



Entergy Nuclear Operations, Inc.
Palisades Nuclear Plant
27780 Blue Star Memorial Highway
Covert, MI 49043
Tel 269 764 2000

Jeffery A. Hardy
Regulatory Assurance Manager

PNP 2015-029

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10 CFR 50.36a

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

Subject: 2014 Annual Radioactive Effluent Release and Waste Disposal Report

Palisades Nuclear Plant
Docket 50-255
License No. DPR-20

Big Rock Point
Dockets 50-155 and 72-043
License No. DPR-6

Dear Sir or Madam:

Attached are the Entergy Nuclear Operations, Inc. 2014 Annual Radioactive Effluent Release and Waste Disposal Reports for Palisades Nuclear Plant (PNP) and Big Rock Point (BRP) Independent Spent Fuel Storage Installation (ISFSI). These reports are submitted in accordance with 10 CFR 50.36a(a)(2).

Attachment 1 contains the report for PNP. Attachment 2 contains the report for the BRP ISFSI.

These reports provide a summary of the quantities of radioactive liquid and gaseous effluent releases and solid radioactive waste processed during the period of January 1, 2014, through December 31, 2014.

This letter contains no new commitments and no revision to existing commitments.

Sincerely,

A handwritten signature in black ink, appearing to read 'JAH' followed by a stylized flourish.

JAH/bed

Attachment 1: Palisades Nuclear Plant 2014 Radioactive Effluent Release Report
Attachment 2: Big Rock Point Independent Spent Fuel Storage Installation 2014
Radioactive Effluent Release Report

CC Administrator, Region III, USNRC
Project Manager, Palisades, USNRC (w/o Attachments)
Resident Inspector, Palisades, USNRC (w/o Attachments)
NRC NMSS Project Manager, USNRC (w/o Attachments)
American Nuclear Insurers (ANI)

Attachment 1
Palisades Nuclear Plant 2014 Radioactive Effluent Release Report

2014 Plant Operating History

Palisades Nuclear Plant (PNP) entered the reporting period online on January 1, 2014, at nominal full power (NFP). PNP commenced a controlled shutdown on January 19, 2014, for refueling outage 1R23. The unit attained criticality on March 15, 2014, and returned to NFP on March 18, 2014. PNP performed a planned shutdown on June 20, 2014, to address P-50C Primary Coolant Pump mechanical seal leakage. The unit attained criticality on June 26, 2014, and returned to NFP on June 30, 2014. PNP was on line for the remainder of 2014. The unit generated 5,830,363 MWHrs of net electrical energy during 2014.

A. Gaseous Effluents

Tables 1A, "Gaseous Effluents – Summation of All Discharges," 1B, "Gaseous Effluents – Ground-Level Release – Batch Mode," and 1C, "Gaseous Effluents – Ground-Level Release – Continuous Mode," list and summarize gaseous effluents released during this reporting period.

B. Liquid Effluents

Tables 2A, "Liquid Effluents – Summation of All Discharges," 2B, "Liquid Effluents – Batch Mode," and 2C, "Liquid Effluents – Continuous Mode," list and summarize liquid effluents released during this reporting period.

C. Solid Waste Storage and Shipments

Table 3, "Low-Level Waste for Waste Classification A, B and C, summarizes solid radioactive waste shipped for processing or burial in 2014 for the following waste streams: resins, filters and evaporator bottoms, dry active waste, irradiated components and other waste.

D. Dose Assessments

Tables 4, "Dose Assessments, 10 CFR Part 50, Appendix I," and 5, "EPA 40 CFR Part 190, Individual in the Unrestricted Area," lists annual dose to the members of the public.

E. Supplemental Information

1. **Regulatory Limits**

a. Noble Gases

The air dose in unrestricted areas due to noble gas released in gaseous effluents shall be limited to the following:

- During the calendar quarter, to ≤ 5 mrad for gamma radiation and ≤ 10 mrad for beta radiation.
- During the calendar year, to ≤ 10 mrad gamma radiation and ≤ 20 mrad for beta radiation.

b. Iodines – Particulates

The dose to a member of the public from radioiodines, radioactive material in particulate form with half-lives greater than eight days, and radionuclides other than noble gas, e.g., tritium, in gaseous effluents released to unrestricted areas shall be limited to the following:

- During any calendar quarter, to ≤ 7.5 mrem to any organ
- During any calendar year, to ≤ 15 mrem to any organ

c. Liquid Effluents

The dose or dose commitment to an individual from radioactive material in liquid effluents released to unrestricted areas shall be limited to the following:

- During any calendar quarter to ≤ 1.5 mrem to the total body and ≤ 5 mrem to any organ.
- During any calendar quarter to ≤ 3 mrem to the total body and ≤ 10 mrem to any organ.

d. Total Dose

The dose or dose commitment to a real individual from all uranium fuel cycle sources is limited to ≤ 25 mrem to the total body or any organ (except the thyroid, which is limited to ≤ 75 mrem) over a period of 12 consecutive months.

2. Maximum Permissible Concentrations (Effluent Concentration Limits)

a. Gaseous Effluents

The dose rate due to radioactive material released in gaseous effluents from the site shall be limited to the following:

- For noble gases: ≤ 500 mrem/yr to the total body and ≤ 3000 mrem/yr to the skin.
- For all radioiodines and for all radioactive materials in particulate form with half-lives greater than eight days and for radionuclides other than noble gases: ≤ 1500 mrem/yr to any organ.

The above limits are provided to ensure that radioactive material discharged in gaseous effluents will not result in the exposure of an individual in an unrestricted area to annual average concentrations exceeding the limits of 10 CFR 20, Appendix B, Table 2, Column 1.

b. Liquid Effluents

The concentration of radioactive material released at any time from the site to unrestricted areas shall be limited to the concentrations specified in 10 CFR 20, Appendix B, Table 2, Column 2, for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to $2\text{E-}4$ $\mu\text{Ci/ml}$ total activity.

3. Average Energy

The average energy (\bar{E}) of the radionuclide mixture in releases of fission and activation gases as defined in Regulatory Guide 1.21, Appendix B, Section A.3 is not applicable because the limits used for gaseous releases are based on calculated dose to members of the public.

4. Measurements and Approximations of Total Radioactivity

Palisades upgraded to a 8192 channel analyzer from a 4096 channel analyzer in the second quarter of 2014.

- a. Fission and activation gases are sampled and then analyzed on a 8192 channel analyzer with a high purity germanium (HpGe) detector.
- b. Iodines are sampled and then analyzed on a 8192 channel analyzer with a HpGe detector.

- c. Particulates are sampled and then analyzed on a 8192 channel analyzer with a HpGe detector.
- d. Liquid effluents are sampled and then analyzed on a 8192 channel analyzer with a HpGe detector. Tritium analysis is performed using liquid scintillation. Fe-55, Ni-63, Sr-89, and Sr-90 analyses are performed by an offsite vendor.

5. Batch Releases – 2014

For PNP, these totals are not directly proportional to actual release volumes due to PNP having two sets of tanks with different volumes in both the gaseous and liquid release systems that are utilized for batch releases. The number of batches performed in this section will fluctuate from year to year due to the utilization of the smaller and larger tanks in different frequencies. This information is better quantified in the tables contained later in this report. Reporting average stream flow during periods of release of effluent into a flowing stream is not required as PNP's releases are made into Lake Michigan, and not a flowing stream of water.

a. Liquid

Number of batch releases for each quarter: 5 in the 1st quarter
 6 in the 2nd quarter
 2 in the 3rd quarter
 1 in the 4th quarter

Total time period for batch releases: 15222 minutes

Maximum time period for a batch release: 2409 minutes

Average time period for a batch release: 1087.2 minutes

Minimum time period for a batch release: 170 minutes

b. Gaseous

Number of batch releases for each quarter: 11 in the 1st quarter
 11 in the 2nd quarter
 1 in the 3rd quarter
 1 in the 4th quarter

Total time period for batch releases: 7637 minutes
Maximum time period for a batch release: 2317 minutes
Average time period for a batch release: 318 minutes
Minimum time period for a batch release: 62 minutes

6. Abnormal Discharges

a. Liquid

Number of releases for each quarter			
1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>

Total activity released in Curies (Ci)			
1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>

b. Gaseous

Number of releases for each quarter			
1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>

Total activity released in Curies (Ci)			
1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>

7. Non-Routine Planned Discharges

None.

8. Radioactive Waste Treatment System Changes

None.

9. Annual Land Use Census Changes

The garden critical receptor is unchanged and remains located in the SSE sector at .69 miles. The residence critical receptor has changed and is now located in the SSW sector at 0.49 miles. The goats are now located in the NE sector at 2.45 miles and are fed stored feed. Beef cattle remain located in the SE sector at 4.27 miles. There are no dairy cows located within five miles of the plant.

10. Effluent Monitoring System Inoperability

Three effluent monitors were out of service for greater than 30 days during the reporting period.

RIA-0631, condenser off-gas monitor, was declared inoperable on November 5, 2013, due to failing to respond to a source check during performance of MR-14, Process Monitor Function Checks – Monthly. Compensatory sampling was initiated per the ODCM. Troubleshooting remained in progress entering 2014. Compensatory actions were performed until the monitor was returned to service on March 6, 2015.

RIA-5211, turbine building sump effluent monitor was out of service for two separate periods of greater than 30 days. The monitor was initially declared non-functional on February 7, 2014, after displaying a false high reading. Compensatory sampling was initiated in accordance with the ODCM until the monitor was declared functional on March 19, 2014. RIA-5211 was then removed from service on March 23, 2014, due to the return of false high readings. Compensatory daily sampling was performed until the monitor was returned to service on June 6, 2014.

RIA-1113, waste gas discharge monitor, was declared inoperable on March 26, 2014, due to failing to meet acceptance criteria during a source check following calibration. Compensatory sampling was initiated per the ODCM, and continued until RIA-1113 was returned to service on October 14, 2014. The extended delay was caused by a parts issue.

11. Offsite Dose Calculation Manual (ODCM) Changes

The Offsite Dose Calculation Manual and Offsite Dose Calculation Manual Appendix A were revised in 2014 to update 10-year X/Q data. The General Manager Plant Operations approval is documented on the procedure cover page. The description and evaluation of the changes are documented on the Offsite Dose Calculation Manual Change Reviews and are supplied with the copies of the revisions. These revisions did not reduce the accuracy or reliability of dose calculations or setpoint determinations. Enclosure 1 contains a copy of the ODCM revision with changes indicated by marginal markings.

12. Process Control Program Changes

None.

13. Errata/Corrections to Previous Reports

None.

14. Other

Groundwater Monitoring

PNP has 21 ground water monitoring wells (MW) strategically placed within the owner controlled area to allow for detection of radioactive contamination of ground water due to leaks or spills from plant systems, four of which were installed in December, 2014, for monitoring starting in 2015. PNP added 18 temporary wells (TW) in 2009 to determine the potential source of tritium in groundwater in the vicinity of MW-3. Tanks T-90, primary makeup tank, T-91, utility water storage tank, and associated underground piping between these tanks and the auxiliary building addition are in this area. TW-15 is most indicative of a historic leak that continues to be monitored and addressed through piping repairs.

Tritium levels in TW-15 trended downward until October, 2014, when tritium peaked at 101,000 pCi/L due to washout from rising groundwater levels. No indications were present of any new underground piping leaks in 2014.

Monitoring of the groundwater tritium plume continues to assess repair effectiveness and follow the site hydrology data. Well locations are depicted in Figure 1.

Depth to Local Water Table – The depth is approximately eight to nine feet.

Classification of Subsurface Aquifers – Not used for drinking water.

Expected Movement/Mobility of Groundwater Plume – Westerly direction down-gradient toward Lake Michigan at approximately two feet per day.

Land Use Characteristics – PNP site property, water not used for drinking or irrigation.

NRC Notification, Date and contact Organization – The NRC was notified on December 10, 2007, by PNP.

Carbon-14

In 2010, PNP and other facilities participated in an EPRI task force to build a model to accurately estimate gaseous C-14 releases, given some key site-specific plant parameters (mass of the primary coolant, average thermal neutron cross section, rated MW, etc). This work was completed in November 2010. The estimates for C-14 were constructed using the aforementioned EPRI methodology contained with EPRI 1021106, Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents. Using the C-14 curie estimates, the annual dose to man was derived from guidance contained within Regulatory Guide 1.109. Because the dose contribution of C-14 from liquid radioactive waste is much less than that contributed by gaseous radioactive waste, evaluation of C-14 in liquid radioactive waste is not required.

Annual C-14 release PNP and subsequent doses for 2014:

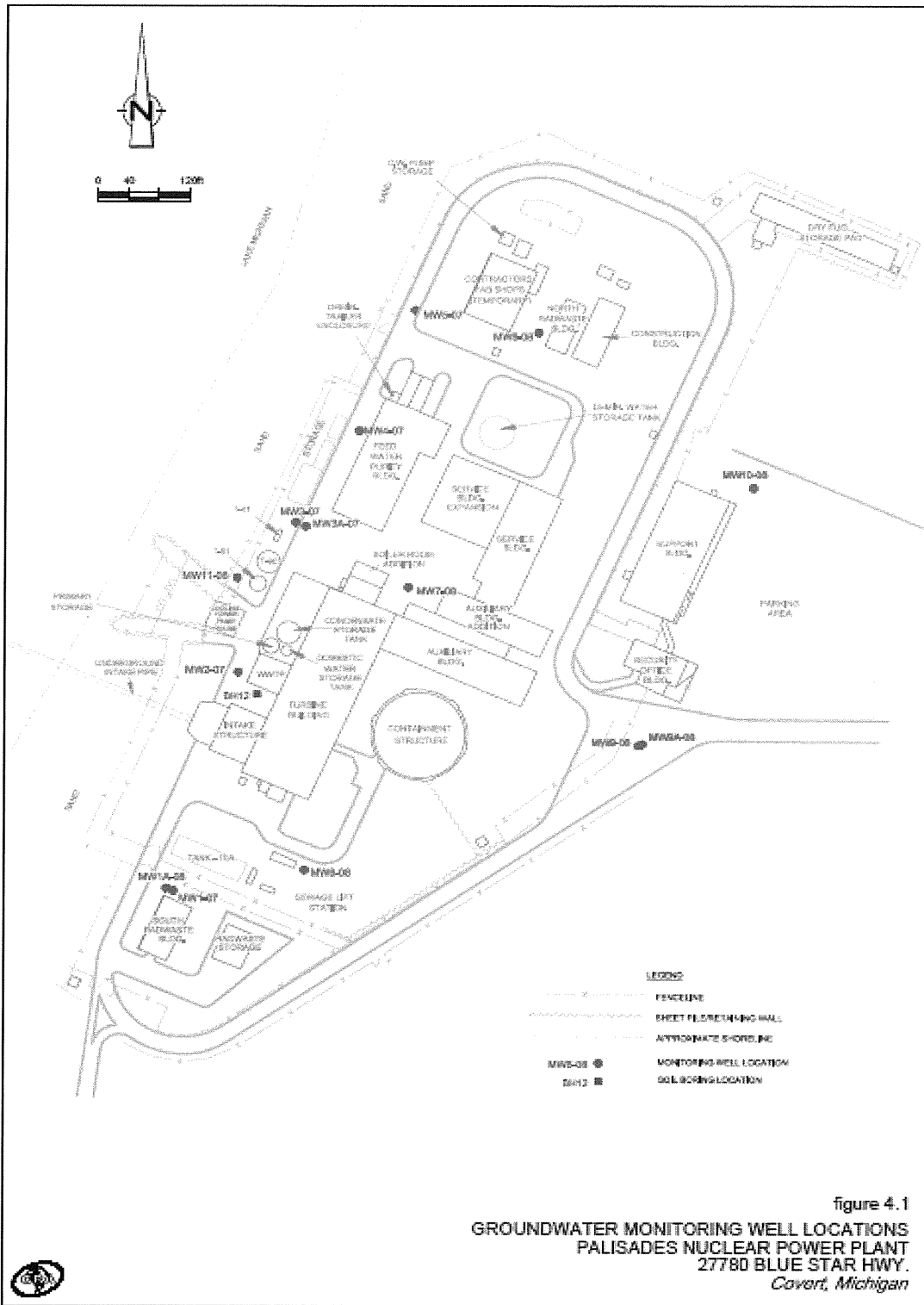
Total Gaseous C-14 Released Curies =	7.11
Gaseous C-14 as CO ₂ Curies =	2.13
Effective Child TB Dose, C-14 mrem =	0.052
Effective Child Bone Dose, C-14 mrem =	0.26

The quarterly curies released are provided in Table 1B. Airborne doses due to C-14 are grouped under the category of Particulate, Iodine, and Tritium which are contained in Table A-4.

Meteorological Data

Meteorological Data recovery was at 97.05%. The two most frequently occurring directions for the year at the 10 meter level were SSE and SE, accounting for over 21% of all observations. At 60 meters, the two predominant directions were S and SW, accounting for over 17% of all observations. The highest average speeds were associated with ESE winds at 10 meters and W winds at 60 meters. The mean speed for all directions at 10 meters was 3.17 m/s (7.09 mph), and at 60 meters was 6.03 m/s (13.49 mph). When compared to last year, the 10 meter average is 0.09 m/s (0.20 mph) lower while the 60 meter average is 0.02 m/s (0.04mph) lower. Data from this report and the annual meteorological data (Hourly Average Data or Joint Frequency Distribution) will be maintained on site in a file that shall be provided to the NRC upon request.

**FIGURE 1
GROUNDWATER MONITORING WELL LOCATIONS**



050633-00/903/GW-DEDC.DWG 03.0000

ATTACHMENT 1
Palisades - Table 1A
2014 Gaseous Effluents – Sum of All Releases

Summation of All Releases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total	Uncertainty (%)
Fission and Activation Gases	Ci	6.28E+00	1.51E+00	5.87E-01	1.46E+00	9.84E+00	8.78
Average Release Rate	µCi/s	7.87E-01	1.91E-01	7.20E-02	1.75E-01	3.12E-01	
% of Limit	%	8.99E-03	7.28E-04	9.73E-04	1.71E-03	3.07E-03	
I-131	Ci	1.24E-04	3.26E-05	4.76E-05	3.36E-05	2.38E-04	4.78
Average Release Rate	µCi/s	1.59E-05	4.15E-06	5.99E-06	4.22E-06	7.54E-06	
% of Limit	%	1.82E-07	4.73E-08	6.83E-08	4.81E-08	8.59E-08	
Particulates	Ci	7.79E-06	7.30E-06	2.34E-07	1.03E-02	1.03E-02	17.2
Average Release Rate	µCi/s	1.00E-06	8.45E-07	2.34E-08	1.54E-07	3.28E-04	
% of Limit	%	2.28E-07	7.90E-07	5.34E-09	7.02E-07	4.31E-07	
Tritium	Ci	4.35E+00	3.08E+00	1.55E+00	1.98E+00	1.10E+01	4.15
Average Release Rate	µCi/s	5.60E-01	3.91E-01	1.95E-01	2.49E-01	3.47E-01	
% of Limit	%	1.28E-03	8.92E-04	4.44E-04	5.68E-04	7.92E-04	
Gross Alpha	Ci	9.66E-07	ND	ND	ND	9.66E-07	30.4
C-14	Ci	1.78E+00	1.78E+00	1.78E+00	1.78E+00	7.12E+00	
Average Release Rate	µCi/s	2.29E-01	2.26E-01	2.24E-01	2.24E-01	2.26E-01	
% of Limit	%	1.74E-06	1.72E-06	1.70E-06	1.70E-06	1.72E-06	

ATTACHMENT 1
Palisades - Table 1B
2014 Gaseous Effluents – Ground Level Release, Continuous Mode

Fission and Activation Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Ar-41	Ci	3.59E-02	ND	ND	ND
Kr-85	Ci	ND	ND	ND	ND
Kr-85m	Ci	ND	ND	ND	ND
Kr-87	Ci	ND	ND	ND	ND
Kr-88	Ci	ND	ND	ND	ND
Xe-131m	Ci	1.74E-03	5.75E-03	ND	ND
Xe-133	Ci	8.46E-01	9.92E-01	ND	1.57E-04
Xe-133m	Ci	ND	6.99E-03	ND	ND
Xe-135	Ci	7.61E-03	1.66E-02	ND	ND
Xe-135m	Ci	ND	ND	ND	ND
Xe-138	Ci	ND	ND	ND	ND
Total	Ci	8.91E-01	1.02E+00	0.00E+00	1.57E-04

Iodines/Halogens	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4
I-131	Ci	1.52E-08	1.52E-06	ND	ND
I-132	Ci	ND	8.28E-07	ND	ND
I-133	Ci	2.88E-06	1.49E-06	ND	ND
I-134	Ci	ND	ND	ND	ND
I-135	Ci	ND	ND	ND	ND
Total	Ci	2.90E-06	3.84E-06	0.00E+00	0.00E+00

Particulates	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Co-58	Ci	ND	4.90E-06	1.86E-07	ND
Co-60	Ci	8.71E-11	1.10E-06	ND	1.22E-06
Na-24	Ci	ND	ND	ND	ND
Cr-51	Ci	ND	ND	ND	ND
Mn-56	Ci	ND	ND	ND	ND
Y-88	Ci	ND	ND	ND	9.34E-03
Sr-92	Ci	ND	ND	ND	ND
Cs-138	Ci	ND	ND	ND	9.80E-04
Nb-95	Ci	ND	6.41E-07	ND	ND
Zr-95	Ci	ND	3.87E-07	4.79E-08	ND
Mn-54	Ci	ND	8.27E-08	ND	ND
Ag-110m	Ci	ND	2.71E-07	ND	ND
Total	Ci	8.71E-11	7.38E-06	2.34E-07	1.03E-02

Tritium	Ci	3.12E-02	4.97E-01	ND	ND
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Gross Alpha	Ci	4.83E-07	ND	ND	ND
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C-14	Ci	NA	NA	NA`	NA
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ND = Measurements performed but no activity detected.
NA = Analysis not required & not performed

ATTACHMENT 1
Palisades - Table 1C
2014 Gaseous Effluents – Ground Level Release, Continuous Mode

Fission and Activation Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Ar-41	Ci	1.96E+00	9.39E-02	1.98E-01	1.33E-01
Kr-85	Ci	ND	ND	ND	ND
Kr-85m	Ci	8.87E-03	1.02E-04	2.44E-03	4.18E-02
Kr-87	Ci	6.33E-02	2.43E-02	2.98E-02	1.07E-01
Kr-88	Ci	4.59E-01	1.95E-02	2.09E-02	9.28E-02
Xe-131m	Ci	ND	ND	ND	ND
Xe-133	Ci	6.91E-02	4.71E-02	1.12E-02	1.36E-01
Xe-133m	Ci	ND	ND	ND	ND
Xe-135	Ci	2.06E+00	1.32E-01	1.46E-01	3.90E-01
Xe-135m	Ci	3.46E-01	9.19E-03	1.94E-03	6.91E-03
Xe-137	Ci	1.67E-01	ND	1.43E-02	6.86E-02
Xe-138	Ci	2.63E-01	1.58E-01	1.62E-01	4.85E-01
Total	Ci	5.39E+00	4.84E-01	5.87E-01	1.46E+00

Iodines/Halogens	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4
I-131	Ci	1.24E-04	3.11E-05	4.76E-05	3.36E-05
I-132	Ci	1.13E-03	1.51E-05	ND	ND
I-133	Ci	1.02E-04	4.85E-05	8.68E-05	1.00E-04
I-134	Ci	ND	ND	ND	ND
I-135	Ci	ND	ND	ND	ND
Total	Ci	1.36E-03	9.48E-05	1.34E-04	1.34E-04

Particulates	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Co-58	Ci	7.79E-06	ND	ND	ND
Co-60	Ci	ND	ND	ND	ND
Mn-54	Ci	ND	ND	ND	ND
Cr-51	Ci	ND	ND	ND	ND
Co-57	Ci	ND	ND	ND	ND
Nb-95	Ci	ND	ND	ND	ND
Zr-95	Ci	ND	ND	ND	ND
Ag-110m	Ci	ND	ND	ND	ND
Sn-113	Ci	ND	ND	ND	ND
Sb-125	Ci	ND	ND	ND	ND
Cs-137	Ci	ND	ND	ND	ND
Ce-144	Ci	ND	ND	ND	ND
Total	Ci	7.79E-06	0.00E+00	0.00E+00	0.00E+00

Tritium	Ci	4.32E+00	2.58E+00	1.55E+00	1.98E+00
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Gross Alpha	Ci	4.83E-07	0.00E+00	0.00E+00	0.00E+00
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C-14	Ci	1.78E+00	1.78E+00	1.78E+00	1.78E+00
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ND = Measurements performed but no activity detected.

ATTACHMENT 1
Palisades - Table 2A
2014 Liquid Effluents – Sum of All Releases

Summation of All Liquid Releases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total	Uncertainty (%)
Fission and Activation Products (excluding tritium, gases, and gross alpha)	Ci	1.02E-02	8.98E-03	1.59E-03	1.48E-04	2.09E-02	6.54
Average Concentration	µCi/ml	5.85E-10	2.42E-10	3.97E-11	3.80E-12	1.57E-10	
% of Limit	%	4.91E-03	4.08E-03	7.01E-04	9.25E-05	2.01E-03	
Tritium	Ci	7.89E+01	3.79E+01	9.64E+01	2.73E+01	2.40E+02	4.01
Average Concentration	µCi/ml	4.52E-06	1.02E-06	2.40E-06	7.02E-07	1.80E-06	
% of Limit	%	4.52E-01	1.02E-01	2.40E-01	7.02E-02	1.80E-01	
Dissolved and Entrained Gases	Ci	8.66E-05	0.00E+00	0.00E+00	0.00E+00	8.66E-05	12.0
Average Concentration	µCi/ml	4.96E-12	0.00E+00	0.00E+00	0.00E+00	6.49E-13	
% Of Limit	%	2.48E-06	0.00E+00	0.00E+00	0.00E+00	3.24E-07	
Gross Alpha	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	41.8
Average Concentration	µCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
Volume of Primary System Liquid Effluent (Before Dilution)	Liters	8.06E+05	7.21E+05	3.83E+05	1.45E+05	2.05E+06	
Dilution Water Used for Above	Liters	1.74E+10	3.71E+10	4.01E+10	3.88E+10	1.33E+11	
Volume of Secondary or Balance-of-Plant Liquid Effluent (e.g., low-activity or unprocessed) (Before Dilution)	Liters	5.94E+09	8.23E+09	1.02E+10	8.01E+09	3.24E+10	
Average Stream Flow	m ³ /s	2.24E+00	4.71E+00	5.05E+00	4.88E+00	4.22E+00	

Dilution flow rate (gal/qtr) = # of Dilution pumps running x days running/qtr x 40,000 gpm/pump x min/day

ATTACHMENT 1
Palisades - Table 2B
2014 Liquid Effluents – Batch Mode

Fission and Activation Products	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Cr-51	Ci	ND	ND	ND	ND
Mn-54	Ci	ND	ND	3.78E-05	ND
Fe-55	Ci	1.33E-04	ND	ND	ND
Fe-59	Ci	ND	ND	ND	ND
Co-57	Ci	ND	ND	ND	ND
Co-58	Ci	6.60E-03	4.23E-03	7.44E-04	3.74E-05
Co-60	Ci	1.20E-03	1.05E-03	5.13E-04	9.40E-05
Sr-89	Ci	ND	ND	ND	ND
Sr-90	Ci	ND	ND	ND	ND
Nb-95	Ci	1.38E-04	2.10E-04	ND	ND
Ag-110m	Ci	5.60E-04	1.02E-03	2.72E-04	1.62E-05
Sn-113	Ci	ND	ND	ND	ND
Sb-124	Ci	ND	ND	ND	ND
Sb-125	Ci	4.20E-04	9.21E-04	ND	ND
I-131	Ci	ND	ND	ND	ND
I-133	Ci	ND	ND	ND	ND
I-135	Ci	ND	ND	ND	ND
Cs-134	Ci	ND	ND	ND	ND
Cs-137	Ci	ND	7.36E-04	2.64E-05	ND
Ni-63	Ci	1.14E-03	8.14E-04	ND	ND
Zn-65	Ci	ND	ND	ND	ND
Zr-95	Ci	ND	ND	ND	ND
La-140	Ci	ND	ND	ND	ND
Totals	Ci	1.02E-02	8.98E-03	1.59E-03	1.48E-04

Dissolved and Entrained Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Kr-85	Ci	ND	ND	ND	ND
Kr-85m	Ci	ND	ND	ND	ND
Kr-88	Ci	ND	ND	ND	ND
Xe-131m	Ci	ND	ND	ND	ND
Xe-133	Ci	8.66E-05	ND	ND	ND
Xe-133m	Ci	ND	ND	ND	ND
Xe-135	Ci	ND	ND	ND	ND
Xe-135m	Ci	ND	ND	ND	ND
Totals		8.66E-05	0.00E+00	0.00E+00	0.00E+00

Tritium	Ci	7.89E+01	3.79E+01	9.64E+01	2.46E+01
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Gross Alpha	Ci	ND	ND	ND	ND
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ND = None Detected

ATTACHMENT 1
Palisades - Table 2C
2014 Liquid Effluents – Continuous Mode

Fission and Activation Products	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Cr-51	Ci	ND	ND	ND	ND
Mn-54	Ci	ND	ND	ND	ND
Fe-55	Ci	ND	ND	ND	ND
Fe-59	Ci	ND	ND	ND	ND
Co-57	Ci	ND	ND	ND	ND
Co-58	Ci	ND	ND	ND	ND
Co-60	Ci	ND	ND	ND	ND
Sr-89	Ci	ND	ND	ND	ND
Sr-90	Ci	ND	ND	ND	ND
Nb-95	Ci	ND	ND	ND	ND
Ag-110m	Ci	ND	ND	ND	ND
Sn-113	Ci	ND	ND	ND	ND
Sb-124	Ci	ND	ND	ND	ND
Sb-125	Ci	ND	ND	ND	ND
I-131	Ci	ND	ND	ND	ND
I-133	Ci	ND	ND	ND	ND
I-135	Ci	ND	ND	ND	ND
Cs-134	Ci	ND	ND	ND	ND
Cs-137	Ci	ND	ND	ND	ND
Ni-63	Ci	ND	ND	ND	ND
Zn-65	Ci	ND	ND	ND	ND
Zr-95	Ci	ND	ND	ND	ND
La-140	Ci	ND	ND	ND	ND
Totals	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Dissolved and Entrained Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Kr-85	Ci	ND	ND	ND	ND
Kr-85m	Ci	ND	ND	ND	ND
Kr-88	Ci	ND	ND	ND	ND
Xe-131m	Ci	ND	ND	ND	ND
Xe-133	Ci	ND	ND	ND	ND
Xe-133m	Ci	ND	ND	ND	ND
Xe-135	Ci	ND	ND	ND	ND
Xe-135m	Ci	ND	ND	ND	ND
Totals		0.00E+00	0.00E+00	0.00E+00	0.00E+00

Tritium	Ci	ND	2.16E-02	3.02E-02	2.67E+00
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Gross Alpha	Ci	ND	ND	ND	ND
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ND = None Detected

ATTACHMENT 1
Palisades - Table 3
2014 Low-Level Waste

1. Solid waste shipped offsite for burial or disposal (not irradiated fuel)

1. Type of waste	Unit	Estimated amount	Est Total Error , %
a. Spent resin, filters, evaporator bottoms, etc.	m ³	1.38E+01	25
	Curies	3.01E+00	
b. Dry compressible waste, contaminated equipment, etc.	m ³	3.27E+02	25
	Curies	5.41E+00	
c. Irradiated components, control rods, etc.	m ³	0.00E+00	0
	Curies	0.00E+00	
d. Other (describe) DAW / Metal Waste / Oil	m ³	2.34E+01	25
	Curies	1.22E-02	

2. Estimate of Major Nuclide composition (by type of waste), list nuclides as needed

a.	Fe-55	5.5%	Ag-110m	5.1%	
	Co-58	11%	Sb-125	3.6%	
	Co-60	30%	Cs-137	2.8%	
	Ni-63	39%			
b.	Cr-51	13%	Ni-63	6%	Cs-137 1%
	Fe-55	4%	Zr-95	5%	
	Co-58	39%	Nb-95	8%	
	Co-60	13.5%	Ag-110m	4%	
c.					
d.	C-14	2%	Co-60	17%	Cm-243 1%
	Cr-51	7%	Ni-63	8%	
	Mn-54	1%	Zr-95	5%	
	Fe-55	12%	Nb-95	8%	
	Co-58	28%	Ag-110m	5%	

ATTACHMENT 1
Palisades - Table 3
2014 Low-Level Waste

3. Solid waste disposition

Number of shipments	Mode of transportation	Destination
1	Truck	Kingston, Tn
20	Truck	Oakridge, Tn
1	Truck	Erwin, Tn

Irradiated fuel shipments (disposition)

Number of shipments	Mode of transportation	Destination
0	N/A	N/A

ATTACHMENT 1
Palisades - Table 4
2014 Dose Assessments, 10 CFR Part 50, Appendix I

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Yearly
Liquid Effluent Dose Limit, Total Body	1.5 mrem	1.5 mrem	1.5 mrem	1.5 mrem	3 mrem
Total Body Dose	1.37E-03	1.31E-03	2.99E-04	5.47E-05	3.03E-03
% Of Limit	0.09%	0.09%	0.02%	0.00%	0.10%
Liquid Effluent Dose Limit, Any Organ	5 mrem	5 mrem	5 mrem	5 mrem	10 mrem
Organ Dose	2.65E-03	2.33E-03	2.97E-04	5.58E-05	5.33E-03
% of Limit	0.05%	0.05%	0.01%	0.00%	0.05%
Gaseous Effluent Dose Limit, Gamma Air	5 mrad	5 mrad	5 mrad	5 mrad	10 mrad
Gamma Air Dose	2.49E-03	2.50E-04	3.04E-04	6.41E-04	3.69E-03
% of Limit	0.05%	0.01%	0.01%	0.01%	0.04%
Gaseous Effluent Dose Limit, Beta Air	10 mrad	10 mrad	10 mrad	10 mrad	20 mrad
Beta Air Dose	1.33E-03	1.99E-04	1.72E-04	4.52E-04	2.15E-03
% of Limit	0.013%	0.002%	0.002%	0.005%	0.011%
Gaseous Effluent Dose Limit, Any Organ (Iodine, Tritium, Particulates with >8 day half-life)	7.5 mrem	7.5 mrem	7.5 mrem	7.5 mrem	15 mrem
Gaseous Effluent Organ Dose (Iodine, Tritium, Particulates with >8-Day half-life)	1.18E-02	3.83E-03	3.69E-03	2.22E-02	4.16E-02
% of Limit	0.16%	0.05%	0.05%	0.30%	0.28%

Palisades - Table 5
2014 EPA 40 CFR Part 190, Individual in the Unrestricted Area

	Whole Body	Thyroid	Any Other Organ
Dose Limit	25 mrem	75 mrem	25 mrem
Dose	1.51E-01	2.01E-02	5.33E-03
% of Limit	0.61%	0.03%	0.02%

ENCLOSURE 1

PALISADES NUCLEAR PLANT

OFFSITE DOSE CALCULATION MANUAL, REVISION 26

OFFSITE DOSE CALCULATION MANUAL APPENDIX A, REVISION 18

ENCLOSURE 1

PALISADES NUCLEAR PLANT

**OFFSITE DOSE CALCULATION MANUAL, REVISION 26
OFFSITE DOSE CALCULATION MANUAL APPENDIX A, REVISION 18**

PALISADES NUCLEAR PLANT
OFFSITE DOSE CALCULATION MANUAL

TITLE: OFFSITE DOSE CALCULATION MANUAL

Process Applicability Exclusion ☐

AKGennrich	/	7/30/14
Procedure Sponsor		Date

MESoja	/	6/22/14
Technical Reviewer		Date

CLJones	/	7/29/14
User Reviewer		Date

ALWilliams	/	7/29/14
General Manager Plant Operations		Date

PALISADES NUCLEAR PLANT
OFFSITE DOSE CALCULATION MANUAL

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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 mrem/yr to the total body and less than or equal to 3000 mrem/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 mrem/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.

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1. Allowable Concentration

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 10.0.

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:

$$R_k = X/Q \times F \times \sum_i C_i/EC_i \leq 10.0 \quad (1.1)$$

where:

C_i = Actual or measured concentration, at ambient temperature and pressure of nuclide i ($\mu\text{Ci/cc}$)

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) (listed in site procedure CH 6.41, "Land Use Census")

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

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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 ($\mu\text{Ci/cc}$) at the monitor is calculated. The detector response to isotopic activities ($\text{cpm}/\mu\text{Ci/cc}$) 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):

$$s = b \times c \quad (1.2)$$

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 $\mu\text{Ci/cc}$ (or R/hr and $\mu\text{Ci/cc}$), 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.

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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. NRC Dose is the Effluent Dose Calculation software that supports LADTAP, GASPAR, and XOQDOQ which perform the actual dose calculations using the equations supplied here.
 - 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 Attachment 2, plus additional nuclides.
 - d) Basic radionuclide data are given in Attachment 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 site procedure CH 6.41, "Land Use Census."
 - 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.

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- i) Potential maximum population (resident) exposure points are identified in site procedure CH 6.41, "Land Use Census."
- j) A semi-infinite cloud model is used.
- k) Radioactive decay is considered for the plume.
- l) Building wake effects on effluent dispersion are considered.
- m) A sector-average dispersion equation is used.
- n) The wind speed classes that are used are as follows:

<u>Wind Speed</u> <u>Class Number</u>	<u>Range (m/s)</u>	<u>Midpoint (m/s)</u>
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	--

- o) 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.
- p) Terrain effects are not considered.

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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:

$$X_i = \sum_{j=1}^9 \sum_{k=1}^7 \left(\frac{2}{\pi} \right)^{1/2} \frac{f_{jk} Q_i p}{\sum_{zk} U_j (2\pi x/n)} \left[\exp \left(-\lambda_i \frac{x}{U_j} \right) \right] \quad (1.3)$$

where:

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

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, $\mu\text{Ci}/\text{s}$.

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.

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For determining the total body dose rate:

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

where:

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

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

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

For determining the skin dose rate:

$$D_s = \sum_i X_i (DFS_i + 1.11 DFY_i) \quad (1.5)$$

where:

D_s = Skin dose rate, mrem/y.

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

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

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 $\mu\text{Ci}/\text{m}^3$ (Attachment 3).

For determining dose rate to a point in air:

$$D_a = \sum_i X_i (DFY_i \text{ or } DFB_i) \quad (1.6)$$

where:

D_a = Air dose rate, mrad/yr.

DFB_i = Air dose factor for beta radiation (Attachment 3).

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- 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 Attachment 2.
 - d) Basic radionuclide data are given in Attachment 3.
 - e) All releases are treated as ground-level.
 - f) Mean annual average X/Q's are given in site procedure CH 6.41, "Land Use Census."
 - 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 (site procedure CH 6.41, "Land Use Census") 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.

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- 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.

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 , $\mu\text{Ci}/\text{m}^3$.

DFI_i = Inhalation dose factor, mrem/pCi (Attachment 5).

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.

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b) Ground Contamination

For determining the ground concentration of any nuclide;

$$G_i = 3.15 \times 10^7 \sum_{k=1}^7 \frac{f_k Q_i DR}{(2\pi x/n) \lambda_i} [1 - \exp(-\lambda_i t_b)] \quad (1.8)$$

where:

G_i	=	Ground concentration of radionuclide i, $\mu\text{Ci}/\text{m}^2$.
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, $\mu\text{Ci}/\text{s}$.
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.

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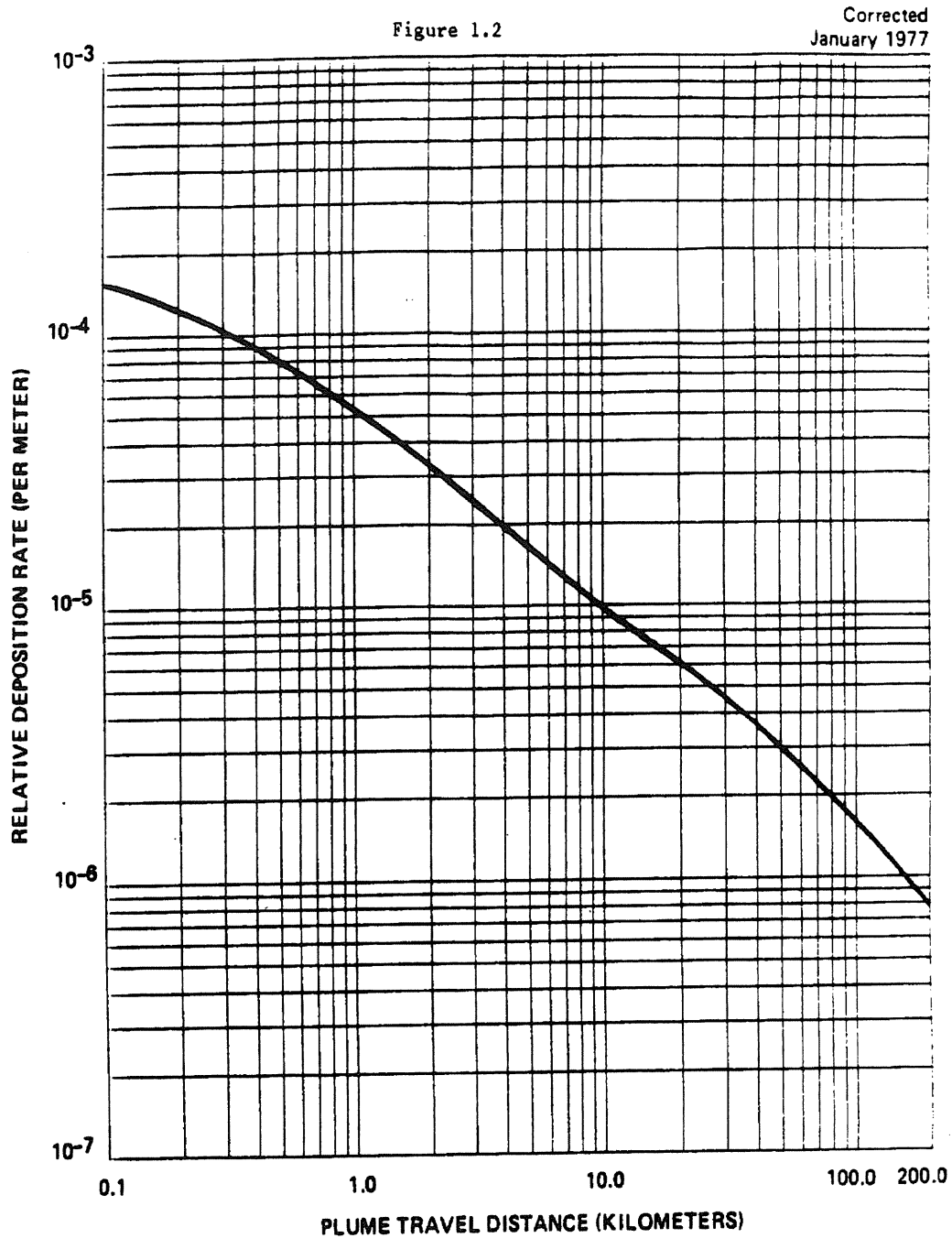


Figure 7. Relative Deposition for Ground Level Releases (All Atmospheric Stability Classes)

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

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

where:

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

G_i = Ground concentration of radionuclide i, $\mu\text{Ci}/\text{m}^2$.

DFG_i = Dose factor for standing on contaminated ground, mrem/h per pCi/m^2 (Attachment 6).

8,760 = Occupation time, h/y.

1×10^6 = $\text{pCi}/\mu\text{Ci}$ 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:

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

where:

CV_i = Concentration of radionuclide i in and on vegetation, $\mu\text{Ci}/\text{kg}$.

k = Stability class.

f_k = Frequency of this stability class and wind direction combination, expressed as a fraction.

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Q_i	=	Average release rate of radionuclide i , $\mu\text{Ci/s}$.
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).
λE_i	=	Effective removal rate constant, $\lambda E_i = \lambda_i + \lambda_w$, where λ_i is the radioactive decay coefficient, h^{-1} , and λ_w is a measure of physical loss by weathering ($\lambda_w = 0.0021 \text{ h}^{-1}$).
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 (Attachment 4).
λ_i	=	Radioactive decay coefficient of radionuclide i , h^{-1} .
t_b	=	Time for buildup of radionuclides on the ground, $1.31 \times 10^5 \text{ h}$ (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).

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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, $\mu\text{Ci/kg}$.

X_{14} = Air concentration of C-14, $\mu\text{Ci/m}^3$.

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, $\mu\text{Ci/m}^3$.

X_T = Air concentration of H-3, $\mu\text{Ci/m}^3$.

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.

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

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

where:

CM_i = Concentration of radionuclide i (including C-14 and H-3) in milk, $\mu\text{Ci/l}$.

CV_i = Concentration of radionuclide i in and on vegetation, $\mu\text{Ci/kg}$.

FM_i = Transfer factor from feed to milk for radionuclide i, d/l (Attachment 4).

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

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

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

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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 (Attachment 8).

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

1x10⁶ = 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 (Attachment 4).

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

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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 (Attachment 8) 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.

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- 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. Land Use Census

Appendix A, Sections J.3.b and J.3.c describe the requirements for an annual land use census. Changes will be effective on January 1 of the year following the year of the survey.

d. 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.

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C. 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 and displacing of cover gases caused by liquid accumulation in the tanks connected to the vent header.

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.

2. Determination of Satisfactory Operation

Doses will be calculated for batch and continuous releases as described in Section I.B. 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 operating history of the Plant has demonstrated the system's consistent performance well below Appendix I limits, no additional operability requirements are specified.

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D. 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 result 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 Attachment 2. The meteorology data is given in site procedure CH 6.41, "Land Use Census." 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 Attachment 2 multiplied by 50/2.15E-02 or 0.11 Ci/sec.

E. PARTICULATE AND IODINE SAMPLING

Particulate and 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 dose calculations. 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.

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Gamma analytical results for particulate and halogen filters are combined for determination of total activity of particulates and halogens released. Sampling and analysis will be performed per Appendix A, Table B-1 requirements.

F. NOBLE GAS SAMPLING

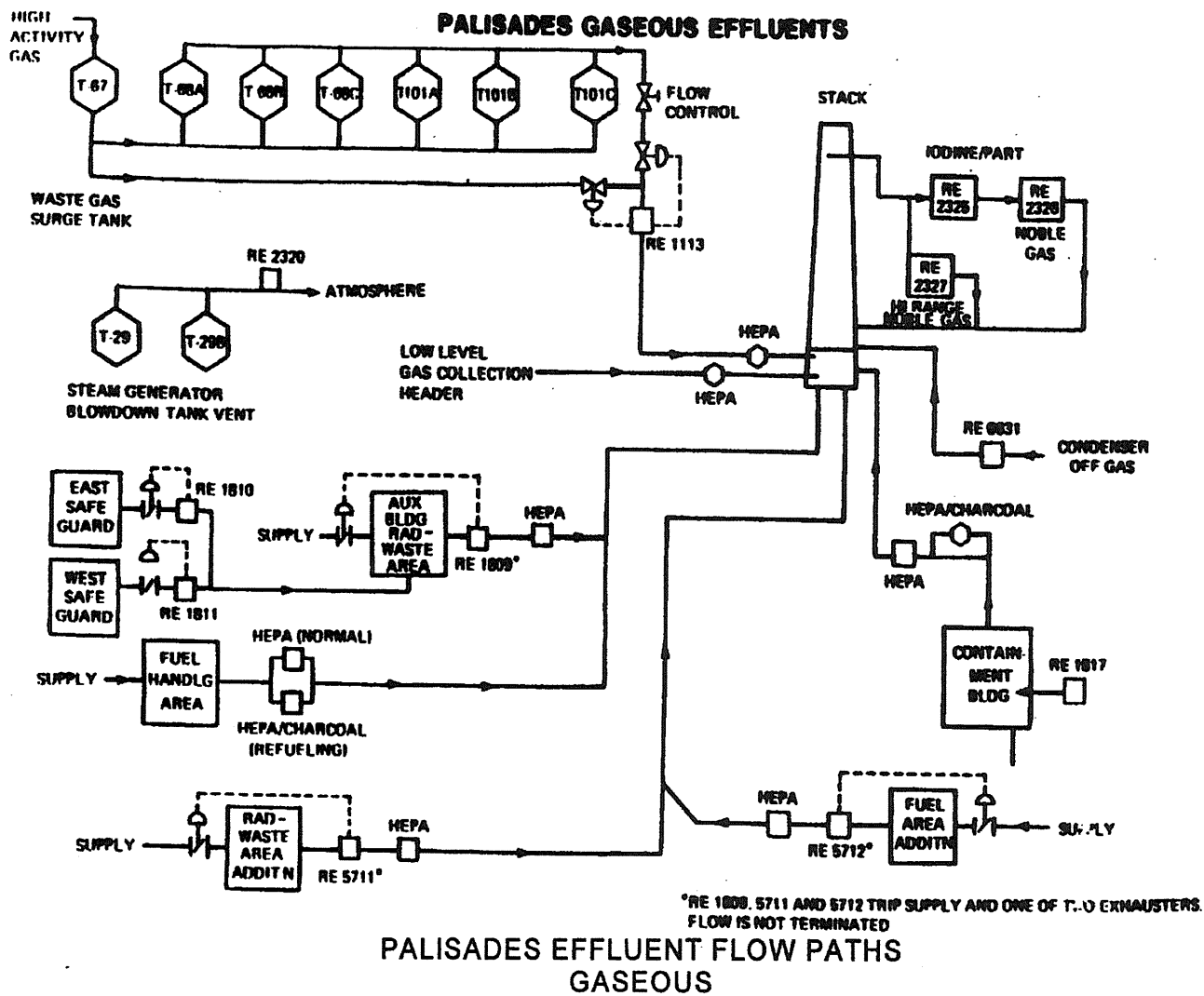
Noble gases will be sampled from Waste Gas Decay Tanks prior to release and the Containment prior to purging. Analysis of these samples will be used for accountability of noble gases. Off gas will be sampled at least weekly and used to calculate monthly noble gas releases. Non-routine releases will be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

G. TRITIUM SAMPLING

Tritium has a low dose consequence to the public because of low energy decay. 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.

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H. FIGURE - GASEOUS EFFLUENTS FLOW PATHS



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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 $\mu\text{Ci/ml}$ 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.

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

where:

C = Total concentration in the liquid effluent at the release point, $\mu\text{Ci/ml}$.

C_i = Concentration of a single radionuclide i , $\mu\text{Ci/ml}$.

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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 , $\mu\text{Ci/ml}$.

EC_i = The EC of radionuclide i , 10 CFR 20, Appendix B, Table 2, Column 2 - $\mu\text{Ci/ml}$.

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.

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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:

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

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, and quarterly 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.

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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 be 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

Dose calculations shall be performed for each batch release, and weekly for continuous releases unless documentation exists to demonstrate an activity below which dose limits of Section II.C.1 will not be exceeded.

a. Water Ingestion

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

$$D_j = \sum_{i=1}^i (DCF)_{ij} \times I_i \quad (2.5)$$

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where:

D_j = Dose for the j^{th} organ from radionuclides releases, mrem.

j = The organ of interest.

$(DCF)_{ij}$ = Ingestion dose commitment factor for the j^{th} organ from the i^{th} radionuclide mrem/pCi, see Attachment 8.

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

I_i is described by:

$$I_i = \frac{(A_i)(V)(365)}{(1000)(d)} (1E06) \quad (2.6)$$

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:

$$D_j = \frac{(3.65E05)(V)}{d} \sum_{i=1}^i (DCF)_{ij} \times A_i \text{ mrem} \quad (2.7)$$

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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:

$$I_i = \frac{A_i B_i F (1E09)}{15d} = \text{pCi} \quad (2.8)$$

where:

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

B_i = Fish concentration factor of i^{th} radionuclide $\frac{\mu\text{Ci/gm}}{\mu\text{Ci/ml}}$
(see Attachment 7).

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 , gm, and Kg to pCi.

Substitution of Equation 2.8 into Equation 2.5 gives:

$$D_j = \frac{(6.7E07)F}{d} \sum_{i=1}^i A_i \times B_i \times \text{DCF}_i \text{ mrem} \quad (2.9)$$

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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, D_j , is described by:

$$D_j = \sum_{i=1}^m D_{ij} \text{ mrem} \quad (2.10)$$

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

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).

$(\text{DCF})_{ij}$ = Adult ingestion dose commitment factor for the j^{th} organ from the i^{th} radionuclide, mrem/pCi (see Attachment 8).

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

I_i for water ingestion is described by:

$$I_i = \frac{A_i V_{\Gamma}}{v d} \mu\text{Ci} \quad (2.12)$$

and for fish ingestion I_i is described by:

$$I_i = \frac{A_i B_i F_{\Gamma}}{v d} \mu\text{Ci} \quad (2.13)$$

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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,

Attachment 7, $\frac{\mu\text{Ci/gm}}{\mu\text{Ci/ml}}$

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 (through deep bed filtration and ion exchange) 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.

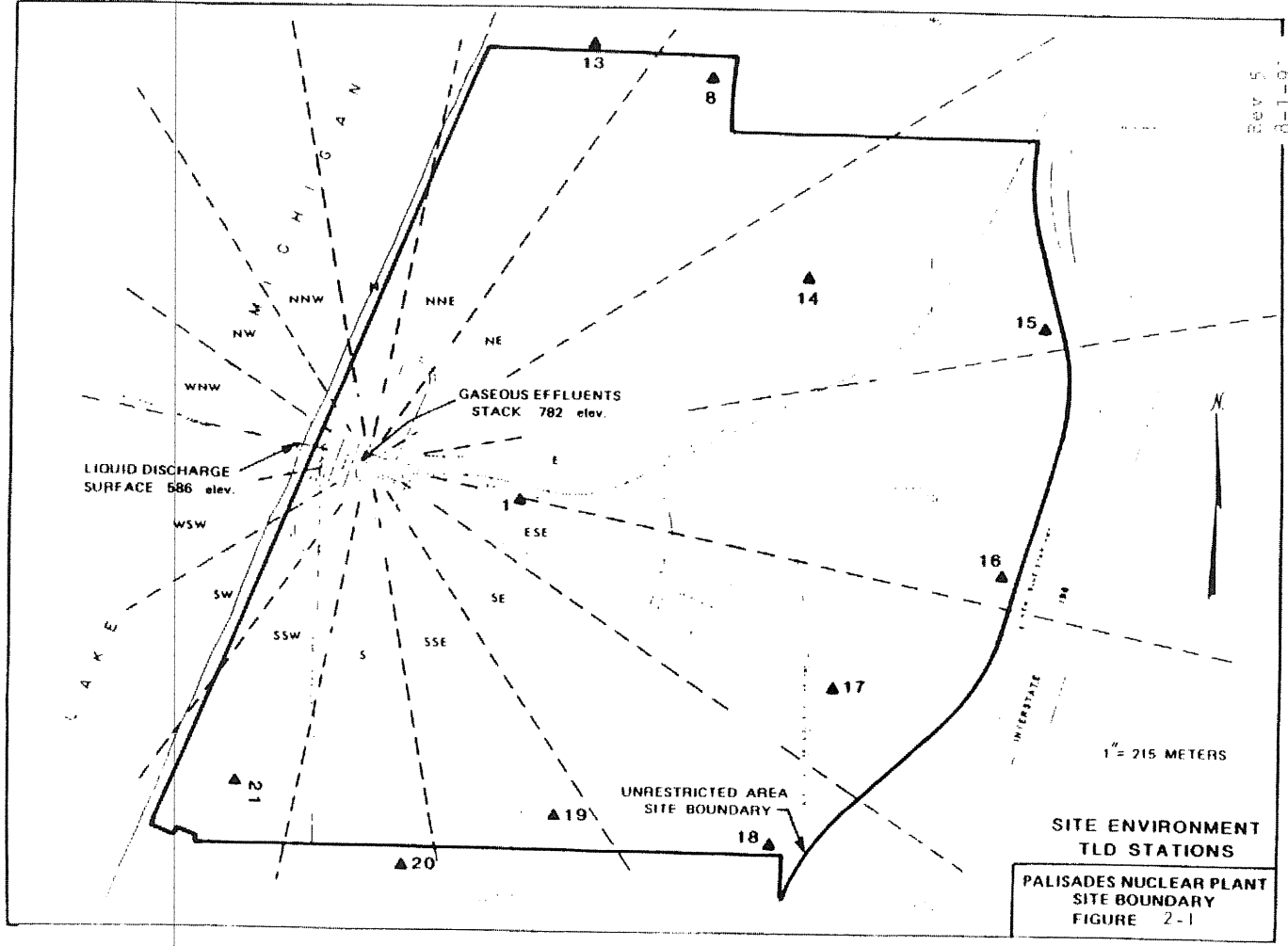
E. RELEASE RATE FOR OFFSITE EC (50 MREM/YR)

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 Attachment 2. 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.

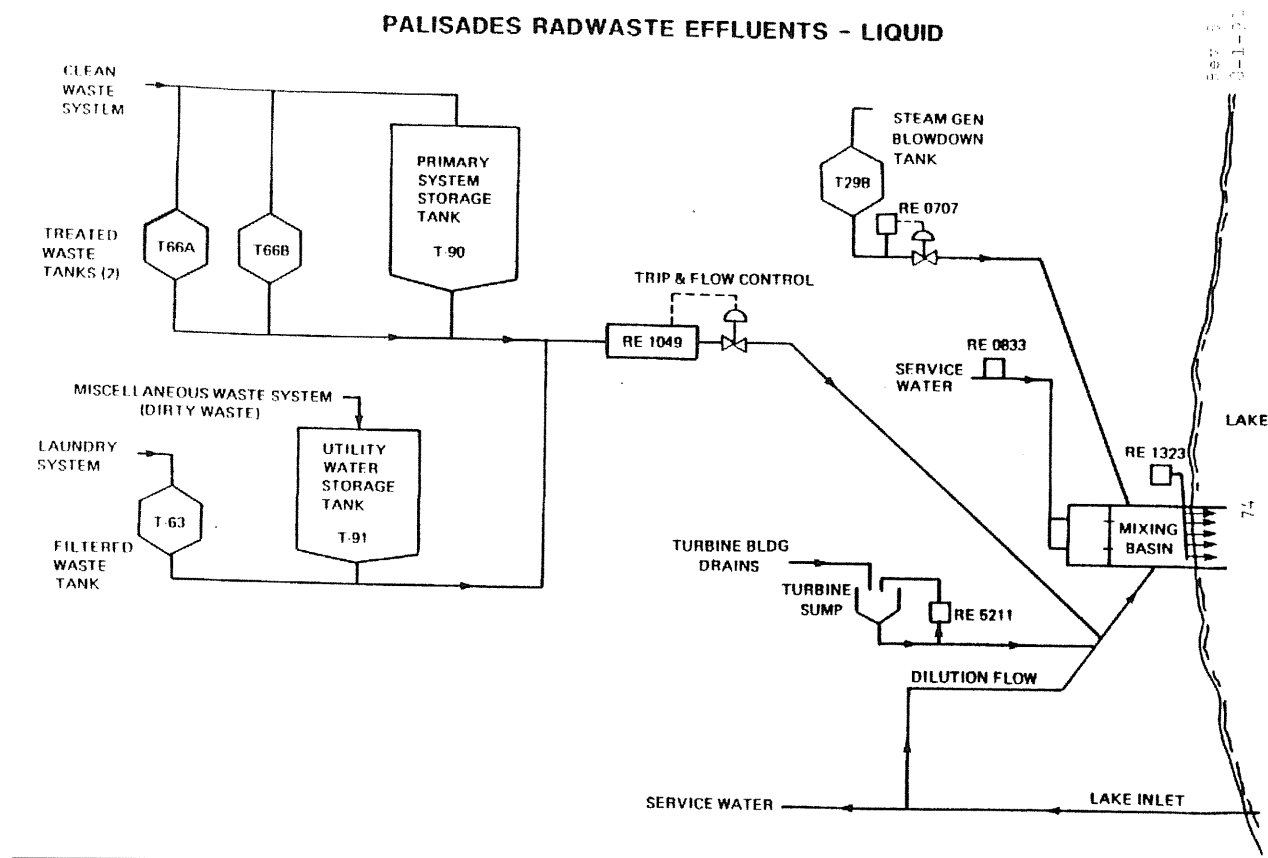
F. FIGURES

Figure 2-1



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Figure 2-2



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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.

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C. DOSE CALCULATION

Maximum doses to the total body and internal organs of an individual shall be determined by use of LADTAP and GASPAP 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 during 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 question (hours).

IV. SOURCE REFERENCE DOCUMENTS

1. Regulatory Guide 1.21, Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants, R1.
2. Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, R1.
3. NUREG-1301, Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors, April 91.
4. NUREG-0472, Standard Radiological Effluent Technical Specifications for Pressurized Water Reactors, R3.
5. NUREG/CR-4013, LADTAP II - Technical Reference and User Guide, April 86.
6. NUREG/CR-4653, GASPAP II - Technical Reference and User Guide, March 87.
7. CH 6.61, Revising the ODCM and ODCM Appendix A.

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

<u>Nuclide</u>	<u>Gaseous(2)</u>	<u>Liquid(2)</u>
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	0.3E-07	0.1E-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.

BASIC RADIONUCLIDE DATA

	<u>NUCLIDE</u>	<u>HALF-LIFE</u> <u>(days)</u>	<u>LAMBDA</u> <u>(1/s)</u>	<u>BETA¹</u> <u>(MEV/DIS)</u>	<u>GAMMA¹</u> <u>(MEV/DIS)</u>
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

BASIC RADIONUCLIDE DATA

	<u>NUCLIDE</u>	<u>HALF-LIFE</u> <u>(days)</u>	<u>LAMBDA</u> <u>(1/s)</u>	<u>BETA¹</u> <u>(MEV/DIS)</u>	<u>GAMMA¹</u> <u>(MEV/DIS)</u>
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.

DOSE FACTORS FOR SUBMERSION IN NOBLE GASES*

	Gamma body dose ¹	Gamma air dose ²	Beta skin dose ¹	Beta air dose ²
Kr-85m	1.17E3	1.23E3	1.46E3	1.97E3
Kr-85	1.61E1	1.72E1	1.34E3	1.95E3
Kr-87	5.92E3	6.17E3	9.73E3	1.03E4
Kr-88	1.47E4	1.52E4	2.37E3	2.93E3
Kr-89	1.66E4	1.73E4	1.01E4	1.06E4
Xe-131m	9.15E1	1.56E2	4.76E2	1.11E3
Xe-133m	2.51E2	3.27E2	9.94E2	1.48E3
Xe-133	2.94E2	3.53E2	3.06E2	1.05E3
Xe-135m	3.12E3	3.36E3	7.11E2	7.39E3
Xe-135	1.81E3	1.92E3	1.86E3	2.46E3
Xe-137	1.42E3	1.51E3	1.22E4	1.27E4
Xe-138	8.83E3	9.21E3	4.13E3	4.75E3
Ar-41	8.84E3	9.30E3	2.69E3	3.28E3

1. mrem/y per $\mu\text{Ci}/\text{m}^3$
2. mrad/y per $\mu\text{Ci}/\text{m}^3$

*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).

STABLE ELEMENT TRANSFER DATA

<u>ELEMENT</u>	<u>F_m - MILK (COW)</u> <u>(DAYS/L)</u>	<u>F_m - MILK (GOAT)</u> <u>(DAYS/L)</u>	<u>F_f - MEAT</u> <u>(DAYS/KG)</u>	<u>B_{iv}</u> <u>(VEG/SOIL)</u>
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

INHALATION DOSE COMMITMENT FACTORS

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	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	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	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	0.	2.29E-07	1.47E-07	0.	0.	0.	4.87E-08
SR89	2.84E-04	0.	8.15E-06	0.	0.	1.45E-03	4.57E-05
SR90	2.92E-02	0.	1.85E-03	0.	0.	8.03E-03	9.36E-05
SR91	6.83E-08	0.	2.47E-09	0.	0.	3.76E-05	5.24E-05
SR92	7.50E-09	0.	2.79E-10	0.	0.	1.70E-05	1.00E-04

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

INHALATION DOSE COMMITMENT FACTORS

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	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	2.24E-04	9.51E-05	6.18E-05	0.	3.19E-04	1.37E-03	1.48E-05
ZR95	8.24E-05	1.99E-05	1.45E-05	0.	2.22E-05	1.25E-03	1.55E-05
ZR97	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	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	1.44E-06	0.	4.85E-07	0.	3.03E-06	3.94E-04	1.15E-05
RU105	8.74E-10	0.	2.93E-10	0.	6.42E-10	1.12E-05	3.46E-05
RU106	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	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	1.01E-05	2.51E-07	6.00E-07	2.47E-07	0.	6.43E-04	7.26E-05
SN126	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	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	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	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	7.62E-08	3.93E-08	2.59E-08	6.38E-08	1.89E-07	1.42E-04	8.51E-05
TE131	1.24E-11	5.87E-12	3.57E-12	1.13E-11	2.85E-11	1.47E-06	5.87E-06
TE132	2.66E-07	1.69E-07	1.26E-07	1.99E-07	7.39E-07	2.43E-04	3.15E-05
TE133M	6.13E-11	3.59E-11	2.74E-11	5.52E-11	1.72E-10	3.92E-06	1.59E-05
TE134	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	2.71E-05	3.17E-05	1.40E-05	1.06E-02	3.70E-05	0.	7.56E-07

INHALATION DOSE COMMITMENT FACTORS

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	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	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	0.	0.	0.	0.	0.	9.78E-08	0.
CS134M	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	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	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	4.00E-05	4.00E-08	2.07E-06	0.	9.59E-09	1.14E-03	2.74E-05
BA141	1.12E-10	7.70E-14	3.55E-12	0.	4.64E-14	2.12E-06	3.39E-06
BA142	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	2.09E-07	1.38E-07	1.58E-08	0.	4.03E-08	8.30E-05	3.55E-05
CE144	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	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	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

INHALATION DOSE COMMITMENT FACTORS

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

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
PB210	8.62E-02	2.02E-02	3.43E-03	0.	6.85E-02	1.76E-01	3.79E-05
BI210	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	0.	0.	0.	0.	0.	9.88E-06	0.
RA223	1.56E-03	2.26E-06	3.12E-04	0.	4.16E-05	2.25E-01	3.04E-04
RA224	1.77E-04	4.00E-07	3.54E-05	0.	7.30E-06	7.91E-02	3.42E-04
RA225	2.57E-03	2.88E-06	5.13E-04	0.	5.31E-05	2.57E-01	2.87E-04
RA226	2.48E-01	1.46E-05	2.05E-01	0.	2.94E-04	7.83E-01	3.05E-04
RA228	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	5.29E+00	8.76E-01	3.28E-01	0.	1.86E-01	1.62E+00	5.27E-05
TH227	1.82E-03	3.03E-05	5.24E-05	0.	1.13E-04	3.27E-01	3.53E-04
TH228	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	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	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	2.57E-01	0.	2.13E-02	0.	2.40E-02	1.49E+00	4.36E-05
U233	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	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	4.79E-02	0.	3.29E-03	0.	9.40E-03	3.06E-01	3.54E-05
NP237	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	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	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

INHALATION DOSE COMMITMENT FACTORS

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	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	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	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	0.	9.33E-08	7.83E-08	0.	0.	0.	5.11E-10
SR89	1.62E-04	0.	4.66E-06	0.	0.	5.83E-04	4.52E-05
SR90	2.73E-02	0.	1.74E-03	0.	0.	3.99E-03	9.28E-05
SR91	3.28E-08	0.	1.24E-09	0.	0.	1.44E-05	4.70E-05
SR92	3.54E-09	0.	1.42E-10	0.	0.	6.49E-06	6.55E-05

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

INHALATION DOSE COMMITMENT FACTORS

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	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	2.07E-04	7.80E-05	5.55E-05	0.	3.00E-04	7.10E-04	1.47E-05
ZR95	5.13E-05	1.13E-05	1.00E-05	0.	1.61E-05	6.03E-04	1.65E-05
ZR97	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	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	7.55E-07	0.	2.90E-07	0.	1.90E-06	1.79E-04	1.21E-05
RU105	4.13E-10	0.	1.50E-10	0.	3.63E-10	4.30E-06	2.69E-05
RU106	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	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	4.95E-06	9.94E-08	2.95E-07	1.03E-07	0.	2.43E-04	7.17E-05
SN126	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	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	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	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	3.63E-08	1.60E-08	1.37E-08	2.64E-08	1.08E-07	5.56E-05	8.32E-05
TE131	5.87E-12	2.28E-12	1.78E-12	4.59E-12	1.59E-11	5.55E-07	3.60E-07
TE132	1.30E-07	7.36E-08	7.12E-08	8.58E-08	4.79E-07	1.02E-04	3.72E-05
TE133M	2.93E-11	1.51E-11	1.50E-11	2.32E-11	1.01E-10	1.60E-06	4.77E-06
TE134	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	1.30E-05	1.30E-05	7.37E-06	4.39E-03	2.13E-05	0.	7.68E-07

INHALATION DOSE COMMITMENT FACTORS

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	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	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	0.	0.	0.	0.	0.	5.17E-08	0.
CS134M	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	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	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	2.00E-05	1.75E-08	1.17E-06	0.	5.71E-09	4.71E-04	2.75E-05
BA141	5.29E-11	2.95E-14	1.72E-12	0.	2.56E-14	7.89E-07	7.44E-08
BA142	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	9.89E-08	5.37E-08	7.77E-09	0.	2.26E-08	3.12E-05	3.44E-05
CE144	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	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	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

INHALATION DOSE COMMITMENT FACTORS

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

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
PB210	8.03E-02	1.85E-02	3.18E-03	0.	6.31E-02	8.74E-02	3.75E-05
BI210	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	0.	0.	0.	0.	0.	4.82E-06	0.
RA223	7.69E-04	8.89E-07	1.54E-04	0.	2.36E-05	8.48E-02	3.00E-04
RA224	8.44E-05	1.53E-07	1.69E-05	0.	4.06E-06	2.92E-02	3.34E-04
RA225	1.28E-03	1.14E-06	2.56E-04	0.	3.02E-05	9.74E-02	2.84E-04
RA226	2.34E-01	7.66E-06	1.92E-01	0.	2.03E-04	3.90E-01	3.02E-04
RA228	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	4.96E+00	8.05E-01	3.07E-01	0.	1.77E-01	8.04E-01	5.22E-05
TH227	9.24E-04	1.26E-05	2.67E-05	0.	6.67E-05	1.26E-01	3.49E-04
TH228	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	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	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	2.19E-01	0.	1.56E-02	0.	1.67E-02	7.42E-01	4.33E-05
U233	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	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	4.09E-02	0.	2.42E-03	0.	6.55E-03	1.53E-01	3.51E-05
NP237	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	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	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

INHALATION DOSE COMMITMENT FACTORS

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.	2.24E-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	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	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	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	0.	4.40E-08	2.91E-08	0.	0.	0.	4.22E-17
SR89	5.43E-05	0.	1.56E-06	0.	0.	3.02E-04	4.64E-05
SR90	1.35E-02	0.	8.35E-04	0.	0.	2.06E-03	9.56E-05
SR91	1.10E-08	0.	4.39E-10	0.	0.	7.59E-06	3.24E-05
SR92	1.19E-09	0.	5.08E-11	0.	0.	3.43E-06	1.49E-05

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

INHALATION DOSE COMMITMENT FACTORS

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	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	6.83E-05	3.38E-05	1.84E-05	0.	1.16E-04	3.67E-04	1.60E-05
ZR95	1.82E-05	5.73E-06	3.94E-06	0.	8.42E-06	3.36E-04	1.86E-05
ZR97	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	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	2.63E-07	0.	1.12E-07	0.	9.29E-07	9.79E-05	1.36E-05
RU105	1.40E-10	0.	5.42E-11	0.	1.76E-10	2.27E-06	1.13E-05
RU106	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	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	1.66E-06	4.42E-08	9.99E-08	3.45E-08	0.	1.26E-04	7.29E-05
SN126	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	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	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	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	1.23E-08	7.51E-09	5.03E-09	9.06E-09	5.49E-08	2.97E-05	7.76E-05
TE131	1.97E-12	1.04E-12	6.30E-13	1.55E-12	7.72E-12	2.92E-07	1.89E-09
TE132	4.50E-08	3.63E-08	2.74E-08	3.07E-08	2.44E-07	5.61E-05	5.79E-05
TE133M	1.01E-11	7.33E-12	5.71E-12	8.18E-12	5.07E-11	8.71E-07	1.23E-07
TE134	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	4.43E-06	6.14E-06	3.30E-06	1.83E-03	1.05E-05	0.	8.11E-07

INHALATION DOSE COMMITMENT FACTORS

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	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	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	0.	0.	0.	0.	0.	4.38E-08	0.
CS134M	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	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	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	6.84E-06	8.38E-09	4.40E-07	0.	2.85E-09	2.54E-04	2.86E-05
BA141	1.78E-11	1.32E-14	5.93E-13	0.	1.23E-14	4.11E-07	9.33E-14
BA142	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	3.32E-08	2.42E-08	2.70E-09	0.	1.08E-08	1.63E-05	3.19E-05
CE144	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	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	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

INHALATION DOSE COMMITMENT FACTORS

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

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
PB210	3.09E-02	8.28E-03	1.07E-03	0.	2.95E-02	4.52E-02	3.87E-05
BI210	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	0.	0.	0.	0.	0.	3.94E-06	0.
RA223	2.57E-04	3.93E-07	5.14E-05	0.	1.12E-05	4.39E-02	3.04E-04
RA224	2.83E-05	6.77E-08	5.65E-06	0.	1.93E-06	1.51E-02	3.29E-04
RA225	4.28E-04	5.04E-07	8.56E-05	0.	1.44E-05	5.04E-02	2.89E-04
RA226	1.33E-01	3.38E-06	9.87E-02	0.	9.67E-05	2.02E-01	3.11E-04
RA228	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	2.49E+00	3.69E-01	1.48E-01	0.	1.07E-01	4.16E-01	5.38E-05
TH227	3.09E-04	5.56E-06	8.93E-06	0.	3.18E-05	6.50E-02	3.57E-04
TH228	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	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	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	7.31E-02	0.	5.23E-03	0.	7.94E-03	3.84E-01	4.46E-05
U233	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	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	1.36E-02	0.	8.10E-04	0.	3.12E-03	7.89E-02	3.62E-05
NP237	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	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	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

INHALATION DOSE COMMITMENT FACTORS

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	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	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	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	0.	3.20E-08	2.12E-08	0.	0.	0.	1.16E-21
SR89	3.80E-05	0.	1.09E-06	0.	0.	1.75E-04	4.37E-05
SR90	1.24E-02	0.	7.62E-04	0.	0.	1.20E-03	9.02E-05
SR91	7.74E-09	0.	3.13E-10	0.	0.	4.56E-06	2.39E-05
SR92	8.43E-10	0.	3.64E-11	0.	0.	2.06E-06	5.38E-06

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

INHALATION DOSE COMMITMENT FACTORS

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	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	5.22E-05	2.92E-06	1.37E-06	0.	1.11E-05	2.13E-05	1.51E-06
ZR95	1.34E-05	4.30E-06	2.91E-06	0.	6.77E-06	2.21E-04	1.88E-05
ZR97	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	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	1.91E-07	0.	8.23E-08	0.	7.29E-07	6.31E-05	1.38E-05
RU105	9.88E-11	0.	3.89E-11	0.	1.27E-10	1.37E-06	6.02E-06
RU106	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	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	1.16E-06	3.12E-08	7.03E-08	2.59E-08	0.	7.37E-05	6.81E-05
SN126	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	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	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	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	8.74E-09	5.45E-09	3.63E-09	6.88E-09	3.86E-08	1.82E-05	6.95E-05
TE131	1.39E-12	7.44E-13	4.49E-13	1.17E-12	5.46E-12	1.74E-07	2.30E-09
TE132	3.25E-08	2.69E-08	2.02E-08	2.37E-08	1.82E-07	3.60E-05	6.37E-05
TE133M	7.24E-12	5.40E-12	4.17E-12	6.27E-12	3.74E-11	5.51E-07	5.49E-08
TE134	3.84E-12	3.22E-12	1.57E-12	3.44E-12	2.18E-11	4.343E-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	3.15E-06	4.47E-06	2.56E-06	1.49E-03	7.66E-06	0.	7.85E-07

INHALATION DOSE COMMITMENT FACTORS

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	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	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	0.	0.	0.	0.	0.	2.44E-08	0.
CS134M	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	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	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	4.88E-06	6.13E-09	3.21E-07	0.	2.09E-09	1.59E-04	2.73E-05
BA141	1.25E-11	9.41E-15	4.20E-13	0.	8.75E-15	2.42E-07	1.45E-17
BA142	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	2.33E-08	1.72E-08	1.91E-09	0.	7.60E-09	9.97E-06	2.83E-05
CE144	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	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	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

INHALATION DOSE COMMITMENT FACTORS

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

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
PB210	2.64E-02	6.73E-03	8.37E-04	0.	2.12E-02	2.62E-02	3.65E-05
BI210	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	0.	0.	0.	0.	0.	2.05E-06	0.
RA223	1.80E-04	2.77E-07	3.60E-05	0.	7.85E-06	2.55E-02	2.84E-04
RA224	1.98E-05	4.78E-08	3.96E-06	0.	1.35E-06	8.77E-03	3.01E-04
RA225	3.00E-04	3.56E-07	5.99E-05	0.	1.01E-05	2.92E-02	2.71E-04
RA226	1.25E-01	2.39E-06	9.14E-02	0.	6.77E-05	1.17E-01	2.94E-04
RA228	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	2.30E+00	3.05E-01	1.36E-01	0.	9.82E-02	2.41E-01	5.08E-05
TH227	2.17E-04	3.92E-06	6.25E-06	0.	2.22E-05	3.77E-02	3.34E-04
TH226	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	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	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	5.14E-02	0.	3.66E-03	0.	5.56E-03	2.22E-01	4.21E-05
U233	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	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	9.58E-03	0.	5.67E-04	0.	2.18E-03	4.58E-02	3.41E-05
NP237	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	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	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

EXTERNAL DOSE FACTORS FOR STANDING ON CONTAMINATED GROUND (DFG_i)
(mrem/hr per pCi/m²)

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

EXTERNAL DOSE FACTORS FOR STANDING ON CONTAMINATED GROUND (DFG)
(mrem/hr per pCi/m²)

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

BIOACCUMULATION FACTORS
μCi/gm per μCi/ml

<u>ELEMENT</u>	<u>FRESHWATER FISH</u>
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

INGESTION DOSE COMMITMENT FACTORS

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	3.08E-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	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	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	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	0.	2.86E-07	1.97E-07	0.	0.	0.	9.74E-08
SR89	2.51E-03	0.	7.20E-05	0.	0.	0.	5.16E-05
SR90	1.85E-02	0.	4.71E-03	0.	0.	0.	2.31E-04
SR91	5.00E-05	0.	1.81E-06	0.	0.	0.	5.92E-05
SR92	1.92E-05	0.	7.13E-07	0.	0.	0.	2.07E-04

INGESTION DOSE COMMITMENT FACTORS

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	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	1.93E-07	9.18E-08	5.54E-08	0.	2.71E-07	0.	2.39E-05
ZR95	2.06E-07	5.02E-08	3.56E-08	0.	5.41E-08	0.	2.50E-05
ZR97	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	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	1.48E-06	0.	4.95E-07	0.	3.08E-06	0.	1.80E-05
RU105	1.36E-07	0.	4.58E-08	0.	1.00E-06	0.	5.41E-05
RU106	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	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	7.41E-05	1.38E-06	3.29E-06	1.36E-06	0.	0.	1.11E-04
SN126	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	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	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	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	1.52E-05	6.12E-06	5.05E-06	1.24E-05	4.21E-05	0.	1.03E-04
TE131	1.76E-07	6.50E-08	4.94E-08	1.57E-07	4.50E-07	0.	7.11E-06
TE132	2.08E-05	1.03E-05	9.61E-06	1.52E-05	6.44E-05	0.	3.81E-05
TE133M	3.91E-07	1.79E-07	1.71E-07	3.45E-07	1.22E-06	0.	1.93E-05
TE134	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	3.59E-05	4.23E-05	1.86E-05	1.39E-02	4.94E-05	0.	1.51E-06

INGESTION DOSE COMMITMENT FACTORS

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	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	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	0.	0.	0.	0.	0.	0.	0.
CS134M	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	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	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	1.71E-04	1.71E-07	8.81E-06	0.	4.06E-08	1.05E-07	4.20E-05
BA141	4.25E-07	2.91E-10	1.34E-08	0.	1.75E-10	1.77E-10	5.19E-06
BA142	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	1.48E-08	9.82E-06	1.12E-09	0.	2.86E-09	0.	5.73E-05
CE144	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	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	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

INGESTION DOSE COMMITMENT FACTORS

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

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
PB210	5.28E-02	1.42E-02	2.38E-03	0.	4.33E-02	0.	5.62E-05
BI210	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	0.	0.	0.	0.	0.	0.	0.
RA223	4.41E-02	6.42E-05	8.82E-03	0.	1.17E-03	0.	3.43E-04
RA224	1.46E-02	3.29E-05	2.91E-03	0.	6.00E-04	0.	3.86E-04
RA225	5.78E-02	6.42E-05	1.15E-02	0.	1.19E-03	0.	3.24E-04
RA226	6.20E-01	4.76E-05	5.14E-01	0.	8.71E-04	0.	3.44E-04
RA228	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	4.49E-03	7.67E-04	2.79E-04	0.	1.56E-04	0.	8.50E-05
TH227	1.20E-04	2.01E-06	3.45E-06	0.	7.41E-06	0.	5.70E-04
TH228	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	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	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	2.42E-02	0.	2.16E-03	0.	2.37E-03	0.	7.04E-05
U233	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	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	4.47E-03	0.	3.33E-04	0.	9.28E-04	0.	5.71E-05
NP237	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	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	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

INGESTION DOSE COMMITMENT FACTORS

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	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	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	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	0.	1.17E-07	1.04E-07	0.	0.	0.	1.02E-09
SR89	1.32E-03	0.	3.77E-05	0.	0.	0.	5.11E-05
SR90	1.70E-02	0.	4.31E-03	0.	0.	0.	2.29E-04
SR91	2.40E-05	0.	9.06E-07	0.	0.	0.	5.30E-05
SR92	9.03E-06	0.	3.62E-07	0.	0.	0.	1.71E-04

INGESTION DOSE COMMITMENT FACTORS

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	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	1.67E-07	6.25E-08	4.45E-08	0.	2.42E-07	0.	2.37E-05
ZR95	1.16E-07	2.55E-08	2.27E-08	0.	3.65E-08	0.	2.66E-05
ZR97	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	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	7.31E-07	0.	2.81E-07	0.	1.84E-06	0.	1.89E-05
RU105	6.45E-08	0.	2.34E-08	0.	5.67E-07	0.	4.21E-05
RU106	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	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	3.55E-05	5.35E-07	1.59E-06	5.55E-07	0.	0.	1.10E-04
SN126	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	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	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	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	7.20E-06	2.49E-06	2.65E-06	5.12E-06	2.41E-05	0.	1.01E-04
TE131	8.30E-08	2.53E-08	2.47E-08	6.35E-08	2.51E-07	0.	4.36E-07
TE132	1.01E-05	4.47E-06	5.40E-06	6.51E-06	4.15E-05	0.	4.50E-05
TE133M	1.87E-07	7.56E-08	9.37E-08	1.45E-07	7.18E-07	0.	5.77E-06
TE134	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	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	0.	1.54E-06

INGESTION DOSE COMMITMENT FACTORS

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	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	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	0.	0.	0.	0.	0.	0.	0.
CS134M	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	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	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	8.31E-05	7.28E-08	4.85E-06	0.	2.37E-08	4.34E-08	4.21E-05
BA141	2.00E-07	1.12E-10	6.51E-09	0.	9.69E-11	6.58E-10	1.14E-07
BA142	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	6.99E-09	3.79E-06	5.49E-10	0.	1.59E-09	0.	5.55E-05
CE144	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	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	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

INGESTION DOSE COMMITMENT FACTORS

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

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
PB210	4.75E-02	1.22E-02	2.09E-03	0.	3.67E-02	0.	5.57E-05
BI210	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	0.	0.	0.	0.	0.	0.	0.
RA223	2.12E-02	2.45E-05	4.24E-03	0.	6.50E-04	0.	3.38E-04
RA224	6.89E-03	1.25E-05	1.38E-03	0.	3.31E-04	0.	3.78E-04
RA225	2.80E-02	2.50E-05	5.59E-03	0.	6.62E-04	0.	3.21E-04
RA226	5.75E-01	1.84E-05	4.72E-01	0.	4.88E-04	0.	3.41E-04
RA228	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	4.12E-03	6.63E-04	2.55E-04	0.	1.46E-04	0.	8.43E-05
TH227	5.85E-05	7.96E-07	1.69E-06	0.	4.22E-06	0.	5.63E-04
TH228	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	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	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	1.76E-02	0.	1.26E-03	0.	1.34E-03	0.	6.98E-05
U233	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	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	3.27E-03	0.	1.94E-04	0.	5.24E-04	0.	5.66E-05
NP237	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	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	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

INGESTION DOSE COMMITMENT FACTORS

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.	5.19E-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	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	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	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	0.	5.50E-08	3.89E-08	0.	0.	0.	8.43E-17
SR89	4.40E-04	0.	1.26E-05	0.	0.	0.	5.24E-05
SR90	8.30E-03	0.	2.05E-03	0.	0.	0.	2.33E-04
SR91	8.07E-06	0.	3.21E-07	0.	0.	0.	3.66E-05
SR92	3.05E-06	0.	1.30E-07	0.	0.	0.	7.77E-05

INGESTION DOSE COMMITMENT FACTORS

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	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	5.53E-08	2.73E-08	1.49E-08	0.	9.65E-08	0.	2.58E-05
ZR95	4.12E-08	1.30E-08	8.94E-09	0.	1.91E-08	0.	3.00E-05
ZR97	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	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	2.55E-07	0.	1.09E-07	0.	8.99E-07	0.	2.13E-05
RU105	2.18E-08	0.	8.46E-09	0.	2.75E-07	0.	1.76E-05
RU106	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	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	1.19E-05	2.37E-07	5.37E-07	1.86E-07	0.	0.	1.12E-04
SN126	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	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	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	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	2.44E-06	1.17E-06	9.76E-07	1.76E-06	1.22E-05	0.	9.39E-05
TE131	2.79E-08	1.15E-08	8.72E-09	2.15E-08	1.22E-07	0.	2.29E-09
TE132	3.49E-06	2.21E-06	2.08E-06	2.33E-06	2.12E-05	0.	7.00E-05
TE133M	6.44E-08	3.66E-08	3.56E-08	5.11E-08	3.62E-07	0.	1.48E-07
TE134	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	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	0.	1.62E-06

INGESTION DOSE COMMITMENT FACTORS

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	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	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	0.	0.	0.	0.	0.	0.	0.
CS134M	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	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	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	2.84E-05	3.48E-08	1.83E-06	0.	1.18E-08	2.34E-08	4.38E-05
BA141	6.71E-08	5.01E-11	2.24E-09	0.	4.65E-11	3.43E-11	1.43E-13
BA142	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	2.35E-09	1.71E-06	1.91E-10	0.	7.67E-10	0.	5.14E-05
CE144	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	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	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

INGESTION DOSE COMMITMENT FACTORS

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

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
PB210	1.81E-02	5.44E-03	7.01E-04	0.	1.72E-02	0.	5.74E-05
BI210	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	0.	0.	0.	0.	0.	0.	0.
RA223	7.11E-03	1.08E-05	1.42E-03	0.	3.10E-04	0.	3.43E-04
RA224	2.31E-03	5.52E-06	4.61E-04	0.	1.58E-04	0.	3.71E-04
RA225	9.37E-03	1.10E-05	1.87E-03	0.	3.15E-04	0.	3.27E-04
RA226	3.22E-01	8.13E-06	2.39E-01	0.	2.32E-04	0.	3.51E-04
RA228	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	2.05E-03	3.03E-04	1.22E-04	0.	8.81E-05	0.	8.68E-05
TH227	1.96E-05	3.52E-07	5.65E-07	0.	2.01E-06	0.	5.75E-04
TH228	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	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	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	5.89E-03	0.	4.21E-04	0.	6.38E-04	0.	7.19E-05
U233	1.24E-03	0.	7.54E-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	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	1.09E-03	0.	6.49E-05	0.	2.50E-04	0.	5.83E-05
NP237	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	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	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

INGESTION DOSE COMMITMENT FACTORS

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	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	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	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	0.	4.01E-08	2.82E-08	0.	0.	0.	2.33E-21
SR89	3.08E-04	0.	8.84E-06	0.	0.	0.	4.94E-05
SR90	7.58E-03	0.	1.86E-03	0.	0.	0.	2.19E-04
SR91	5.67E-06	0.	2.29E-07	0.	0.	0.	2.70E-05
SR92	2.15E-06	0.	9.30E-08	0.	0.	0.	4.26E-05

INGESTION DOSE COMMITMENT FACTORS

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	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	4.18E-08	2.34E-09	1.09E-09	0.	8.87E-09	0.	2.43E-06
ZR95	3.04E-08	9.75E-09	6.60E-09	0.	1.53E-08	0.	3.09E-05
ZR97	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	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	1.85E-07	0.	7.97E-08	0.	7.06E-07	0.	2.16E-05
RU105	1.54E-08	0.	6.08E-09	0.	1.99E-07	0.	9.42E-06
RU106	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	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	8.33E-06	1.68E-07	3.78E-07	1.39E-07	0.	0.	1.04E-04
SN126	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	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	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	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	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	0.	8.40E-05
TE131	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	0.	2.79E-09
TE132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	0.	7.71E-05
TE133M	4.62E-08	2.70E-08	2.60E-08	3.91E-08	2.67E-07	0.	6.64E-08
TE134	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	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	0.	1.57E-06

INGESTION DOSE COMMITMENT FACTORS

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	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	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	0.	0.	0.	0.	0.	0.	0.
CS134M	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	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	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	2.03E-05	2.55E-08	1.33E-06	0.	8.67E-09	1.46E-08	4.18E-05
BA141	4.71E-08	3.56E-11	1.59E-09	0.	3.31E-11	2.02E-11	2.22E-17
BA142	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	1.65E-09	1.22E-06	1.35E-10	0.	5.37E-10	0.	4.56E-05
CE144	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	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	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

INGESTION DOSE COMMITMENT FACTORS

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

ISOTOPE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
PB210	1.53E-02	4.37E-03	5.44E-04	0.	1.23E-02	0.	5.42E-05
BI210	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	0.	0.	0.	0.	0.	0.	0.
RA223	4.97E-03	7.65E-06	9.94E-04	0.	2.17E-04	0.	3.21E-04
RA224	1.61E-03	3.90E-06	3.23E-04	0.	1.10E-04	0.	3.40E-04
RA225	6.56E-03	7.78E-06	1.31E-03	0.	2.21E-04	0.	3.06E-04
RA226	3.02E-01	5.74E-06	2.20E-01	0.	1.63E-04	0.	3.32E-04
RA228	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	1.87E-03	2.48E-04	1.11E-04	0.	8.00E-05	0.	8.19E-05
TH227	1.37E-05	2.48E-07	3.95E-07	0.	1.41E-06	0.	5.40E-04
TH228	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	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	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	4.13E-03	0.	2.95E-04	0.	4.47E-04	0.	6.78E-05
U233	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	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	7.67E-04	0.	4.54E-05	0.	1.75E-04	0.	5.50E-05
NP237	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	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	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

PALISADES 10 YEAR X/Q - D/Q DATA

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0

RUN DATE: 28FEB14

***** PALISADES XOQDOQ82 ***** USING 01/01/2004 - 12/31/2013 MET DATA *****

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

RELEASE ID	TYPE OF LOCATION	DIRECTION FROM SITE	DISTANCE (MILES) (METERS)	X/Q NO DECAY UNDEPLETED	X/Q 2.260 DAY DECAY UNDEPLETED	X/Q 8.000 DAY DECAY DEPLETED	D/Q (PER SQ.METER)
A	SITE BOUNDARY	NNE	0.50 805.	1.58E-06	1.57E-06	1.44E-06	7.61E-09
A	SITE BOUNDARY	NE	0.65 1046.	1.23E-06	1.23E-06	1.11E-06	8.80E-09
A	SITE BOUNDARY	ENE	0.87 1400.	5.88E-07	5.86E-07	5.19E-07	4.27E-09
A	SITE BOUNDARY	E	0.82 1320.	6.99E-07	6.96E-07	6.19E-07	5.29E-09
A	SITE BOUNDARY	ESE	0.76 1223.	8.34E-07	8.31E-07	7.42E-07	6.93E-09
A	SITE BOUNDARY	SE	0.63 1014.	1.39E-06	1.38E-06	1.25E-06	1.25E-08
A	SITE BOUNDARY	SSE	0.48 772.	2.28E-06	2.28E-06	2.09E-06	2.01E-08
A	SITE BOUNDARY	S	0.42 676.	1.96E-06	1.95E-06	1.80E-06	1.11E-08
A	SITE BOUNDARY	SSW	0.48 772.	1.26E-06	1.25E-06	1.15E-06	6.25E-09
A	RESIDENCE	NNE	1.68 2704.	2.59E-07	2.57E-07	2.17E-07	9.83E-10
A	RESIDENCE	NE	1.14 1835.	5.32E-07	5.30E-07	4.61E-07	3.39E-09
A	RESIDENCE	ENE	1.19 1915.	3.70E-07	3.67E-07	3.19E-07	2.50E-09
A	RESIDENCE	E	1.67 2688.	2.43E-07	2.41E-07	2.04E-07	1.56E-09
A	RESIDENCE	ESE	0.99 1593.	5.60E-07	5.58E-07	4.90E-07	4.43E-09
A	RESIDENCE	SE	0.90 1448.	8.02E-07	7.98E-07	7.06E-07	6.86E-09
A	RESIDENCE	SSE	0.80 1287.	1.05E-06	1.04E-06	9.28E-07	8.64E-09
A	RESIDENCE	S	0.77 1239.	7.87E-07	7.84E-07	6.99E-07	4.12E-09
A	RESIDENCE	SSW	0.49 789.	1.22E-06	1.21E-06	1.11E-06	6.04E-09
A	GARDEN	NNE	1.75 2816.	2.45E-07	2.43E-07	2.05E-07	9.16E-10
A	GARDEN	NE	1.67 2688.	3.03E-07	3.01E-07	2.54E-07	1.76E-09
A	GARDEN	ENE	2.62 4216.	1.16E-07	1.14E-07	9.29E-08	6.34E-10
A	GARDEN	E	2.68 4313.	1.21E-07	1.20E-07	9.70E-08	6.83E-10
A	GARDEN	ESE	1.83 2945.	2.24E-07	2.22E-07	1.86E-07	1.54E-09
A	GARDEN	SE	1.49 2398.	3.77E-07	3.75E-07	3.20E-07	2.89E-09
A	GARDEN	SSE	0.69 1110.	1.31E-06	1.31E-06	1.17E-06	1.11E-08
A	GARDEN	SSW	4.82 7757.	4.54E-08	4.43E-08	3.38E-08	1.17E-10
A	GOAT	ENE	2.62 4216.	1.16E-07	1.14E-07	9.29E-08	6.34E-10
A	GOAT	E	4.25 6840.	6.17E-08	6.05E-08	4.67E-08	3.01E-10
A	BEEF CATTLE	SE	4.27 6872.	8.01E-08	7.85E-08	6.06E-08	4.53E-10

ATTACHMENT 2
BIG ROCK POINT INDEPENDENT SPENT FUEL STORAGE INSTALLATION
2014 RADIOACTIVE EFFLUENT RELEASE REPORT

This report provides information relating to radioactive effluent releases and solid radioactive waste disposal at Big Rock Point (BRP) for the year 2014. The report format is detailed in the BRP Offsite Dose Calculation Manual (ODCM). Effluent releases from BRP are controlled by the Defueled Technical Specifications and the ODCM requirements. The ODCM was not revised in 2014.

2014 Operating History

On January 8, 2007, the Nuclear Regulatory Commission (NRC) approved release of the former BRP Nuclear Plant property for unrestricted use in accordance with the BRP License Termination Plan¹. On April 11, 2007, the license for BRP, DPR-06, was transferred to Entergy Nuclear Operations, Inc.

During 2014, normal Independent Spent Fuel Storage Installation (ISFSI) operations continued. There were no operational activities that generated any solid radioactive waste.

Liquid and gaseous effluent monitoring is no longer conducted as the former BRP nuclear plant property has been released from the license. Short-lived radionuclides, including iodines and noble gas, are neither expected nor reported.

1. Supplemental Information

A. Batch Releases

There were no batch releases of gaseous or liquid effluents during 2014. All batch releases of radioactive liquids as described in the ODCM ceased in 2004.

B. Abnormal Releases

There were no abnormal releases from BRP during 2014.

C. Radioactive Effluent Monitoring Instrumentation

BRP ODCM currently specifies required actions when less than the minimum number of radioactive effluent monitoring instrument channels are operable. The ODCM also specifies these actions be taken when installed effluent monitoring systems are removed from service for decommissioning.

All plant-installed liquid and gaseous radioactive effluent monitoring instrument channels have been permanently removed and dismantled.

¹ Letter from the USNRC dated January 8, 2007, "Release of Land from Part 50 License for Unrestricted Use"

2. Gaseous Effluents

Although there were no gaseous effluents released during 2014, Table 2 provides a summary of all gaseous radioactive effluent monitoring conducted during the reporting period as required by the ODCM.

3. Liquid Effluents

There were no liquid effluent batch releases during 2014. Table 3 lists and summarizes liquid effluent releases in accordance with the ODCM.

4. Solid Waste

There was no solid radioactive waste generated or shipped during 2014.

5. Summary of Radiological Impact on Man

The ODCM specifies that the annual effluent release report provide potential dose calculations based on measured effluent to liquid and gaseous pathways, if estimates of dose exceed one millirem to an organ or total body of any individual or more than one person-rem to the population within 50 miles. During 2014, there were no releases. Therefore, no calculations were required.

6. Offsite Dose Calculation Manual

The ODCM describes the radiological release requirements for the BRP site. There were no revisions to the ODCM in 2014.

7. Process Control Program (PCP)

The Process Control Program (PCP) describes solid waste processing and disposal methods utilized at the BRP site. The PCP was not revised during 2014.

TABLE 1
Big Rock Point
Batch Releases
January 1, 2014 to December 31, 2014

A. GASEOUS

B. LIQUID	Units	1ST QTR	2ND QTR	3RD QTR	4TH QTR
Number of Releases		N/A	N/A	N/A	N/A
Total Release Time	Minutes	N/A	N/A	N/A	N/A
Maximum Release Time	Minutes	N/A	N/A	N/A	N/A
Average Release Time	Minutes	N/A	N/A	N/A	N/A
Minimum Release Time	Minutes	N/A	N/A	N/A	N/A

TABLE 2
Big Rock Point
Gaseous Effluent Releases
January 1, 2014 to December 31, 2014

A. FISSION AND ACTIVATION GASES	Units	1ST QTR	2ND QTR	3RD QTR	4TH QTR	Est Total Error %
1. Total release	Ci	N/A	N/A	N/A	N/A	N/A
2. Average release rate for period	μCi/sec	N/A	N/A	N/A	N/A	
3. Percent of annual avg EC	%	N/A	N/A	N/A	N/A	

B. IODINES						
1. Total iodine	Ci	N/A	N/A	N/A	N/A	N/A
2. Average release rate for period	μCi/sec	N/A	N/A	N/A	N/A	
3. Percent of annual avg EC	%	N/A	N/A	N/A	N/A	

C. PARTICULATES						
1. Particulates with half-life >8 day	Ci	N/A	N/A	N/A	N/A	N/A
2. Average release rate for period	μCi/sec	N/A	N/A	N/A	N/A	
3. Percent of annual avg EC	%	N/A	N/A	N/A	N/A	
4. Gross alpha radioactivity	Ci	N/A	N/A	N/A	N/A	

D. TRITIUM					
1. Total Release	Ci	N/A	N/A	N/A	N/A
2. Average release rate for period	μCi/sec	N/A	N/A	N/A	N/A
3. Percent of annual avg EC	%	N/A	N/A	N/A	N/A

E. WHOLE BODY DOSE					
1. Beta Air dose at Site Boundary due to Noble Gases (ODCM Section 1, 1.3.2 a (1) (2))	mrads	N/A	N/A	N/A	N/A
2. Percent limit	%	N/A	N/A	N/A	N/A
3. Gamma Air dose at Site Boundary due to Noble Gas (ODCM Section 1, 1.3.2 a (1) (2))	mrads	N/A	N/A	N/A	N/A
4. Percent limit	%	N/A	N/A	N/A	N/A

F. ORGAN DOSE (ODCM Section 1, 1.3.2b (1) (2))					
1. Maximum organ dose to pubic based on Critical Receptors (child bone)	mrem	N/A	N/A	N/A	N/A
2. Percent of limit (7.5 mrem/quarter)	%	N/A	N/A	N/A	N/A

TABLE 2
Big Rock Point
Gaseous Effluent Releases
January 1, 2014 to December 31, 2014

1. FISSION GASES	Units	1ST QTR	2ND QTR	3RD QTR	4TH QTR
Krypton-85m	Ci	N/A	N/A	N/A	N/A
Krypton-87	Ci	N/A	N/A	N/A	N/A
Krypton-88	Ci	N/A	N/A	N/A	N/A
Xenon-133	Ci	N/A	N/A	N/A	N/A
Xenon-133m	Ci	N/A	N/A	N/A	N/A
Xenon-135	Ci	N/A	N/A	N/A	N/A
Xenon-135m	Ci	N/A	N/A	N/A	N/A
Xenon-138	Ci	N/A	N/A	N/A	N/A
Total for Period	Ci	N/A	N/A	N/A	N/A

2. IODINES					
Iodine-131	Ci	N/A	N/A	N/A	N/A
Iodine-132	Ci	N/A	N/A	N/A	N/A
Iodine-133	Ci	N/A	N/A	N/A	N/A
Iodine-134	Ci	N/A	N/A	N/A	N/A
Iodine-135	Ci	N/A	N/A	N/A	N/A
Total for Period	Ci	N/A	N/A	N/A	N/A

TABLE 2
Big Rock Point
Gaseous Effluent Releases
January 1, 2014 to December 31, 2014

3. PARTICULATES*	Units	1ST QTR	2ND QTR	3RD QTR	4TH QTR
Chromium-51	Ci	N/A	N/A	N/A	N/A
Manganese-54	Ci	N/A	N/A	N/A	N/A
Cobalt-58	Ci	N/A	N/A	N/A	N/A
Iron-59	Ci	N/A	N/A	N/A	N/A
Cobalt-60	Ci	N/A	N/A	N/A	N/A
Zinc-65	Ci	N/A	N/A	N/A	N/A
Silver-110m	Ci	N/A	N/A	N/A	N/A
Cesium-134	Ci	N/A	N/A	N/A	N/A
Cesium-137	Ci	N/A	N/A	N/A	N/A
Barium-140	Ci	N/A	N/A	N/A	N/A
Europium-152	Ci	N/A	N/A	N/A	N/A
Strontium-89	Ci	N/A	N/A	N/A	N/A
Strontium-90	Ci	N/A	N/A	N/A	N/A
Net unidentified beta	Ci	N/A	N/A	N/A	N/A
Total	Ci	N/A	N/A	N/A	N/A

* Particulates with half-life >8 days

TABLE 3
Big Rock Point
Liquid Effluent Releases
January 1, 2014 to December 31, 2014

A. FISSION AND ACTIVATION PRODUCTS		Units	1ST QTR	2ND QTR	3RD QTR	4TH QTR	Est Total Error %
1. Total release (not including tritium, gases, alpha)		Ci	N/A	N/A	N/A	N/A	N/A
2. Average diluted concentration during period		µCi/ml	N/A	N/A	N/A	N/A	
3. Percent of EC		%	N/A	N/A	N/A	N/A	
B. TRITIUM							
1. Total release		Ci	N/A	N/A	N/A	N/A	N/A
2. Average diluted concentration during period		µCi/ml	N/A	N/A	N/A	N/A	
3. Percent of EC		%	N/A	N/A	N/A	N/A	
C. DISSOLVED AND ENTRAINED GASES							
1. Total release		Ci	N/A	N/A	N/A	N/A	N/A
2. Average diluted concentration during period		µCi/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		Ci	N/A	N/A	N/A	N/A	
E. VOLUME OF WASTE RELEASED (Prior to dilution)		Liters	N/A	N/A	N/A	N/A	
F. VOLUME OF DILUTION WATER USED DURING PERIOD		Liters	N/A	N/A	N/A	N/A	
G. MAXIMUM DOSE COMMITMENT WHOLEBODY		mrem	N/A	N/A	N/A	N/A	
Percent of ODCM Section 1, 2.3.2 a (1.5 mrem)		%	N/A	N/A	N/A	N/A	
H. MAXIMUM DOSE COMMITMENT – ORGAN		Mrem	N/A	N/A	N/A	N/A	
Percent of ODCM Section 1, 2.3.2 b (3.0 mrem)		%	N/A	N/A	N/A	N/A	

TABLE 3
Big Rock Point
Liquid Effluent Releases
January 1, 2014 to December 31, 2014

1. NUCLIDES RELEASED	Units	1ST QTR	2ND QTR	3RD QTR	4TH QTR
Chromium-51	Ci	--	--	--	--
Manganese 54	Ci	--	--	--	--
Cobalt-58	Ci	--	--	--	--
Iron-59	Ci	--	--	--	--
Cobalt-60	Ci	--	--	--	--
Zinc-65	Ci	--	--	--	--
Strontium-89	Ci	--	--	--	--
Strontium-90	Ci	--	--	--	--
Molybdenum-99	Ci	--	--	--	--
Silver-110m	Ci	--	--	--	--
Iodine-131	Ci	--	--	--	--
Cesium-134	Ci	--	--	--	--
Cesium-137	Ci	--	--	--	--
Antimony-125	Ci	--	--	--	--
Tin-113	Ci	--	--	--	--
Net Unidentified Beta	Ci	--	--	--	--
Fission & Activation Product Total	Ci	--	--	--	--
Xenon-133	Ci	--	--	--	--
Tritium	Ci	--	--	--	--
Grand Total	Ci	--	--	--	--