-09	4.14E-06	1.58E-05
EU152	2.38E-04	5.41E-05	4.76E-05	0.	3.35E-04	3.43E-04	1.59E-05
EU154	7.40E-04	9.10E-05	6.48E-05	0.	4.36E-04	5.84E-04	3.40E-05
EU155	1.01E-04	1.43E-05	9.21E-06	0.	6.59E-05	9.46E-05	5.95E-06
EU156	1.93E-06	1.48E-06	2.40E-07	0.	9.95E-07	8.56E-05	4.50E-05
TB160	2.21E-05	0.	2.75E-06	0.	9.10E-06	1.92E-04	2.68E-05
HO166M	3.37E-04	1.05E-04	8.00E-05	0.	1.57E-04	3.94E-04	1.59E-05
W181	6.23E-09	2.03E-09	2.17E-10	0.	0.	1.71E-06	2.53E-07
W185	1.95E-07	6.47E-08	6.81E-09	0.	0.	5.57E-05	1.07E-05
W187	1.06E-09	8.85E-10	3.10E-10	0.	0.	3.63E-06	1.94E-05

TABLE 1.7 (continued)

ADULT INHALATION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INHALED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
PB210+D	2.64E-02	6.73E-03	8.37E-04	0.	2.12E-02	2.62E-02	3.65E-05
BI210+D	0.	1.59E-06	1.32E-07	0.	1.92E-05	1.11E-03	2.95E-05
PO210	3.97E-04	8.60E-04	9.58E-05	0.	2.95E-03	3.14E-02	4.19E-05
RN222+D	0.	0.	0.	0.	0.	2.05E-06	0.
RA223+D	1.80E-04	2.77E-07	3.60E-05	0.	7.85E-06	2.55E-02	2.84E-04
RA224+D	1.98E-05	4.78E-08	3.96E-06	0.	1.35E-06	8.77E-03	3.01E-04
RA225+D	3.00E-04	3.56E-07	5.99E-05	0.	1.01E-05	2.92E-02	2.71E-04
RA226+D	1.25E-01	2.39E-06	9.14E-02	0.	6.77E-05	1.17E-01	2.94E-04
RA228+D	4.41E-02	1.23E-06	4.78E-02	0.	3.48E-05	1.61E-01	5.00E-05
AC225	4.23E-04	5.82E-04	2.84E-05	0.	6.63E-05	2.21E-02	2.52E-04
AC227+D	2.30E+00	3.05E-01	1.36E-01	0.	9.82E-02	2.41E-01	5.08E-05
TH227+D	2.17E-04	3.92E-06	6.25E-06	0.	2.22E-05	3.77E-02	3.34E-04
TH226+D	2.00E-01	3.39E-03	6.77E-03	0.	1.89E-02	1.01E+00	3.49E-04
TH229	8.88E+00	1.33E-01	4.36E-01	0.	6.52E-01	3.49E+00	3.17E-04
TH230	2.29E+00	1.31E-01	6.36E-02	0.	6.40E-01	6.21E-01	3.73E-05
TH232+D	2.56E+00	1.12E-01	9.04E-02	0.	5.47E-01	5.96E-01	3.17E-05
TH234	1.63E-06	9.56E-08	4.70E-08	0.	5.41E-07	1.89E-04	7.03E-05
PA231+D	5.08E+00	1.91E-01	1.98E-01	0.	1.07E+00	5.75E-02	4.44E-05
PA233	1.21E-06	2.42E-07	2.09E-07	0.	9.15E-07	3.52E-05	1.02E-05
U232+D	5.14E-02	0.	3.66E-03	0.	5.56E-03	2.22E-01	4.21E-05
U233+D	1.09E-02	0.	6.60E-04	0.	2.54E-03	5.32E-02	3.89E-05
U234	1.04E-02	0.	6.46E-04	0.	2.49E-03	5.22E-02	3.81E-05
U235+D	1.00E-02	0.	6.07E-04	0.	2.34E-03	4.90E-02	4.84E-05
U236	1.00E-02	0.	6.20E-04	0.	2.39E-03	5.00E-02	3.57E-05
U237	3.67E-08	0.	9.77E-09	0.	1.51E-07	1.02E-05	1.20E-05
U238+D	9.58E-03	0.	5.67E-04	0.	2.18E-03	4.58E-02	3.41E-05
NP237+D	1.69E+00	1.47E-01	6.87E-02	0.	5.10E-01	5.22E-02	4.92E-05
NP238	2.96E-07	8.00E-09	4.61E-09	0.	2.72E-08	1.02E-05	2.13E-05
NP239	2.87E-08	2.82E-09	1.55E-09	0.	8.75E-09	4.70E-06	1.49E-05
PU238	2.74E+00	3.87E-01	6.90E-02	0.	2.96E-01	1.82E-01	4.52E-05
PU239	3.19E+00	4.31E-01	7.75E-02	0.	3.30E-01	1.72E-01	4.13E-05
PU240	3.18E+00	4.30E-01	7.73E-02	0.	3.29E-01	1.72E-01	4.21E-05
PU241+D	6.41E-02	3.28E-03	1.29E-03	0.	5.93E-03	1.52E-04	8.65E-07
PU242	2.95E+00	4.15E-01	7.46E-02	0.	3.17E-01	1.65E-01	4.05E-05
PU244	3.45E+00	4.76E-01	8.54E-02	0.	3.64E-01	1.89E-01	6.03E-05
AM241	1.01E+00	3.59E-01	6.71E-02	0.	5.04E-01	6.06E-02	4.60E-05
AM242M	1.02E+00	3.46E-01	6.73E-02	0.	5.01E-01	2.44E-02	5.79E-05
AM243	1.01E+00	3.47E-01	6.57E-02	0.	4.95E-01	5.75E-02	5.40E-05
CM242	1.48E-02	1.51E-02	9.84E-04	0.	4.48E-03	3.92E-02	4.91E-05
CM243	7.86E-01	2.97E-01	4.61E-02	0.	2.15E-01	6.31E-02	4.84E-05
CM244	5.90E-01	2.54E-01	3.51E-02	0.	1.64E-01	6.06E-02	4.68E-05
CM245	1.26E+00	3.59E-01	7.14E-02	0.	3.33E-01	5.85E-02	4.36E-05
CM246	1.25E+00	3.59E-01	7.13E-02	0.	3.33E-01	5.96E-02	4.29E-05
CM247+D	1.22E+00	3.53E-01	7.03E-02	0.	3.28E-01	5.85E-02	5.63E-05
CM248	1.01E+01	2.91E+00	5.79E-01	0.	2.70E+00	4.82E-01	9.09E-04
CF252	9.78E-01	0.	2.33E-02	0.	0.	1.99E-01	1.78E-04

TABLE 1.8
EXTERNAL DOSE FACTORS FOR STANDING ON CONTAMINATION GROUND (DFG_i)
(MREM/HR PER PCI/M^2)

ELEMENT	TOTAL BODY	SKIN
H-3	0.0	0.0
C-14	0.0	0.0
Na-24	2.50E-08	2.90E-08
P-32	0.0	0.0
Cr-51	2.20E-10	2.60E-10
Mn-54	5.80E-09	6.80E-09
Mn-56	1.10E-08	1.30E-08
Fe-55	0.0	0.0
Fe-59	8.00E-09	9.40E-09
Co-58	7.00E-09	8.20E-09
Co-60	1.70E-08	2.00E-08
Ni-63	0.0	0.0
Ni-65	3.70E-09	4.30E-09
Cu-64	1.50E-09	1.70E-09
Zn-65	4.00E-09	4.60E-09
Zn-69	0.0	0.0
Br-83	6.40E-11	9.30E-11
Br-84	1.20E-08	1.40E-08
Br-85	0.0	0.0
Rb-86	6.30E-10	7.20E-10
Rb-88	3.50E-09	4.00E-09
Rb-89	1.50E-08	1.80E-08
Sr-89	5.60E-13	6.50E-13
Sr-91	7.10E-09	8.30E-09
Sr-92	9.00E-09	1.00E-08
Y-90	2.20E-12	2.60E-12
Y-91m	3.80E-09	4.40E-09
Y-91	2.40E-11	2.70E-11
Y-92	1.60E-09	1.90E-09
Y-93	5.70E-10	7.80E-10
Zr-95	5.00E-09	5.80E-09
Zr-97	5.50E-09	6.40E-09
Nb-95	5.10E-09	6.00E-09
Mo-99	1.90E-09	2.20E-09
Tc-99m	9.60E-10	1.10E-09
Tc-101	2.70E-09	3.00E-09

TABLE 1.8 (continued)
EXTERNAL DOSE FACTORS FOR STANDING ON CONTAMINATION GROUND (DFG$_i$)
(MREM/HR PER PCI/M^2)

ELEMENT	TOTAL BODY	SKIN
Ru-103	3.60E-09	4.20E-09
Ru-105	4.50E-09	5.10E-09
Ru-106	1.50E-09	1.80E-09
Ag-110m	1.80E-08	2.10E-08
Te-125m	3.50E-11	4.80E-11
Te-127m	1.10E-12	1.30E-12
Te-127	1.00E-11	1.10E-11
Te-129m	7.70E-10	9.00E-10
Te-129	7.10E-10	8.40E-10
Te-131m	8.40E-09	9.90E-09
Te-131	2.20E-09	2.60E-06
Te-132	1.70E-09	2.00E-09
I-130	1.40E-08	1.70E-08
I-131	2.80E-09	3.40E-09
I-132	1.70E-08	2.00E-08
I-133	3.70E-09	4.50E-09
I-134	1.60E-08	1.90E-08
I-135	1.20E-08	1.40E-08
Cs-134	1.20E-08	1.40E-08
Cs-136	1.50E-08	1.70E-08
Cs-137	4.20E-09	4.90E-09
Cs-138	2.10E-08	2.40E-08
Ba-139	2.40E-09	2.70E-09
Ba-140	2.10E-09	2.40E-09
Ba-141	4.30E-09	4.90E-09
Ba-142	7.90E-09	9.00E-09
La-140	1.50E-08	1.70E-08
La-142	1.50E-08	1.80E-08
Ce-141	5.50E-10	6.20E-10
Ce-143	2.20E-09	2.50E-09
Ce-144	3.20E-10	3.70E-10
Pr-143	0.0	0.0
Pr-144	2.00E-10	2.30E-10
Nd-147	1.00E-09	1.20E-09
W-187	3.10E-09	3.60E-09
Np-239	9.50E-10	1.10E-09

TABLE 1.9
2001 PALISADES GASEOUS DESIGN OBJECTIVE ANNUAL QUANTITIES

Nuclide	Organ	Dose Factor Mrem/Ci	Design Objective Annual Quantity Ci
Ag-110m	GI-Tract-T	2.13E+00	7.04E+00
Ar-41	Total Body	3.64E - 04	1.37E+04
Ba-139	GI Tract-C	2.97E - 03	5.05E+03
Ba-140	Lung-T	1.26E - 01	1.19E+02
Br-82	total Body-C	4.97E - 03	1.01E+03
C-14	Bone-C	1.48E - 01	1.01E+02
Ce-141	GI Tract-T	1.34E - 01	1.12E+02
Ce-144	GI Tract-T	3.37E+00	4.45E+00
Co-57	GI Tract-T	8.53E - 02	1.76E+02
Co-58	GI Tract-T	2.59E - 01	5.79E+01
Co-60	GI Tract-T	6.86E+00	2.19E+00
Cr-51	GI Tract-A	3.75E - 03	1.33E+03
Cs-134	Liver-C	8.77E+00	1.71E+00
Cs-136	Liver-I	5.32E-01	2.82E+01
Cs-137	Bone-C	9.58E+00	1.57E+00
Cs-138	Total body-C	1.00E - 01	5.00E+01
Fe-55	Bone-C	2.06E - 01	7.28E+01
Fe-59	GI Tract-T	3.20E - 01	4.69E+01
H-3	Total Body-C	2.19E - 04	2.28E+04
I-129	Thyroid-A	3.66E+02	4.10E - 02
I-131	Thyroid-I	1.97E+01	7.61E - 01
I-132	Thyroid-C	1.12E - 02	1.34E+03
I-133	Thyroid-C	2.46E - 01	6.11E+01
I-134	Thyroid-C	2.45E - 03	6.12E+03
I-135	Thyroid-C	4.93E - 02	3.04E+02

TABLE 1.9
2001 PALISADES GASEOUS DESIGN OBJECTIVE ANNUAL QUANTITIES

Nuclide	Organ	Dose Factor Mrem/Ci	Design Objective Annual Quantity Ci
Kr-83m	Skin	8.82E - 07	1.70E+07
Kr-85	Skin	9.14E - 05	1.64E+05
Kr-85m	Total Body	5.22E - 05	9.58E+04
Kr-87	Skin	8.03E - 04	1.87E+04
Kr-88	Total Body	6.35E - 04	7.87E+03
Kr-89	Total Body	5.08E - 04	9.84E+03
La-140	GI Tract-T	3.04E - 02	4.93E+02
Mn-54	GI Tract-T	6.29E - 01	2.38E+01
Mn-56	GI Tract-C	6.91E - 03	2.17E+03
Mo-99	GI Tract-T	1.66E - 02	9.04E+02
N-13	Total Body-C	3.44E - 06	1.45E+06
Na-24	Total Body-C	4.02E - 03	1.24E+03
Nb-95	GI Tract-A	1.92E - 01	7.81E+01
Ni-63	Bone-C	1.21E+01	1.24E+00
Ni-65	GI Tract-C	4.70E - 03	3.19E+03
Np-239	GI Tract-T	8.13E - 03	1.84E+03
Rb-88	Total Body-C	2.38E - 05	2.10E+05
Ru-103	GI Tract-A	2.93E - 01	5.12E+01
Ru-105	GI Tract-C	5.82E - 03	2.58E+03
Sb-124	GI Tract-T	9.47E - 01	1.58E+01
Sb-125	GI Tract-T	4.35E - 01	3.45E+01
Sr-89	Bone-C	8.98E+00	1.67E+00
Sr-90	Bone-C	3.73E+02	4.02E - 02
Sr-91	Bone-I	2.46E+00	6.10E+00
Sr-92	GI Tract-C	1.37E - 02	1.09E+03

TABLE 1.9
2001 PALISADES GASEOUS DESIGN OBJECTIVE ANNUAL QUANTITIES

Nuclide	Organ	Dose Factor Mrem/Ci	Design Objective Annual Quantity Ci
Tc-99	GI Tract-T	5.85E - 01	2.62E+01
Tc-99m	GI Tract-T	3.64E - 04	4.12E+04
Tc-101	GI Tract-T	8.33E - 05	1.80E+05
Te-127	GI Tract-T	4.87E - 03	3.08E+03
Xe-131m	Skin	4.03E - 05	3.72E+05
Xe-133	Total Body	1.39E - 05	3.60E+05
Xe-133m	Skin	8.39E - 05	1.79E+05
Xe-135	Total Body	8.32E - 05	6.01E+04
Xe-135m	Total Body	9.55E - 05	5.24E+04
Xe-137	Skin	5.85E - 04	2.56E+04
Xe-138	Total body	2.70E - 04	1.85E+04
Zn-65	Liver-C	9.38E - 01	1.60E+01
Zr-95	GI Tract-T	3.90E - 01	3.85E+01
Pu-238	Bone-T	1.42E+03	1.06E - 02
Pu-239	Bone-T	1.64E+03	9.15E - 03
Pu-241	Bone-T	3.45E+01	4.35E - 01
Am-241	Bone-T	5.25E+02	2.86E - 02
Cm-242	Lung-T	3.35E+01	4.48E - 01
Cm-244	Bone-T	3.20E+02	4.69E - 02

II. LIQUID EFFLUENTS

A. CONCENTRATION

1. Requirements

Appendix A, Section III.G requires that the concentration of radioactive material released at any time from the site to unrestricted areas shall be limited to ten times the Effluent Concentration (EC) specified in 10 CFR 20, Appendix B, Table 2, Column 2 for nuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2E-04 μCi/ml total activity. To ensure compliance, the following approach will be used for each release.

2. Prerelease Analysis

Most tanks will be recirculated through two volume changes prior to sampling for release to the environment to ensure that a representative sample is obtained. The appropriate recirculation time for those tanks too large to provide two volume changes will be the time that the suspended particulate concentration reaches steady state. Either a one-time test, or prior sampling data, may be used to determine appropriate recirculation time.

Prior to release, a grab sample will be analyzed for each release, and the concentration of each radionuclide determined.

$$C = \sum_{i=1}^{n} C_i \qquad (2.1)$$

where:

C = Total concentration in the liquid effluent at the release point, μCi/ml.

C_i = Concentration of a single radionuclide i, μCi/ml.

3. **Effluent Concentration (EC) - Sum of the Ratios**

The EC-Fraction (R_j) for each release point will be calculated by the relationship defined by Note 4 of Appendix B, 10 CFR 20:

$$R_j = \sum_i \frac{C_i}{EC_i} \leq 10.0 \quad (2.2)$$

where:

C_i = Effluent concentration of radionuclide i, μCi/ml.

EC_i = The EC of radionuclide i, 10 CFR 20, Appendix B, Table 2, Column 2 - μCi/ml.

R_j = The Total EC-Fraction for the release point.

The sum of the ratios at the discharge to the lake must be ≤ 10 due to the releases from any or all concurrent releases. The following relationship will assure this criterion is met:

$$f_1(R_1 - 1) + f_2(R_2 - 1) + f_3(R_3 - 1) \leq F \quad (2.3)$$

where:

f_1, f_2, f_3 = The effluent flow rate (gallons/minute) for the respective releases, determined by Plant personnel.

R_1, R_2, R_3 = The Total EC-Fractions for the respective releases as determined by Equation 2.2.

F = Minimum required dilution flow rate. Normally, a conservatively high dilution flow rate is used, that is, flow rate used = $(b_i)(F)$ where b_i is a conservative factor greater than 1.0.

B. INSTRUMENT SETPOINTS

1. Setpoint Determination

Appendix A, Section III.F requires alarm setpoints for each liquid effluent monitor will be established using Plant instructions to ensure the requirements of Appendix A, Section III.G are not exceeded. Concentration, flow rate, dilution, principal gamma emitter, geometry, and detector efficiency are combined to give an equivalent setpoint in counts per minute (cpm). The identification number for each liquid effluent radiation detector is contained in Figure 2-2.

The respective alarm/trip setpoints at each release point will be set such that the sum of the ratios at each point, as calculated by Equation 2.2, will not be exceeded. The value of R is directly related to the total concentration calculated by Equation 2.1. An increase in the concentration would indicate an increase in the value of R. A large increase would cause the limits specified in Section 2.1.1 to be exceeded. The minimum alarm/trip setpoint value is equal to the release concentration, but for ease of operation it may be desired that the setpoint (S) be set above the effluent concentration (C) by the same factor (b) utilized in setting dilution flow. That is:

$$S = b \times C \qquad (2.4)$$

Liquid effluent flow paths and release points are indicated in Figure 2.1.

2. Composite Samplers

Effluent pathways, Turbine Sump and Service Water, are equipped with continuous compositors to meet the requirements of Appendix A, Table D-1. These compositors are adjustable and normally set in a time mode and collect three to six samples hourly, 24 hours a day with a total collection of approximately one gallon per day. A representative sample is collected daily from the compositor and saved for the weekly, monthly analysis requirements of Appendix A, Table D-1. In the event that a compositor is not operational, effluent releases via this pathway may continue provided that grab samples are collected and analyzed for gross beta or gamma radioactivity at least once per 24 hours per Appendix A, Table C-1, Action 3.

3. Post-Release Analysis

A post-release analysis will be done using actual release data to ensure that the limits specified in Section 1 were not exceeded.

A composite list on concentrations (C_i), by isotope, will be used with the actual liquid radwaste (f) and dilution (F) flow rates (or volumes) during the release. The data will be substituted into Equation 2.3 to demonstrate compliance with the limits in Section 1. This data and setpoints will be recorded in auditable records by Plant personnel.

C. DOSE

1. RETS Requirement

Appendix A, Section III.H.1 requires that the quantity of radionuclides released by limited such that the dose or dose commitment to an individual from radioactive materials in liquid effluents release to unrestricted areas from the reactor (see Figure 2-1) will not exceed:

a. During any calendar quarter, 1.5 mrem to the total body and 5 mrem to any organ, and

b. During any calendar year, 3 mrem to the total body and 10 mrem to any organ.

To ensure compliance, quantities of activity of each radionuclide released will be summed for each release and accumulated for each quarter as follows in Section 2.

2. Release Analysis

Calculations shall be performed for each batch release, and weekly for continuous releases according to the formula:

$$\sum_{i} A_i/C_i \leq 0.5 \qquad (2.5)$$

where:

A_i = Cumulative quarterly activity of nuclide i identified in liquid release (C_i).

C_i = Design objective annual quantity of radionuclide i from Table 2.2.

The design basis quantities are derived in such a conservative manner that doses may be greatly overestimated by this technique. As a consequence of this conservatism, and in light of historically consistent operations with releases well below annual design basis quantities, the Appendix A, effluent requirements do not require monthly dose projections. Instead, if at any time, calculations by Equation (2.5) results in values greater than 0.5 for a given quarter or 1.0 for year-to-date, the NRC LADTAP code will be run to ensure that Appendix A, Section III.H.1 has been met.

Values for the design basis quantities (C_i), and the dose per Curie (Dc/Cc)i for each nuclide i shown in Table 2.2, were calculated as follows in Sections 2.1 and 2.2.

a. Water Ingestion

The dose to an individual from ingestion of radioactivity from any source as described by the following equation:

$$D_j \sum_{i=l}^{i} (DCF)_{ij} \times I_i \qquad (2.6)$$

where:

D_j = Dose for the jth organ from radionuclides releases, mrem.

j = The organ of interest.

$(DCF)_{ij}$ = Ingestion dose commitment factor for the jth organ from the i^{th} radionuclide mrem/pCi, see Table 2.1.

I_i = Activity ingested of the i^{th} radionuclide, pCi.

I_i is described by:

$$I_i = \frac{(A_i)(V)(365)}{(1000)(d)}(1E06) \qquad (2.7)$$

where:

365 = Days per year.

A_i = Annual activity released of i^{th} radionuclide, μCi.

V = Average rate of water consumption (2000 ml/d - adult, 1400 ml/d - teen and child, 900 ml/d - infant, ICRP 23, p 358).

d = Dilution water flow for year, ml.

1000 = Dispersion factor from discharge to nearest drinking water supply.

1E06 = Conversion μCi to pCi.

The dose equation then becomes:

$$D_j = \frac{(3.65E05)(V)}{d} \sum_{i=1}^{i} (DCF)_{ij} \times A_i \text{ mrem} \qquad (2.8)$$

b. Fish Ingestion

The dose to an individual from the consumption of fish is described by Equation 2.10. In this case, the activity ingested of the i[th] radionuclide (I_i) is described by:

$$I_i = \frac{A_i B_i F(1E09)}{15d} = pCi \qquad (2.9)$$

where:

A_i = Annual released of i[th] radionuclide, μCi.

B_i = Fish concentration factor of i[th] radionuclide $\frac{\mu Ci/gm}{\mu Ci/ml}$ (see Table 2.0).

F = Amount of fish eaten per year (21 kg adult, 16 kg teen, 6.9 kg child, none infant).

15 = Dispersion factor from discharge to fish exposure point.

d = Dilution water flow for year, ml.

1E09 = Conversion of μCi and Kgm to gross.

Substitution of Equation 2.9 into Equation 2.6 gives:

$$D_j = \frac{(6.7E07)F}{d} \sum_{i=1}^{i} A_i \times B_i \times DCF_i \text{ mrem} \qquad (2.10)$$

c. Annual Analysis

A complete analysis utilizing the NRC computer code LADTAP with the total source release will be done annually in conjunction with the annual environmental report. This analysis will provide estimates of dose to the total body and various organs in addition to the dose limiting organs considered in the method of Section 2. The following approach is utilized on LADTAP. The dose to the j^{th} organ from m radionuclides, Dj, is described by:

$$D_j = \sum_{i=1}^{m} D_{ij} \text{ mrem}$$

$$= \sum_{i=1}^{m} (DCF)_{ij} \times I_j \text{ mrem} \quad (2.11)$$

where:

D_j = Dose to the j^{th} organ from the i^{th} radionuclide, mrem.

j = The organ of interest (bone, GI tract, thyroid, liver, kidney, lung, or total body).

$(DCF)_{ij}$ = Adult ingestion dose commitment factor for the j^{th} organ from the i^{th} radionuclide, mrem/pCi (see Table 2.1).

I_i = Activity ingested of the i^{th} radionuclide, μCi.

I_i for water ingestion is described by:

$$I_i = \frac{A_i V_r}{vd} \ \mu\text{Ci} \quad (2.13)$$

and for fish ingestion I_i is described by:

$$I_i = \frac{A_i B_i F_r}{v\ d} \ \mu\text{Ci}$$

where:

A_i = Activity release of j^th radionuclide during the year, μCi.

V = Average rate of water consumption (2000 ml/d).

Γ = Number of days during the year (365 d).

v = Dispersion factor from point of discharge to point of exposure.

d = Dilution water volume (ml).

B_i = Fish concentration factor of the i^th radionuclide,

Table 2.0, $\frac{\mu Ci/gm}{\mu Ci/ml}$

F = Amount of fish eaten per day (57.5 gm/d).

D. **OPERABILITY OF LIQUID RADWASTE EQUIPMENT**

The Palisades liquid radwaste system is designed to reduce the radioactive materials in liquid wastes prior to their discharge (by recycle or shipment for disposal) so that radioactivity in liquid effluent releases to unrestricted areas (see Figure 2-1) will not exceed the limits of Appendix A, III.H.1. Maintaining the cumulative fraction if allowable release for each batch release and weekly for continuous releases assures compliance with this requirement. In addition, 13 years of operating experience (to the date this ODCM was first adopted) has shown that design basis quantities never have been exceeded.

E. RELEASE RATE FOR OFFSITE EC (50 mRem/yr)

10 CFR 20.1302 requires radioactive effluent releases to unrestricted areas be less than the limits specified in Appendix B, Table 2 when averaged over a period not to exceed one year. Concentrations at this Effluent Concentration (EC) level, if ingested for one year, will result in a dose of 50 millirem to the total body. In addition, 10 CFR 50.36a requires that the release of radioactive materials be kept as low as is reasonably achievable. Appendix I to 10 CFR 50 provides the numerical guidelines on limiting conditions for operations to meet the as low as is reasonably achievable requirement.

The LADTAP code has been run to determine the dose due to drinking water at Plant discharge concentration (1,000 x nearest drinking water intake concentration). The nominal average source term used is given in Table 1.1. Dose to the most limiting organ of the person hypothetically drinking this water is 3.88E-03 mrem. This is only 0.13% of the more conservative 50 mrem/yr total body value.

F. **FIGURES AND TABLES**

Figure 2-1

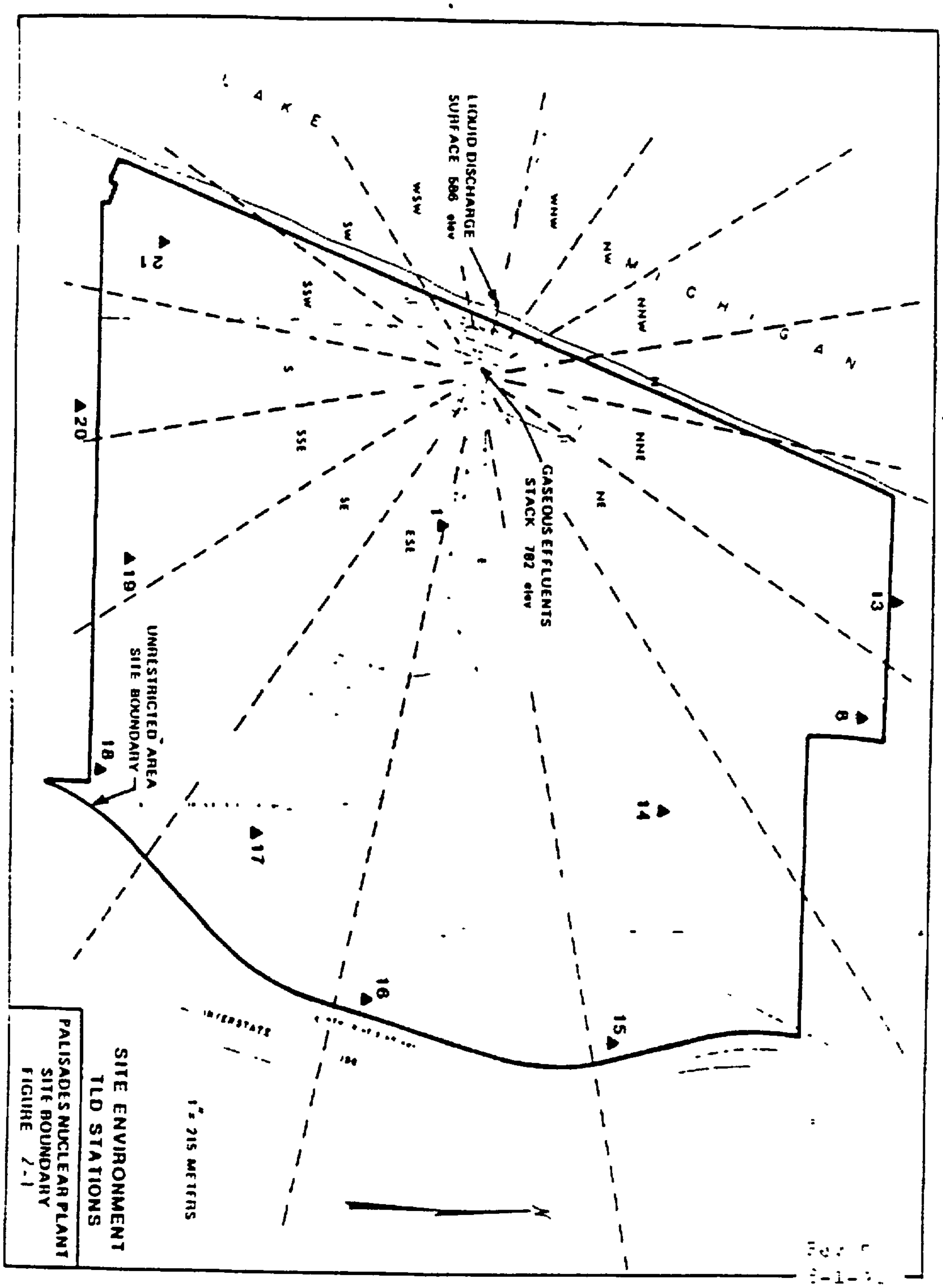


Figure 2-2

PALISADES RADWASTE EFFLUENTS - LIQUID

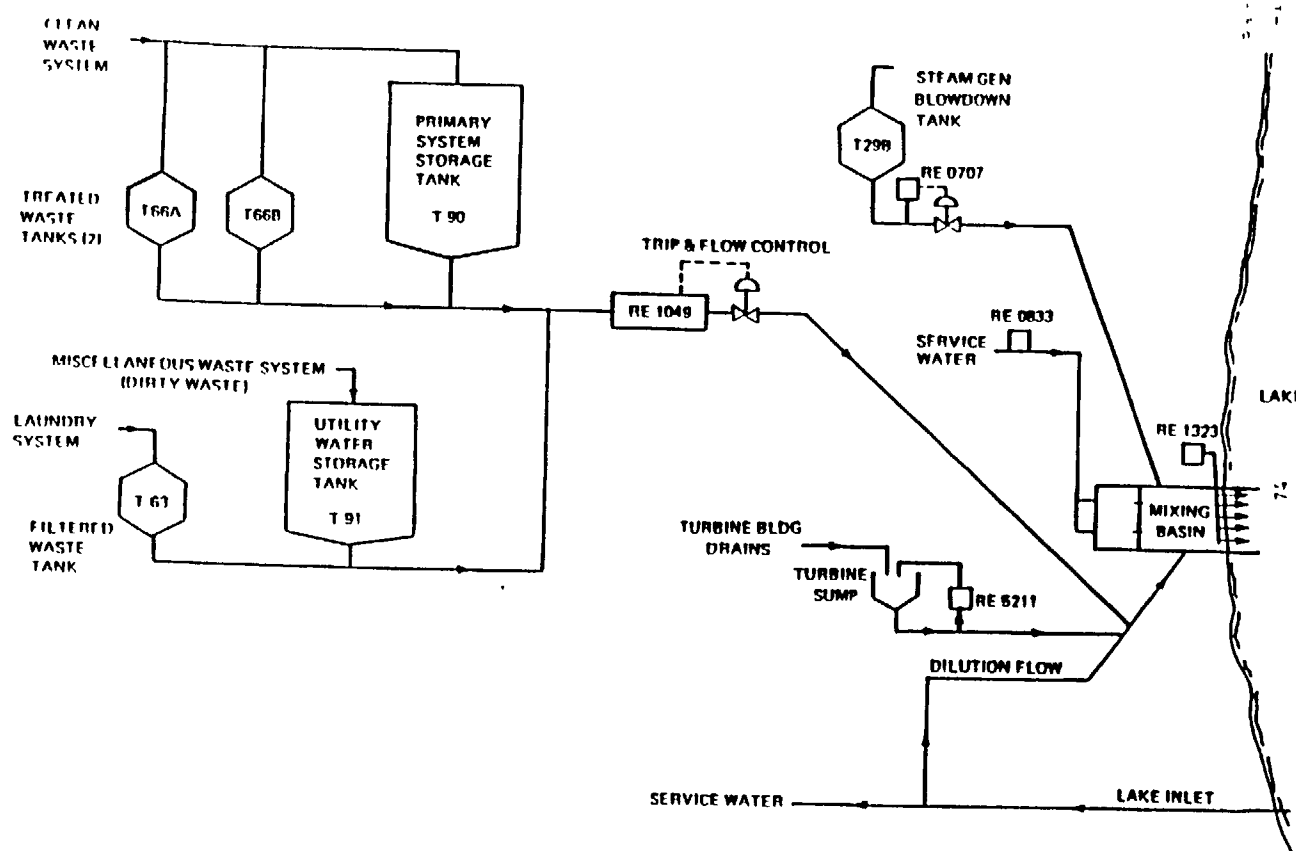


TABLE 2.0

BIOACCUMULATION FACTORS
μCi/gm per μCi/ml

ELEMENT	FRESHWATER FISH
H	9.0E-01
C	4.6E 03
NA	1.0E 02
P	1.0E 05
CR	2.0E 02
MN	4.0E 02
FE	1.0E 02
CO	5.0E 01
NI	1.0E 02
CU	5.0E 01
ZN	2.0E 03
BR	4.2E 02
RB	2.0E 03
SR	3.0E 01
Y	2.5E 01
ZR	3.3E 00
NB	3.0E 04
MO	1.0E 01
TC	1.5E 01
RU	1.0E 01
RH	1.0E 01
TE	4.0E 02
I	1.5E 01
CS	2.0E 03
BA	4.0E 00
LA	2.5E 01
CE	1.0E 00
PR	2.5E 01
ND	2.5E 01
W	1.2E 03
NP	1.0E 01

TABLE 2.1

INFANT INGESTION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INGESTED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
H3	0.	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.083-07
BE10	1.71E-05	2.49E-06	5.16E-07	0.	1.64E-06	0.	2.78E-05
C14	2.37E-05	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06
N13	5.85E-08	5.85E-08	5.85E-08	5.835E-08	5.85E-08	5.85E-08	5.85E-08
F18	5.19E-06	0.	4.43E.07	0.	0.	0.	1.22E-06
NA22	9.83E-05	9.83E-05	9.83E-05	9.83E-05	9.83E-05	9.83E-05	9.83E-05
NA24	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05
P32	1.70E-03	1.00E-04	6.59E-05	0.	0.	0.	2.30E-05
AR39	0.	0.	0.	0.	0.	0.	0.
AR41	0.	0.	0.	0.	0.	0.	0.
CA41	3.74E-04	0.	4.08E-05	0.	0.	0.	1.91E-07
SC46	3.75E-08	5.41E-08	1.69E-08	0.	3.56E-08	0.	3.53E-05
CR51	0.	0.	1.41E-08	9.20E-09	2.01E-09	1.79E-08	4.11E-07
MN54	0.	1.99E-05	4.51E-06	0.	4.41E-06	0.	7.31E-06
MN56	0.	8.18E-07	1.41E-07	0.	7.03E-07	0.	7.43E-05
FE55	1.39E-05	8.98E-06	2.40E-06	0.	0.	4.39E-06	1.14E-06
FE59	3.08E-05	5.38E-05	2.12E-05	0.	0.	1.59E-05	2.57E-05
CO57	0.	1.15E-06	1.87E-06	0.	0.	0.	3.92E-06
CO58	0.	3.60E-06	8.98E-06	0.	0.	0.	8.97E-06
CO60	0.	1.08E-05	2.55E-05	0.	0.	0.	2.57E-05
NI59	4.78E-05	1.45E-05	8.17E-06	0.	0.	0.	7.16E-07
NI63	6.34E-04	3.92E-05	2.20E-05	0.	0.	0.	1.95E-06
NI65	4.70E-06	5.32E-07	2.42E-07	0.	0.	0.	4.05E-05
CU64	0.	6.09E-07	2.82E-07	0.	1.03E-06	0.	1.25E-05
ZN65	1.84E-05	6.31E-05	2.91E-05	0.	3.06E-05	0.	5.33E-05
ZN69M+D	1.50E-06	3.06E-06	2.79E-07	0.	1.24E-06	0.	4.24E-05
ZN69	9.33E-08	1.68E-07	1.25E-08	0.	6.98E-08	0.	1.37E-05
SE79	0.	2.10E-05	3.90E-06	0.	2.43E-05	0.	5.58E-07
BR82	0.	0.	1.27E-05	0.	0.	0.	0.
BR83+D	0.	0.	3.63E-07	0.	0.	0.	0.
BR84	0.	0.	3.82E-07	0.	0.	0.	0.
BR85	0.	0.	1.94E-08	0.	0.	0.	0.
KR83M	0.	0.	0.	0.	0.	0.	0.
KR85M	0.	0.	0.	0.	0.	0.	0.
KR85	0.	0.	0.	0.	0.	0.	0.
KR87	0.	0.	0.	0.	0.	0.	0.
KR88+D	0.	0.	0.	0.	0.	0.	0.
KR89	0.	0.	0.	0.	0.	0.	0.
RB86	0.	1.70E-04	8.40E-05	0.	0.	0.	4.35E-06
RB87	0.	8.88E-05	3.52E-05	0.	0.	0.	5.98E-07
RB88	0.	4.98E-07	2.73E-07	0.	0.	0.	4.85E-07
RB89+D	0.	2.86E-07	1.97E-07	0.	0.	0.	9.74E-08
SR89+D	2.51E-03	0.	7.20E-05	0.	0.	0.	5.16E-05
SR90+D	1.85E-02	0.	4.71E-03	0.	0.	0.	2.31E-04
SR91+D	5.00E-05	0.	1.81E-06	0.	0.	0.	5.92E-05
SR92+D	1.92E-05	0.	7.13E-07	0.	0.	0.	2.07E-04

TABLE 2.1

INFANT INGESTION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INGESTED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y90	8.69E-08	0.	2.33E-09	0.	0.	0.	1.20E-04
Y91M+D	8.10E-10	0.	2.76E-11	0.	0.	0.	2.70E-06
Y91	1.13E-06	0.	3.01E-08	0.	0.	0.	8.10E-05
Y92	7.65E-09	0.	2.15E-10	0.	0.	0.	1.46E-04
Y93	2.43E-08	0.	6.62E-10	0.	0.	0.	1.92E-04
ZR93+D	1.93E-07	9.18E-08	5.54E-08	0.	2.71E-07	0.	2.39E-05
ZR95+D	2.06E-07	5.02E-08	3.56E-08	0.	5.41E-08	0.	2.50E-05
ZR97+D	1.48E-08	2.54E-09	1.16E-09	0.	2.56E-09	0.	1.62E-04
NB93M	1.23E-07	3.33E-08	1.04E-08	0.	3.25E-08	0.	3.98E-06
NB95	4.20E-08	1.73E-08	1.00E-08	0.	1.24E-08	0.	1.46E-05
NB97	4.59E-10	9.79E-11	3.53E-11	0.	7.65E-11	0.	3.09E-05
MO93	0.	5.65E-05	1.82E-06	0.	1.13E-05	0.	1.21E-06
MO99+D	0.	3.40E-05	6.63E-06	0.	5.08E-05	0.	1.12E-05
TC99M	1.92E-09	3.96E-09	5.10E-08	0.	4.26E-08	2.07E-09	1.15E-06
TC99	1.08E-06	1.46E-06	4.55E-07	0.	1.23E-05	1.42E-07	6.31E-06
TC101	2.27E-09	2.86E-09	2.83E-08	0.	3.40E-08	1.56E-09	4.86E-07
RU103+D	1.48E-06	0.	4.95E-07	0.	3.08E-06	0.	1.80E-05
RU105+D	1.36E-07	0.	4.58E-08	0.	1.00E-06	0.	5.41E-05
RU106+D	2.41E-05	0.	3.01E-06	0.	2.85E-05	0.	1.83E-04
RH105	1.09E-06	7.13E-07	4.79E-07	0.	1.98E-06	0.	1.77E-05
PD107	0.	1.19E-06	8.45E-08	0.	6.79E-06	0.	9.46E-07
PD109	0.	1.50E-06	3.62E-07	0.	5.51E-06	0.	3.68E-05
AG110M+D	9.96E-07	7.27E-07	4.81E-07	0.	1.04E-06	0.	3.77E-05
AG111	5.20E-07	2.02E-07	1.07E-07	0.	4.22E-07	0.	4.82E-05
CD113M	0.	1.77E-05	6.52E-07	0.	1.34E-05	0.	2.66E-05
CD115M	0.	1.42E-05	4.93E-07	0.	7.41E-06	0.	8.09E-05
SN123	2.49E-04	3.89E-06	6.50E-06	3.91E-06	0.	0.	6.58E-05
SN125+D	7.41E-05	1.38E-06	3.29E-06	1.36E-06	0.	0.	1.11E-04
SN126+D	5.53E-04	7.26E-06	1.80E-05	1.91E-06	0.	0.	2.52E-05
SB124	2.14E-05	3.15E-07	6.63E-06	5.68E-08	0.	1.34E-05	6.60E-05
SB125+D	1.23E-05	1.19E-07	2.53E-06	1.54E-08	0.	7.72E-06	1.64E-05
SB126	8.06E-06	1.58E-07	2.91E-06	6.19E-08	0.	5.07E-06	8.35E-05
SB127	2.23E-06	3.98E-08	6.90E-07	2.84E-08	0.	1.15E-06	5.91E-05
TE125M	2.33E-05	7.79E-06	3.15E-06	7.84E-06	0.	0.	1.11E-05
TE127M+D	5.85E-05	1.94E-05	7.08E-06	1.69E-05	1.44E-04	0.	2.36E-05
TE127	1.00E-06	3.35E-07	2.15E-07	8.14E-07	2.44E-06	0.	2.10E-05
TE129M+D	1.00E-04	3.43E-05	1.54E-05	3.84E-05	2.50E-04	0.	5.97E-05
TE129	2.84E-07	9.79E-08	6.63E-08	2.38E-07	7.07E-07	0.	2.27E-05
TE131M+D	1.52E-05	6.12E-06	5.05E-06	1.24E-05	4.21E-05	0.	1.03E-04
TE131+D	1.76E-07	6.50E-08	4.94E-08	1.57E-07	4.50E-07	0.	7.11E-06
TE132+D	2.08E-05	1.03E-05	9.61E-06	1.52E-05	6.44E-05	0.	3.81E-05
TE133M+D	3.91E-07	1.79E-07	1.71E-07	3.45E-07	1.22E-06	0.	1.93E-05
TE134+D	2.67E-07	1.34E-07	1.38E-07	2.39E-07	9.03E-07	0.	3.06E-06
I129	2.86E-05	2.12E-05	1.55E-05	1.36E-02	2.51E-05	0.	4.24E-07
I130	6.00E-06	1.32E-05	5.30E-06	1.48E-03	1.45E-05	0.	2.83E-06
I131+D	3.59E-05	4.23E-05	1.86E-05	1.39E-02	4.94E-05	0.	1.51E-06

TABLE 2.1

INFANT INGESTION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INGESTED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
I132	1.66E-06	3.37E-06	1.20E-06	1.58E-04	3.76E-06	0.	2.73E.06
I133+D	1.25E-05	1.82E-05	5.33E-06	3.31E-03	2.14E-05	0.	3.08E-06
I134	8.69E-07	1.78E-06	6.33E-07	4.15E-05	1.99E-06	0.	1.84E-06
I135+D	3.64E-06	7.24E-06	2.64E-06	6.49E-04	8.07E-06	0.	2.62E-06
XE131M	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.
XE133	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.
XE135	0.	0.	0.	0.	0.	0.	0.
XE137	0.	0.	0.	0.	0.	0.	0.
XE138+D	0.	0.	0.	0.	0.	0.	0.
CS134M+D	1.76E-07	2.93E-07	1.48E-07	0.	1.13E-07	2.60E-08	2.32E-07
CS134	3.77E-04	7.03E-04	7.10E-05	0.	1.81E-04	7.42E-05	1.91E-06
CS135	1.33E-04	1.21E-04	6.30E-06	0.	3.44E-05	1.31E-05	4.37E-07
CS136	4.59E-05	1.35E-04	5.04E-05	0.	5.38E-05	1.10E-05	2.05E-06
CS137+D	5.22E-04	6.11E-04	4.33E-05	0.	1.64E-04	6.64E-05	1.91E-06
CS138	4.81E-07	7.82E-07	3.79E-07	0.	3.90E-07	6.09E-08	1.25E-06
CS139+D	3.10E-07	4.24E-07	1.62E-07	0.	2.19E-07	3.30E-08	2.66E-08
BA139	8.81E-07	5.84E-10	2.55E-08	0.	3.51E-10	3.54E-10	5.58E-05
BA140+D	1.71E-04	1.71E-07	8.81E-06	0.	4.06E-08	1.05E-07	4.20E-05
BA141+D	4.25E-07	2.91E-10	1.34E-08	0.	1.75E-10	1.77E-10	5.19E-06
BA142+D	1.84E-07	1.53E-10	9.06E-09	0.	8.81E-11	9.26E-11	7.59E-07
LA140	2.11E-08	8.32E-09	2.14E-09	0.	0.	0.	9.77E-05
LA141	2.89E-09	8.38E-10	1.46E-10	0.	0.	0.	9.61E-05
LA142	1.10E-09	4.04E-10	9.67E-11	0.	0.	0.	6.86E-05
CE141	7.87E-08	4.80E-08	5.65E-09	0.	1.48E-08	0.	2.48E-05
CE143+D	1.48E-08	9.82E-06	1.12E-09	0.	2.86E-09	0.	5.73E-05
CE144+D	2.98E-06	1.22E-06	1.67E-07	0.	4.93E-07	0.	1.71E-04
PR143	8.18E-08	3.04E-08	4.03E-09	0.	1.13E-08	0.	4.29E-05
PR144	2.74E-10	1.06E-10	1.38E-11	0.	3.84E-11	0.	4.93E-06
ND147+D	5.53E-08	5.68E-08	3.48E-09	0.	2.19E-08	0.	3.60E-05
PM147	3.88E-07	3.27E-08	1.59E-08	0.	4.88E-08	0.	9.27E-06
PM148M+D	1.65E-07	4.18E-08	3.28E-08	0.	4.80E-08	0.	5.443-05
PM148	6.32E-08	9.13E-09	4.60E-09	0.	1.09E-08	0.	9.74E-05
PM149	1.38E-08	1.81E-09	7.90E-10	0.	2.20E-09	0.	4.86E-05
PM151	6.18E-09	9.01E-10	4.56E-10	0.	1.07E-09	0.	4.17E-05
SM151	2.90E-07	6.67E-08	1.44E-08	0.	4.53E-08	0.	5.58E-06
SM153	7.72E-09	5.97E-09	4.58E-10	0.	1.25E-09	0.	3.12E-05
EU152	6.74E-07	1.79E-07	1.51E-07	0.	5.02E-07	0.	1.59E-05
EU154	2.64E-06	3.67E-07	2.20E-07	0.	9.95E-07	0.	4.58E-05
EU155	5.42E-07	6.25E-08	3.23E-08	0.	1.40E-07	0.	8.37E-05
EU156	1.14E-07	7.06E-08	1.12E-08	0.	3.26E-08	0.	6.67E-05
TB160	2.59E-07	0.	3.24E-08	0.	7.37E-08	0.	3.45E-05
HO166M	1.25E-06	2.69E-07	2.13E-07	0.	3.57E-07	0.	0.
W181	8.85E-08	2.72E-08	3.04E-09	0.	0.	0.	3.82E-07
W185	3.62E-06	1.13E-06	1.29E-07	0.	0.	0.	1.62E-05
W187	9.03E-07	6.28E-07	2.17E-07	0.	0.	0.	3.69E-05

TABLE 2.1

INFANT INGESTION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INGESTED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
PB210+D	5.28E-02	1.42E-02	2.38E-03	0.	4.33E-02	0.	5.62E-05
BI210+D	4.16E-06	2.68E-05	3.58E-07	0.	2.08E-04	0.	5.27E-05
PO210	3.10E-03	5.93E-03	7.41E-04	0.	1.26E-02	0.	6.61E-05
RN222+D	0.	0.	0.	0.	0.	0.	0.
RA223+D	4.41E-02	6.42E-05	8.82E-03	0.	1.17E-03	0.	3.43E-04
RA224+D	1.46E-02	3.29E-05	2.91E-03	0.	6.00E-04	0.	3.86E-04
RA225+D	5.78E-02	6.42E-05	1.15E-02	0.	1.19E-03	0.	3.24E-04
RA226+D	6.20E-01	4.76E-05	5.14E-01	0.	8.71E-04	0.	3.44E-04
RA228+D	4.32E-01	2.58E-05	4.86E-01	0.	4.73E-04	0.	5.86E-05
AC225	3.92E-05	5.03E-05	2.63E-06	0.	3.69E-06	0.	4.36E-04
AC227+D	4.49E-03	7.67E-04	2.79E-04	0.	1.56E-04	0.	8.50E-05
TH227+D	1.20E-04	2.01E-06	3.45E-06	0.	7.41E-06	0.	5.70E-04
TH228+D	2.47E-03	3.38E-05	8.36E-05	0.	1.58E-04	0.	5.84E-04
TH229	1.48E-02	1.94E-04	7.29E-04	0.	9.29E-04	0.	5.31E-04
TH230	3.80E-03	1.90E-04	1.06E-04	0.	9.12E-04	0.	6.24E-05
TH232+D	4.24E-03	1.63E-04	1.65E-04	0.	7.79E-04	0.	5.31E-05
TH234	6.92E-07	3.77E-08	2.00E-08	0.	1.39E-07	0.	1.19E-04
PA231+D	7.57E-03	2.50E-04	3.02E-04	0.	1.34E-03	0.	7.44E-05
PA233	3.11E-08	6.09E-09	5.43E-09	0.	1.67E-08	0.	1.46E-05
U232+D	2.42E-02	0.	2.16E-03	0.	2.37E-03	0.	7.04E-05
U233+D	5.08E-03	0.	3.87E-04	0.	1.08E-03	0.	6.51E-05
U234	4.88E-03	0.	3.80E-04	0.	1.06E-03	0.	6.37E-05
U235+D	4.67E-03	0.	3.56E-04	0.	9.93E-04	0.	8.10E-05
U236	4.67E-03	0.	3.64E-04	0.	1.01E-03	0.	5.98E-05
U237	4.95E-07	0.	1.32E-07	0.	1.23E-06	0.	2.11E-05
U238+D	4.47E-03	0.	3.33E-04	0.	9.28E-04	0.	5.71E-05
NP237+D	2.53E-03	1.93E-04	1.05E-04	0.	6.34E-04	0.	8.23E-05
NP238	1.24E-07	3.12E-09	1.92E-09	0.	6.81E-09	0.	4.17E-05
NP239	1.11E-08	9.93E-10	5.61E-10	0.	1.98E-09	0.	2.87E-05
PU238	1.34E-03	1.69E-04	3.40E-05	0.	1.21E-04	0.	7.57E-05
PU239	1.45E-03	1.77E-04	3.54E-05	0.	1.28E-04	0.	6.91E-05
PU240	1.45E-03	1.77E-04	3.54E-05	0.	1.28E-04	0.	7.04E-05
PU241+D	4.38E-05	1.90E-06	8.82E-07	0.	3.17E-06	0.	1.45E-06
PU242	1.35E-03	1.70E-04	3.41E-05	0.	1.23E-04	0.	6.77E-05
PU244	1.57E-03	1.95E-04	3.91E-05	0.	1.41E-04	0.	1.01E-04
AM241	1.53E-03	7.18E-04	1.09E-04	0.	6.55E-04	0.	7.70E-05
AM242M	1.58E-03	7.02E-04	1.13E-04	0.	6.64E-04	0.	9.69E-05
AM243	1.51E-03	6.88E-04	1.06E-04	0.	6.36E-04	0.	9.03E-05
CM242	1.37E-04	1.24E-04	9.10E-06	0.	2.62E-05	0.	8.23E-05
CM243	1.45E-03	6.88E-04	8.98E-05	0.	3.27E-04	0.	8.10E-05
CM244	1.22E-03	6.16E-04	7.59E-05	0.	2.71E-04	0.	7.84E-05
CM245	1.88E-03	7.49E-04	1.13E-04	0.	4.32E-04	0.	7.30E-05
CM246	1.87E-03	7.49E-04	1.13E-04	0.	4.31E-04	0.	7.17E-05
CM247+D	1.82E-03	7.36E-04	1.11E-04	0.	4.24E-04	0.	9.43E-05
CM248	1.51E-02	6.07E-03	9.16E-04	0.	3.50E-03	0.	1.52E-03
CF252	1.24E-03	0.	2.95E-05	0	0.	0.	2.99E-04

TABLE 2.1

CHILD INGESTION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INGESTED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
H3	0.	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07
BE10	1.35E-05	1.57E-06	3.39E-07	0.	1.11E-06	0.	2.75E-05
C14	1.21E-05	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06
N13	3.10E-08	3.10E-08	3.10E-08	3.10E-08	3.10E-08	3.10E-08	3.10E-08
F18	2.49E-06	0.	2.47E-07	0.	0.	0.	6.74E-07
NA22	5.88E-05	5.88E-05	5.88E-05	5.88E-05	5.88E-05	5.88E-05	5.88E-05
NA24	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06
P32	8.25E-04	3.86E-05	3.18E-05	0.	0.	0.	2.28E-05
AR39	0.	0.	0.	0.	0.	0.	0.
AR41	0.	0.	0.	0.	0.	0.	0.
CA41	3.47E-04	0.	3.79E-05	0.	0.	0.	1.90E-07
SC46	1.97E-08	2.70E-08	1.04E-08	0.	2.30E-08	0.	3.95E-05
CR51	0.	0.	8.90E-09	4.94E-09	1.35E-09	9.02E-09	4.72E-07
MN54	0.	1.07E-05	2.85E-06	0.	3.00E-06	0.	8.98E-06
MN56	0.	3.34E-07	7.54E-08	0.	4.04E-07	0.	4.84E-05
FE55	1.15E-05	6.10E-06	1.89E-06	0.	0.	3.45E-06	1.13E-06
FE59	1.65E-05	2.67E-05	1.33E-05	0.	0.	7.74E-06	2.78E-05.
CO57	0.	4.93E-07	9.98E-07	0.	0.	0.	4.04E-06
CO58	0.	1.80E-06	5.51E-06	0.	0.	0.	1.05E-05
CO60	0.	5.29E-06	1.56E-05	0.	0.	0.	2.93E-05
NI59	4.02E-05	1.07E-05	6.82E-06	0.	0.	0.	7.10E-07
NI63	5.38E-04	2.88E-05	1.83E-05	0.	0.	0.	1.94E-06
NI65	2.22E-06	2.09E-07	1.22E-07	0.	0.	0.	2.56E-05
CU64	0.	2.45E-07	1.48E-07	0.	5.92E-07	0.	1.15E-05
ZN65	1.37E-05	3.65E-05	2.27E-05	0.	2.30E-05	0.	6.41E-06
ZN69M+D	7.10E-07	1.21E-06	1.43E-07	0.	7.03E-07	0.	3.94E-05
ZN69	4.38E-08	6.33E-08	5.85E-09	0.	3.84E-08	0.	3.99E-06
SE79	0.	8.43E-06	1.87E-06	0.	1.37E-05	0.	5.53E-07
BR82	0.	0.	7.55E-06	0.	0.	0.	0.
BR83+D	0.	0.	1.71E-07	0.	0.	0.	0.
BR84	0.	0.	1.98E-07	0.	0.	0.	0.
BR85	0	0.	9.12E-09	0.	0.	0.	0.
KR83M	0.	0.	0.	0.	0.	0.	0.
KR85M	0.	0.	0.	0.	0.	0.	0.
KR85	0.	0.	0.	0.	0.	0.	0.
KR87	0.	0.	0.	0.	0.	0.	0.
KR88+D	0.	0.	0.	0.	0.	0.	0.
KR89	0.	0.	0.	0.	0.	0.	0.
RB86	0.	6.70E-05	4.12E-05	0.	0.	0.	4.31E-06
RB87	0.	3.95E-05	1.83E-05	0.	0.	0.	5.92E-07
RB88	0.	1.90E-07	1.32E-07	0.	0.	0.	9.32E-09
RB89+D	0.	1.17E-07	1.04E-07	0.	0.	0.	1.02E-09
SR89+D	1.32E-03	0.	3.77E-05	0.	0.	0.	5.11E-05
SR90+D	1.70E-02	0.	4.31E-03	0.	0.	0.	2.29E-04
SR91+D	2.40E-05	0.	9.06E-07	0.	0.	0.	5.30E-05
SR92+D	9.03E-06	0.	3.62E-07	0.	0.	0.	1.71E-04

TABLE 2.1

CHILD INGESTION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INGESTED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y90	4.11E-08	0.	1.10E-09	0.	0.	0.	1.17E-04
Y91M+D	3.82E-10	0.	1.39E-11	0.	0.	0.	7.48E-07
Y91	6.02E-07	0.	1.61E-08	0.	0.	0.	8.02E-05
Y92	3.60E-09	0.	1.03E-10	0.	0.	0.	1.04E-04
Y93	1.14E-08	0.	3.13E-10	0.	0.	0.	1.70E-04
ZR93+D	1.67E-07	6.25E-08	4.45E-08	0.	2.42E-07	0.	2.37E-05
ZR95+D	1.16E-07	2.55E-08	2.27E-08	0.	3.65E-08	0.	2.66E-05
ZR97+D	6.99E-09	1.01E-09	5.96E-10	0.	1.45E-09	0.	1.53E-04
NB93M	1.05E-07	2.62E-08	8.61E-09	0.	2.83E-08	0.	3.95E-06
NB95	2.25E-08	8.76E-09	6.26E-09	0.	8.23E-09	0.	1.62E-05
NB97	2.17E-10	3.92E-11	1.83E-11	0.	4.35E-11	0.	1.21E-05
MO93	0.	2.41E-05	8.65E-07	0.	6.35E-06	0.	1.22E-06
MO99+D	0.	1.33E-05	3.29E-06	0.	2.84E-05	0.	1.10E-05
TC99M	9.23E-10	1.81E-09	3.00E-08	0.	2.63E-08	9.19E-10	1.03E-06
TC99	5.35E-07	5.96E-07	2.14E-07	0.	7.02E-06	5.27E-08	6.25E-06
TC101	1.07E-09	1.12E-09	1.42E-08	0.	1.91E-08	5.92E-10	3.56E-09
RU103+D	7.31E-07	0.	2.81E-07	0.	1.84E-06	0.	1.89E-05
RU105+D	6.45E-08	0.	2.34E-08	0.	5.67E-07	0.	4.21E-05
RU106+D	1.17E-05	0.	1.46E-06	0.	1.58E-05	0.	1.82E-04
RH105	5.14E-07	2.76E-07	2.36E-07	0.	1.10E-06	0.	1.71E-05
PD107	0.	4.72E-07	4.01E-08	0.	3.95E-06	0.	9.37E-07
PD109	0.	5.67E-07	1.70E-07	0.	3.04E-06	0.	3.35E-05
AG110M+D	5.39E-07	3.64E-07	2.91E-07	0.	6.78E-07	0.	4.33E-05
AG111	2.48E-07	7.76E-08	5.12E-08	0.	2.34E-07	0.	4.75E-05
CD113M	0.	1.02E-05	4.34E-07	0.	1.05E-05	0.	2.63E-05
CD115M	0.	5.89E-06	2.51E-07	0.	4.38E-06	0.	8.01E-05
SN123	1.33E-04	1.65E-06	3.24E-06	1.75E-06	0.	0.	6.52E-05
SN125+D	3.55E-05	5.35E-07	1.59E-06	5.55E-07	0.	0.	1.10E-04
SN126+D	3.33E-04	4.15E-06	9.46E-06	1.14E-06	0.	0.	2.50E-05
SB124	1.11E-05	1.44E-07	3.89E-06	2.45E-08	0.	6.16E-06	6.94E-05
SB125+D	7.16E-06	5.52E-08	1.50E-06	6.63E-09	0.	3.99E-06	1.71E-05
SB126	4.40E-06	6.73E-08	1.58E-06	2.58E-08	0.	2.10E-06	8.87E-05
SB127	1.06E-06	1.64E-08	3.68E-07	1.18E-08	0.	4.60E-07	5.97E-05
TE125M	1.14E-05	3.09E-06	1.52E-06	3.20E-06	0.	0.	1.10E-05
TE127M+D	2.89E-05	7.78E-06	3.43E-06	6.91E-06	8.24E-05	0.	2.34E-05
TE127	4.71E-07	1.27E-07	1.01E-07	3.26E-07	1.34E-06	0.	1.84E-05
TE129M+D	4.87E-05	1.36E-05	7.56E-06	1.57E-05	1.43E-04	0.	5.94E-05
TE129	1.34E-07	3.74E-08	3.18E-08	9.56E-08	3.92E-07	0.	8.34E-06
TE131M+D	7.20E-06	2.49E-06	2.65E-06	5.12E-06	2.41E-05	0.	1.01E-04
TE131+D	8.30E-08	2.53E-08	2.47E-08	6.35E-08	2.51E-07	0.	4.36E-07
TE132+D	1.01E-05	4.47E-06	5.40E-06	6.51E-06	4.15E-05	0.	4.50E-05
TE133M+D	1.87E-07	7.56E-08	9.37E-08	1.45E-07	7.18E-07	0.	5.77E-06
TE134+D	1.29E-07	5.80E-08	7.74E-08	1.02E-07	5.37E-07	0.	5.89E-07
I129	1.39E-05	8.53E-06	7.62E-06	5.58E-03	1.44E-05	0.	4.29E-07
I130	2.92E-06	5.90E-06	3.04E-06	6.50E-04	8.82E-06	0.	2.76E-06
I131+D	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	0.	1.54E-06

TABLE 2.1

CHILD INGESTION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INGESTED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
I132	8.00E-07	1.47E-06	6.76E-07	6.82E-05	2.25E-06	0.	1.73E-06
I133+D	5.92E-06	7.32E-06	2.77E-06	1.36E-03	1.22E-05	0.	2.95E-06
I134	4.19E-07	7.78E-07	3.58E-07	1.79E-05	1.19E-06	0.	5.16E-07
I135+D	1.75E-06	3.15E-06	1.49E-06	2.79E-04	4.83E-06	0.	2.40E-06
XE131M	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.
XE133	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.
XE135	0.	0.	0.	0.	0.	0.	0.
XE137	0.	0.	0.	0.	0.	0.	0.
XE138+D	0.	0.	0.	0.	0.	0.	0.
CS134M+D	8.44E-08	1.25E-07	8.16E-08	0.	6.59E-08	1.09E-08	1.58E-07
CS134	2.34E-04	3.84E-04	8.10E-05	0.	1.19E-04	4.27E-05	2.07E-06
CS135	8.30E-05	5.78E-05	5.93E-06	0.	2.04E-05	6.81E-06	4.33E-07
CS136	2.35E-05	6.46E-05	4.18E-05	0.	3.44E-05	5.13E-06	2.27E-06
CS137+D	3.27E-04	3.13E-04	4.62E-05	0.	1.02E-04	3.67E-05	1.96E-06
CS138	2.28E-07	3.17E-07	2.01E-07	0.	2.23E-07	2.40E-08	1.46E-07
CS139+D	1.45E-07	1.61E-07	7.74E-08	0.	1.21E-07	1.22E-08	1.45E-11
BA139	4.14E-07	2.21E-10	1.20E-08	0.	1.93E-10	1.30E-10	2.39E-05
BA140+D	8.31E-05	7.28E-08	4.85E-06	0.	2.37E-08	4.34E-08	4.21E-05
BA141+D	2.00E-07	1.12E-10	6.51E-09	0.	9.69E-11	6.58E-10	1.14E-07
BA142+D	8.74E-08	6.29E-11	4.88E-09	0.	5.09E-11	3.70E-11	1.14E-09
LA140	1.01E-08	3.53E-09	1.19E-09	0.	0.	0.	9.84E-05
LA141	1.35E-09	3.17E-10	6.88E-11	0.	0.	0.	7.05E-05
LA142	5.24E-10	1.67E-10	5.23E-11	0.	0.	0.	3.31E-05
CE141	3.97E-08	1.98E-08	2.94E-09	0.	8.68E-09	0.	2.47E-05
CE143+D	6.99E-09	3.79E-06	5.49E-10	0.	1.59E-09	0.	5.55E-05
CE144+D	2.08E-06	6.52E-07	1.11E-07	0.	3.61E-07	0.	1.70E-04
PR143	3.93E-08	1.18E-08	1.95E-09	0.	6.39E-09	0.	4.24E-05
PR144	1.29E-10	3.99E-11	6.49E-12	0.	2.11E-11	0.	8.59E-08
ND147+D	2.79E-08	2.26E-08	1.75E-09	0.	1.24E-08	0.	3.58E-05
PM147	3.18E-07	2.27E-08	1.22E-08	0.	4.01E-08	0.	9.19E-06
PM148M+D	1.03E-07	2.05E-08	2.05E-08	0.	3.04E-08	0.	5.78E-05
PM148	3.02E-08	3.63E-09	2.35E-09	0.	6.17E-09	0.	9.70E-05
PM149	6.49E-09	6.90E-10	3.74E-10	0.	1.22E-09	0.	4.71E-05
PM151	2.92E-09	3.55E-10	2.31E-10	0.	6.02E-10	0.	4.03E-05
SM151	2.56E-07	3.81E-08	1.20E-08	0.	3.94E-08	0.	5.53E-06
SM153	3.65E-09	2.27E-09	2.19E-10	0.	6.91E-10	0.	3.02E-05
EU152	6.15E-07	1.12E-07	1.33E-07	0.	4.73E-07	0.	1.84E-05
EU154	2.30E-06	2.07E-07	1.89E-07	0.	9.09E-07	0.	4.81E-05
EU155	4.82E-07	3.47E-08	2.72E-08	0.	1.30E-07	0.	8.69E-05
EU156	5.62E-08	3.01E-08	6.23E-09	0.	1.94E-08	0.	6.83E-05
TB160	1.66E-07	0.	2.06E-08	0.	4.94E-08	0.	3.68E-05
HO166M	1.08E-06	2.26E-07	1.91E-07	0.	3.22E-07	0.	0.
W181	4.23E-06	1.04E-08	1.43E-09	0.	0.	0.	3.79E-07
W185	1.73E-06	4.32E-07	6.05E-08	0.	0.	0.	1.61E-05
W187	4.29E-07	2.54E-07	1.14E-07	0.	0.	0.	3.57E-05

TABLE 2.1

CHILD INGESTION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INGESTED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
PB210+D	4.75E-02	1.22E-02	2.09E-03	0.	3.67E-02	0.	5.57E-05
BI210+D	1.97E-06	1.02E-05	1.69E-07	0.	1.15E-04	0.	5.17E-05
PO210	1.52E-03	2.43E-03	3.67E-04	0.	7.56E-03	0.	6.55E-05
RN222+D	0.	0.	0.	0.	0.	0.	0.
RA223+D	2.12E-02	2.45E-05	4.24E-03	0.	6.50E-04	0.	3.38E-04
RA224+D	6.89E-03	1.25E-05	1.38E-03	0.	3.31E-04	0.	3.78E-04
RA225+D	2.80E-02	2.50E-05	5.59E-03	0.	6.62E-04	0.	3.21E-04
RA226+D	5.75E-01	1.84E-05	4.72E-01	0.	4.88E-04	0.	3.41E-04
RA228+D	3.85E-01	9.99E-06	4.32E-01	0.	2.65E-04	0.	5.81E-05
AC225	1.88E-05	1.94E-05	1.26E-06	0.	2.07E-06	0.	4.31E-04
AC227+D	4.12E-03	6.63E-04	2.55E-04	0.	1.46E-04	0.	8.43E-05
TH227+D	5.85E-05	7.96E-07	1.69E-06	0.	4.22E-06	0.	5.63E-04
TH228+D	2.07E-03	2.65E-05	7.00E-05	0.	1.38E-04	0.	5.79E-04
TH229	1.38E-02	1.81E-04	6.80E-04	0.	8.84E-04	0.	5.27E-04
TH230	3.55E-03	1.78E-04	9.91E-05	0.	8.67E-04	0.	6.19E-05
TH232+D	3.96E-03	1.52E-04	3.01E-04	0.	7.41E-04	0.	5.27E-05
TH234	3.42E-07	1.51E-08	9.88E-09	0.	8.01E-08	0.	1.18E-04
PA231+D	7.07E-03	2.34E-04	2.81E-04	0.	1.28E-03	0.	7.37E-05
PA233	1.81E-08	2.82E-09	3.16E-09	0.	1.04E-08	0.	1.44E-05
U232+D	1.76E-02	0.	1.26E-03	0.	1.34E-03	0.	6.98E-05
U233+D	3.72E-03	0.	2.25E-04	0.	6.10E-04	0.	6.45E-05
U234	3.57E-03	0.	2.21E-04	0.	5.98E-04	0.	6.32E-05
U235+D	3.42E-03	0.	2.07E-04	0.	5.61E-04	0.	8.03E-05
U236	3.42E-03	0.	2.12E-04	0.	5.73E-04	0.	5.92E-05
U237	2.36E-07	0.	6.27E-08	0.	6.81E-07	0.	2.08E-05
U238+D	3.27E-03	0.	1.94E-04	0.	5.24E-04	0.	5.66E-05
NP237+D	2.36E-03	1.81E-04	9.79E-05	0.	6.05E-04	0.	8.16E-05
NP238	5.83E-08	1.18E-09	9.08E-10	0.	3.76E-09	0.	4.04E-05
NP239	5.25E-09	3.77E-10	2.65E-10	0.	1.09E-09	0.	2.79E-05
PU238	1.25E-03	1.56E-04	3.16E-05	0.	1.15E-04	0.	7.50E-05
PU239	1.36E-03	1.65E-04	3.31E-05	0.	1.22E-04	0.	6.85E-05
PU240	1.36E-03	1.65E-04	3.31E-05	0.	1.22E-04	0.	6.98E-05
PU241+D	4.00E-05	1.72E-06	8.04E-07	0.	2.96E-06	0.	1.44E-06
PU242	1.26E-03	1.59E-04	3.19E-05	0.	1.17E-04	0.	6.71E-05
PU244	1.47E-03	1.82E-04	3.65E-05	0.	1.35E-04	0.	1.00E-04
AM241	1.43E-03	6.40E-04	1.02E-04	0.	6.23E-04	0.	7.64E-05
AM242M	1.47E-03	6.25E-04	1.04E-04	0.	6.30E-04	0.	9.61E-05
AM243	1.41E-03	6.14E-04	9.83E-05	0.	6.06E-04	0.	8.95E-05
CM242	8.80E-05	6.73E-05	5.84E-06	0.	1.87E-05	0.	8.16E-05
CM243	1.33E-03	6.03E-04	8.24E-05	0.	3.08E-04	0.	8.03E-05
CM244	1.11E-03	5.36E-04	6.93E-05	0.	2.54E-04	0.	7.77E-05
CM245	1.76E-03	6.64E-04	1.05E-04	0.	4.11E-04	0.	7.24E-05
CM246	1.74E-03	6.64E-04	1.05E-04	0.	4.10E-04	0.	7.11E-05
CM247+D	1.70E-03	6.53E-04	1.03E-04	0.	4.04E-04	0.	9.35E-05
CM248	1.41E-02	5.38E-03	8.52E-04	0.	3.33E-03	0.	1.51E-03
CF252	1.07E-03	0.	2.54E-05	0.	0.	0.	2.96E-04

TABLE 2.1

TEEN INGESTION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INGESTED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
H3	0.	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07
BE10	4.48E-06	6.94E-07	1.13E-07	0.	5.30E-07	0.	2.84E-05
C14	4.06E-06	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07
N13	1.15E-08	1.15E-08	1.15E-08	1.15E-08	1.15E-08	1.15E-08	1.15E-08
F18	8.64E-07	0.	9.47E-08	0.	0.	0.	7.78E-08
NA22	2.34E-05	2.34E-05	2.34E-05	2.34E-05	2.34E-05	2.34E-05	2.34E-05
NA24	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06
P32	2.76E-04	1.71E-05	1.07E-05	0.	0.	0.	2.32E-05
AR39	0.	0.	0.	0.	0.	0.	0.
AR41	0.	0.	0.	0.	0.	0.	0.
CA41	1.97E-04	0.	2.13E-05	0.	0.	0.	1.95E-07
SC46	7.24E-09	1.41E-08	4.18E-09	0.	1.35E-08	0.	4.80E-05
CR51	0.	0.	3.60E-09	2.00E-09	7.89E-10	5.14E-09	6.05E-07
MN54	0.	5.90E-06	1.17E-06	0.	1.76E-06	0.	1.21E-05
MN56	0.	1.58E-07	2.81E-08	0.	2.00E-07	0.	1.04E-05
FE55	3.78E-06	2.68E-06	6.25E-07	0.	0.	1.70E-06	1.16E-06
FE59	5.87E-06	1.37E-05	5.29E-06	0.	0.	4.32E-06	3.24E-05
CO57	0.	2.38E-07	3.99E-07	0.	0.	0.	4.44E-06
CO58	0.	9.72E-07	2.24E-06	0.	0.	0.	1.34E-05
CO60	0	2.81E-06	6.33E-06	0.	0.	0.	3.66E-05
NI59	1.32E-05	4.66E-06	2.24E-06	0.	0.	0.	7.31E-07
NI63	1.77E-04	1.25E-05	6.00E-06	0.	0.	0.	1.99E-06
NI65	7.49E-07	9.57E-08	4.36E-08	0.	0.	0.	5.193-06
CU64	0.	1.15E-07	5.41E-08	0.	2.91E-07	0.	8.92E-06
ZN65	5.76E-06	2.00E-05	9.33E-06	0.	1.28E-05	0.	8.47E-06
ZN69M+D	2.40E-07	5.66E-07	5.19E-08	0.	3.44E-07	0.	3.11E-05
ZN69	1.47E-08	2.80E-08	1.96E-09	0.	1.83E-08	0.	5.16E-08
SE79	0.	3.73E-06	6.27E-07	0.	6.50E-06	0.	5.70E-07
BR82	0.	0.	3.04E-06	0.	0.	0.	0.
BR83+D	0.	0.	5.74E-08	0.	0.	0.	0.
BR84	0.	0.	7.22E-08	0.	0.	0.	0.
BR85	0.	0.	3.05E-09	0.	0.	0.	0.
KR83M	0.	0.	0.	0.	0.	0.	0.
KR85M	0.	0.	0.	0.	0.	0.	0.
KR85	0.	0.	0.	0.	0.	0.	0.
KR87	0.	0.	0.	0.	0.	0.	0.
KR88+D	0.	0.	0.	0.	0.	0.	0.
KR89	0.	0.	0.	0.	0.	0.	0.
RB86	0.	2.98E-05	1.40E-05	0.	0.	0.	4.41E-06
RB87	0.	1.75E-05	6.11E-06	0.	0.	0.	6.11E-07
RB88	0.	8.52E-08	4.54E-08	0.	0.	0.	7.30E-15
RB89+D	0.	5.50E-08	3.89E-08	0.	0.	0.	8.43E-17
SR89+D	4.40E-04	0.	1.26E-05	0.	0.	0.	5.24E-05
SR90+D	8.30E-03	0.	2.05E-03	0.	0.	0.	2.33E-04
SR91+D	8.07E-06	0.	3.21E-07	0.	0.	0.	3.66E-05
SR92+D	3.05E-06	0.	1.30E-07	0.	0.	0.	7.77E-05

TABLE 2.1

TEEN INGESTION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INGESTED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y90	1.37E-08	0.	3.69E-10	0.	0.	0.	1.13E-04
Y91M+D	1.29E-10	0.	4.93E-12	0.	0.	0.	6.09E-09
Y91	2.01E-07	0.	5.39E-09	0.	0.	0.	8.24E-05
Y92	1.21E-09	0.	3.50E-11	0.	0.	0.	3.32E-05
Y93	3.83E-09	0.	1.05E-10	0.	0.	0.	1.17E-04
ZR93+D	5.53E-08	2.73E-08	1.49E-08	0.	9.65E-08	0.	2.58E-05
ZR95+D	4.12E-08	1.30E-08	8.94E-09	0.	1.91E-08	0.	3.00E-05
ZR97+D	2.37E-09	4.69E-10	2.16E-10	0.	7.11E-10	0.	1.27E-04
NB93M	3.44E-08	1.13E-08	2.83E-09	0.	1.32E-08	0.	4.07E-06
NB95	8.22E-09	4.56E-09	2.51E-09	0.	4.42E-09	0.	1.95E-05
NB97	7.37E-11	1.83E-11	6.68E-12	0.	2.14E-11	0.	4.37E-07
MO93	0.	1.06E-05	2.90E-07	0.	3.04E-06	0.	1.29E-06
MO99+D	0.	6.03E-06	1.15E-06	0.	1.38E-05	0.	1.08E-05
TC99M	3.32E-10	9.26E-10	1.20E-08	0.	1.38E-08	5.14E-10	6.08E-07
TC99	1.79E-07	2.63E-07	7.17E-08	0.	3.34E-06	2.72E-08	6.44E-06
TC101	3.60E-10	5.12E-10	5.03E-09	0.	9.26E-09	3.12E-10	8.75E-17
RU103+D	2.55E-07	0.	1.09E-07	0.	8.99E-07	0.	2.13E-05
RU105+D	2.18E-08	0.	8.46E-09	0.	2.75E-07	0.	1.76E-05
RU106+D	3.92E-06	0.	4.94E-07	0.	7.56E-06	0.	1.88E-04
RH105	1.73E-07	1.25E-07	8.20E-08	0.	5.31E-07	0.	1.59E-05
PD107	0.	2.08E-07	1.34E-08	0.	1.88E-06	0.	9.66E-07
PD109	0.	2.51E-07	5.70E-08	0.	1.45E-06	0.	2.53E-05
AG110M+D	2.05E-07	1.94E-07	1.18E-07	0.	3.70E-07	0.	5.45E-05
AG111	8.29E-08	3.44E-08	1.73E-08	0.	1.12E-07	0.	4.80E-05
CD113M	0.	4.51E-06	1.45E-07	0.	4.99E-06	0.	2.71E-05
CD115M	0.	2.60E-06	8.39E-08	0.	2.08E-06	0.	8.23E-05
SN123	4.44E-05	7.29E-07	1.08E-06	5.84E-07	0.	0.	6.71E-05
SN125+D	1.19E-05	2.37E-07	5.37E-07	1.86E-07	0.	0.	1.12E-04
SN126+D	1.16E-04	2.16E-06	3.30E-06	5.69E-07	0.	0.	2.58E-05
SB124	3.87E-06	7.13E-08	1.51E-06	8.78E-09	0.	3.38E-06	7.80E-05
SB125+D	2.48E-06	2.71E-08	5.80E-07	2.37E-09	0.	2.18E-06	1.93E-05
SB126	1.59E-06	3.25E-08	5.71E-07	8.99E-09	0.	1.14E-06	9.41E-05
SB127	3.63E-07	7.76E-09	1.37E-07	4.08E-09	0.	2.47E-07	6.16E-05
TE125M	3.83E-06	1.38E-06	5.12E-07	1.07E-06	0.	0.	1.13E-05
TE127M+D	9.67E-06	3.43E-06	1.15E-06	2.30E-06	3.92E-05	0.	2.41E-05
TE127	1.58E-07	5.60E-08	3.40E-08	1.09E-07	6.40E-07	0.	1.22E-05
TE129M+D	1.63E-05	6.05E-06	2.58E-06	5.26E-06	6.82E-05	0.	6.12E-05
TE129	4.48E-08	1.67E-08	1.09E-08	3.20E-08	1.88E-07	0.	2.45E-07
TE131M+D	2.44E-06	1.17E-06	9.76E-07	1.76E-06	1.22E-05	0.	9.39E-05
TE131+D	2.79E-08	1.15E-08	8.72E-09	2.15E-08	1.22E-07	0.	2.29E-09
TE132+D	3.49E-06	2.21E-06	2.08E-06	2.33E-06	2.12E-05	0.	7.00E-05
TE133M+D	6.44E-08	3.66E-08	3.56E-08	5.11E-08	3.62E-07	0.	1.48E-07
TE134+D	4.47E-08	2.87E-08	3.00E-08	3.67E-08	2.74E-07	0.	1.66E-09
I129	4.66E-06	3.92E-06	6.54E-06	4.77E-03	7.01E-06	0.	4.57E-07
I130	1.03E-06	2.98E-06	1.19E-06	2.43E-04	4.59E-06	0.	2.29E-06
I131+D	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	0.	1.62E-06

TABLE 2.1

TEEN INGESTION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INGESTED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
I132	2.79E-07	7.30E-07	2.62E-07	2.46E-05	1.15E-06	0.	3.18E-07
I133+D	2.01E-06	3.41E-06	1.04E-06	4.76E-04	5.98E-06	0.	2.58E-06
I134	1.46E-07	3.87E-07	1.39E-07	6.45E-06	6.10E-07	0.	5.10E-09
I135+D	6.10E-07	1.57E-06	5.82E-07	1.01E-04	2.48E-06	0.	1.74E-06
XE131M	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.
XE133	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.
XE135	0.	0.	0.	0.	0.	0.	0.
XE137	0.	0.	0.	0.	0.	0.	0.
XE138+D	0.	0.	0.	0.	0.	0.	0.
CS134M+D	2.94E-08	6.09E-08	3.13E-08	0.	3.39E-08	5.95E-09	4.05E-08
CS134	8.37E-05	1.97E-04	9.14E-05	0.	6.26E-05	2.39E-05	2.45E-06
CS135	2.78E-05	2.55E-05	5.96E-06	0.	9.73E-06	3.52E-06	4.46E-07
CS136	8.59E-06	3.38E-05	2.27E-05	0.	1.84E-05	2.90E-06	2.72E-06
CS137+D	1.12E-04	1.49E-04	5.19E-05	0.	5.07E-05	1.97E-05	2.12E-06
CS138	7.76E-08	1.49E-07	7.45E-08	0.	1.10E-07	1.28E-08	6.76E-11
CS139+D	4.87E-08	7.17E-08	2.63E-08	0.	5.79E-08	6.34E-09	3.33E-23
BA139	1.39E-07	9.78E-11	4.05E-09	0.	9.22E-11	6.74E-11	1.24E-06
BA140+D	2.84E-05	3.48E-08	1.83E-06	0.	1.18E-08	2.34E-08	4.38E-05
BA141+D	6.71E-08	5.01E-11	2.24E-09	0.	4.65E-11	3.43E-11	1.43E-13
BA142+D	2.99E-08	2.99E-11	1.84E-09	0.	2.53E-11	1.99E-11	9.18E-20
LA140	3.48E-09	1.71E-09	4.55E-10	0.	0.	0.	9.82E-05
LA141	4.55E-10	1.40E-10	2.31E-11	0.	0.	0.	2.48E-05
LA142	1.79E-10	7.95E-11	1.98E-11	0.	0.	0.	2.42E-06
CE141	1.33E-08	8.88E-09	1.02E-09	0.	4.18E-09	0.	2.54E-05
CE143+D	2.35E-09	1.71E-06	1.91E-10	0.	7.67E-10	0.	5.14E-05
CE144+D	6.96E-07	2.88E-07	3.74E-08	0.	1.72E-07	0.	1.75E-04
PR143	1.31E-08	5.23E-09	6.52E-10	0.	3.04E-09	0.	4.31E-05
PR144	4.30E-11	1.76E-11	2.18E-12	0.	1.01E-11	0.	4.74E-14
ND147+D	9.38E-09	1.02E-08	6.11E-10	0.	5.99E-09	0.	3.68E-05
PM147	1.05E-07	9.96E-09	4.06E-09	0.	1.90E-08	0.	9.47E-06
PM148M+D	4.14E-08	1.05E-08	8.21E-09	0.	1.59E-08	0.	6.61E-05
PM148	1.02E-08	1.66E-09	8.36E-10	0.	3.00E-09	0.	9.90E-05
PM149	2.17E-09	3.05E-10	1.25E-10	0.	5.81E-10	0.	4.49E-05
PM151	9.87E-10	1.63E-10	8.25E-11	0.	2.93E-10	0.	3.66E-05
SM151	8.73E-08	1.68E-08	3.94E-09	0.	1.84E-08	0.	5.70E-06
SM153	1.22E-09	1.01E-09	7.43E-11	0.	3.30E-10	0.	2.85E-05
EU152	2.45E-07	5.90E-08	5.20E-08	0.	2.74E-07	0.	2.17E-05
EU154	7.91E-07	1.02E-07	7.19E-08	0.	4.56E-07	0.	5.39E-05
EU155	1.74E-07	1.68E-08	1.04E-08	0.	6.57E-08	0.	9.63E-05
EU156	1.92E-08	1.44E-08	2.35E-09	0.	9.69E-09	0.	7.36E-05
TB160	6.47E-08	0.	8.07E-09	0.	2.56E-08	0.	4.19E-05
HO166M	3.57E-07	1.10E-07	7.96E-08	0.	1.61E-07	0.	0.
W181	1.42E-08	4.58E-09	4.79E-10	0.	0.	0.	3.90E-07
W185	5.79E-07	1.91E-07	2.02E-08	0.	0.	0.	1.65E-05
W187	1.46E-07	1.19E-07	4.17E-08	0.	0.	0.	3.22E-05

TABLE 2.1

TEEN INGESTION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INGESTED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
PB210+D	1.81E-02	5.44E-03	7.01E-04	0.	1.72E-02	0.	5.74E-05
BI210+D	6.59E-07	4.51E-06	5.66E-08	0.	5.48E-05	0.	5.15E-05
PO210	6.09E-04	1.07E-03	1.23E-04	0.	3.60E-03	0.	6.75E-05
RN222+D	0.	0.	0.	0.	0.	0.	0.
RA223+D	7.11E-03	1.08E-05	1.42E-03	0.	3.10E-04	0.	3.43E-04
RA224+D	2.31E-03	5.52E-06	4.61E-04	0.	1.58E-04	0.	3.71E-04
RA225+D	9.37E-03	1.10E-05	1.87E-03	0.	3.15E-04	0.	3.27E-04
RA226+D	3.22E-01	8.13E-06	2.39E-01	0.	2.32E-04	0.	3.51E-04
RA228+D	1.37E-01	4.41E-06	1.51E-01	0.	1.26E-04	0.	5.98E-05
AC225	6.29E-06	8.59E-06	4.22E-07	0.	9.85E-07	0.	4.36E-04
AC227+D	2.05E-03	3.03E-04	1.22E-04	0.	8.81E-05	0.	8.68E-05
TH227+D	1.96E-05	3.52E-07	5.65E-07	0.	2.01E-06	0.	5.75E-04
TH228+D	6.80E-04	1.14E-05	2.30E-05	0.	6.41E-05	0.	5.97E-04
TH229	8.39E-03	1.26E-04	4.11E-04	0.	6.10E-04	0.	5.43E-04
TH230	2.16E-03	1.23E-04	6.00E-05	0.	5.99E-04	0.	6.38E-05
TH232+D	2.42E-03	1.05E-04	1.63E-04	0.	5.11E-04	0.	5.43E-05
TH234	1.14E-07	6.68E-09	3.31E-09	0.	3.81E-08	0.	1.21E-04
PA231+D	4.31E-03	1.62E-04	1.68E-04	0.	9.10E-04	0.	7.60E-05
PA233	7.33E-09	1.41E-09	1.26E-09	0.	5.32E-09	0.	1.61E-05
U232+D	5.89E-03	0.	4.21E-04	0.	6.38E-04	0.	7.19E-05
U233+D	1.24E-03	0.	7.543-05	0.	2.90E-04	0.	6.65E-05
U234	1.19E-03	0.	7.39E-05	0.	2.85E-04	0.	6.51E-05
U235+D	1.14E-03	0.	6.94E-05	0.	2.67E-04	0.	8.28E-05
U236	1.14E-03	0.	7.09E-05	0.	2.73E-04	0.	6.11E-05
U237	7.89E-08	0.	2.10E-08	0.	3.24E-07	0.	2.09E-05
U238+D	1.09E-03	0.	6.49E-05	0.	2.50E-04	0.	5.83E-05
NP237+D	1.44E-03	1.25E-04	5.85E-05	0.	4.33E-04	0.	8.41E-05
NP238	1.95E-08	5.22E-10	3.04E-10	0.	1.79E-09	0.	3.83E-05
NP239	1.76E-09	1.66E-10	9.22E-11	0.	5.21E-10	0.	2.67E-05
PU238	7.21E-04	1.02E-04	1.82E-05	0.	7.80E-05	0.	7.73E-05
PU239	8.27E-04	1.12E-04	2.01E-05	0.	8.57E-05	0.	7.06E-05
PU240	8.26E-04	1.12E-04	2.01E-05	0.	8.56E-05	0.	7.19E-05
PU241+D	1.84E-05	9.42E-07	3.69E-07	0.	1.71E-06	0.	1.48E-06
PU242	7.66E-04	1.08E-04	1.94E-05	0.	8.25E-05	0.	6.92E-05
PU244	8.95E-04	1.23E-04	2.22E-05	0.	9.45E-05	0.	1.03E-04
AM241	8.62E-04	3.29E-04	5.75E-05	0.	4.31E-04	0.	7.87E-05
AM242M	8.70E-04	3.19E-04	5.80E-05	0.	4.30E-04	0.	9.90E-05
AM243	8.60E-04	3.17E-04	5.62E-05	0.	4.22E-04	0.	9.23E-05
CM242	2.94E-05	2.97E-05	1.95E-06	0.	8.89E-06	0.	8.40E-05
CM243	6.91E-04	2.86E-04	4.09E-05	0.	1.91E-04	0.	8.28E-05
CM244	5.32E-04	2.49E-04	3.19E-05	0.	1.49E-04	0.	8.00E-05
CM245	1.07E-03	3.33E-04	6.10E-05	0.	2.85E-04	0.	7.46E-05
CM246	1.06E-03	3.32E-04	6.09E-05	0.	2.84E-04	0.	7.33E-05
CM247+D	1.03E-03	3.27E-04	6.00E-05	0.	2.80E-04	0.	9.63E-05
CM248	8.60E-03	2.69E-03	4.95E-04	0.	2.31E-03	0.	1.55E-03
CR252	3.51E-04	0.	8.37E-06	0.	0.	0.	3.05E-04

TABLE 2.1

ADULT INGESTION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INGESTED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
H3	0.	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
BE10	3.18E-06	4.91E-07	7.94E-08	0.	3.71E-07	0.	2.68E-05
C14	2.84E-06	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07
N13	8.36E-09	8.36E-09	8.36E-09	8.36E-09	8.36E-09	8.36E-09	8.36E-09
F18	6.24E-07	0.	6.92E-08	0.	0.	0.	1.85E-08
NA22	1.74E-05	1.74E-05	1.74E-05	1.74E-05	1.74E-05	1.74E-05	1.74E-05
NA24	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06
P32	1.93E-04	1.20E-05	7.46E-06	0.	0.	0.	2.17E-05
AR39	0.	0.	0.	0.	0.	0.	0.
AR41	0.	0.	0.	0.	0.	0.	0.
CA41	1.83E-05	0.	2.00E-05	0.	0.	0.	1.84E-07
SC46	5.51E-09	1.07E-08	3.11E-09	0.	9.99E-09	0.	5.21E-05
CR51	0.	0.	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
MN54	0.	4.57E-06	8.72E-07	0.	1.36E-06	0.	1.40E-05
MN56	0.	1.15E-07	2.04E-08	0.	1.46E-07	0.	3.67E-06
FE55	2.75E-06	1.90E-06	4.43E-07	0.	0.	1.06E-06	1.09E-06
FE59	4.34E-06	1.02E-05	3.91E-06	0.	0.	2.85E-06	3.40E-05
CO57	0.	1.75E-07	2.91E-07	0.	0.	0.	4.44E-06
CO58	0.	7.45E-07	1.67E-06	0.	0.	0.	1.51E-05
CO60	0.	2.14E-06	4.72E-06	0.	0.	0.	4.02E-05
NI59	9.76E-06	3.35E-06	1.63E-06	0.	0.	0.	6.90E-07
NI63	1.30E-04	9.01E-06	4.36E-06	0.	0.	0.	1.88E-06
NI65	5.28E-07	6.86E-08	3.13E-08	0.	0.	0.	1.74E-06
CU64	0.	8.33E-08	3.91E-08	0.	2.10E-07	0.	7.10E-06
ZN65	4.84E-06	1.54E-05	6.96E-06	0.	1.03E-05	0.	9.70E-06
ZN69M+D	1.70E-07	4.08E-07	3.73E-08	0.	2.47E-07	0.	2.49E-05
ZN69	1.03E-08	1.97E-08	1.37E-09	0.	1.28E-08	0.	2.96E-09
SE79	0.	2.63E-06	4.39E-07	0.	4.55E-06	0.	5.38E-07
BR82	0.	0.	2.26E-06	0.	0.	0.	2.59E-06
BR83+D	0.	0.	4.02E-08	0.	0.	0.	5.79E-08
BR84	0.	0.	5.21E-08	0.	0.	0.	4.09E-13
BR85	0.	0.	2.14E-09	0.	0.	0.	0.
KR83M	0.	0.	0.	0.	0.	0.	0.
KR85M	0.	0.	0.	0.	0.	0.	0.
KR85	0.	0.	0.	0.	0.	0.	0.
KR87	0.	0.	0.	0.	0.	0.	0.
KR88+D	0.	0.	0.	0.	0.	0.	0.
KR89	0.	0.	0.	0.	0.	0.	0.
RB86	0.	2.11E-05	9.83E-06	0.	0.	0.	4.16E-06
RB87	0.	1.23E-05	4.28E-06	0.	0.	0.	5.76E-07
RB88	0.	6.05E-08	3.21E-08	0.	0.	0.	8.36E-19
RB89+D	0.	4.01E-08	2.82E-08	0.	0.	0.	2.33E-21
SR89+D	3.08E-04	0.	8.84E-06	0.	0.	0.	4.94E-05
SR90+D	7.58E-03	0.	1.86E-03	0.	0.	0.	2.19E-04
SR91+D	5.67E-06	0.	2.29E-07	0.	0.	0.	2.70E-05
SR92+D	2.15E-06	0.	9.30E-08	0.	0.	0.	4.26E-05

TABLE 2.1

ADULT INGESTION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INGESTED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y90	9.62E-09	0.	2.58E-10	0.	0.	0.	1.02E-04
Y91M+D	9.09E-11	0.	3.52E-12	0.	0.	0.	2.67E-10
Y91	1.41E-07	0.	3.77E-09	0.	0.	0.	7.76E-05
Y92	8.45E-10	0.	2.47E-11	0.	0.	0.	1.48E-05
Y93	2.68E-09	0.	7.40E-11	0.	0.	0.	8.50E-05
ZR93+D	4.18E-08	2.34E-09	1.09E-09	0.	8.87E-09	0.	2.43E-06
ZR95+D	3.04E-08	9.75E-09	6.60E-09	0.	1.53E-08	0.	3.09E-05
ZR97+D	1.68E-09	3.39E-10	1.55E-10	0.	5.12E-10	0.	1.05E-04
NB93M	2.55E-08	8.32E-09	2.05E-09	0.	9.57E-09	0.	3.84E-06
NB95	6.22E-09	3.46E-09	1.86E-09	0.	3.42E-09	0.	2.10E-05
NB97	5.22E-11	1.32E-11	4.82E-12	0.	1.54E-11	0.	4.87E-08
MO93	0.	7.51E-06	2.03E-07	0.	2.13E-06	0.	1.22E-06
MO99+D	0.	4.31E-06	8.20E-07	0.	9.76E-06	0.	9.99E-06
TC99M	2.47E-10	6.98E-10	8.89E-09	0.	1.06E-08	3.42E-10	4.13E-07
TC99	1.25E-07	1.86E-07	5.02E-08	0.	2.34E-06	1.58E-08	6.08E-06
TC101	2.54E-10	3.66E-10	3.59E-09	0.	6.59E-09	1.87E-10	1.10E-21
RU103+D	1.85E-07	0.	7.97E-08	0.	7.06E-07	0.	2.16E-05
RU105+D	1.54E-08	0.	6.08E-09	0.	1.99E-07	0.	9.42E-06
RU106+D	2.75E-06	0.	3.48E-07	0.	5.31E-06	0.	1.78E-04
RH105	1.21E-07	8.85E-08	5.83E-08	0.	3.76E-07	0.	1.41E-05
PD107	0.	1.47E-07	9.40E-09	0.	1.32E-06	0.	9.11E-07
PD109	0.	1.77E-07	3.99E-08	0.	1.01E-06	0.	1.96E-05
AG110M+D	1.60E-07	1.48E-07	8.79E-08	0.	2.91E-07	0.	6.04E-05
AG111	5.81E-08	2.43E-08	1.21E-08	0.	7.84E-08	0.	4.46E-05
CD113M	0.	3.18E-06	1.02E-07	0.	3.50E-06	0.	2.56E-05
CD115M	0.	1.84E-06	5.87E-08	0.	1.46E-06	0.	7.74E-05
SN123	3.11E-05	5.15E-07	7.59E-07	4.38E-07	0.	0.	6.33E-05
SN125+D	8.33E-06	1.68E-07	3.78E-07	1.39E-07	0.	0.	1.04E-04
SN126+D	8.45E-05	1.67E-06	2.40E-06	4.92E-07	0.	0.	2.43E-05
SB124	2.80E-06	5.29E-08	1.11E-06	6.79E-09	0.	2.18E-06	7.95E-05
SB125+D	1.79E-06	2.00E-08	4.26E-07	1.82E-09	0.	1.38E-06	1.97E-05
SB126	1.15E-06	2.34E-08	4.15E-07	7.04E-09	0.	7.05E-07	9.40E-05
SB127	2.58E-07	5.65E-09	9.90E-08	3.10E-09	0.	1.53E-07	5.90E-05
TE125M	2.68E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	0.	1.07E-05
TE125M+D	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	0.	2.27E-05
TE127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	0.	8.68E-06
TE129M+D	1.15E-05	4.29E-06	1.82E-06	3.95E-06	4.80E-05	0.	5.79E-05
TE129	3.14E-08	1.18E-08	7.65E-09	2.41E-08	1.32E-07	0.	2.37E-08
TE131M+D	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	0.	8.40E-05
TE131+D	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	0.	2.79E-09
TE132+D	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	0.	7.71E-05
TE133M+D	4.62E-08	2.70E-08	2.60E-08	3.91E-08	2.67E-07	0.	6.64E-08
TE134+D	3.24E-08	2.12E-08	1.30E-08	2.83E-08	2.05E-07	0.	3.59E-11
I129	3.27E-06	2.81E-06	9.21E-06	7.23E-03	6.04E-06	0.	4.44E-07
I130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	0.	1.92E-06
I131+D	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	0.	1.57E-06

TABLE 2.1

ADULT INGESTION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INGESTED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
I132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	0.	1.02E-07
I133+D	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	0.	2.22E-06
I134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	0.	2.51E-10
I135+D	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	0.	1.31E-06
XE131M	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.
XE133	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.
XE135	0.	0.	0.	0.	0.	0.	0.
XE137	0.	0.	0.	0.	0.	0.	0.
XE138+D	0.	0.	0.	0.	0.	0.	0.
CS134M+D	2.13E-08	4.48E-08	2.29E-08	0.	2.43E-08	3.83E-09	1.58E-08
CS134	6.22E-05	1.48E-04	1.21E-04	0.	4.79E-05	1.59E-05	2.59E-06
CS135	1.95E-05	1.80E-05	7.99E-06	0.	6.81E-06	2.04E-06	4.21E-07
CS136	6.51E-06	2.57E-05	1.85E-05	0.	1.43E-05	1.96E-06	2.92E-06
CS137+D	7.97E-05	1.09E-04	7.14E-05	0.	3.70E-05	1.23E-05	2.11E-06
CS138	6.52E-08	1.09E-07	5.40E-08	0.	8.01E-08	7.91E-09	4.65E-13
CS139+D	3.41E-08	5.08E-08	1.85E-08	0.	4.07E-08	3.70E-09	1.10E-30
BA139	9.70E-08	6.91E-11	2.84E-09	0.	6.46E-11	3.92E-11	1.72E-07
BA140+D	2.03E-05	2.55E-08	1.33E-06	0.	8.67E-09	1.46E-08	4.18E-05
BA141+D	4.71E-08	3.56E-11	1.59E-09	0.	3.31E-11	2.02E-11	2.22E-17
BA142+D	2.13E-08	2.19E-11	1.34E-09	0.	1.85E-11	1.24E-11	3.00E-26
LA140	2.50E-09	1.26E-09	3.33E-10	0.	0.	0.	9.25E-05
LA141	3.19E-10	9.90E-11	1.62E-11	0.	0.	0.	1.18E-05
LA142	1.28E-10	5.82E-11	1.45E-11	0.	0.	0.	4.25E-07
CE141	9.36E-09	6.33E-09	7.18E-10	0.	2.94E-09	0.	2.42E-05
CE143+D	1.65E-09	1.22E-06	1.35E-10	0.	5.37E-10	0.	4.56E-05
CE144+D	4.88E-07	2.04E-07	2.62E-08	0.	1.21E-07	0.	1.65E-04
PR143	9.20E-09	3.69E-09	4.56E-10	0.	2.13E-09	0.	4.03E-05
PR144	3.01E-11	1.25E-11	1.53E-12	0.	7.05E-12	0.	4.33E-18
ND147+D	6.29E-09	7.27E-09	4.35E-10	0.	4.25E-09	0.	3.49E-05
PM147	7.54E-08	7.09E-09	2.87E-09	0.	1.34E-08	0.	8.93E-06
PM148M+D	3.07E-08	7.95E-09	6.08E-09	0.	1.20E-08	0.	6.74E-05
PM148	7.17E-09	1.19E-09	5.99E-10	0.	2.25E-09	0.	9.35E-05
PM149	1.52E-09	2.15E-10	8.78E-11	0.	4.06E-10	0.	4.03E-05
PM151	6.97E-10	1.17E-10	5.91E-11	0.	2.09E-10	0.	3.22E-05
SM151	6.90E-08	1.19E-08	2.85E-09	0.	1.33E-08	0.	5.25E-06
SM153	8.57E-10	7.15E-10	5.22E-11	0.	2.31E-10	0.	2.55E-05
EU152	1.95E-07	4.44E-08	3.90E-08	0.	2.75E-07	0.	2.56E-05
EU154	6.15E-07	7.56E-08	5.38E-08	0.	3.62E-07	0.	5.48E-05
EU155	8.60E-08	1.22E-08	7.87E-09	0.	5.63E-08	0.	9.60E-06
EU156	1.37E-08	1.06E-08	1.71E-09	0.	7.08E-09	0.	7.26E-05
TB160	4.70E-08	0.	5.86E-09	0.	1.94E-08	0.	4.33E-05
HO166M	2.70E-07	8.43E-08	6.40E-08	0.	1.26E-07	0.	0.
W181	9.91E-09	3.23E-09	3.46E-10	0.	0.	0.	3.68E-07
W185	4.05E-07	1.35E-07	1.42E-08	0.	0.	0.	1.56E-05
W187	1.03E-07	8.61E-08	3.01E-08	0.	0.	0.	2.82E-05

TABLE 2.1

ADULT INGESTION DOSE COMMITMENT FACTORS (MREM/50Y PER PCI INGESTED IN FIRST YR)

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
PB210+D	1.53E-02	4.37E-03	5.44E-04	0.	1.23E-02	0.	5.42E-05
BI210+D	4.61E-07	3.18E-06	3.96E-08	0.	3.83E-05	0.	4.75E-05
PO210	3.56E-04	7.56E-04	8.59E-05	0.	2.52E-03	0.	6.36E-05
RN222+D	0.	0.	0.	0.	0.	0.	0.
RA223+D	4.97E-03	7.65E-06	9.94E-04	0.	2.17E-04	0.	3.21E-04
RA224+D	1.61E-03	3.90E-06	3.23E-04	0.	1.10E-04	0.	3.40E-04
RA225+D	6.56E-03	7.78E-06	1.31E-03	0.	2.21E-04	0.	3.06E-04
RA226+D	3.02E-01	5.74E-06	2.20E-01	0.	1.63E-04	0.	3.32E-04
RA228+D	1.12E-01	3.12E-06	1.21E-01	0.	8.83E-05	0.	5.64E-05
AC225	4.40E-06	6.06E-06	2.96E-07	0.	6.90E-07	0.	4.07E-04
AC227+D	1.87E-03	2.48E-04	1.11E-04	0.	8.00E-05	0.	8.19E-05
TH227+D	1.37E-05	2.48E-07	3.95E-07	0.	1.41E-06	0.	5.40E-04
TH228+D	4.96E-04	8.40E-06	1.68E-05	0.	4.67E-05	0.	5.63E-04
TH229	7.98E-03	1.19E-04	3.91E-04	0.	5.75E-04	0.	5.12E-04
TH230	2.06E-03	1.17E-04	5.70E-05	0.	5.65E-04	0.	6.02E-05
TH232+D	2.30E-03	1.00E-04	1.50E-04	0.	4.82E-04	0.	5.12E-05
TH234	8.01E-08	4.71E-09	2.31E-09	0.	2.67E-08	0.	1.13E-04
PA231+D	4.10E-03	1.54E-04	1.59E-04	0.	8.64E-04	0.	7.17E-05
PA233	5.26E-09	1.06E-09	9.12E-10	0.	3.99E-09	0.	1.64E-05
U232+D	4.13E-03	0.	2.95E-04	0.	4.47E-04	0.	6.78E-05
U233+D	8.71E-04	0.	5.28E-05	0.	2.03E-04	0.	6.27E-05
U234	8.36E-04	0.	5.17E-05	0.	1.99E-04	0.	6.14E-05
U235+D	8.01E-04	0.	4.86E-05	0.	1.87E-04	0.	7.81E-05
U236	8.01E-04	0.	4.96E-05	0.	1.91E-04	0.	5.76E-05
U237	5.52E-8	0.	1.47E-08	0.	2.27E-07	0.	1.94E-05
U238+D	7.67E-04	0.	4.54E-05	0.	1.75E-04	0.	5.50E-05
NP237+D	1.37E-03	1.19E-04	5.54E-05	0.	4.12E-04	0.	7.94E-05
NP238	1.37E-08	3.69E-10	2.13E-10	0.	1.25E-09	0.	3.43E-05
NP239	1.19E-09	1.17E-10	6.45E-11	0.	3.65E-10	0.	2.40E-05
PU238	6.80E-04	9.58E-05	1.71E-05	0.	7.32E-05	0.	7.30E-05
PU239	7.87E-04	1.06E-04	1.91E-05	0.	8.11E-05	0.	6.66E-05
PU240	7.85E-04	1.06E-04	1.91E-05	0.	8.10E-05	0.	6.78E-05
PU241+D	1.65E-05	8.44E-07	3.32E-07	0.	1.53E-06	0.	1.40E-06
PU242	7.29E-04	1.02E-04	1.84E-05	0.	7.81E-05	0.	6.53E-05
PU244	8.52E-04	1.17E-04	2.11E-05	0.	8.95E-05	0.	9.73E-05
AM241	8.19E-04	2.88E-04	5.41E-05	0.	4.07E-04	0.	7.42E-05
AM242M	8.24E-04	2.78E-04	5.43E-05	0.	4.05E-04	0.	9.34E-05
AM243	8.18E-04	2.78E-04	5.30E-05	0.	3.99E-04	0.	8.70E-05
CM242	2.06E-05	2.10E-05	1.37E-06	0.	6.22E-06	0.	7.92E-05
CM243	6.39E-04	2.41E-04	3.75E-05	0.	1.75E-04	0.	7.81E-05
CM244	4.83E-04	2.07E-04	2.87E-05	0.	1.34E-04	0.	7.55E-05
CM245	1.02E-03	2.87E-04	5.76E-05	0.	2.69E-04	0.	7.04E-05
CM246	1.01E-03	2.87E-04	5.75E-05	0.	2.68E-04	0.	6.91E-05
CM247+D	9.84E-04	2.83E-04	5.67E-05	0.	2.64E-04	0.	9.09E-05
CM248	8.18E-03	2.33E-03	4.67E-04	0.	2.18E-03	0.	1.47E-03
CF252	2.64E-04	0.	6.29E-06	0.	0.	0.	2.88E-04

TABLE 2.2

PALISADES
Liquid Effluent

Design Objective Annual Quantity

Nuclide	Half-Life	Dose Conversion Factors (mrem/Ci)	Individual/Organ	Design Objective Annual Quantity (Curies)
H-3	12.3 yr	1.75E-06	Adult/TB	1.71E+06
Na-24	15 h	5.44E-03	Teen/TB	551.5
Sc-46	83.9 d	2.02E-02	Teen/TB	148.5
Cr-51	27.8 d	1.56E-03	Adult/GI (LLI)	6,410.0
Mn-54	303 d	3.50E-02	Teen/TB	85.7
Fe-55	2.6 yr	4.48E-03	Child/Bone	2,232.0
Mn-56	2.576 h	1.86E-03	Teen/TB	1,612.0
Co-57	270 d	4.39E-03	Teen/TB	683.4
Co-58	71.3 d	1.03E-02	Teen/TB	291.3
Fe-59	45.6 d	4.08E-02	Adult/GI (LLI)	245.1
Co-60	5.26 yr	4.71E-01	Teen/TB	6.37
Cu-64	12.8 h	1.32E-03	Teen/GI (LLI)	7,575.0
Ni-65	2.56 h	5.82E-04	Teen/TB	5,154.0
Zn-65	245 d	1.83E-01	Teen/TB	16.4
Br-84	31.8 mo	2.02E-03	Teen/TB	1,485.2
Rb-86	1.02 mo	3.06E-01	Child/TB	9.80
Rb-88	17.8 mo	6.92E-04	Teen/TB	4,335.3
Sr-89	52.7 d	1.56E-01	Child/Bone	64.1
Sr-90	27.7 yr	2.71E-00	Adult/Bone	3.69
Sr-91	9.67 h	1.16E-03	Teen/TB	2,586.0
Sr-92	2.71 h	1.51E-03	Teen/TB	1,986.8
Y-92	3.53 h	2.69E-04	Teen/TB	11,150.0
Nb-95	35 d	7.24E+00	Adult/GI (LLI)	1.38
Zr-95	65.5 d	6.17E-03	Teen/TB	486.2
Nb-97	72 mo	6.95E-04	Teen/TB	4,316.6
Zr-97	17 h	9.28E-04	Teen/TB	3,232.8
Mo-99	66.7 h	1.11E-03	Teen/Kidney	9,009.0
Tc-99m	6.05 h	1.42E-04	Teen/TB	21,126.8
Ru-103	39.5 d	2.74E-03	Teen/TB	1,094.9
Ag-110m	255 d	7.75E-02	Teen/TB	38.7

TABLE 2.2 (continued)

PALISADES
Liquid Effluent

Design Objective Annual Quantity

Nuclide	Half-Life	Dose Conversion Factors (mrem/Ci)	Individual/Organ	Design Objective Annual Quantity (Curies)
Cd-113m	13.6 yr	6.02E-02	Adult/GI (LLI)	166.1
Sb-124	60 d	1.51E-02	Teen/TB	198.7
Sb-125	2.7 yr	5.11E-02	Teen/TB	58.7
Te-127	9.4 h	7.38E-03	Teen/GI (LLI)	1,355.0
Te-127m	109 d	1.39E-01	Teen/Kidney	71.9
Te-129m	34.1 d	2.66E-01	Adult/GI (LLI)	37.6
I-130	12.3 h	1.17E-02	Child/Thyroid	854.7
I-131	8.05 d	3.27E-01	Child/Thyroid	30.6
Te-131m	30 h	2.27E-01	Adult/GI (LLI)	44.0
I-132	2.26 h	3.18E-05	Teen/TB	94,339.0
Te-132	77.7 h	2.93E-01	Adult/GI (LLI)	34.1
I-133	20.3 h	3.94E-02	Child/Thyroid	253.8
Cs-134	2 yr	2.86E+00	Adult/TB	1.04
I-134	52 mo	2.43E-03	Teen/TB	1,234.0
I-135	6.68 h	1.64E-03	Child/Thyroid	6,097.0
Cs-136	13.7 d	4.13E-01	Adult/TB	7.26
Cs-137	30 yr	1.71E+00	Adult/TB	1.75
Cs-138	32.2 mo	2.31E-03	Teen/TB	1,298.0
Ba-139	82.9 mo	4.66E-05	Teen/TB	64,377.0
Ba-140	12.8 d	7.96E-04	Teen/TB	3,768.0
La-140	40.22 h	1.85E-02	Adult/GI (LLI)	540.5
Ce-141	32.5 d	3.70E-04	Teen/TB	8,108.0
Ce-144	284 d	1.56E-03	Teen/TB	1,923.0
Eu-152	12.7 yr	3.24E-01	Teen/TB	9.25
W-187	23.9 h	1.98E-01	Adult/GI (LLI)	50.5
Np-239	2.346 d	2.26E-03	Adult/GI (LLI)	4,424.0

III. URANIUM FUEL CYCLE DOSE

A. SPECIFICATION

In accordance with Appendix A, Section III.I.1, if either liquid or gaseous quarterly releases exceed the quantity which would cause offsite doses more than twice the limit of Appendix A, Sections III.C.1, III.D.1, or III.H.1, then the cumulative dose contributions from combined release plus direct radiation sources (from the reactor unit and radwaste storage tanks) shall be calculated. The dose is to be determined for the member of the public protected to be the most highly exposed to these combined sources.

B. ASSUMPTIONS

1. The full time resident determined to be maximally exposed individual (excluding infant) is assumed also to be a fisherman. This individual is assumed to drink water and ingest local fish at the rates specified in Sections II.C.2.1 and II.C.2.2.

2. Amount of shore line fishing (at accessible shoreline adjacent to site security fence) is conservatively assumed as 48 hours per quarter (average of approximately 1/2 hour per day each day of the quarter) for the second and third quarters of the year, 36 hours for the fourth quarter and 16 hours for the first quarter.

C. DOSE CALCULATION

Maximum doses to the total body and internal organs of an individual shall be determined by use of LADTAP and GASPAR computer codes, and doses to like organs and total body summed. Added to this sum will be a mean dose rate, calculated or measured for the shoreline due to Plant present curing the quarter in question, times the assumed fishing time.

$$D_{40} = D_G + D_L + (R_T)(T) \quad (2.15)$$

where:

D_{40} = 40 CFR 190 dose (mrem).

D_G = Limiting dose to an individual from gaseous source term (mrem).

D_L = Limiting dose to an individual from liquid source term (mrem)..

R_T = Mean dose rate calculated to be applicable to Lake Michigan shoreline adjacent to Plant site (mrem/hr).

T = Assumed shoreline fishing time for the quarter in questions (hours).