Entergy

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 2016-024

April 25, 2016 10 CFR 50.36a

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

Subject: 2015 Annual Radioactive Effluent Release and Waste Disposal Report

Palisades Nuclear Plant	Big Rock Point
Docket 50-255	Dockets 50-155 and 72-043
License No. DPR-20	License No. DPR-6

Dear Sir or Madam:

Attached are the Entergy Nuclear Operations, Inc. 2015 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, 2015, through December 31, 2015.

IE48
NMSS26
NRR
NMSS

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

Sincerely,

JAH/bed

Attachment 1: Palisades Nuclear Plant 2015 Radioactive Effluent Release Report
Attachment 2: Big Rock Point Independent Spent Fuel Storage Installation 2015 Radioactive Effluent Release Report

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

ATTACHMENT 1
Palisades Nuclear Plant 2015 Radioactive Effluent Release Report

2015 Plant Operating History

Palisades Nuclear Plant (PNP) entered the reporting period online on January 1, 2015, at essentially 100% full power. PNP experienced an unexpected scram on September 16, 2015, because of a digital electrohydraulic control system malfunction on the turbine. Refueling outage 1R24 commenced shortly thereafter on September 18, 2015. The unit attained criticality on October 19, 2015, and returned to full power on October 22, 2015. The unit generated 6,318,519 MWHrs of net electrical energy during 2015.

A. Gaseous Effluents

Tables 1A, "Gaseous Effluents – Summation of All Releases," 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 Releases," 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 2015 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 2E-4 µCi/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

PNP uses 0.25 KeV per channel with a range of 0-2000 KeV.

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

b. Iodines are sampled and then analyzed on an 8192 channel analyzer with an HpGe detector.

c. Particulates are sampled and then analyzed on an 8192 channel analyzer with an HpGe detector.

d. Liquid effluents are sampled and then analyzed on an 8192 channel analyzer with an 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 – 2015

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:
1 in the 1st quarter
1 in the 2nd quarter
5 in the 3rd quarter
4 in the 4th quarter

Total time period for batch releases: 10598 minutes

Maximum time period for a batch release: 2580 minutes

Average time period for a batch release: 963 minutes

Minimum time period for a batch release: 434 minutes

b. Gaseous

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

Total time period for batch releases: 2897 minutes

Maximum time period for a batch release: 930 minutes

Average time period for a batch release: 322 minutes

Minimum time period for a batch release: 78 minutes

6. Abnormal Discharges

a. Liquid

Number of releases for each quarter

1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1	0	0	0

Total activity released in Curies (Ci)

1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
0.0387	0	0	0

On February 26, 2015, as a result of routine monitoring well sampling, PNP identified tritium in temporary wells 7 and 8, located within the plant protected area. PNP completed notifications, in accordance with NEI 07-07 Criterion 2.2.b, on March 19, 2015. Tritium concentrations were less than the threshold value (20,000 pci/L) for initiating voluntary communications in accordance with NEI Ground Water Protection Initiative. The station promptly isolated the pipe that runs from the turbine sump oil/water separator to the turbine building drain tank as the likely source. Subsequent sample concentrations from samples obtained on March 18, 2015, resulted in concentrations of tritium less than the minimum detectable activity, thus confirming the source.

The pipe that runs from the turbine sump oil/water separator to the turbine building drain tank is a monitored effluent pathway that discharges waste to Lake Michigan. All activity and volume along this pathway is accounted for by routine effluent calculations, as shown in Table 2C. However, the activity released to the ground through this path is considered abnormal due to the fact that the release did not occur at the designed discharge location. The fraction of release from the pipe is unknown, so it was conservatively assumed that 100% of the liquid discharge traveling through the pipe went to the ground. The most conservative range of time during which this could have occurred was calculated to be between October 2, 2014, and March 7, 2015, based upon groundwater well measurements and groundwater flowrates. Therefore, it is conservatively estimated that 0.0387 Ci of tritium in 1st Quarter 2015, and 0.0533 Ci in 4th Quarter 2014 was released to the ground from this pipe.

Voluntary notifications were made to the Michigan Department of Environmental Quality, VanBuren County Administrator, Covert, Geneva, and South Haven Township Supervisors, as well as the City of South Haven Mayor and City Manager.

The NRC Resident Inspectors were notified, and reporting was completed in accordance with 10 CFR 50.72(b)(2)(xi).

b. Gaseous

None.

7. Controlled Discharge

a. Liquid

None.

b. Gaseous

Number of releases for each quarter

1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
0	1	8	15

Total activity released in Curies (Ci)

1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
0	0.00000626	1.42	0.0165

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 0.69 miles. The residence critical receptor is unchanged and remains in the SSW sector at 0.49 miles. The goat critical receptor is unchanged and remains 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**

One effluent monitor was out of service for greater than 30 days during the reporting period.

RIA-2320, steam generator blowdown tank vent monitor, was declared inoperable on November 3, 2015, due to the failure of a monthly monitor functional check. Compensatory actions were taken in accordance with the ODCM Table A-1. The monitor was declared operable on December 8, 2015. The extended delay was a result of having to send the spare detector to the vendor upon failing to make the spare detector operable.

11. Offsite Dose Calculation Manual (ODCM) Changes

The Offsite Dose Calculation Manual (ODCM), ODCM Appendix A, and ODCM Appendix B were not revised in 2015. The General Manager Plant Operations approval is required for changes to the ODCM.

The ODCM, ODCM Appendix A and ODCM Appendix B are being revised in 2016. Revision will include the updated meteorological data and turbine sump totalizer surveillance frequency.

A copy of the ODCM, ODCM Appendix A, and ODCM Appendix B are attached in Enclosure 1.

12. Process Control Program Changes

None.

13. Errata/Corrections to Previous Reports

On page 18 of 108 of the 2014 Annual Radioactive Effluent Release and Waste Disposal Report the volume of type 'a' waste, spent resin, filters, evaporator bottoms, etc., was reported as 1.38 m^3 but should have been reported as 1.83 m^3. This means the value reported was less conservative than the actual value by 25%. This is considered a large error under the guidance of regulatory guide 1.21. A special submittal was not made to the NRC upon discovery of this error because the error was discovered within 90 days of the submittal of this report which is within guidance of Regulatory guide 1.21. The total curries shipped for this category was reported correctly.

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 these MW 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. Of the 18 TW installed, 16 are still functional. 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 located in this area.

TW-15 is most indicative of an historic leak that continues to be monitored. 2015 tritium levels in TW-15 peaked in January at 31,846 pCi/L. Tritium levels spike in TW-15 when the water table rises from a large rainfall or spring melt. The high tritium levels in this area are a result of a leak which was reported to the NRC on December 10, 2007. None of the wells between TW-15 and Lake Michigan have had reportable concentrations of tritium in this reporting period.

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 range for 2015 was approximately 7 to 8.5 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 2.2 feet per day.

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

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 within 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. Gaseous C-14 is reported as CO_2 Curies because the major pathway by which C-14 contributes to the dose to man is by entering vegetables in the form of CO_2 and then being ingested.

Annual C-14 release for PNP and subsequent doses for 2015:

Total Gaseous C-14 Released Curies =	7.74
Gaseous C-14 as CO_2 Curies =	2.32
Effective Child TB Dose, C-14 mrem =	0.0703
Effective Child Bone Dose, C-14 mrem =	0.352

The quarterly curies released are provided in Table 1A, Table 1B, and Table 1C. Airborne doses due to C-14 are contained in Table 1A.

Meteorological Data

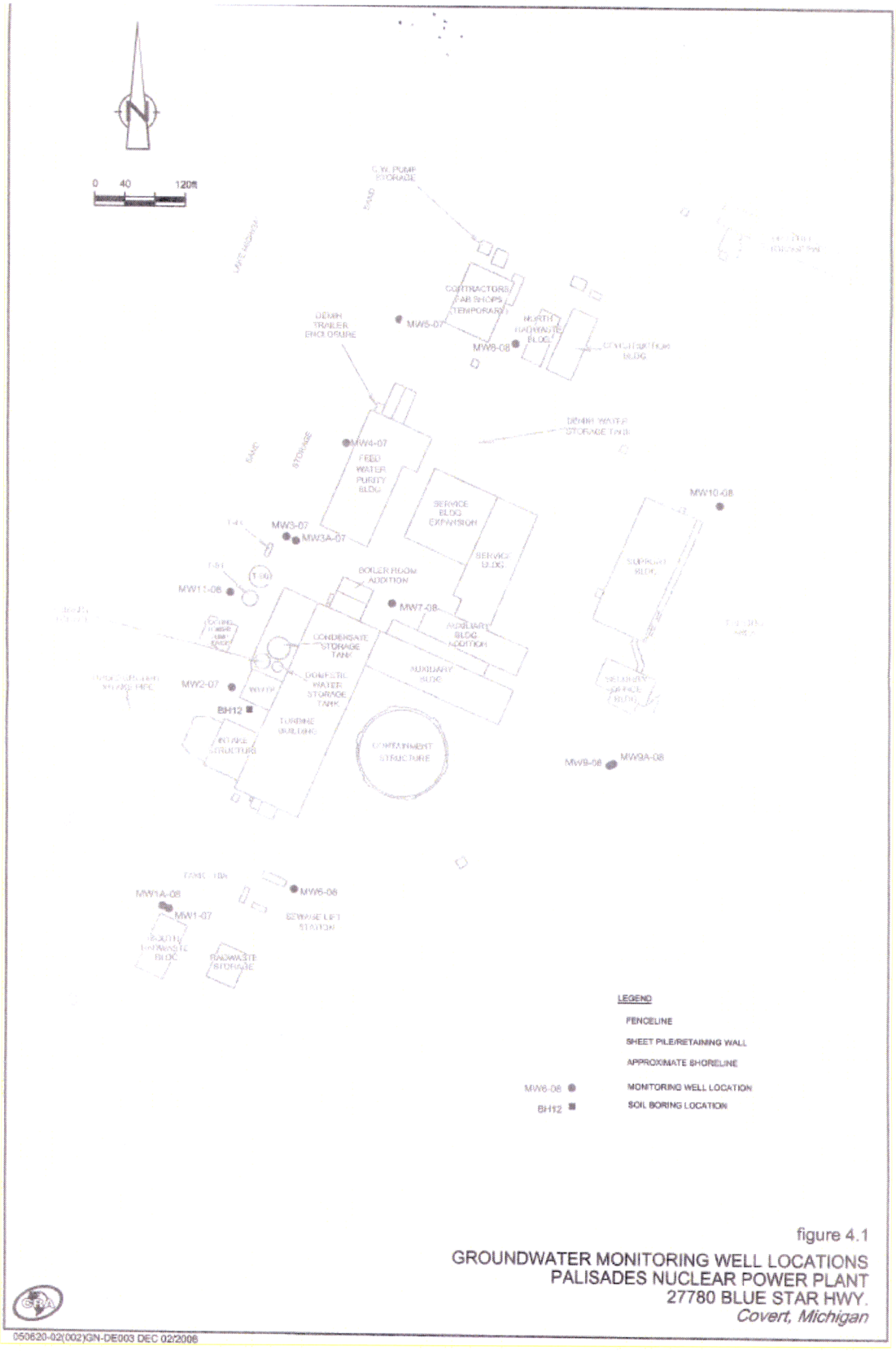
A meteorological monitoring report is generated semiannually. From January 1, 2015, to June 30, 2015, the meteorological data recovery was at 96% or greater for all variables. The two most frequently occurring directions at the 10-meter level were in the SSE and WNW sectors, accounting for over 22% of the observations from January through June. The two most frequently occurring directions at 60 meters were WNW and S, accounting for over 19% of the observations from January through June. The highest average speeds were associated with NNW winds at both the 10-meter and 60-meter levels. The mean speed for all directions at 10 meters was 3.63 m/s (8.12 mph), and at 60 meters was 6.42 m/s (14.36 mph). Compared to the same period in the previous year, the 10-meter speed was 0.23 m/s (0.51 mph) lower while the 60-meter speed was 0.50 m/s (1.12 mph) lower.

From July 1, 2015, to December 31, 2015, the meteorological data recovery was at 99% or greater for all variables. The two most frequently occurring directions at the 10-meter level were SE and SSE, which accounted for over 24% of all observations from July to December. At 60 meters, the two predominant directions were SW and NNW, which accounted for over 20% of all observations from July to December. The highest average speeds were associated with SE winds at 10 meters and SW winds at 60 meters. The mean speed for all directions at 10 meters was 2.26 m/s (5.06 mph), and at 60 meters was 4.91 m/s (10.98mph). Compared to the same period in the previous year, the 10-meter speed is 0.02 m/s (0.04 mph) higher while the 60-meter speed is 0.19 m/s (0.43 mph) higher.

Data from this report and the annual meteorological data (Hourly Average Data or Joint Frequency Distribution) will be maintained on site and will be made available upon NRC request.

FIGURE 1

PALISADES NUCLEAR PLANT GROUNDWATER MONITORING WELL LOCATIONS



ATTACHMENT 1
Palisades - Table 1A
2015 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	2.79E+00	1.86E+00	2.99E+00	3.16E+00	1.08E+01	24.03
Average Release Rate	µCi/s	3.59E-01	2.36E-01	3.76E-01	3.98E-01	3.43E-01	
% of Limit	%	3.66E-03	2.67E-03	4.69E-03	3.28E-03	3.58E-03	
I-131	Ci	4.27E-05	3.50E-05	5.64E-05	9.45E-05	2.29E-04	12.20
Average Release Rate	µCi/s	5.49E-06	4.45E-06	7.10E-06	1.19E-05	7.25E-06	
% of Limit	%	6.29E-08	5.09E-08	8.13E-08	1.36E-07	8.30E-08	
Particulates	Ci	0.00E+00	1.88E-05	1.89E-05	1.82E-04	2.20E-04	16.2
Average Release Rate	µCi/s	0.00E+00	2.40E-06	2.38E-06	2.29E-05	6.96E-06	
% of Limit	%	0.00E+00	1.10E-05	1.08E-05	9.66E-06	7.90E-06	
Tritium	Ci	1.93E+00	1.71E+00	2.88E+00	4.37E+00	1.09E+01	4.42
Average Release Rate	µCi/s	2.48E-01	2.18E-01	3.62E-01	5.50E-01	3.45E-01	
% of Limit	%	5.68E-04	4.99E-04	8.30E-04	1.26E-03	7.91E-04	
Gross Alpha	Ci	ND	ND	ND	ND	ND	N/A
C-14	Ci	2.13E+00	2.15E+00	1.78E+00	1.71E+00	7.74E+00	
Average Release Rate	µCi/s	2.73E-01	2.73E-01	2.24E-01	2.15E-01	2.45E-01	
% of Limit	%	2.09E-06	2.08E-06	1.71E-06	1.64E-06	1.87E-06	

ATTACHMENT 1
Palisades - Table 1B
2015 Gaseous Effluents – Ground Level Release, Batch Mode

Fission and Activation Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Ar-41	Ci	ND	ND	ND	ND	ND
Kr-85	Ci	ND	ND	2.70E-04	2.35E-04	5.05E-04
Kr-85m	Ci	ND	ND	ND	2.30E-03	2.30E-03
Kr-87	Ci	ND	ND	ND	ND	ND
Kr-88	Ci	ND	ND	ND	ND	ND
Xe-131m	Ci	ND	ND	ND	2.40E-03	2.40E-03
Xe-133	Ci	ND	ND	8.40E-04	1.03E+00	1.03E+00
Xe-133m	Ci	ND	ND	ND	2.13E-02	2.13E-02
Xe-135	Ci	ND	ND	2.36E-05	5.48E-02	5.48E-02
Xe-135m	Ci	ND	ND	ND	ND	ND
Xe-137	Ci	ND	ND	ND	ND	ND
Xe-138	Ci	ND	ND	ND	ND	ND
(List Others)	Ci	ND	ND	ND	ND	ND
Total	Ci	ND	ND	1.13E-03	1.11E+00	1.11E+00
Iodines/Halogens	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
I-131	Ci	ND	ND	ND	7.99E-05	7.99E-05
I-132	Ci	ND	ND	ND	ND	ND
I-133	Ci	ND	ND	ND	ND	ND
I-134	Ci	ND	ND	ND	ND	ND
I-135	Ci	ND	ND	ND	ND	ND
Total	Ci	ND	ND	ND	7.99E-05	7.99E-05
Particulates	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Co-58	Ci	ND	3.53E-08	1.02E-07	9.99E-06	1.01E-05
Co-60	Ci	ND	1.88E-05	1.88E-05	1.60E-05	5.36E-05
Cr-51	Ci	ND	ND	ND	4.25E-07	4.25E-07
Mn-54	Ci	ND	ND	ND	ND	ND
Mn-56	Ci	ND	ND	ND	ND	ND
Rb-88	Ci	ND	ND	ND	1.47E-04	1.47E-04
Sr-89	Ci	NR	NR	NR	NR	NR
Sr-90	Ci	NR	NR	NR	NR	NR
Sr-92	Ci	ND	ND	ND	ND	ND
Nb-95	Ci	ND	ND	ND	2.63E-06	2.63E-06
Zr-95	Ci	ND	ND	ND	1.48E-07	1.48E-07
Nb-97	Ci	ND	ND	ND	5.43E-06	5.43E-06
Ag-110m	Ci	ND	ND	ND	1.47E-07	1.47E-07
Sb-125	Ci	ND	ND	ND	ND	ND
Cs-137	Ci	ND	ND	ND	9.82E-08	9.82E-08
Ce-144	Ci	ND	ND	ND	ND	ND
Total	Ci	ND	1.88E-05	1.89E-05	1.82E-04	2.20E-04

ATTACHMENT 1
Palisades - Table 1B
2015 Gaseous Effluents – Ground Level Release, Batch Mode

Fission and Activation Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Tritium	Ci	ND	ND	ND	3.83E-01	3.83E-01
Gross Alpha	Ci	NR	NR	NR	NR	NR
C-14	Ci	NA	NA	NA	NA	ND

ND = Measurements performed but no activity detected.
NA = Not applicable
NR = Analysis not required & not performed

ATTACHMENT 1
Palisades - Table 1C
2015 Gaseous Effluents – Ground Level Release, Continuous Mode

Fission and Activation Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Ar-41	Ci	3.62E-01	3.01E-01	9.40E-01	6.04E-01	2.21E+00
Kr-85	Ci	ND	ND	ND	ND	ND
Kr-85m	Ci	7.00E-02	3.51E-02	4.79E-02	9.47E-03	1.62E-01
Kr-87	Ci	1.60E-01	8.11E-02	9.45E-02	8.74E-02	4.23E-01
Kr-88	Ci	1.16E-01	7.22E-02	3.71E-02	3.08E-02	2.56E-01
Xe-131m	Ci	ND	ND	ND	ND	ND
Xe-133	Ci	2.46E-01	1.48E-01	3.82E-01	1.11E-01	8.88E-01
Xe-133m	Ci	ND	ND	ND	ND	ND
Xe-135	Ci	7.04E-01	3.25E-01	4.38E-01	5.02E-01	1.97E+00
Xe-135m	Ci	3.48E-02	1.62E-02	1.99E-03	ND	5.30E-02
Xe-137	Ci	2.33E-01	3.54E-01	4.41E-01	1.52E-01	1.18E+00
Xe-138	Ci	8.66E-01	5.26E-01	6.07E-01	5.55E-01	2.55E+00
Total	Ci	2.79E+00	1.86E+00	2.99E+00	2.05E+00	9.69E+00
Iodines/Halogens	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
I-131	Ci	4.27E-05	3.50E-05	5.64E-05	1.46E-05	1.49E-04
I-132	Ci	ND	ND	ND	ND	ND
I-133	Ci	8.15E-05	1.03E-04	5.76E-05	ND	2.42E-04
I-134	Ci	ND	ND	ND	ND	ND
I-135	Ci	ND	ND	ND	ND	ND
Total	Ci	1.24E-04	1.38E-04	1.14E-04	1.46E-05	3.91E-04
Particulates	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Co-58	Ci	ND	ND	ND	ND	ND
Co-60	Ci	ND	ND	ND	ND	ND
Cr-51	Ci	ND	ND	ND	ND	ND
Mn-54	Ci	ND	ND	ND	ND	ND
Mn-56	Ci	ND	ND	ND	ND	ND
Rb-88	Ci	ND	ND	ND	ND	ND
Sr-89	Ci	ND	ND	ND	ND	ND
Sr-90	Ci	ND	ND	ND	ND	ND
Sr-92	Ci	ND	ND	ND	ND	ND
Nb-95	Ci	ND	ND	ND	ND	ND
Zr-95	Ci	ND	ND	ND	ND	ND
Nb-97	Ci	ND	ND	ND	ND	ND
Ag-110m	Ci	ND	ND	ND	ND	ND
Sb-125	Ci	ND	ND	ND	ND	ND
Cs-137	Ci	ND	ND	ND	ND	ND
Ce-144	Ci	ND	ND	ND	ND	ND
Total	Ci	ND	ND	ND	ND	ND

ATTACHMENT 1
Palisades - Table 1C
2015 Gaseous Effluents – Ground Level Release, Continuous Mode

Fission and Activation Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Tritium	Ci	1.93E+00	1.71E+00	2.88E+00	3.99E+00	1.05E+01
Gross Alpha	Ci	ND	ND	ND	ND	ND
C-14	Ci	2.13E+00	2.15E+00	1.78E+00	1.71E+00	7.74E+00
ND = Measurements performed but no activity detected.						

ATTACHMENT 1
Palisades - Table 2A
2015 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	0.00E+00	1.17E-04	4.19E-04	2.58E-03	3.11E-03	11.50
Average Concentration	µCi/ml	0.00E+00	3.49E-12	1.26E-11	8.03E-11	2.25E-11	
% of Limit	%	0.00E+00	4.97E-05	2.43E-04	1.01E-03	3.05E-04	
Tritium	Ci	8.09E+01	1.71E+02	2.41E+02	3.70E+01	5.30E+02	4.01
Average Concentration	µCi/ml	2.06E-06	5.10E-06	7.21E-06	1.15E-06	3.83E-06	
% of Limit	%	2.06E-01	5.10E-01	7.21E-01	1.15E-01	3.83E-01	
Dissolved and Entrained Gases	Ci	0.00E+00	0.00E+00	6.57E-04	0.00E+00	6.57E-04	43.3
Average Concentration	µCi/ml	0.00E+00	0.00E+00	1.97E-11	0.00E+00	4.75E-12	
% Of Limit	%	0.00E+00	0.00E+00	9.85E-06	0.00E+00	2.38E-06	
Gross Alpha	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A
Average Concentration	µCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
Volume of Batch Liquid Effluent (Before Dilution)	Liters	0.00E+00	1.79E+05	0.00E+00	0.00E+00	1.79E+05	
Dilution Water Used for Above	Liters	3.93E+10	3.36E+10	3.34E+10	3.21E+10	1.38E+11	
Volume of Continuous or Balance-of-Plant Liquid Effluent (e.g., low-activity or unprocessed) (Before Dilution)	Liters	7.84E+09	7.93E+09	8.49E+09	7.75E+09	3.20E+10	
Average Stream Flow	m^3/s	5.05E+00	4.27E+00	4.20E+00	4.04E+00	4.39E+00	

Dilution flow rate (gal/qtr) = # of Dilution pumps running x days running/qtr x 4000 gpm/pump x min/day

ATTACHMENT 1
Palisades - Table 2B
2015 Liquid Effluents – Batch Mode

Fission and Activation Products	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Cr-51	Ci	ND	ND	ND	ND	ND
Mn-54	Ci	ND	ND	ND	ND	ND
Fe-55	Ci	ND	ND	ND	ND	ND
Fe-59	Ci	ND	ND		3.56E-05	3.56E-05
Co-57	Ci	ND	ND		ND	ND
Co-58	Ci	ND	2.45E-05	2.42E-05	1.51E-03	1.56E-03
Co-60	Ci	ND	ND	1.45E-04	2.15E-04	3.60E-04
Sr-89	Ci	ND	ND	ND	ND	ND
Sr-90	Ci	ND	ND	ND	ND	ND
Nb-95	Ci	ND	ND	ND	5.55E-05	5.55E-05
Nb-97	Ci	ND	ND	6.03E-05	ND	6.03E-05
Ag-110m	Ci	ND	9.28E-05	1.89E-04	6.40E-04	9.22E-04
Sn-113	Ci	ND	ND	ND	ND	ND
Sb-124	Ci	ND	ND	ND	ND	ND
Sb-125	Ci	ND	ND	ND	ND	ND
I-131	Ci	ND	ND	ND	ND	ND
I-133	Ci	ND	ND	ND	ND	ND
I-135	Ci	ND	ND	ND	ND	ND
Cs-134	Ci	ND	ND	ND	ND	ND
Cs-137	Ci	ND	ND	ND	2.68E-05	2.68E-05
Ni-63	Ci	ND	ND	ND	ND	ND
Zn-65	Ci	ND	ND	ND	ND	ND
Zr-95	Ci	ND	ND	ND	ND	ND
Mo-99	Ci	ND	ND	ND	ND	ND
Ru-105	Ci	ND	ND	ND	5.65E-05	5.65E-05
La-140	Ci	ND	ND	ND	ND	ND
Ce-141	Ci	ND	ND	ND	ND	ND
Ce-144	Ci	ND	ND	ND	ND	ND
Totals	Ci	ND	1.17E-04	4.19E-04	2.54E-03	3.08E-03
Dissolved and Entrained Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Kr-85	Ci	ND	ND	ND	ND	ND
Kr-85m	Ci	ND	ND	ND	ND	ND
Kr-88	Ci	ND	ND	ND	ND	ND
Xe-131m	Ci	ND	ND	ND	ND	ND
Xe-133	Ci	ND	ND	6.57E-04	ND	6.57E-04
Xe-133m	Ci	ND	ND	ND	ND	ND
Xe-135	Ci	ND	ND	ND	ND	ND
Xe-135m	Ci	ND	ND	ND	ND	ND
Totals		ND	ND	6.57E-04	ND	6.57E-04

ATTACHMENT 1
Palisades - Table 2B
2015 Liquid Effluents – Batch Mode

Fission and Activation Products	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Tritium	Ci	8.08E+01	1.71E+02	2.41E+02	3.70E+01	5.30E+02
Gross Alpha	Ci	ND	ND	ND	ND	ND
ND = None Detected						

ATTACHMENT 1
Palisades - Table 2C
2015 Liquid Effluents – Continuous Mode

Fission and Activation Products	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Cr-51	Ci	ND	ND	ND	ND	ND
Mn-54	Ci	ND	ND	ND	ND	ND
Fe-55	Ci	ND	ND	ND	ND	ND
Fe-59	Ci	ND	ND	ND	ND	ND
Co-57	Ci	ND	ND	ND	ND	ND
Co-58	Ci	ND	ND	ND	ND	ND
Co-60	Ci	ND	ND	ND	ND	ND
Sr-89	Ci	ND	ND	ND	ND	ND
Sr-90	Ci	ND	ND	ND	ND	ND
Nb-95	Ci	ND	ND	ND	ND	ND
Nb-97	Ci	ND	ND	ND	ND	ND
Ag-110m	Ci	ND	ND	ND	ND	ND
Sn-113	Ci	ND	ND	ND	ND	ND
Sb-124	Ci	ND	ND	ND	ND	ND
Sb-125	Ci	ND	ND	ND	ND	ND
I-131	Ci	ND	ND	ND	ND	ND
I-133	Ci	ND	ND	ND	ND	ND
I-135	Ci	ND	ND	ND	ND	ND
Cs-134	Ci	ND	ND	ND	ND	ND
Cs-137	Ci	ND	ND	ND	3.75E-05	3.75E-05
Ni-63	Ci	ND	ND	ND	ND	ND
Zn-65	Ci	ND	ND	ND	ND	ND
Zr-95	Ci	ND	ND	ND	ND	ND
Mo-99	Ci	ND	ND	ND	ND	ND
Ru-105	Ci	ND	ND	ND	ND	ND
La-140	Ci	ND	ND	ND	ND	ND
Ce-141	Ci	ND	ND	ND	ND	ND
Ce-144	Ci	ND	ND	ND	ND	ND
Totals	Ci	ND	ND	ND	3.75E-05	3.75E-05
Dissolved and Entrained Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Kr-85	Ci	ND	ND	ND	ND	ND
Kr-85m	Ci	ND	ND	ND	ND	ND
Kr-88	Ci	ND	ND	ND	ND	ND
Xe-131m	Ci	ND	ND	ND	ND	ND
Xe-133	Ci	ND	ND	ND	ND	ND
Xe-133m	Ci	ND	ND	ND	ND	ND
Xe-135	Ci	ND	ND	ND	ND	ND
Xe-135m	Ci	ND	ND	ND	ND	ND
Totals		ND	ND	ND	ND	ND

ATTACHMENT 1
Palisades - Table 2C
2015 Liquid Effluents – Continuous Mode

Fission and Activation Products	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Tritium	Ci	5.40E-02	5.34E-02	1.50E-02	1.37E-02	1.36E-01
Gross Alpha	Ci	ND	ND	ND	ND	ND
ND = None Detected						

ATTACHMENT 1
Palisades - Table 3
2015 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 Curies	9.28E+00 2.65E+01	25
b. Dry compressible waste, dry active waste contaminated equipment, etc.	m^3 Curies	2.22E+02 3.50E+00	25
c. Irradiated components, control rods, etc.	m^3 Curies	0.00E+00 0.00E+00	
d. Other (metal waste, and used oil)	m^3 Curies	8.62E+00 3.67E+00	25
e. sum of all waste	m^3 Curies	2.40E+02 3.37E+01	25

ATTACHMENT 1
Palisades - Table 3
2015 Low-Level Waste

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

a.	Co-60	52%	H-3	1.64%
	Fe-55	18%	Sb-125	1.73%
	Ni-63	19%	Co-58	5.28%
b.	Co-60	24%	Co-58	16.71%
	Fe-55	17%	Ni-63	11.79%
	Cs-137	1%	Nb-95	5.94%
	Cr-51	5%	Cm-243	1.69%
	AG-110m	4.73%	H-3	1.27%
	Zr-95	3.44%	C-14	2.81%
c.	NA	NA	NA	NA
d.	H-3	3%	Co-60	5.39%
	C-14	2%	Ni-63	77.79%
	Sr-90	1%	Fe-55	9%
	Pu-241	1%		
e.	H-3	1.72%	Ag-110m	1.06%
	Fe-55	16.71%	Sb-125	1.43%
	Co-58	5.90%	Ni-63	24.84%
	Co-60	43.70%		

NA - Not Applicable

ATTACHMENT 1
Palisades - Table 3
2015 Low-Level Waste

3. Solid waste disposition

Number of shipments	Mode of transportation	Destination
2	Hittman Transport	Alaron-Nuclear 2138 State Route 18
1	Hittman Transport	Duratek Gallaher Road Facility 628 Gallaher Road
11	Hittman Transport	Entergy Solutions Bear Creek Facility 1560 Bear Creek Road
1	Landstar Inway	Entergy Solutions Bear Creek Facility 1560 Bear Creek Road
1	Landstar Ranger Inc.	Entergy Solutions Bear Creek Facility 1560 Bear Creek Road

Irradiated fuel shipments (disposition)

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

ATTACHMENT 1
Palisades - Table 4
2015 Dose Assessments, 10 CFR Part 50, Appendix I

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Liquid Effluent Dose Limit, Total Body	1.5 mrem	1.5 mrem	1.5 mrem	1.5 mrem	3 mrem
Total Body Dose (mrem)	6.07E-05	1.52E-04	2.43E-04	2.65E-04	6.44E-04
% Of Limit	0.00%	0.01%	0.02%	0.02%	0.02%
Liquid Effluent Dose Limit, Any Organ	5 mrem	5 mrem	5 mrem	5 mrem	10 mrem
Liquid Effluent Organ Dose (mrem)	6.07E-05	1.53E-04	2.45E-04	4.88E-04	8.72E-04
% of Limit	0.00%	0.00%	0.00%	0.01%	0.01%
Gaseous Effluent Dose Limit, Gamma Air	5 mrad	5 mrad	5 mrad	5 mrad	10 mrad
Gamma Air Dose (mrad)	1.16E-03	7.62E-04	1.24E-03	9.72E-04	4.14E-03
% of Limit	0.02%	0.02%	0.02%	0.02%	0.04%
Gaseous Effluent Dose Limit, Beta Air	10 mrad	10 mrad	10 mrad	10 mrad	20 mrad
Beta Air Dose (mrad)	8.97E-04	7.27E-04	1.03E-03	7.35E-04	3.39E-03
% of Limit	0.009%	0.007%	0.010%	0.007%	0.017%
Gaseous Effluent Dose Limit, Any Organ (mrem) (Iodine, Tritium, Particulates)	7.5 mrem	7.5 mrem	7.5 mrem	7.5 mrem	15 mrem
Gaseous Effluent Organ Dose (mrem) (Iodine, Tritium, Particulates)	4.50E-03	3.94E-03	6.07E-03	7.88E-03	2.24E-02
% of Limit	0.06%	0.05%	0.08%	0.11%	0.15%

ATTACHMENT 1
Palisades - Table 5
2015 Dose Assessments, EPA 40 CFR Part 190, Individual in the Unrestricted Area

	Whole Body	Thyroid	Any Other Organ
Dose Limit (mrem)	25	75	25
Dose (mrem)	8.05E-02	8.98E-02	3.75E-01
% of Limit	0.32%	0.12%	1.50%

ENCLOSURE 1

PALISADES NUCLEAR PLANT
OFFSITE DOSE CALCULATION MANUAL, REVISION 26
OFFSITE DOSE CALCULATION MANUAL APPENDIX A, REVISION 18
OFFSITE DOSE CALCULATION MANUAL APPENDIX B, REVISION 0

229 Pages Follow

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

Table of Contents

Table of Contents

I. GASEOUS EFFLUENTS

A. ALARM/TRIP SETPOINT METHOD

Appendix A, Section III.B.1 requires that the dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the SITE BOUNDARY shall be limited to the following:

- For noble gases: Less than or equal to 500 mrems/yr to the total body and less than or equal to 3000 mrems/yr to the skin, and

- For iodine-131, for iodine-133, for tritium, and for all radionuclides in particulate form with half lives greater than 8 days: Less than or equal to 1500 mrems/yr to any organ.

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

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

1. Allowable Concentration

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:

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

where:

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

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

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

X/Q = Most conservative sector site boundary dispersion (sec/m^3) (listed in site procedure CH 6.41, "Land Use Census")

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

2. Monitor Response

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

a. Normal Release (aged fission gasses)

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

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

b. Accident Releases

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

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

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

B. DOSE RATE CALCULATION

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

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:

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

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.

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:

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

where:

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

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, $\mu Ci/s$.

p = Fraction of radionuclide remaining in plume.

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

U_j = Midpoint value of wind speed class interval j, m/s.

x = Downwind distance, m.

n = Number of sectors, 16.

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

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

For determining the total body dose rate:

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

where:

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

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

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

For determining the skin dose rate:

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

where:

D_s = Skin dose rate, mrem/y.

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

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

For determining dose rate to a point in air:

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

where:

D_a = Air dose rate, mrad/yr.

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

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.

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:

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

where:

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

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

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

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

$1x10^6$ = pCi/μCi conversion factor.

b) Ground Contamination

For determining the ground concentration of any nuclide;

$$G_i = 3.15 \times 10^7 \sum_{k=1}^{7} \frac{f_k Q_i DR}{(2\pi x/n)\lambda_1}[1 - \exp(-\lambda_i t_b)] \qquad (1.8)$$

where:

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

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, $\mu Ci/s$.

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

x = Downwind distance, m.

n = Number of sectors, 16.

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

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

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

3.15×10^7 = s/y conversion factor.

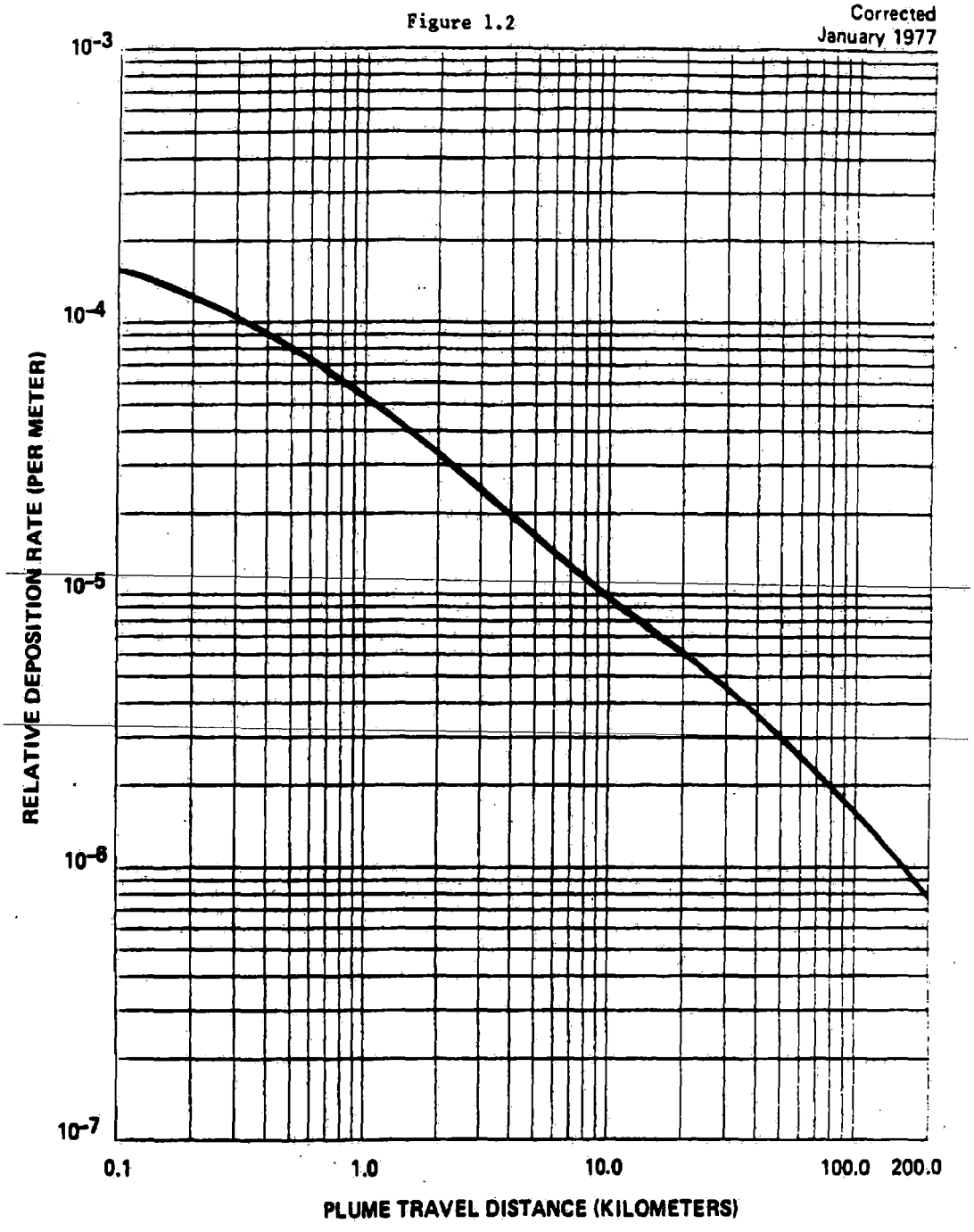


Figure 7. Relative Deposition for Ground Level Releases (All Atmospheric Stability Classes)

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

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

where:

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

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

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

8,760 = Occupation time, h/y.

$1x10^6$ = pCi/μCi conversion factor.

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

c) Milk and Vegetation Ingestion

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

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

where:

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

k = Stability class.

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

Q_i	=	Average release rate of radionuclide i, μCi/s.
DR	=	Relative deposition rate, m^{-1} (Figure 1.2).
x	=	Downwind distance, m.
n	=	Number of sectors, 16.
$2\pi x/n$	=	Sector width at point of interest, m.
r	=	Fraction of deposited activity retained on vegetation (1.0 for iodines, 0.2 for particulates).
λEi	=	Effective removal rate constant, $\lambda Ei = \lambda_i + \lambda_w$, where λ_i is the radioactive decay coefficient, h^{-1}, and λ_w is a measure of physical loss by weathering ($\lambda_w = 0.0021\ h^{-}$).
t_e	=	Period over which deposition occurs, 720 h.
Y_v	=	Agricultural yield, 0.7 kg/m^2.
B_{iv}	=	Transfer factor from soil to vegetation of radionuclide i (Attachment 4).
λ_i	=	Radioactive decay coefficient of radionuclide i, h^{-1}.
t_b	=	Time for buildup of radionuclides on the ground, 1.31×10^5 h (15Y).
p	=	Effective surface density of soil, 240 kg/m^2.
3,600	=	s/h conversion factor.
t_h	=	Holdup time between harvest and consumption of food (2,160 hours for stored food).

For determining the concentration of C-14 in vegetation:

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

where:

CV_{14} = Concentration of C-14 in vegetation, $\mu Ci/kg$.

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

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

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

$1x10^3$ = g/kg conversion factor.

For determining the concentration of H-3 in vegetation:

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

where:

CV_T = Concentration of H-3 in vegetation, $\mu Ci/m^3$.

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

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.

$1x10^3$ = g/kg conversion factor.

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

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

where:

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

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

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

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

$$D = 1 \times 10^{6} \sum_{i} CM_i \, DF_i \, UM \qquad (1.14)$$

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.

$1x10^6$ = pCi/μCi conversion factor.

d) Meat Ingestion (Beef)

To calculate the concentration of a nuclide in animal flesh:

$$C_{fi} = F_{fi} \; CV_i \; Q_{fi} \; \exp(-\lambda_i t_s) \qquad (1.15)$$

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).

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.

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.

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.

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 results in a dose of 100 mrem whole body. 10 CFR 50.36a requires that the release of radioactive materials be kept as low as reasonably achievable. However, the section further states that the licensee is permitted the flexibility of operation, to assure a dependable source of power even under unusual operating conditions, to release quantities of material higher than a small percentage of 10 CFR 20.1302 limits but still within those limits. Appendix I to 10 CFR 50 provides the numerical guidelines on limiting conditions for operations to meet the as low as reasonably achievable requirement.

The GASPAR code has been run to determine the dose due to external radiation and inhalation. The source term used is listed in 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.

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.

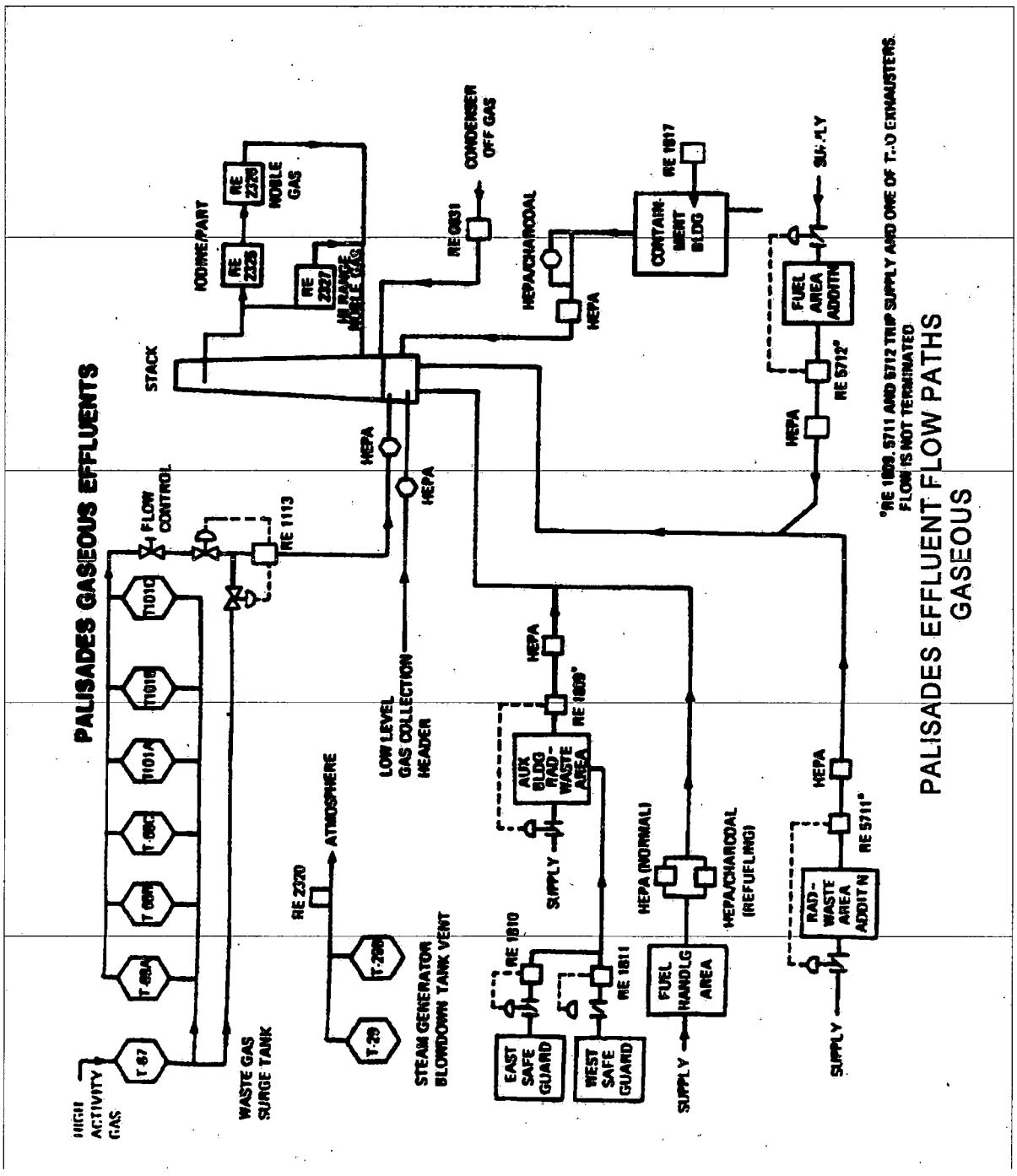
F. NOBLE GAS SAMPLING

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 1E-06 μCi/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.

H. FIGURE – GASEOUS EFFLUENTS FLOW PATHS



II. LIQUID EFFLUENTS

A. CONCENTRATION

1. Requirements

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

2. Prerelease Analysis

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

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

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

where:

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

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

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

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

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

where:

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

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

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

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

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

where:

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

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

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

B. INSTRUMENT SETPOINTS

1. Setpoint Determination

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

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

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

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

2. Composite Samplers

Effluent pathways, Turbine Sump and Service Water, are equipped with continuous compositors to meet the requirements of Appendix A, Table D-1. These compositors are adjustable and normally set in a time mode and collect three to six samples hourly, 24 hours a day with a total collection of approximately one gallon per day. A representative sample is collected daily from the compositor and saved for the weekly, monthly, 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.

3. Post-Release Analysis

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

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

C. DOSE

1. RETS Requirement

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

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

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

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

2. Release Analysis

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:

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

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 jth 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:

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

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:

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

b. Fish Ingestion

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

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

where:

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

B_i = Fish concentration factor of i^{th} radionuclide $\frac{\mu Ci/gm}{\mu Ci/ml}$ (see 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:

$$D_j = \frac{(6.7E07)F}{d} \sum_{i=1}^{i} A_i \times B_i \times DCF_i \, mrem \qquad (2.9)$$

c. Annual Analysis

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

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

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

where:

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

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

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

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

I_i for water ingestion is described by:

$$I_i = \frac{A_i V_r}{vd} \mu Ci \qquad (2.12)$$

and for fish ingestion I_i is described by:

$$I_i = \frac{A_i B_i F_r}{v d} \mu Ci \qquad (2.13)$$

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

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

D. OPERABILITY OF LIQUID RADWASTE EQUIPMENT

The Palisades liquid radwaste system is designed to reduce the radioactive materials in liquid wastes prior to their discharge (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

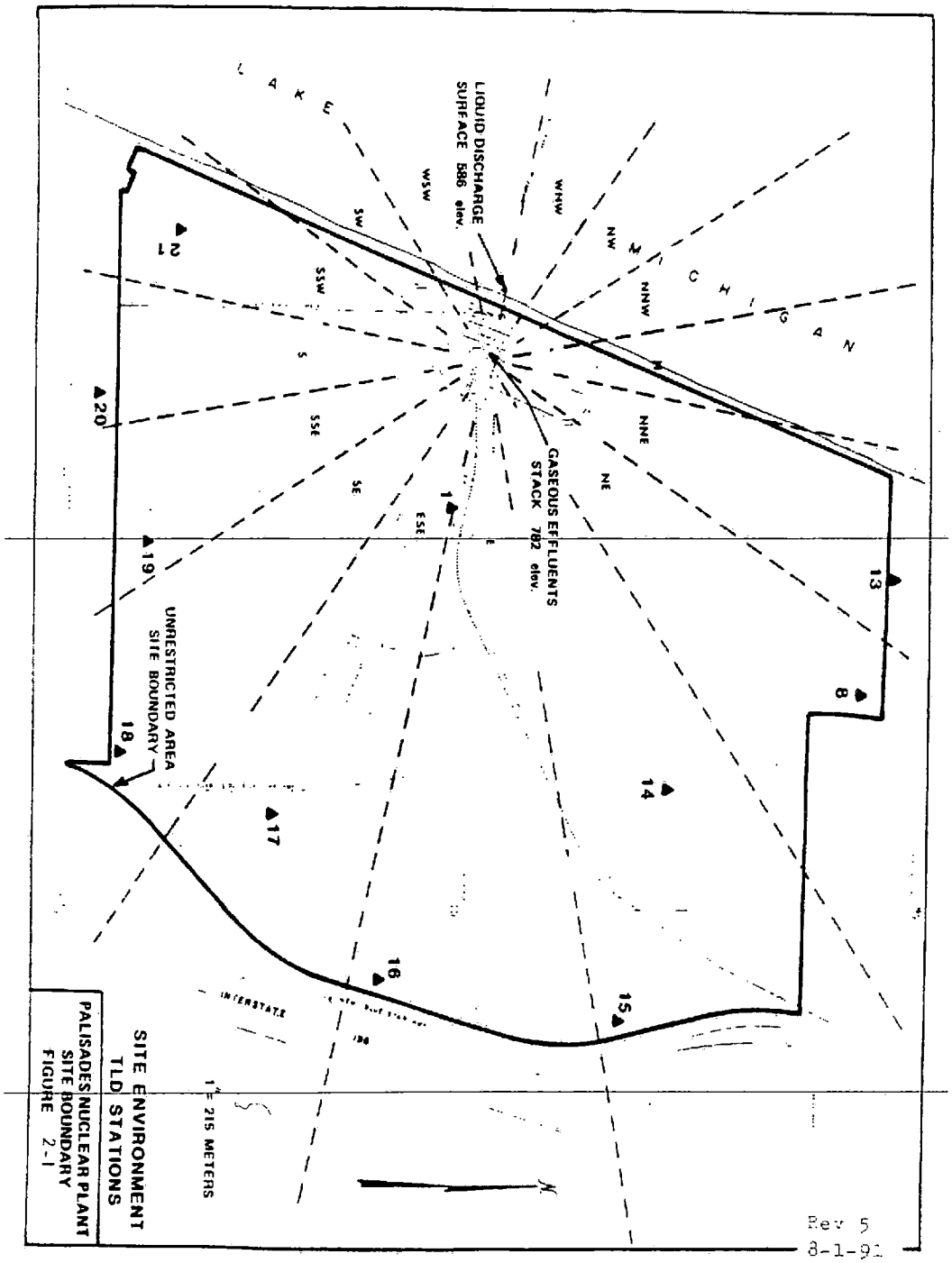
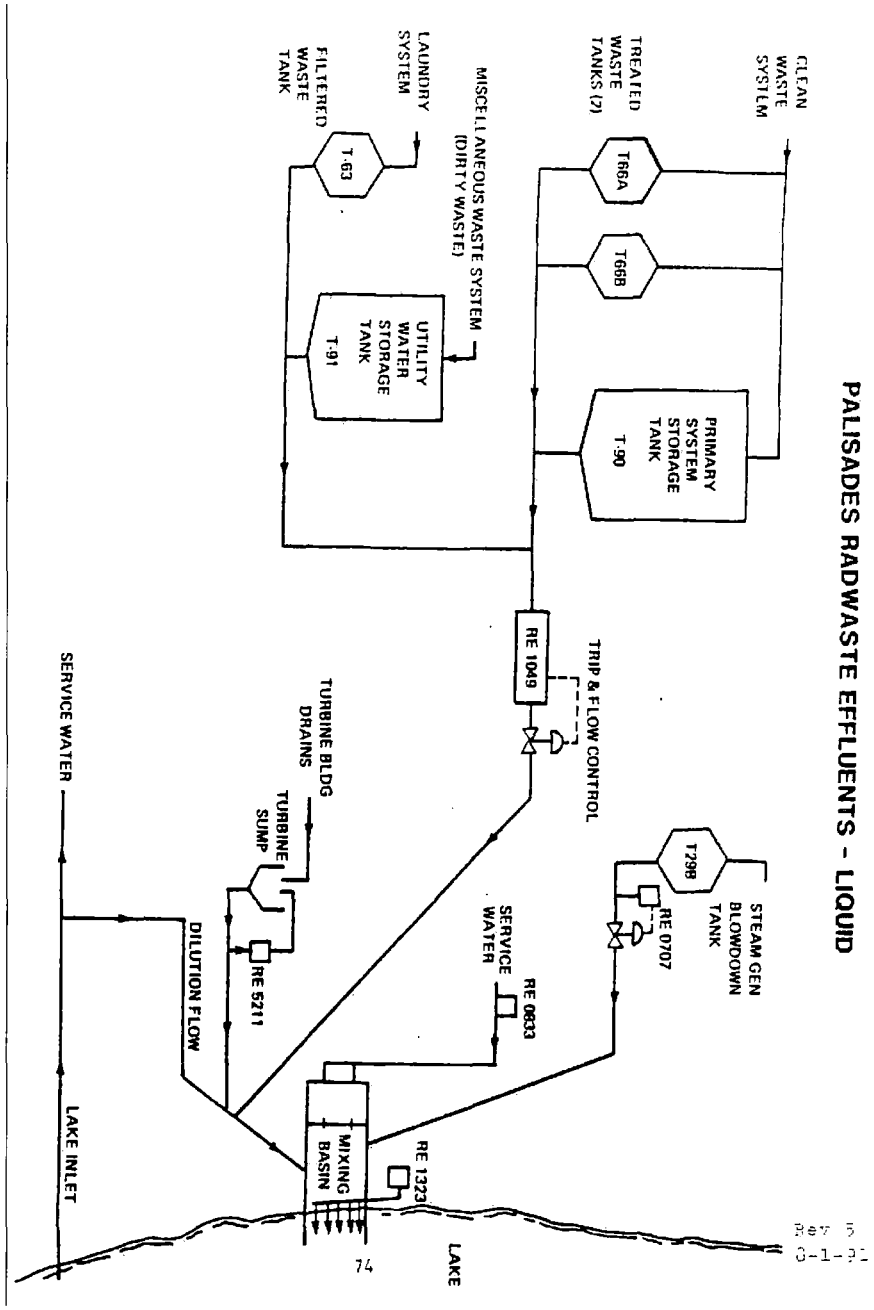


Figure 2-2


PALISADES RADWASTE EFFLUENTS - LIQUID
CLEAN WASTE SYSTEM
TREATED WASTE TANKS (2)
T66A
T66B
PRIMARY SYSTEM STORAGE TANK T-90
LAUNDRY SYSTEM
MISCELLANEOUS WASTE SYSTEM (DIRTY WASTE)
FILTERED WASTE TANK
T-63
UTILITY WATER STORAGE TANK T-91
RE 1049
TRIP & FLOW CONTROL
T29B
STEAM GEN BLOWDOWN TANK
RE 0707
SERVICE WATER
RE 0633
TURBINE BLDG DRAINS
TURBINE SUMP
RE 5211
DILUTION FLOW
SERVICE WATER
LAKE INLET
MIXING BASIN
RE 1323
LAKE
74

III. URANIUM FUEL CYCLE DOSE

A. SPECIFICATION

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

B. ASSUMPTIONS

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

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

C. DOSE CALCULATION

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

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

where:

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

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

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

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

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

IV. SOURCE REFERENCE DOCUMENTS

1. Regulatory Guide 1.21, Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioacitve 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, GASPAR 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)

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

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

BASIC RADIONUCLIDE DATA

	NUCLIDE	HALF-LIFE (days)	LAMBDA (1/s)	BETA[1] (MEV/DIS)	GAMMA[1] (MEV/DIS)
41	TC-99	7.74E 07	1.04E-13	8.46E-02	0.0
42	TC-104	1.25E-02	6.42E-04	1.60E 00	1 ,95E 00
43	RU-106	3.67E 02	2.19E-08	1.01E-02	0.0
44	TE-132	3.24E 00	2.48E-06	1.00E-01	2.33E-01
45	I-129	6.21E 09	1.29E-15	5.43E-02	2.46E-02
46	I-131	8.05E 00	9.96E-07	1.94E-01	3.81E-01
47	I-132	9.58E-02	8.37E-05	4.89E-01	2.24E 00
48	I-133	8.75E-01	9.17E-06	4.08E-01	6.02E-01
49	I-134	3.61E-02	2.22E-04	6.16E-01	2.59E 00
50	I-135	2.79E-01	2.87E-05	3.68E-01	1.55E 00
51	XE-131m	1.18E 01	6.80E-07	1.43E-01	2.01E-02
52	XE-133m	2.26E 00	3.55E-06	1.90E-01	4.15E-02
53	XE-133	5.27E 00	1.52E-06	1.35E-01	4.60E-02
54	XE-135m	1.08E-02	7.43E-04	9.58E-02	4.32E-01
55	XE-135	3.83E-01	2.09E-05	3.17E-01	2.47E-01
56	XE-137	2.71E 03	2.96E-03	1.77E 00	1.88E-01
57	XE-138	9.84E-03	8.15E-04	6.65E-01	1.10E 00
58	CS-134	7.48E 02	1.07E-08	1.63E-01	1.55E 00
59	CS-135	1.10E 09	7.29E-15	5.63E-02	0.0
60	CS-136	1.30E 01	6.17E-07	1.37E-01	2.15E 00
61	CS-137	1.10E 04	7.29E-10	1.71E-01	5.97E-01
62	CS-138	2.24E-02	3.58E-04	1.20E 00	2.3OE 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 $\mu Ci/m^3$
2. mrad/y per $\mu Ci/m^3$

*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

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

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.	2.24F-10	1.90E-06	7.18E-06
FE55	4.18E-06	2.98E-06	6.93E-07	0.	0.	1.55E-05	7.99E-07
FE59	1.99E-06	4.62E-06	1.79E-06	0.	0.	1.91E-04	2.23E-05
CO57	0.	1.18E-07	1.15E-07	0.	0.	7.33E-05	3.93E-06
CO58	0.	2.59E-07	3.47E-07	0.	0.	1.68E-04	1.19E-05
CO60	0.	1.89E-06	2.48E-06	0.	0.	1.09E-03	3.24E-05
NI59	5.44E-06	2.02E-06	9.24E-07	0.	0.	1.41E-05	6.48E-07
NI63	7.25E-05	5.43E-06	2.47E-06	0.	0.	3.84E-05	1.77E-06
NI65	2.73E-10	3.66E-11	1.59E-11	0.	0.	1.17E-06	4.59E-06
CU64	0.	2.54E-10	1.06E-10	0.	8.01E-10	1.39E-06	7.68E-06
ZN65	4.82E-06	1.67E-05	7.80E-06	0.	1.08E-05	1.55E-04	5.83E-06
ZN69M	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	4.343-07	2.97E-11
I129	2.48E-06	2.11E-06	6.91E-06	5.54E-03	4.53E-06	0.	2.22E-07
I130	5.72E-07	1.68E-06	6.60E-07	1.42E-04	2.61E-06	0.	9.61E-07
I131	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/m^2)

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

EXTERNAL DOSE FACTORS FOR STANDING ON CONTAMINATED GROUND (DFG_i)
(mrem/hr per pCi/m^2)

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

BIOACCUMULATION FACTORS
µCi/gm per µCi/ml

ELEMENT	FRESHWATER FISH
H	9.0E-01
C	4.6E 03
NA	1.0E 02
P	1.0E 05
CR	2.0E 02
MN	4.0E 02
FE	1.0E 02
CO	5.0E 01
NI	1.0E 02
CU	5.0E 01
ZN	2.OE 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	3.083-07
BE10	1.71E-05	2.49E-06	5.16E-07	0.	1.64E-06	0.	2.78E-05
C14	2.37E-05	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06
N13	5.85E-08	5.85E-08	5.85E-08	5.835E-08	5.85E-08	5.85E-08	5.85E-08
F18	5.19E-06	0.	4.43E.07	0.	0.	0.	1.22E-06
NA22	9.83E-05	9.83E-05	9.83E-05	9.83E-05	9.83E-05	9.83E-05	9.83E-05
NA24	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05
P32	1.70E-03	1.00E-04	6.59E-05	0.	0.	0.	2.30E-05
AR39	0.	0.	0.	0.	0.	0.	0.
AR41	0.	0.	0.	0.	0.	0.	0.
CA41	3.74E-04	0.	4.08E-05	0.	0.	0.	1.91E-07
SC46	3.75E-08	5.41E-08	1.69E-08	0.	3.56E-08	0.	3.53E-05
CR51	0.	0.	1.41E-08	9.20E-09	2.01E-09	1.79E-08	4.11E-07
MN54	0.	1.99E-05	4.51E-06	0.	4.41E-06	0.	7.31E-06
MN56	0.	8.18E-07	1.41E-07	0.	7.03E-07	0.	7.43E-05
FE55	1.39E-05	8.98E-06	2.40E-06	0.	0.	4.39E-06	1.14E-06
FE59	3.08E-05	5.38E-05	2.12E-05	0.	0.	1.59E-05	2.57E-05
CO57	0.	1.15E-06	1.87E-06	0.	0.	0.	3.92E-06
CO58	0.	3.60E-06	8.98E-06	0.	0.	0.	8.97E-06
CO60	0.	1.08E-05	2.55E-05	0.	0.	0.	2.57E-05
NI59	4.78E-05	1.45E-05	8.17E-06	0.	0.	0.	7.16E-07
NI63	6.34E-04	3.92E-05	2.20E-05	0.	0.	0.	1.95E-06
NI65	4.70E-06	5.32E-07	2.42E-07	0.	0.	0.	4.05E-05
CU64	0.	6.09E-07	2.82E-07	0.	1.03E-06	0.	1.25E-05
ZN65	1.84E-05	6.31E-05	2.91E-05	0.	3.06E-05	0.	5.33E-05
ZN69M	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.	5.193-06
CU64	0.	1.15E-07	5.41E-08	0.	2.91E-07	0.	8.92E-06
ZN65	5.76E-06	2.00E-05	9.33E-06	0.	1.28E-05	0.	8.47E-06
ZN69M	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.	7.543-05	0.	2.90E-04	0.	6.65E-05
U234	1.19E-03	0.	7.39E-05	0.	2.85E-04	0.	6.51E-05
U235	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)	DISTANCE (METERS)	X/Q (SEC/CUB.METER) NO DECAY UNDEPLETED	X/Q (SEC/CUB.METER) 2.260 DAY DECAY UNDEPLETED	X/Q (SEC/CUB.METER) 8.000 DAY DECAY DEPLETED	D/Q (PER SQ.METER)
A	SITE BOUNDARY	NNE	0.50	805.	1.58E-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

PALISADES NUCLEAR PLANT
OFFSITE DOSE CALCULATION MANUAL

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Process Applicability Exclusion	☐

CLJones	/	11/13/14
Procedure Sponsor		Date
CLJones	/	9/17/14
Technical Reviewer		Date
ALWilliams	/	11/11/14
General Manager Plant Operations		Date

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table of Contents

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table of Contents

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table of Contents

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table of Contents

TABLES

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

I. INTRODUCTION

The NRC, through 10CFR50.36a, requires implementation of Technical Specifications on effluents from nuclear power plants. NRC Generic Letter 89-01, dated January 31, 1989, allowed relocation of the existing procedural requirements from the Technical Specifications (implemented in Amendment 85, November 9, 1984). The relocated procedural requirements related to gaseous and liquid effluents, total dose, environmental monitoring program, and associated procedural reporting requirements follow below. Programmatic controls are retained in the Administrative Controls section of the Technical Specification to satisfy the regulatory requirements of 10CFR50.36a. The Technical Specifications programmatic controls include requirements for the establishment, implementation, maintenance, and changes to the Offsite Dose Calculation Manual (ODCM) as well as record retention and reporting requirements.

II. DEFINITIONS

A. CHANNEL CALIBRATION

- a Channel Calibration shall be the adjustment, as necessary, of the channel output such that it responds with the necessary range and accuracy to known values of the parameter which the channel monitors. The Channel Calibration shall encompass the entire channel including the sensor and alarm and/or trip functions, and shall include the Channel Function Test. The Channel Calibration may be performed by any series of sequential, overlapping, or total channel steps such that the entire channel is calibrated.

B. CHANNEL CHECK

- a Channel Check shall be the qualitative assessment of channel behavior during operation by observation. This determination shall include, where possible, comparison of the channel indication and/or status with other indications and/or status derived from independent instrumentation channels measuring the same parameter.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

C. CHANNEL FUNCTIONAL TEST

- a Channel Functional Test shall be:

1. Analog channels - the injection of a simulated signal into the channel as close to the sensor as practicable to verify operability including alarm and/or trip functions.

2. Bistable channels - the injection of a simulated signal into the sensor to verify operability including alarm and/or trip functions.

D. SOURCE CHECK

- a source check shall be the qualitative assessment of channel response when the channel sensor is exposed to a radioactive source.

E. OFFSITE DOSE CALCULATION MANUAL

- (per Plant Technical Specifications) - the Offsite Dose Calculation Manual (ODCM) shall contain the methodology and parameters used in the calculation of offsite doses resulting from radioactive gaseous and liquid effluents, in the calculation of gaseous and liquid effluent monitoring alarm/trip setpoints, and in the conduct of the Radiological Environmental Monitoring Program. The ODCM shall also contain: 1) the Radioactive Effluent Controls and Radiological Environmental Monitoring Programs required by the Technical Specifications, and 2) descriptions of the information that should be included in the Annual Radiological Environmental Operating and Radioactive Effluent Release Reports required by the Technical Specifications.

F. GASEOUS RADWASTE TREATMENT SYSTEM

- any system designed and installed to reduce radioactive gaseous effluents by collecting primary coolant system off gases from the primary system and providing for delay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.

G. MEMBERS OF THE PUBLIC

- all persons who are not occupationally associated with the Plant. This category does not include employees of the utility, its contractors, or vendors. Also excluded from this category are persons who enter the site to service equipment or to make deliveries.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

H. PROCESS CONTROL PROGRAM (PCP)

- shall contain the current formula, sampling, analyses, tests, and determinations to be made to ensure that the processing and packaging of solid radioactive wastes based on demonstrated processing of actual or simulated wet solid wastes will be accomplished in such a way as to assure compliance with 10CFR Part 20, 10CFR Part 71 and Federal and State regulations and other requirements governing the disposal of the radioactive waste.

I. SITE BOUNDARY

- that line beyond which the land is neither owned nor otherwise controlled by the licensee.

J. UNRESTRICTED AREA

- any area at or beyond the Site Boundary access which is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials or, any area within the Site Boundary used for residential quarters or for industrial, commercial, institutional, and/or recreational purposes.

K. VENTILATION EXHAUST TREATMENT SYSTEM

- any system designed and installed to reduce gaseous radioiodine or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal absorbers and/or HEPA filters for the purpose of removing iodines or particulates from the gaseous exhaust stream prior to the release to the environment. Such a system is not considered to have any effect on noble gas effluents. Engineered Safety Feature (ESF) atmospheric cleanup systems are not considered to be ventilation exhaust treatment system components.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

III. PROCEDURAL AND SURVEILLANCE REQUIREMENTS AND BASES

A. RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

1. Requirement

The radioactive gaseous effluent monitoring instrumentation channels shown in Table A-1 shall be operable with their alarm/trip setpoints set to ensure that the limits of requirement III.B.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters in the ODCM.

2. Action

a. With a radioactive gaseous effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above requirement, without delay, suspend the release of radioactive gaseous effluents monitored by the affected channel or declare the channel inoperable or change the setpoint so it is acceptably conservative.

b. With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels operable, take the action shown in Table A-1. Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner.

3. Surveillance Requirements

Each radioactive gaseous effluent monitoring instrumentation channel shall be demonstrated operable by performance of the Channel Check, Source Check, Channel Calibration, and Channel Functional Test operations at the frequencies shown in Table A-2.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

4. Bases

The radioactive gaseous effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in gaseous effluents during actual or potential releases of gaseous effluents. The alarm/trip setpoints for these instruments shall be calculated and adjusted in accordance with the methodology and parameters in the ODCM to ensure that the alarm/trip will occur prior to exceeding the limits of 10CFR Part 20.

The operability and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10CFR Part 50.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table A-1
Radioactive Gaseous Effluent Monitoring Instrumentation

Instrument	Minimum Operable Channels	Applicability	Action
1. **WASTE GAS HOLDUP SYSTEM**			
a. Noble Gas Activity Monitor (RIA 1113) Providing Alarm and Automatic Termination of Release	(1)	At All Times	1
2. **CONDENSER EVACUATION SYSTEM (RIA 0631)**			
a. Noble Gas Activity Monitor	(1)	Above 210°F Modes 1, 2, 3, 4	3
b. Evacuation Flow Indicator (FI-0631 or FI-0632)	(1)***	Above 210°F Modes 1, 2, 3, 4	
3. **STACK GAS EFFLUENT SYSTEM**			
a. Noble Gas Activity Monitor (RIA 2326)*	(1)	At All Times	3
b. Iodine/Particulate/Sampler/Monitor (RIA 2325)	(1)	At All Times	6
c. Sampler Flow Rate Monitor (FE-2346)	(1)	At All Times	2
d. Hi Range Noble Gas (RIA 2327)*	(1)	Above 210°F Modes 1, 2, 3, 4	4
4. **STEAM GENERATOR BLOWDOWN VENT SYSTEM**			
a. Noble Gas Activity Monitor (RIA 2320)	(1)	Above 210°F Modes 1, 2, 3, 4	3
5. **MAIN STEAM SAFETY AND DUMP VALVE DISCHARGE LINE**			
a. Gross Gamma Activity Monitor* (RIA 2323 and 2324)	1 per Main Steam Line	Above 325°F Modes 1, 2, 3	4
6. **ENGINEERED SAFEGUARDS PUMP ROOM VENTILATION HIGH RADIATION SYSTEM**			
a. Noble Gas Activity Monitor ** (RIA 1810 and 1811)	1 per Room	Above 210°F Modes 1, 2, 3, 4	5

* Setpoints for these instruments are exempted from III.B.1 limits, but are governed by Emergency Implementing Procedures or Operating procedures.

** Setpoints for these instruments are exempted from III.B.1 limits, but are governed by Technical Specifications SR 3.3.10.3.

*** Documentation of operability not required.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table A-1 (Cont'd)

TABLE NOTATION - ACTION STATEMENTS

ACTION 1 - With the number of channels operable less than required by the Minimum Operable Channels requirements, the contents of the tank(s) may be released to the environment provided that prior to initiating the release:

a. At least two independent samples of the tank's contents are analyzed, and

b. At least two technically qualified members of the facility staff independently verify the release rate calculations and discharge valve line up;

Otherwise, suspend release of radioactive effluents via this pathway.

ACTION 2 - With the number of channels operable less than required by the Minimum Operable Channels requirement, effluent releases via this pathway may continue provided the flow rate is estimated at least once per 24 hours.

ACTION 3 - With the number of channels operable less than required by the Minimum Operable Channels requirement, effluent releases via this pathway may continue provided grab samples are taken at least once per 12 hours and these samples are analyzed for gross activity within 24 hours.

ACTION 4 - With the number of operable channels less than required by the Minimum Operable Channels requirements, initiate the preplanned alternate method of monitoring the appropriate parameter(s), within 72 hours, and:

a. Either restore the inoperable channel(s) to operable status within 7 days of the event, or

b. Prepare and submit a Special Report to the NRC within 30 days following the event outlining the actions taken, the cause of the inoperability, and the plans and schedule for restoring the system to operable status.

ACTION 5 - If either channel fails low or is otherwise inoperable, the ventilation dampers associated with that channel shall be closed immediately and action shall be taken to have the affected channel repaired. The dampers associated with the channel shall not be opened until the affected channel has been declared operable.
(Reference Technical Specifications LCO 3.3.10.)

ACTION 6 - With the number of channels operable less than required by the Minimum Operable Channels requirement, effluent releases via the affected pathway may continue provided samples are continuously collected with auxiliary sampling equipment as required in Table B-1.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER
NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table A-2
Radioactive Gaseous Effluent Monitoring Instrumentation Surveillance Requirements

Instrument	Channel Check	Source Check	Channel Calibration	Channel Functional Test	Modes in Which Surveillance Required
1. **WASTE GAS HOLDUP SYSTEM**					
a. Noble Gas Activity Monitor-Providing Alarm and Automatic Termination of Release	D(4)	P	R(3)	Q(1)(2)	*
2. **CONDENSER EVACUATION SYSTEM**					
a. Noble Gas Activity Monitor	D	M	R(3)	Q(2)	Above 210°F
b. Evacuation Flow Indicator (FI-0632) or	***	***	***	***	Modes 1, 2, 3, 4
c. Evacuation Flow Indicator (FI-0631)	***	***	***	***	
3. **STACK GAS EFFLUENT SYSTEM**					
a. Noble Gas Activity Monitor	D	M	R(3)	Q(2)	*
b. Iodine Particulate Sampler/Monitor	W	M**	R(3)**	NA	*
c. Sampler Flow Rate Monitor	D	NA	R	NA	*
d. Hi Range Noble Gas	D	M	R(3)	Q(2)	Above 210°F Modes 1, 2, 3, 4
4. **STEAM GENERATOR BLOWDOWN VENT SYSTEM**					
a. Noble Gas Activity Monitor	D	M	R(3)	Q(2)	Above 210°F Modes 1, 2, 3, 4
5. **MAIN STEAM SAFETY AND DUMP VALVE DISCHARGE LINE**					
a. Gross Gamma Activity Monitor	D	M	R(3)	Q(2)	Above 325°F Modes 1, 2, 3
6. **ENGINEERED SAFEGUARDS PUMP ROOM VENTILATION HIGH RADIATION SYSTEM**					
a. Noble Gas Activity Monitor (Technical Specifications SR 3.3.10 and SR 3.7.13.1)	12 hours	31 days	18 months (3)	31 days(1)(2)	Above 210°F Modes 1, 2, 3, 4

* At all times other than when the line is valved out and locked.
** Sampler not applicable
*** This type of Flowmeter doesn't have any surveillance requirements.

Table A-2 (Cont'd)

Table Notation

(1) The Channel Functional Test shall also demonstrate that automatic isolation of this pathway occurs if instrument indicates measured levels above the alarm/trip setpoint.

(2) The Channel Functional Test shall also demonstrate that Control Room alarm annunciation occurs if either of the following conditions exists.

a. Instrument indicates measured levels above the alarm setpoint (not applicable for Item 3.d, Hi Range Noble Gas).

b. Circuit failure.

(3) a. The Channel Calibration shall be performed using one or more of the reference standards traceable to the National Institute of Standards and Technology or using standards that have been obtained from suppliers that participate in measurement assurance activities with NIST. These standards shall permit calibrating the system over its intended range of energy and measurement range.

b. For subsequent Channel Calibration, sources that have been related to the (1) calibration may be used.

(4) Channel Check shall be made at least once per 24 hours on days on which continuous or batch releases are made.

TABLE FREQUENCY NOTATION

S	At least once per 12 hours
D	At least once per 24 hours
M	At least once per 31 days
P	Prior to radioactive batch release
Q	At least once per 92 days
R	At least once per 18 months
W	At least once per week

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

B. GASEOUS EFFLUENTS DOSE RATE

1. Requirement

The dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the Site Boundary (see Figure 2-1) shall be limited to the following:

a. For noble gases: Less than or equal to 500 mrems/yr to the total body and less than or equal to 3000 mrems/yr to the skin, and

b. For Iodine-131, for Iodine-133, for tritium, and for all radionuclides in particulate form with half-lives greater than 8 days: Less than or equal to 1500 mrems/yr to any organ.

2. Action

With the dose rate(s) averaged over a period of one hour exceeding the above limits, without delay, restore the release rate to within the above limit(s).

3. Surveillance Requirements

a. The dose rate due to noble gases in gaseous effluents shall be determined to be within the limits of B.1.a in accordance with the methodology and parameters in the ODCM.

b. The dose rate due to Iodine-131, Iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents shall be determined to be within the limits of B.1.b in accordance with the methodology and parameters in the ODCM by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Table B-1.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

4. Bases

This is provided to ensure that the dose at any time at and beyond the Site Boundary from gaseous effluents from all units on the site will be within 10 times the annual dose limits of 10CFR Part 20 to Unrestricted Areas. The annual dose limits are the doses associated with the concentrations of 10 times 10CFR Part 20, Appendix B, Table 2, Column 1. These restrictions provide reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of a Member of the Public in an Unrestricted Area, either within or outside the Site Boundary, to annual exposure greater than design objectives of 10CFR 50, Appendix I, Section II.B.1. For Members of the Public who may at times be within the Site Boundary, the occupancy of the Member of the Public will usually be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the Site Boundary. Examples of calculations for such Members of the Public, with the appropriate occupancy factors, shall be given in the ODCM. The specified release rate limits restrict, at all times, the corresponding dose rate above background to a Member of the Public at or beyond the Site Boundary to less than or equal to 500 mrems/yr to the total body.

The required detection capabilities for radioactive materials in gaseous waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD and other detection limits can be found in HASL Procedures Manual, HASL-300, Currie, L A, "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry," Anal Chem 40, 586-93 (1968), and Hartwell, JK, "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Hanford Company Report ARH-SA-215 (June 1975).

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

C. NOBLE GASES DOSE

1. Requirement

The air dose due to noble gases released in gaseous effluents to areas at and beyond the Site Boundary (see Figure 2-1) shall be limited to the following:

a. During any calendar quarter: Less than or equal to 5 mrads for gamma radiation and less than or equal to 10 mrads for beta radiation, and

b. During any calendar year: Less than or equal to 10 mrads for gamma radiation and less than or equal to 20 mrads for beta radiation.

2. Action

With the calculated air dose from radioactive noble gases in gaseous effluents exceeding any of the above limits, prepare and submit to the NRC within 30 days a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

3. Surveillance Requirements

Cumulative dose contributions for the current calendar quarter and current calendar year for noble gases shall be determined in accordance with the methodology and parameters in the ODCM at least once per 31 days.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

4. Bases

This requirement is provided to implement the requirements of Sections II.B, III.A, and IV.A of Appendix I, 10CFR Part 50. The limiting Condition for Operation implements the guides set forth in Section II.B of Appendix I. The Action statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in gaseous effluents to Unrestricted Areas will be kept "as low as is reasonably achievable." The Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a Member of the Public through appropriate pathways is unlikely to be substantially underestimated. The dose calculation methodology and parameters established in the ODCM for calculating the doses due to the actual release rates of radioactive noble gases in gaseous effluents are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR Part 50, Appendix I," Revision 1, October 1977 and Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, July 1977. The ODCM equations provided for determining the air doses at and beyond the Site Boundary are based upon the historical average atmospheric conditions.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

D. I-131, I-133, TRITIUM, AND PARTICULATES

1. Requirement

The dose to a Member of the Public from Iodine-131, Iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released, from each reactor unit, to areas at and beyond the Site Boundary (see Figure 2-1) shall be limited to the following:

a. During any calendar quarter: Less than or equal to 7.5 mrems to any organ, and

b. During any calendar year: Less than or equal to 15 mrems to any organ.

2. Action

With the calculated dose from the release of Iodine-131, Iodine-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days, in gaseous effluents exceeding any of the above limits, prepare and submit to the NRC within 30 days a Special Report that identifies the cause(s) for exceeding the limit and define(s) the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

3. Surveillance Requirements

Cumulative dose contributions for the current calendar quarter and current calendar year for Iodine-131, Iodine-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days shall be determined in accordance with the methodology and parameters in the ODCM at least once per 31 days.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

4. Bases

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

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER
NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table B-1
Radioactive Gaseous Waste Sampling and Analysis Program

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit Detection (LLD)[a] (µCi/ml)
A. Waste Gas Storage Tank	P Each Tank Grab Sample	P Each Tank	Principal Gamma Emitters[b]	1×10^{-4}
B. Containment PURGE	P Each PURGE Grab Sample	P Each PURGE	Principal Gamma Emitters[b]	1×10^{-4}
C. Stack Gas Effluent	Continuous[c]	W[d,e] Charcoal Sample	I-131, I-133	1×10^{-12}
	Continuous[c]	W[d,e] Particulate Sample	Principal Gamma Emitters[b]	1×10^{-11}
	Continuous[c]	Q Composite Particulate Sample	Sr-89, Sr-90, and Gross Alpha	1×10^{-11}
	Continuous[c]	Noble Gas Monitor	Noble Gases Gross Beta or Gamma	1E-06

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit Detection (LLD)[a] (µCi/ml)
D. Condenser Evacuation System	Continuous	Noble Gas Monitor	Noble Gases	1×10^{-6}
	W[f] Grab	W	Principal Gamma Emitters[b]	1×10^{-4}

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table B-1 (Cont'd)

Table Notation

a The LLD is defined, in Table E-3, note C.

b The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 for gaseous emissions and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141, and Ce-144 for particulate emissions. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Radioactive Effluent Release Report.

c The ratio of the sample flow rate to the sample stream flow rate shall be known for the time period covered by each dose or dose rate calculation made in accordance with requirements III.B.1, III.C.1, and III.D.1.

d Samples shall be changed at least once per 7 days and analyses shall be completed within 48 hours after changing or after removal from sampler.

e With channels operable on iodine monitor RIA 2325 less than required per III.A.1, sampling shall also be performed at least once per 24 hours for at least 7 days following each shutdown, start-up or Thermal Power change exceeding 15 percent of Rated Thermal Power in one hour and analyses shall be completed within 48 hours of changing. When samples collected for 24 hours are analyzed, the corresponding LLDs may be increased by a factor of 10. This requirement does not apply if, 1) analysis shows that the Dose Equivalent I-131 concentration in the primary coolant has not increased more than a factor of 3, and 2) the noble gas monitor shows that effluent activity has not increased more than a factor of 3.

f Obtain and analyze a gas sample weekly for noble gas quantification.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

E. GASEOUS WASTE TREATMENT SYSTEM

1. Requirement

When gaseous waste exceeds a Xe-133 concentration of 1E-05 µCi/cc, the Waste Gas Decay Tank System shall be used to reduce radioactive gaseous effluents by holding gaseous waste collected by the system for a minimum of 15 days.

2. Action

a. If a waste gas decay tank is required to be released with less than 15 days holdup time, the system waste gas tank contents shall be evaluated and the waste gas decay tank with the lowest dose consequence shall be released.

b. Gaseous waste may be discharged directly from the waste gas surge tank through a high-efficiency filter or from a waste gas decay tank with less than 15 days of holdup directly to the stack for a period not to exceed 7 days if the holdup system equipment is not available and the release rates meet requirements III.B, C, and D.

3. Surveillance Requirements

Not Applicable.

4. Bases

The requirement that the appropriate portions of these systems be used, when specified, provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable" by meeting the design objectives given in Section II.D of Appendix I to 10CFR50.

It is expected that releases of radioactive materials in effluents shall be kept at small fractions of the limits specified in 20.1302 of 10CFR20. At the same time the licensee is permitted the flexibility of operation, compatible with considerations of health and safety, to assure that the public is provided a dependable source of power even under unusual operating conditions which may temporarily result in releases higher than such small fractions, but still within the limits specified in III.B, C, and D.

F. RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

1. Requirement

The radioactive liquid effluent monitoring instrumentation channels shown in Table C-1 shall be operable with their alarm/trip setpoints set to ensure that the limits of III.G are not exceeded. The alarm/trip setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters in the Offsite Dose Calculation Manual (ODCM).

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

2. Action

a. With a radioactive liquid effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above specification, without delay suspend the release of radioactive liquid effluents monitored by the affected channel or declare the channel inoperable, or change the setpoint so it is acceptably conservative.

b. With less than the minimum number of radioactive liquid effluent monitoring instrumentation channels Operable, take the Action shown in Table C-1. Exert best efforts to return the instruments to Operable status within 30 days and, if unsuccessful, explain in the next Radioactive Effluent Release Report why the inoperability was not corrected in a timely manner.

3. Surveillance Requirements

Each radioactive liquid effluent monitoring instrumentation channel shall be demonstrated Operable by performance of the Channel Check, Source Check, Channel Calibration, and Channel Functional Test operations at the frequencies shown in Table C-2.

4. Bases

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

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table C-1

Radioactive Liquid Effluent Monitoring Instrumentation

Instrument	Minimum Operable Channels	Applicability	Action
1. **GROSS RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE**			
a. Liquid Radwaste Effluent Line (RIA 1049)	(1)	For Effluent Releases	1
b. Steam Generator Blowdown Effluent Line (RIA 0707)	(1)	For Effluent Releases	2
2. **GROSS BETA OR GAMMA RADIOACTIVE MONITORS PROVIDING ALARM BUT NOT PROVIDING AUTOMATIC TERMINATION OF RELEASE**			
a. Service Water System Effluent Line (RIA 0833)	(1)	For Effluent Releases	3
b. Turbine Building (Floor Drains) Sumps Effluent Line (RIA 5211)	(1)	For Effluent Releases	3
3. **FLOW RATE MEASUREMENT DEVICES**			
a. Liquid Radwaste Effluent Line (FIC 1051 or 1050)	(1)	For Effluent Releases	4
4. **CONTINUOUS COMPOSITE SAMPLERS** (Alarm/Trip Setpoints are not applicable)			
a. Turbine Building Sumps Effluent Line	(1)	For Effluent Releases	3
b. Service Water System Effluent	(1)	For Effluent Releases	3
c. Steam Generator Blowdown Effluent	(1)	For Effluent Releases	3

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table C-1 (Cont'd)

TABLE NOTATION

ACTION 1 - With the number of channels operable less than required by the Minimum Operable Channels requirement, effluent releases may continue provided that prior to initiating a release:

a. At least two independent samples are analyzed in accordance with requirements and

b. At least two technically qualified members of the Facility Staff independently verify the release rate calculations and discharge line valving;

Otherwise, suspend release of radioactive effluents via this pathway.

ACTION 2 - With the number of channels operable less than required by the Minimum Operable Channels requirement, effluent releases via this pathway may continue provided grab samples are analyzed for radioactivity at a lower limit of detection as specified in Table D-1 for principle gamma emitters and I-131 at least once per 12 hours.

NOTE:	The Steam Generator blowdown monitor is normally used in a clean up closed loop system instead of as an effluent monitor. The action statement only applies when the monitor is used as an effluent monitor.

ACTION 3 - With the number of channels operable less than required by the Minimum Operable Channels requirement, effluent releases via this pathway may continue provided that, at least once per 24 hours, grab samples are collected and analyzed for radioactivity at a lower limit of detection as specified in Table D-1 for principle gamma emitters and I-131.

ACTION 4 - With the number of channels operable less than required by the Minimum Operable Channels requirement, effluent releases via this pathway may continue provided the flow rate is estimated at least once per 4 hours during actual releases. Pump performance curves or tank levels may be used to estimate flow.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER
NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table C-2

Radioactive Liquid Effluent Monitoring Instrumentation Surveillance Requirements

Instrument	Channel Check	Source Check	Channel Calibration	Channel Functional Test
1. **GROSS RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE**				
a. Liquid Radwaste Effluent Line (RIA 1049)	P	P	R(3)	Q(1)(2)
b. Steam Generator Blowdown Effluent Line (RIA 0707)	D	M	R(3)	Q(1)(2)
2. **GROSS GAMMA OR GAMMA RADIOACTIVITY MONITORS PROVIDING ALARM BUT NOT PROVIDING AUTOMATIC TERMINATION OF RELEASE**				
a. Service Water System Effluent Line (RIA 0833)	D	M	R(3)	Q(2)
b. Turbine Building (Floor Drains) Sumps Effluent Line (RIA 5211)	D	M	R(3)	Q(2)
3. **FLOW RATE MEASUREMENT DEVICES (5)**				
a. Liquid Radwaste Effluent Line (FIC 1051 or 1050)	D(4)	NA	R	NA
4. **TURBINE SUMP EFFLUENT COMPOSITER**	D(4)	NA	NA	NA
5. **SERVICE WATER SYSTEM EFFLUENT COMPOSITE SAMPLER**	D(4)	NA	NA	NA
6. **STEAM GENERATOR BLOWDOWN EFFLUENT COMPOSITER**	D(4)	NA	NA	NA

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table C-2 (Cont'd)

TABLE NOTATION

(1) The Channel Functional Test shall also demonstrate that automatic isolation of this pathway occurs if instrument indicates measured levels above the alarm/trip setpoint.

(2) The Channel Functional Test shall also demonstrate that Control Room alarm annunciation occurs if either of the following conditions exists:

a. Instrument indicates measured levels above the alarm setpoint.

b. Circuit failure.

(3) a. The Channel Calibration shall be performed using one or more of the reference standards traceable to the National Institute of Standards and Technology or using standards that have been obtained from suppliers that participate in measurement assurance activities with NIST. These standards shall permit calibrating the system over its intended range of energy and measurement range.

b. For subsequent Channel Calibration, sources that have been related to the (a) calibration may be used.

(4) Channel Check shall consist of verifying indication of flow during periods of releases. Channel Check shall be made at least once per 24 hours on days on which continuous or batch releases are made.

(5) Turbine Sump Discharge Flow Meter FQI-5210 was calibrated at factory and doesn't require recalibration.

TABLE FREQUENCY NOTATION

D	At least once per 24 hours	Q	At least once per 92 days
M	At least once per 31 days	R	At least once per 18 months
P	Prior to radioactive batch release	W	At least once per week

G. LIQUID EFFLUENTS CONCENTRATION

1. Requirement

The concentration of radioactive material released in liquid effluents to Unrestricted Areas shall be limited to 10 times the concentrations specified in 10CFR Part 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 2×10^{-4} microcuries/ml total activity.

2. Action

With the concentration of radioactive material released in liquid effluents to Unrestricted Areas exceeding the above limits, without delay, restore the concentration to within the above limits.

3. Surveillance Requirements

a. Radioactive liquid wastes shall be sampled and analyzed according to the sampling and analysis program of Table D-1.

b. The results of the radioactivity analysis shall be used in accordance with the methodology and parameters in the ODCM to assure that the concentrations at the point of release are maintained within the limits of G.1 above.

4. Bases

This requirement is provided to ensure that the concentration of radioactive materials released in liquid waste effluents to Unrestricted Areas will be less than 10 times the concentration levels specified in 10CFR Part 20, Appendix B, Table 2, Column 2. This limitation provides additional assurance that the levels of radioactive materials in bodies of water in Unrestricted Areas will result in exposures within the Section II.A design objectives of Appendix I, 10CFR Part 50, to a Member of the Public. The concentration limit for dissolved or entrained noble gases is based upon the assumption that Xe-135 is the controlling radioisotope and 10 times the effluent concentration in air (submersion) was converted to an equivalent concentration in water using the methods described in International Commission on Radiological Protection (ICRP) Publication 2.

The required detection capabilities for radioactive materials in liquid waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD and other detection limits can be found in HASL Procedures Manual, HASL-300, Currie, LA, "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry," Anal Chem 40, 586-93 (1968), and Hartwell, JK, "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Hanford Company Report ARH-SA-215 (June 1975).

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER
NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table D-1
Radioactive Liquid Waste Sampling and Analysis Program

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit Detection (LLD)[a] (µCi/ml)
A. Batch Waste Release Tanks[b]	P Each Batch	P Each Batch	Principal Gamma Emitters[c] I-131	5×10^{-7} 1×10^{-6}
	P One Batch/M	M	Dissolved and Entrained Gases (Gamma Emitters)	1×10^{-5}
	P Each Batch	M Composite[d]	H-3 Gross Alpha	1×10^{-5} 1×10^{-7}
	P Each Batch	Q Composite[d]	Sr-89, Sr-90 Fe-55, Ni-63	5×10^{-8} 1×10^{-6}
B. Continuous Releases[e] (Turbine Sump, Steam Generator Blowdown, and Service Water)	Continuous[f]	W Composite[f]	Principal Gamma Emitters[c] I-131	5×10^{-7} 1×10^{-6}
	M Grab Sample	M	Dissolved and Entrained Gases (Gamma Emitters)	1×10^{-5}
	Continuous[f]	M Composite[f]	H-3 Gross Alpha	1×10^{-5} 1×10^{-7}
	Continuous[f]	Q Composite[f]	Sr-89, Sr-90	5×10^{-8}

Frequency Notation

P Prior to batch release
M Calendar month
Q Calendar quarter
W Calendar week

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table D-1 (Cont'd)

TABLE NOTATION

a The LLD is defined, in Table E-3, Note C.

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

c The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141, and Ce-144*. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Radioactive Effluent Release Report.

*LLD - 5E-06 because of low gamma yields.

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

e A continuous release is the discharge of liquid wastes of a nondiscrete volume; eg, from a volume of a system that has an input flow during the continuous release.

f To be representative of the quantities and concentrations of radioactive materials in liquid effluents, samples shall be collected in a series of aliquots of constant volume collected at regular time intervals and combined to form a single sample. Prior to analyses, all samples taken for the composite shall be thoroughly mixed in order for the composite sample to be representative of the effluent release.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

H. LIQUID EFFLUENT DOSE

1. Requirement

The dose or dose commitment to a Member of the Public from radioactive materials in liquid effluents released from each reactor unit to Unrestricted Areas shall be limited:

a. During any calendar quarter to less than or equal to 1.5 mrems to the total body and to less than or equal to 5 mrems to any organ, and

b. During any calendar year to less than or equal to 3 mrems to the total body and to less than or equal to 10 mrems to any organ.

2. Action

With the calculated dose from the release of radioactive materials in liquid effluents exceeding any of the above limits, prepare and submit to the NRC within 30 days a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits. This Special Report shall also include the results of radiological analyses of the drinking water source.

3. Surveillance Requirements

Cumulative dose contributions from liquid effluents for the current calendar quarter and the current calendar year shall be determined in accordance with the methodology and parameters in the ODCM at least once every 31 days.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

4. Bases

This requirement is provided to implement the requirements of Sections II.A, III.A, and IV.A of Appendix I, 10CFR Part 50. The Limiting Condition for Operation implements the guides set forth in Section II.A of Appendix I. The Action statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in liquid effluents to Unrestricted Areas will be kept "as low as is reasonably achievable." Also, for freshwater sites with drinking water supplies that can be potentially affected by Plant operations, there is reasonable assurance that the operation of the facility will not result in radionuclide concentrations in the finished drinking water that are in excess of the requirements of 40CFR Part 141. The dose calculation methodology and parameters in the ODCM implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a Member of the Public through appropriate pathways is unlikely to be substantially underestimated. The equations specified in the ODCM for calculating the doses due to the actual release rates of radioactive materials in liquid effluents are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR Part 50, Appendix I," Revision 1, October 1977 and Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents From Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1977.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

I. TOTAL DOSE

1. Requirement

The annual (calendar year) dose or dose commitment to any Member of the Public due to releases of radioactivity and to radiation from uranium fuel cycle sources shall be limited to less than or equal to 25 mrems to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrems.

2. Action

With the calculated doses from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of III.C.1.a, III.C.1.b, III.D.1.a, III.D.1.b, III.H.1.a, or III.H.1.b, calculations should be made including direct radiation contributions from the reactor units and from outside storage tanks to determine whether the above limits of III.I.1 have been exceeded. If such is the case, prepare and submit to the NRC within 30 days a Special Report that defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the above limits and includes the schedule for achieving conformance with the above limits. This Special Report, as defined in 10CFR Part 20.2203, shall include an analysis that estimates the radiation exposure (dose) to a Member of the Public from uranium fuel cycle sources, including all effluent pathways and direct radiation, for the calendar year that includes the release(s) covered by this report. It shall also describe levels of radiation and concentrations of radioactive material involved and the cause of the exposure levels or concentrations. If the estimated dose(s) exceeds the above limits, and if the release condition resulting in violation of 40CFR Part 190 has not already been corrected, the Special Report shall include a request for a variance in accordance with the provisions of 40CFR Part 190. Submittal of the report is considered a timely request and a variance is granted until staff action on the request is complete.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

3. Surveillance Requirements

a. Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with III.C.1, III.D.1, and III.H.1 and in accordance with the methodology and parameters in the ODCM.

b. Cumulative dose contributions from direct radiation from the reactor units and from radwaste storage tanks shall be determined in accordance with the methodology and parameters in the ODCM. This requirement is applicable only under conditions set forth in Action I.2 above.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

4. Bases

This requirement is provided to meet the dose limitations of 40CFR Part 190 that have been incorporated into 10CFR Part 20 by 46 FR 18525. It also requires the preparation and submittal of a Special Report whenever the calculated doses from Plant generated radioactive effluents and direct radiation exceed 25 mrems to the total body or any organ, except for thyroid, which shall be limited to less than or equal to 75 mrems. For sites containing up to 4 reactors, it is highly unlikely that the resultant dose to a Member of the Public will exceed the dose limits of 40CFR Part 190 if the individual reactors remain within twice the dose design objectives of Appendix I and if direct radiation doses from the reactor units and outside storage tanks are kept small. The Special Report will describe a course of action that should result in the limitation of the annual dose to a Member of the Public to within the 40CFR Part 190 limits. For the purposes of the Special Report, it may be assumed that the dose commitment to the Member of the Public from other uranium fuel cycle sources is negligible, with the exception that dose contributions from other nuclear fuel cycle facilities at the same site or within a radius of 8 km must be considered. If the dose to any Member of the Public is estimated to exceed the requirements of 40CFR Part 190, the Special Report with a request for a variance (provided the release conditions resulting in violation of 40CFR Part 190 have not already been corrected), in accordance with the provisions of 40CFR Part 190.11 and 10CFR Part 20.2203, is considered to be a timely request and fulfills the requirements of 40CFR Part 190 until NRC staff action is completed. The variance only relates to the limits of 40CFR Part 190 and does not apply in any way to the other requirements for dose limitation of 10CFR Part 20. An individual is not considered a Member of the Public during any period in which he/she is engaged in carrying out any operation that is part of the nuclear fuel cycle.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

J. RADIOLOGICAL ENVIRONMENTAL MONITORING

1. Requirement

The radiological environmental monitoring program shall be conducted as specified in Table E-1.

2. Action

a. With the radiological environmental monitoring program not being conducted as specified in Table E-1, prepare and submit to the NRC, in the Annual Radiological Environmental Operating Report a description of the reasons for not conducting the program as required and the plans for preventing a recurrence.

b. With the level of radioactivity as the result of Plant effluents in an environmental sampling medium at a specified location exceeding the reporting levels of Table E-2 when averaged over any calendar quarter, prepare and submit to the NRC within 30 days a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions to be taken to reduce radioactive effluents. When more than one of the radionuclides in Table E-2 are detected in the sampling medium, this report shall be submitted if:

$$\frac{\text{Concentration (1)}}{\text{Reporting Level (1)}} + \frac{\text{Concentration (2)}}{\text{Reporting Level (2)}} + ... \geq 1.0$$

When radionuclides other than those in Table E-2 are detected and are the result of Plant effluents, this report shall be submitted if the potential annual dose to a Member of the Public is equal to or greater than the calendar year limits of III.C.1, III.D.1, and III.H.1. This report is not required if the measured level of radioactivity was not the result of Plant effluents; however, in such an event, the condition shall be reported and described in the Annual Radiological Environmental Operating Report.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

c. With milk or fresh leafy vegetable samples unavailable from one or more of the sample locations required by Table E-1, identify locations for obtaining replacement samples and add them to the radiological environmental monitoring program within 30 days. The specific locations from which samples were unavailable may then be deleted from the monitoring program. Identify the cause of the unavailability of samples and identify the new location(s) for obtaining replacement samples in the next Annual Radiological Environmental Report.

3. Surveillance Requirements

a. The radiological environmental monitoring samples shall be collected pursuant to Table E-1 and shall be analyzed pursuant to the requirements of Table E-1 and the detection capabilities required by Table E-3.

b. A land use census shall be conducted and shall identify within a distance of 8 km (5 miles) the location in each of the 9 overland meteorological sectors of the nearest milk animal, the nearest residence and the nearest garden of greater than 50 m^2 (500 ft^2) producing broad leaf vegetation.

c. The land use census shall be conducted during the growing season at least once per 12 months using that information that will provide the best results, such as by a door-to-door survey, aerial survey, or by consulting local agriculture authorities. The results of the land use census shall be included in the Annual Radiological Environmental Operating Report and shall be included in a revision of the ODCM for use in the following calendar year.

d. Analyses shall be performed on radioactive materials supplied as part of an Interlaboratory Comparison Program that has been approved by the NRC.

e. A summary of the results obtained as part of the above required Interlaboratory Comparison Program shall be included in the Annual Radiological Environmental Operating Report.

f. The environmental air samplers shall be operationally checked monthly and airflow verified annually.

4. Bases

a. Monitoring Program

The radiological environmental monitoring program provides representative measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposures of Members of the Public resulting from the station operation. This monitoring program implements Section IV.B.2 of Appendix I to 10CFR Part 50 and thereby supplements the radiological effluent monitoring program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and the modeling of the environmental exposure pathways. Guidance for this monitoring program is provided by the Radiological Assessment Branch Technical Position on Environmental Monitoring. The initially specified monitoring program will be effective for at least the first three years of commercial operation. Following this period, program changes may be initiated based on operational experience.

The required detection capabilities for environmental sample analyses are tabulated in terms of the lower limits of detection (LLDs). The LLDs required by Table E-3 are considered optimum for routine environmental measurements in industrial laboratories.

Detailed discussion of the LLD, and other detection limits, can be found in HASL Procedures Manual, HASL-300, Currie, LA, "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry," Anal Chem 40, 586-92 (1968), and Hartwell, JK, "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Hanford Company Report ARH-SA-15 (June 1975).

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

b. Land Use Census:

This requirement is provided to ensure that changes in the use of areas at and beyond the site boundary are identified and that modifications to the radiological environmental monitoring program are made if required by results of this census. The best information from the door-to-door survey, from aerial survey or from consulting with local agricultural authorities shall be used. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10CFR Part 50. Restricting the census to gardens of greater than 50 m^2 provides assurance that significant exposure pathways via leafy vegetables will be identified and monitored since a garden of this size is the minimum required to produce the quantity (16 kg/yr) of leafy vegetables assumed in Regulatory Guide 1.109 for consumption by a child.

To determine this minimum garden size, the following assumptions were made: (1) 20% of the garden was used for growing broad leaf vegetation (ie, similar to lettuce and cabbage), and (2) a vegetation yield of 2 kg/m^2.

c. Interlaboratory Comparison Program:

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

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table E-1

Radiological Environmental Monitoring Program

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations[a]	Sampling and Collection Frequency	Type and Frequency of Analysis
1. **DIRECT RADIATION[b]**	23 routine monitoring stations either with two or more dosimeters or with one instrument for measuring and recording dose rate continuously, placed as follows: One on site TLD in the vicinity of the Plant. An inner ring of stations, one in each overland meteorological sector (9) in the general area of the Site Boundary and one additional location near the State Park camping area in the NE sector. An outer ring of stations, one in each overland meteorological sector (9) within the 12 km range from the site. The balance of the stations (3) to be placed to serve as control stations.	Quarterly	Gamma dose quarterly

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations[a]	Sampling and Collection Frequency	Type and Frequency of Analysis
2. **AIRBORNE**			
Radioiodine and Particulates	Samples from 5 locations. 3 samples from within 6 km of the Site Boundary in different sectors (2.5 km-SSW, 5.8 km-ESE and .96 km-NE). 1 sample from the vicinity of a community having the highest calculated annual average ground level D/Q (Covert-6.2 km-SE). 1 sample from a control location in the least prevalent wind direction[c] (Grand Rapids 82 km-NE)[h].	Continuous sample operation with sample collection weekly or more frequently if required by dust loading.	Radioiodine Canister: I-131 analysis weekly for each filter change. Particulate Sampler: Gross beta radioactivity analysis following filter change[d]. Gamma isotopic[e] analysis on quarterly composite
3. **WATERBORNE**			
a. Lake (surface)	Plant lake water inlet.	Composite sample over 1-month period[f].	Gamma isotopic[e] and tritium analyses monthly.
b. Lake (drinking)	1 sample of South Haven drinking water supply.	Composite sample over 1-month period[f].	Gamma isotopic[e], gross beta, and tritium analyses monthly.
	1 sample from a control location (Ludington Pumped Storage 201 km N)	Composite sample over 1-month period[f].	Gamma isotopic[e], gross beta, and tritium analyses monthly.
c. Well (drinking)	1 grab sample per month when Palisades Park community drinking water well is in operation (Park is seasonal in operations and is only open for the summer months)	1 grab sample per month when operational	Gamma isotopic[e] and tritium analyses monthly when Park is operational.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations[a]	Sampling and Collection Frequency	Type and Frequency of Analysis
d. Sediment from shoreline	1 sample from between north boundary and Van Buren State Park beach, approximately ½ mile north of the Plant discharge.	Semiannually	Gamma isotopic[e] analysis semiannually.
4. **INGESTION**			
a. Milk	Samples from milking animals in 3 locations between 5-8 km distance.	Monthly	Gamma isotopic[e] and I-131 analyses monthly.
	1 sample from milking animals at a control location, 15-30 km distance.	Monthly	Gamma isotopic[e] and I-131 analyses monthly.
b. Broad leaf vegetation	Samples of 3 different kinds of broad leaf vegetation grown nearest each of two different offsite locations of highest predicted annual average ground level D/Q if milk sample is not performed. (SE or SSE sectors near site.)	Monthly during growing season	Gamma isotopic[e] and I-131 analyses
	1 sample of each of the similar broad leaf vegetation grown 15-30 km distance in the least prevalent wind direction if milk sampling is not performed. (NNE or NE sectors.)	Monthly during growing season	Gamma isotopic[e] and I-131 analyses
c. Fish	Sample 2 species of commercially and/or recreationally important species in vicinity of Plant discharge area. 1 sample of same species in areas not influenced by Plant discharge.	Sample in season or semiannually if they are not seasonal.	Gamma isotopic[e] analysis
d. Food Products	1 sample each of two principal fruit crops (blueberries and apples).	At time of harvest[g]	Gamma isotopic[e] and I-131 analyses.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table E-1 (Cont'd)
Table Notation

a Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunction, every effort shall be made to complete corrective action prior to the end of the next sampling period. All deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Operating Report. It is recognized that, at times, it may not be possible or practicable to continue to obtain samples of the media of choice at the most desired location or time. In these instances, suitable alternative media and locations may be chosen for the particular pathway in question and appropriate substitutions made within 30 days in the radiological environmental monitoring program.

b One or more instruments, such as a pressurized ion chamber, for measuring and recording dose rate continuously may be used in place, or in addition to, integrating dosimeters. For the purposes of this table, a thermoluminescent dosimeter (TLD) is considered to be one phosphor; two or more phosphors or phosphor readout zones in a packet are considered as two or more dosimeters.

c The purpose of this sample is to obtain background information. If it is not practical to establish control locations in accordance with the distance and wind direction criteria, other sites that provide valid background data may be substituted.

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

e Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.

f A composite sample is one in which the quantity (aliquot) of liquid samples is proportional to the quantity of liquid discharged and in which the method of sampling employed results in a specimen that is representative of the liquid released (continuous composites or daily grab composites which meet this criteria are acceptable).

g If harvest occurs more than once a year, sampling shall be performed during each discrete harvest.

h The Control Air sample results from Cook Nuclear Plant, except Coloma, may be used as a backup of the Grand Rapids control.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER
NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table E-2
Reporting Levels for Radioactivity Concentrations in Environmental Samples

Reporting Levels

Analysis	Water (pCi/l)	Airborne Particulates or Gases (pCi/m^3)	Fish (pCi/kg, Wet)	Milk (pCi/l)	Food Products (pCi/kg, Wet)
H-3	20,000*				
Mn-54	1,000		30,000		
Fe-59	400		10,000		
Co-58	1,000		30,000		
Co-60	300		10,000		
Zn-65	300		20,000		
Zr-Nb-95	400				
I-131	2	0.9		3	100
Cs-134	30	10	1,000	60	1,000
Cs-137	50	20	2,000	70	2,000
Ba-La-140	200			300	

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

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER
NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table E-3

Detection Capabilities for Environmental Sample Analysis[a]
Lower Limit of Detection (LLD)[bc]

Analysis	Water (pCi/l)	Airborne Particulates or Gases (pCi/m[3)]	Fish (pCi/kg, Wet)	Milk (pCi/l)	Food Products (pCi/kg, Wet)	Sediment (pCi/kg, Dry)
Gross Beta	4	0.01				
H-3	2,000*					
Mn-54	15		130			
Fe-59	30		260			
Co-58	15		130			
Co-60	15		130			
Zn-65	30		260			
Zr-95	30					
Nb-95	15					
I-131	1[d]	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-140	60			60		
La-140	15			15		

* If no drinking water pathway exists, a value of 3,000 pCi/l may be used.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table E-3 (Cont'd)
TABLE NOTATION

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

b Required detection capabilities for thermoluminescent dosimeters used for environmental measurements are given in Regulatory Guide 4.13.

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

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

$$LLD = \frac{4.66 \times s_b}{E \times V \times 2.22 \times Y \times Exp(-\lambda \Delta t)}$$

Where:

LLD is the "a priori" lower limit of detection as defined above, as picocuries per unit mass or volume.

s_b is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate, as counts per minute.

E is the counting efficiency, as counts per disintegration.

V is the sample size in units of mass or volume.

2.22 is the number of disintegrations per minute per picocurie.

Y is the fractional radiochemical yield, when applicable.

λ is the radioactive decay constant for the particular radionuclide.

Δt for environmental samples is the elapsed time between sample collection, or end of the sample collection period, and time of counting.

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

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

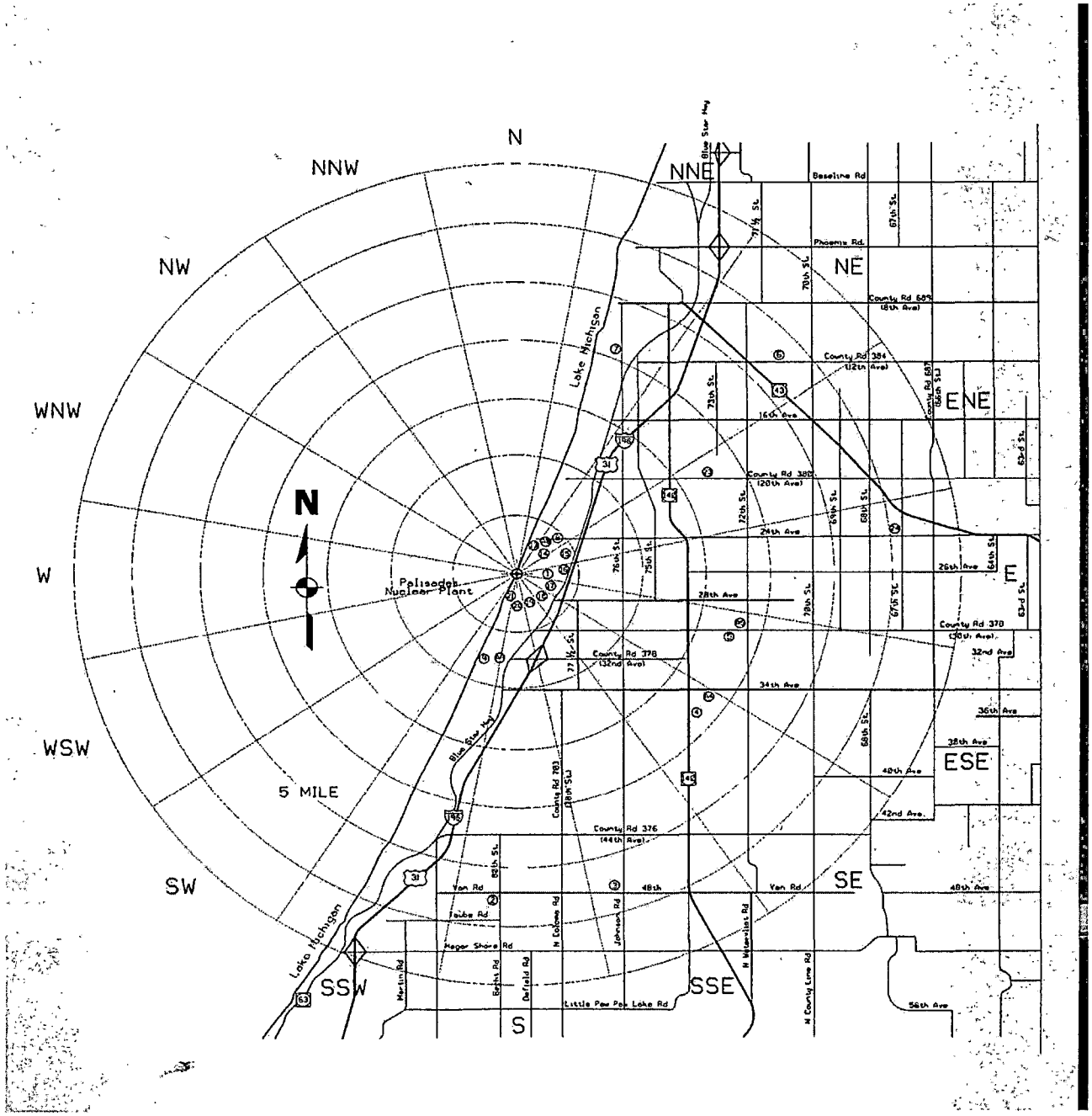
Table E-3 (Cont'd)
Table Notation

It should be recognized that the LLD is defined as an "a priori" (before the fact) limit representing the capability of a measurement system and not as an "a posteriori" (after the fact) limit for a particular measurement. Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unavoidable small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors shall be identified and described in the Annual Radiological Environmental Operating Report.

d LLD for drinking water samples. If no drinking water pathway exists, the LLD of gamma isotopic analysis may be used.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER
NRC GENERIC LETTER 89-01 (TAC NO 75060)

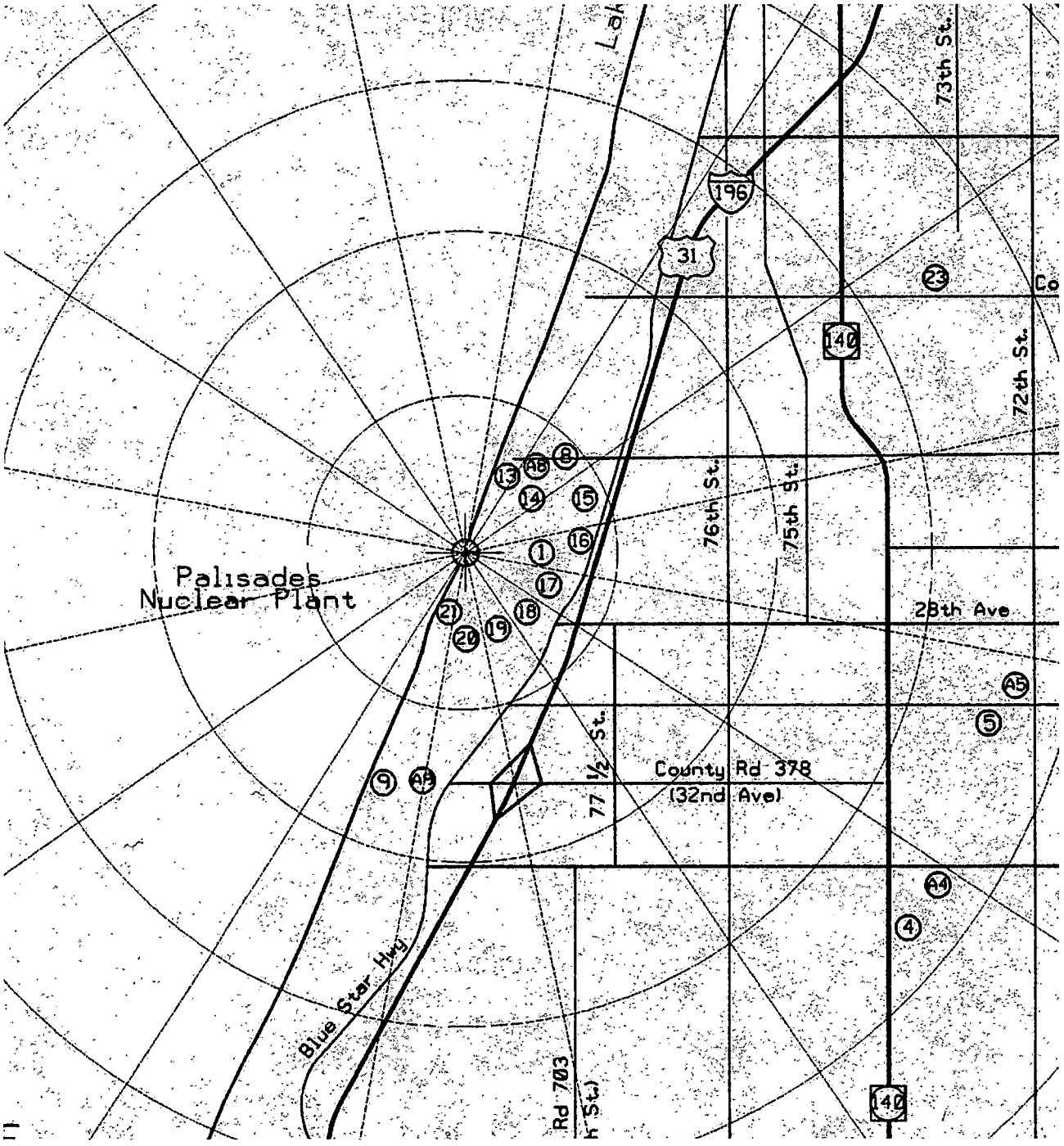
Table E-4
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM LOCATIONS
Seven Mile Map



TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM LOCATIONS

Four Mile Map



TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM LOCATIONS

TLDs

Location	Coordinates	Distance (miles)	Degrees	Sector
Stack	N 42 19 22.5 W 86 18 50.8			
1	N 42 19 20.5 W 86 18 36.1	0.213	100.36	E
Inner Ring				
13	N 42 19 47.2 W 86 18 34.1	0.530	26.56	NNE
8	N 42 19 46.8 W 86 18 24.0	0.602	39.19	NE
14	N 42 19 41.1 W 86 18 21.2	0.551	49.64	NE
15	N 42 19 41.7 W 86 17 58.1	0.834	63.76	ENE
16	N 42 19 28.0 W 86 17 54.6	0.804	82.45	E
17	N 42 19 10.5 W 86 18 13.9	0.572	113.74	ESE
18	N 42 19 4.2 W 86 18 28.9	0.469	138.49	SE
19	N 42 19 0.9 W 86 18 39.7	0.443	159.19	SSE
20	N 42 19 1.1 W 86 18 48.8	0.412	176.05	S
21	N 42 19 3.4 W 86 18 58.4	0.382	196.40	SSW
Outer Ring - Displayed on 7 mile map				
7	N 42 22 40.8 W 86 17 0.4	4.115	22.35	NNE
6	N 42 22 30.6 W 86 14 15.9	5.314	47.18	NE
23	N 42 20 44.6 W 86 15 35.4	3.189	60.37	ENE
24	N 42 19 59.5 W 86 11 49.4	6.021	83.19	E
5	N 42 18 27.6 W 86 14 57.5	3.475	107.63	ESE
4	N 42 17 10.8 W 86 15 43.5	3.668	133.54	SE
3	N 42 14 37.9 W 86 16 60.0	5.684	163.92	SSE

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM LOCATIONS

TLDs

Location	Coordinates	Distance (miles)	Degrees	Sector
2	N 42 14 33.4 W 86 19 16.4	5.560	183.75	S
9	N 42 18 1.73 W 86 19 34.6	1.670	201.86	SSW
Control TLDs				
10	N 42 53 16.7 W 85 40 35.9	50.746	39.49	NE
11	N 42 15 24.5 W 85 32 49.3	39.472	96.39	E
12	N 41 56 54.3 W 86 6 24.5	27.971	157.61	SSE

TLD 10 is located within the Consumers Energy Grand Rapids service facility attached to a pole located adjacent to the south fence.

TLD 11 is located within Consumers Energy Kalamazoo service facility attached to a pole in the far NE corner of the facility, past the employee parking lot.

TLD 12 is located approximately 30 yards from the road, NE and next to a private residence located at 58399 Wilbur Road, Dowagiac, MI.

Air Sample Stations

Location	Coordinates	Distance (miles)	Degrees	Sector
A8 (State Park)	N 42 19 46.8 W 86 18 24.8	0.595	38.34	NE
A9 (Township Park)	N 42 18 4.6 W 86 19 12.0	1.525	191.38	SSW
A4 (Covert)	N 42 17 12.1 W 86 15 21.7	3.882	130.12	SE
A5 (Rood)	N 42 18 30.5 W 86 14 47.8	3.590	106.12	ESE
A10 (Grand Rapids)	N 42 53 16.7 W 85 40 33.8	50.765	39.52	NE

Air Sample Station 10 is located within Consumers Energy Grand Rapids service facility, south side, next to a small service building and due east of TLD 10.

Control fish and water samples are normally obtained from the Consumers Energy Pump Storage Facility located in Ludington, MI or another location not influenced by Palisades plant discharges.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Palisade Park Wells

Location	Coordinates	Distance (miles)	Degrees	Sector
Community Well	N 42 18 47.5 W 86 19 11.4	0.729	203.63	SSW
Commercial Well	N 42 18 48.5 W 86 18 46.8	.652	175.06	S

The Community Well services the community residents with well water to their homes; the Commercial Well services the community gardens and drinking fountains on the east side of the property.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

K. SIRW OR TEMPORARY LIQUID STORAGE TANK

1. Requirement

The concentration of radioactive material (excluding tritium and noble gases) contained in the SIRW tank or any unprotected outside temporary tank* shall be limited such that the mixture radionuclides do not exceed 1,000 times the effluent concentration (EC) as listed in 10CFR Part 20, Appendix B, Table 2, Column 2.

$$\frac{C_a}{EC_a} + \frac{C_b}{EC_b} \ldots + \frac{C_i}{EC_i} = <1000$$

2. Action

With the quantity of radioactive material in any of the above listed tanks exceeding the above concentration, immediately suspend all additions of radioactive material to the tank, within 48 hours reduce the tank contents to within the limit, and describe the events leading to this condition in the next Radiological Effluent Release Report.

3. Surveillance Requirement

The concentration of radioactive material contained in each of the above listed tanks shall be determined to be within the above limit by analyzing a representative sample of the tank's contents at least once per 7 days when radioactive materials are being added to the tank.

or

A calculational methodology performed prior to the material being transferred may be used to show compliance with the requirement of this section if a representative sample cannot be obtained at least once per seven days. A representative sample of the radioactive material to be added to the SIRW or Temporary Liquid Storage Tank shall be analyzed and a calculation performed to show compliance with the 1000 EC limit.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

4. Bases

This requirement will provide reasonable assurance that in the event of an uncontrolled release of the tanks' contents, the resulting concentrations would be less than the limits of 10CFR Part 20, Appendix B, Table 2, Column 2, at the nearest potable water supply and the nearest surface water supply in an Unrestricted Area. (The dilution between Palisades and the South Haven drinking water supply has been established as 1000.)

*Tanks included in this specification are those outdoor tanks that are not surrounded by liners, dikes, or walls capable of holding the tank contents and that do not have tank overflows and surrounding area drains connected to the liquid radwaste treatment system.

NOTE:	The limit for the SIRW Tank may be exceeded for operational flexibility if the conditions of this section are met.

L. SURVEILLANCE REQUIREMENT TIME INTERVALS

1. Requirement

Each Surveillance Requirement shall be performed within the specified surveillance interval with a maximum allowable extension not to exceed 25 percent of the specified surveillance interval.

2. Action

Failure to perform a Surveillance Requirement within the allowed surveillance interval shall constitute noncompliance with the operability requirements. The time limits of the action requirements are applicable at the time it is identified that a Surveillance Requirement has not been performed. The action requirements may be delayed for up to 24 hours to permit the completion of the surveillance when the allowed outage time limits of the action requirements are less than 24 hours. Surveillance Requirements do not have to be performed on inoperable equipment.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

3. Surveillance Requirements

The applicable surveillance interval frequencies are specified in Tables A-2 and C-2. The applicable sampling and/or analysis frequencies are specified in Tables A-1, B-1, C-1, D-1, and E-1. Extendable surveillance requirements are limited to Channel Checks, Source Checks, Channel Calibrations, Channel Functional Checks, sampling frequencies and/or analysis frequencies.

4. Bases

The maximum allowable extension for a surveillance interval is consistent with the surveillance requirements specified in the Technical Specifications, Section 4.0. Until relocated in the ODCM, all of the effluent surveillances were subject to these same requirements.

M. SEALED SOURCE CONTAMINATION

1. Requirement

Each sealed source containing radioactive material either in excess of 100 microcuries of beta and/or gamma emitting material or 5 microcuries of alpha emitting material shall be free of greater than or equal to 0.005 microcuries of removable contamination.

2. Action

a. With a sealed source having removable contamination in excess of 0.005 microcuries, immediately withdraw the sealed source from use and either:

   (1) Decontaminate and repair the sealed source, or

   (2) Dispose of the sealed source in accordance with applicable regulations.

b. A report shall be prepared and submitted to the Commission on an annual basis if sealed source leakage tests reveal the presence of greater than or equal to 0.005 microcuries of removable contamination.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

3. Surveillance Requirements

a. Each category of sealed sources as described in the requirement with a half-life greater than 30 days (excluding Hydrogen-3), and in any other form than gas, shall be tested for leakage and/or contamination at intervals not to exceed 6 months.

b. The test shall be performed by the licensee or by other persons specifically authorized by the Commission or an Agreement State. The test method shall have a detection sensitivity of at least 0.005 microcuries per test sample.

c. The test sample shall be taken from the sealed source or, in the case of permanently mounted sources, from the surfaces of the mounting device on which contamination would be expected to accumulate.

d. The periodic leak test does not apply to sealed sources that are stored and not being used. These sources shall be tested prior to use or transfer to another licensee, unless tested within the previous 6 months. Sealed sources which are continuously enclosed within a shielded mechanism (ie, sealed sources within radiation monitoring or boron measuring devices) are considered to be stored and need not be tested unless they are removed from the shielded mechanism.

e. Sealed sources transferred without a certificate indicating the last test date shall be tested prior to being placed in use.

4. Bases

The requirement, actions, and surveillance requirements are the same as contained in the Technical Specifications 6.21 prior to relocation to the ODCM and will provide assurance that sealed sources are tested to demonstrate that source integrity is being maintained.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

IV. REPORTING REQUIREMENTS

A. RADIOLOGICAL EFFLUENT RELEASE REPORT

The Radioactive Effluent Release Report (RERR) shall be submitted in accordance with 10CFR 50.36a prior to May 1 of each year. The report shall include a summary of the quantities of liquid and gaseous effluents and solid waste released as outlined in Regulatory Guide 1.21, R1, Measuring, Evaluating and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Material in Liquid and Gaseous Effluents from Light Water Cooled Nuclear Power Plants, with data summarized on a quarterly basis following the format of Appendix B, thereof.

The following information shall also be included in the RERR:

- Assessment of the radiation doses due to the liquid and gaseous effluents released during the previous year
- Inoperable effluent radiation monitors that exceeded 30 continuous days; explain causes of inoperability and actions taken to prevent reoccurrence
- Evaluation to show conformance with 40 CFR 190, Environmental Radiation Protection Standards for Nuclear Power Operation
- Unplanned releases of radioactive materials in gaseous or liquid effluents to unrestricted areas on a quarterly basis
- Any changes to this procedure made during the reporting period
- Groundwater monitoring results taken in support of the Groundwater Protection Initiative, but are not part of the REMP

Solid radioactive waste data shall be reported as follows:

- Type of waste (example: spent resin, dry waste. Irradiated components)
- Volume in cubic meters, include estimated error
- Curie quantity per type of waste, include estimated error
- Principal radionuclides in each category
- Disposition of waste shipments and irradiated fuel shipments (identify number of shipments mode of transport and destination)

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

B. RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

The Radiological Environmental Operating Report covering the operation of the unit during the previous calendar year shall be submitted prior to May 15 of each year. The report shall include summaries, interpretations, and analysis of trends of the results of the Radiological Environmental Monitoring Program for the reporting period. The material provided shall be consistent with the objectives outlined in: (1) the ODCM, and (2) Sections IV.B.2, IV.B.3, and IV.C of Appendix 1 to 10CFR50.

The Annual Radiological Environmental Operating Reports shall include summaries, interpretation and statistical evaluation of the results of the radiological environmental surveillance activities for the report period, including a comparison with preoperational studies, operational controls (as appropriate), and previous environmental surveillance reports and an assessment of the observed impacts of the Plant operation on the environment. The reports shall also include the results of land use census pursuant to III.J.3.c.

The Annual Radiological Environmental Operating Reports shall include summarized and tabulated results in the format of Table F-1 of all radiological environmental samples taken during the report period. In the event that some results are not available for inclusion with the report, the report shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted as soon as possible in a supplementary report.

The reports shall also include the following; a summary description of the radiological environmental monitoring program, including sampling methods for each sample type, a map of all sampling locations keyed to a table giving distances and directions from the reactor and the results of land use census required by III.J.3.c and results of the Interlaboratory Comparison Program required by III.J.3.e.

C. NONROUTINE REPORTS

A report shall be submitted to the NRC in the event that: 1) the Radiological Environmental Monitoring Programs are not substantially conducted as described in Section III.J, or 2) an unusual or important event occurs from Plant operation that causes a significant environmental impact or affects a potential environmental impact. Reports shall be submitted within 30 days.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

Table F-1
Environmental Radiological Monitoring Program Summary

Name of Facility _____ Docket No _____

Location of Facility (County, State) _____ Reporting Period _____

Medium or Pathway Sampled (Unit of Measure)	Type/Total Number of Analyses Performed	Lower Limit of Detection[a] (LLD)	All Indicator Locations Mean (f)[b] Range[b]	Name Distance & Direction	Mean (f)[b] Range[b]	Control Locations Mean(f)[b] Range[b]	Number of REPORTABLE OCCURRENCES
Air Particulates (pCi/m^3)	Gross ß 416	0.003	0.08 (200/312) (0.05-2.0)	Middletown 5 miles 340°	0.10 (5/52) (0.08-2.0)	0.08 (8/104)- (0.05-1.40)	1
	γ-Spec 32						
	Cs-137	0.003	0.05 (4/24) (0.03-0.13)	Smithville 2.5 miles 160°	0.08 (2/4) (0.03-0.13)	<LLD	4
	Ba-140	0.003	0.03 (2/24) (0.01-0.08)	Podunk 4 miles 270°	0.05 (2/4) (0.01-0.08)	0.02 (1/8)	1
	Sr-89 40	0.002	<LLD	--	--	<LLD	0
	Sr-90 40	0.0003	<LLD	--	--	<LLD	0
Fish pCi/kg (dry weight)	γ-Spec 8		<LLD				
	Cs-137	80		--	<LLD	90 (1/4)	0
	Cs-134	80	<LLD	--	<LLD	<LLD	0
	Co-60	80	120 (3/4) (90-200)	River Mile 35 Podunk River	See Column 4	<LLD	0

a Nominal Lower Limit of Detection (LLD) as defined in table notation c of Table E-3.

b Mean and range based upon detectable measurements only. Fraction of detectable measurements at specific locations is indicated in parentheses (f).

NOTE: The example data are provided for illustrative purposes only.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

V. MAJOR MODIFICATIONS TO RADIOACTIVE LIQUID AND GASEOUS WASTE TREATMENT SYSTEMS

A. LICENSEE MODIFICATIONS

Licensee initiated major modifications to the radioactive liquid and gaseous waste systems.

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

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

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

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

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

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

B. DEFINITION OF MAJOR RADWASTE SYSTEM MODIFICATION

1. Purpose:

   The purpose of this definition is to assure that this requirement will be satisfied under clearly identifiable circumstances, and with the objective that current radwaste system capabilities are not jeopardized.

2. Definition:

   A major radwaste system modification is a modification which would remove (either by bypassing for greater than 7 days or physical removal) or replace with less efficient equipment, any components of the radwaste system:

   a. Letdown filters or demineralizers.

   b. Vacuum degassifier (not applicable when the reactor is in cold shutdown and depressurized).

   c. Miscellaneous or clean waste evaporators.

   d. The present waste gas compressor/decay tank system.

   e. Fuel Pool filters/demineralizers.

   f. Radwaste polishing demineralizers.

   g. Radwaste Solidification system.

   Improvements or additions to improve efficiency will not be considered major modifications unless a complete substitution of equipment or systems is made with equipment of unrelated design. Examples would be: 1) replacement of mechanical degassifier with steam, jet degassifier, 2) replacement of waste gas system with cryogenic system, 3) replacement of asphalt solidification with cement system, and 4) change from deep bead resins to Powdex, etc.

TITLE: RELOCATED TECHNICAL SPECIFICATIONS PER NRC GENERIC LETTER 89-01 (TAC NO 75060)

VI. ONSITE GROUND WATER MONITORING

Palisades installed 5 ground water monitoring wells in 2007 and added an additional 9 wells in 2008. These wells were installed in response to NEI 07-07, Industry Ground Water Protection Initiative – Final Guidance Document. These wells are strategically placed within the Owner Controlled Area, both inside and outside the Protected Area to allow detection of radioactive contamination of ground water due to leaks or spills from plant systems.

ODCM

Appendix B

DOCKET 50-255 - LICENSE DPR-20 - PALISADES PLANT

REQUEST TO RETAIN SOIL IN ACCORDANCE WITH 10CFR 20.302

Revision 0

August 1, 1991

Approved KM Haas 8/20/91 MRN
Manager - Radiological Services Date

TP Neal 8/1/91
RMC Administrator Date

ML Grogan 8/14/91
Tech Review Date

PF Bruce 91-082d 8/14/91
Date

Applicability Reviewed: TPNeal 5/5/93

Gerald B. Slade 11/30/93
Plant General Manager Date

Applicability Reviewed: TPNeal 5/11/93

Request to Retain Soil in Accordance with 10CFR 20.302

Consumers Power Company correspondence dated November 12, 1987 and January 25, 1988 requested authorization to dispose of contaminated soil in place as specified by 10CFR 20.302. The area known as the South Radwaste Area has been contaminated by numerous cooling tower overflows and contamination was redistributed by heavy rain showers. Although the majority of the radioactive material has been packed for waste shipment, a large volume of very low activity radioactive material remains. This volume of material would be very expensive to ship as waste.

The specific area contaminated is noted as Area B on the attached survey grid map in reference 1. The entire area is fenced and is about 12,000 sq ft of soil exposed with the remainder buildings and asphalt. The inhalation pathway is for breathing suspended soil from this area. The radworker could receive 8.03E-04 mRem/50-year maximum organ (liver) dose and the infant could receive 3.16E-05 mRem/50-year maximum organ (liver) dose, both of which are insignificant. Direct dose to a radworker is less than 2E-03 mRem/hr. Occupancy in this area should not average more than 2 hours/week or 100 hours/year, which would result in a dose of <1 mRem/year.

The radwaste activities which caused the contamination of the soil were completely relocated to a new east radwaste area. The South Building has been deconned and is being used for non-radwaste activities. Some fixed contamination is present in floor cracks and vaults. This has been documented for plant decommissioning. No further contamination will be added to the south area from the South Radwaste Building. In spite of this commitment, revocation of Michigan shipping privileges in November 1990 require the use of this area to store packaged low level radioactive waste (LLW). Use of this building is addressed in CPCo's letter to NRC Document Control Desk, April 24, 1991 which is entered as reference 6.

This LLW, in the form of dry active waste (DAW) will be packaged in metal boxes and labeled, ready for future shipment to burial sites. The DAW metal shipping boxes will be stored off the floor to prevent water damage. The metal shipping boxes are strong, tight containers designed to prevent any leakage of radioactive material during transportation. Incidental water contact will not result in the spread of contamination. Radioactive waste will not be processed in the South Radwaste Building and the building will be maintained as a normally clean (radiologically) area.

References

(1) CPCo's letters, T.C. Bordine to NRC Document Control Desk, November 12, 1987 and January 25, 1988.

(2) Memorandum from L.J. Cunningham, DREP to T.R. Quay, T.V. Wambach, "Request for Additional Information (RAI)", March 15, 1988, April 7, 1989, and January 12, 1990.

(3) CPCo's supplement to Reference (1), J.L. Kuemin to NRC Document Control Desk, June 27, 1988.

(4) CPCo's supplement to References (1, 2), G.B. Slade to NRC Document Control Desk, August 31, 1990.

(5) CPCo's letter, T.P. Neal to B. Holian, October 23, 1990. (Typo of 10/13/90 in original reference).

(6) CPCo's letter, G.B. Slade to NRC Document Control Desk, April 24, 1991. "Use of South Storage Building as an Interim Radioactive Waste Storage Building".

(7) NRC Letter, Brian Holian to G.B. Slade, CPCo, June 7, 1991, "Approval and Conditions to Retain Soil in Place".

Consumers Power
POWERING MICHIGAN'S PROGRESS
General Offices: 1945 West Parnall Road, Jackson, MI 49201 • (517) 788-0550

November 12, 1987

Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

DOCKET 50-255 - LICENSE DPR-20 - PALISADES PLANT -
REQUEST TO RETAIN SOIL IN ACCORDANCE WITH 10CFR20.302

1252

The Code of Federal Regulations, Title 10, section 20.302 allows for approval of proposed procedures to dispose of licensed material in a manner not otherwise authorized in the regulations. Flooding of the South Radwaste Building has caused contamination of 4,173 cubic feet of soil with 2,992.6 µCi of Cs-137 and 79.3 µCi of Co-60. The area is approximately 30 meters from Lake Michigan. Site hydrology (Attachment 2, FSAR 2.2) indicates most of the activity will migrate to Lake Michigan in a few years. In July, 1986 a two-fold evaluation began to identify and map the extent of the ground contamination in the flood plain. The initial findings and evaluation were provided to NRC and the Michigan Department of Public Health by internal letter dated September 26, 1986, to LHueter, NRC, Region III.

3745

Consumers Power Company requests authorization to dispose of this soil inplace as the costs of disposal at a burial ground is estimated at $270,000 while radiological consequences to the general public and site employees is very low. The activities in the contaminated soil were input as a single radioactive liquid release to Lake Michigan into the NRC LADTAP Code. The output indicated an estimated wholebody dose to the general public (50 mile radius population 1.05E06) of 1.69E-02 manRem or 1.6E-05 millirem per person. The maximum estimated wholebody dose to an individual would be 5.13E-03 millirem and maximum organ dose (teenage liver) would be 8.67E-03 millirem. The maximum whole body dose rate was assumed to be at 18 inches from contaminated soil. The maximum whole body dose rate calculated using the Microshield Code was 1.02E-02 mR/hr. Occupancy of this area is controlled by the Radiological Safety Department and secured by a locked fence. Average yearly occupancy is approximately 8 hours per week per individual for 4 to 5 individuals. A radiation worker should not exceed an additional wholebody dose of 4.08 millirem/year.

Flooding of the South Radwaste Building as a result of the cooling tower overflows is being addressed in two stages. For the short term the cooling tower bypass valve is now electrically isolated during cooling tower operation. Most previous flooding has been due to instrument failures that cause the valve to open during normal operation. In addition the South Radwaste Building has been decontaminated to eliminate or minimize contamination that

could be transported to the environment. A long term solution to remove radwaste activities from this area is being included in the Five-Year Plan.

The activity released to the environment from a flooding release prior to 1986 was estimated and added to the liquid section of the Semi-Annual Radiological Effluent Release Report dated February 28, 1986. Following approval of this application, it is proposed to account for current activity as an abnormal liquid release included in the semi-annual effluent report. A background, evaluation and survey results discussion follows in Attachment A. Attachment 1 is the Microshield Code output and Attachment 2 is FSAR section 2.2 (including referenced tables and figures) on site hydrology.

Pursuant to 10CFR170.12(c) a check in the amount of $150 is attached.

Thomas C Bordine (Signed)

Thomas C Bordine
Administrator, Nuclear Licensing

CC Administrator, Region III, NRC
NRC Resident Inspector - Palisades

Attachment

ATTACHMENT A

Consumers Power Company
Palisades Plant
Docket 50-255

EVALUATION AND SURVEY RESULTS

November 12, 1987

10 Pages

Background

In 1986, a soil survey was conducted south of the Turbine Building which included the South Radwaste area. The survey was conducted due to the South Radwaste Building being in the main flowpath of 'A' Cooling Tower, which has overflowed on three separate occasions in 8 years. The survey found that radioactive material was deposited in the soil due to the flooding of contamination and radioactive material areas inside the South Radwaste Building. Other areas sampled that were not in the flood plain were; liquid radwaste storage tanks, T-90, T-91, storm drains, the beach and the sand dunes. The survey included a survey grid, surface sample results and core sample results. All contaminated areas found in Area A (Figure 1) were packaged as radwaste. In addition, the highest activity areas adjoining the South Radwaste Building were also packaged. A total of 16-98 cubic foot boxes were packaged containing over 85 percent of the estimated activity.

Evaluation

In August of 1987, the survey was conducted again to prepare this report and to verify the location of the ground contamination and if any contamination migrated further into the ground since the 1986 survey. The survey was a two phase evaluation with the first phase being a mapped area consisting of 25' x 25' squares south of the Turbine Building. Once mapped out, surface samples were taken in this area. The intent of this phase was to accurately map the location and determine the activity in µCi/gram of all ground surface contamination. Each surface sample consisted of approximately 20 grams of soil taken

from the top 1/2" of ground and placed in a petri dish for analysis on the Multi-Channel Analyzer (MCA). Over 275 samples were collected and analyzed with two surface samples being taken in each sector. All samples were counted on MCA, Intrinsic Detector #1. Figure 2 shows the sector where activity was detected and their highest levels in µCi/gram.

Phase II was initiated after completion of the "surface" sample analysis. This consisted of taking core samples in 6" increments where activity was detected. Core samples were taken until two consecutive core samples reflected no activity. Core samples were also taken below the activity levels found in the 1986 soil survey until two consecutive core samples revealed no activity.

Figure 3 indicates the depth level where activity was no longer detectable. For example, 6 inches is indicated in H-10 on Figure 3. This indicates that activity was only detected on the surface. H-9 and I-10 indicate 18" which means activity was detected only at 12". Table 1 shows the results summary in µCi/gram of the highest activity at all sample locations. The sector numbers respond to grid coordinates shown on Figures 1, 2 and 3.

In addition to the sample sectors shown on Figure 1, 25 samples were collected at various locations on site. These include surface and core samples around T-90, and T-91 on the Northwest side of the Turbine Building (location not shown on figures). Surface samples were taken under the asphalt around the South Radwaste Building. These are indicated by a hexagon on Figure 1 in F-11, I-12 and K-10 sectors. Core samples taken under the South Radwaste Building are indicated by circles on Figure 1. Of the areas sampled above activity was

found only under the East side of the South Radwaste Building in sector I-9 (Table 1).

In the 1986 soil survey other areas were sampled that were not in the flood plain of the South Radwaste Building. Those included Feedwater Purity Building, North Storage Building, beach areas North and South of Plant, North and Northeast sand dunes and various storm drains. In all of these areas no activity was detected. Therefore, they were not sampled in the 1987 soil survey as they were not in the flood plain.

Since the 1986 soil survey, asphalt has been placed over various locations in the protected area. Asphalt was placed around all storm drains and approximately 50% of the South end of the Turbine Building. Before asphalt was laid down, about 3-6" of the top soil was removed and taken offsite. The soil before leaving site was sampled and counted with no activity detected.

Results

To quantify activity and determine impact, the areas of ground contamination were separated into two areas. Area A which contains all the sectors (A-L, 1-8) North of the "black top" to the Turbine Building. Area B contains all sectors (C-L, 9-14) South of "black top" in the vicinity of the South Radwaste Building. In Area A no activity was detected, therefore it was not used in determining activity or impact.

In Area B activity was detected in almost all sectors to the East of the South Radwaste Building (Figure 2). Activities ranged from 2.07E-6 µCi/gram (E-11) to 3.75E-5 µCi/gram (H-11). Cs-137 was the primary radionuclide present in all samples with two other samples containing Co-60 1.12E-5 µCi/gram at 6" and 5.80E-6 µCi/gram at 12" (I-9 East Figure 2). The greatest depth where activity was detected was in sector H-11 at 18" and when compared to the 1986 soil survey the activity has migrated down into the soil 6" inches further. Activity was detected at the surface in sectors E-11, E-13, J-12 and L-9 and at 6" in L-9. This was a result of moving the sand deposited on the asphalt during the flood to these sectors and the movement of soil during the grading and dumping during the asphalting of the South Radwaste area.

Activity in µCi was calculated for each sector (Table 2) by the following formula: sector ft^2 x depth of activity ft x *48144 grams/ft^3 x activity (µCi/gram) = µCi. *Average liter of soil weighed 1700 grams x 28.32 L/ft^3 = 48144 grams/ft^3. The first level at which no activity was detected was used to determine depth of activity. In a few sectors, activity was only detected on the first 1/2" of soil, but for determining cubic feet and activity a depth of 6" was used. For example, activity for H-10 was calculated as follows: 625 ft^2 x .5 ft. depth x 48144 grams/ft^3 x 2.6E-6 µCi/gram activity of surface sample equals 39.12 µCi.

Total volume in cubic feet and total activity in µCi were calculated for each sector of Area B. For sectors with activity, the highest activity detected per sector was used in the µCi calculation. Total contaminated area in Area B is

4173 ft^3, total activity is 3071.9 µCi. Sector H-11 contains 73.5% of the total activity which comprises 14.5% of the total contaminated area of Area B.

To quantify the dose to the population projections, 2992.6 µCi of Cs-137 and 79.3 µCi of Co-60 was entered into the LADTAP computer program. Assuming that the total 3071.9 µCi was eventually released to Lake Michigan thru the water table, and the uptake pathways which included fish, drinking, swimming, boating and shoreline the 50 mile population estimated at 1.05E6 would receive a total body dose of 1.69E-2 manRem, or 1.61E-5 millirem per person. The maximum wholebody dose to an individual would be 5.13E-3 millirem and maximum organ dose (teenage liver) would be 8.67E-03 millirem.

Direct dose to an individual working in the affected areas was calculated using the MICROSHIELD code. The activities from sectors H-11 and I-9 were used for a dose 18 inches above the surface. The dose rates from H-11 and I-9 are 8.75E-06 R/hr and 1.02E-05 R/hr respectively (Attachment 1). Therefore, a 50 hour occupancy in one week could result in a maximum exposure of 0.51 millirem. Normal occupancy of this area is on an as needed bases and averages less than 8 hours/week per individual in contact with contaminated soil.

Table 1

Soil Sample Core Results (uCi/gram)

Sector #	Surface	6"	12"	18"	24	30"	36"	42"	48"
E-11	2.07E-6	<MDA	<MDA	<MDA					
E-13	4.39E-6	<MDA	<MDA	<MDA					
H-9	4.19E-6	<MDA	4.79E-6	<MDA	<MDA	<MDA			
H-10	2.60E-6	<MDA	<MDA						
H-11	3.75E-5	<MDA	<MDA	8.45E-6	<MDA	<MDA	<MDA		
I-9	1.24E-5	<MDA	<MDA						
I-10	<MDA	<MDA	5.39E-6	<MDA	<MDA	<MDA	<MDA	<MDA	
J-9	5.39E-6	<MDA	<MDA						
J-12	6.39E-6	<MDA	<MDA						
L-9	<MDA	6.77E-6	<MDA	<MDA					
T-90	<MDA	<MDA							
T-91	<MDA	<MDA							
**I-9 #1	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA		
**I-9 #2	<MDA	1.40E-5*	5.80E-6+	<MDA	<MDA	<MDA	<MDA		
**I-10 #3	<MDA	<MDA							
**I-11 #4	<MDA	<MDA							
***K-10	<MDA								
***I-12	<MDA								
***F-11	<MDA								

+ Activity is all Co-60

* Includes 1.12E-5 μCi/gram of Co-60. All other activities listed were identified as Cs-137.

** Core samples under foundation of the South Radwaste Building.

*** Surface samples under asphalt in South Radwaste area.

Table 2

Activity Calculations per Sector

Area B

Sector #	Sq.ft.	X	Depth	=	ft^3	X	g/ft^3	X uCi/g	=	Total uCi
E-11	375		0.5		187.5		48144	2.07E-6		18.7
E-13	375		0.5		187.5		48144	4.39E-6		39.6
H-9	625		1.5		937.5		48144	4.79E-6		216.2
H-10	625		0.5		312.5		48144	2.60E-6		39.1
H-11	625		2.0		1250.0*		48144	3.75E-5		2256.8*
I-9	527		0.5		263.5		48144	1.24E-5		157.3
I-10	275		1.5		412.5		48144	5.39E-6		107.0
J-9	450		0.5		225		48144	5.39E-6		58.4
J-12	200		0.5		100		48144	6.39E-6		30.8
L-9	150		1.0		150		48144	6.77E-6		48.9
I-9 east	98		1.5		147		48144	1.40E-5		99.1
	4325				4173					3071.9
					*1250			=		*2256.8 = 73.5% of total activity

FIGURE 1

SURVEY GRID

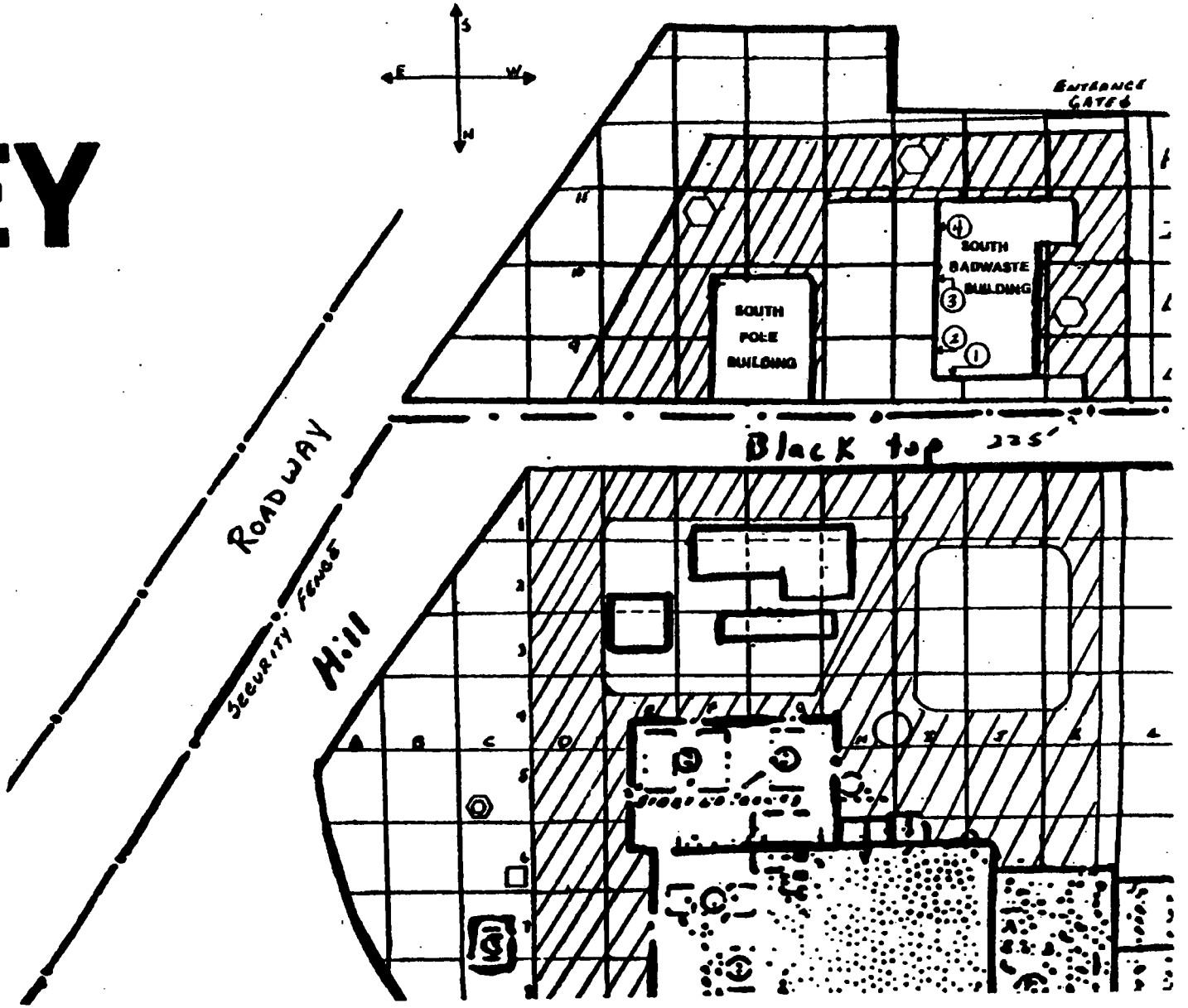
LEGEND

ASPHALT AREAS

25' x 25' SECTORS

AREA "B"

AREA "A"



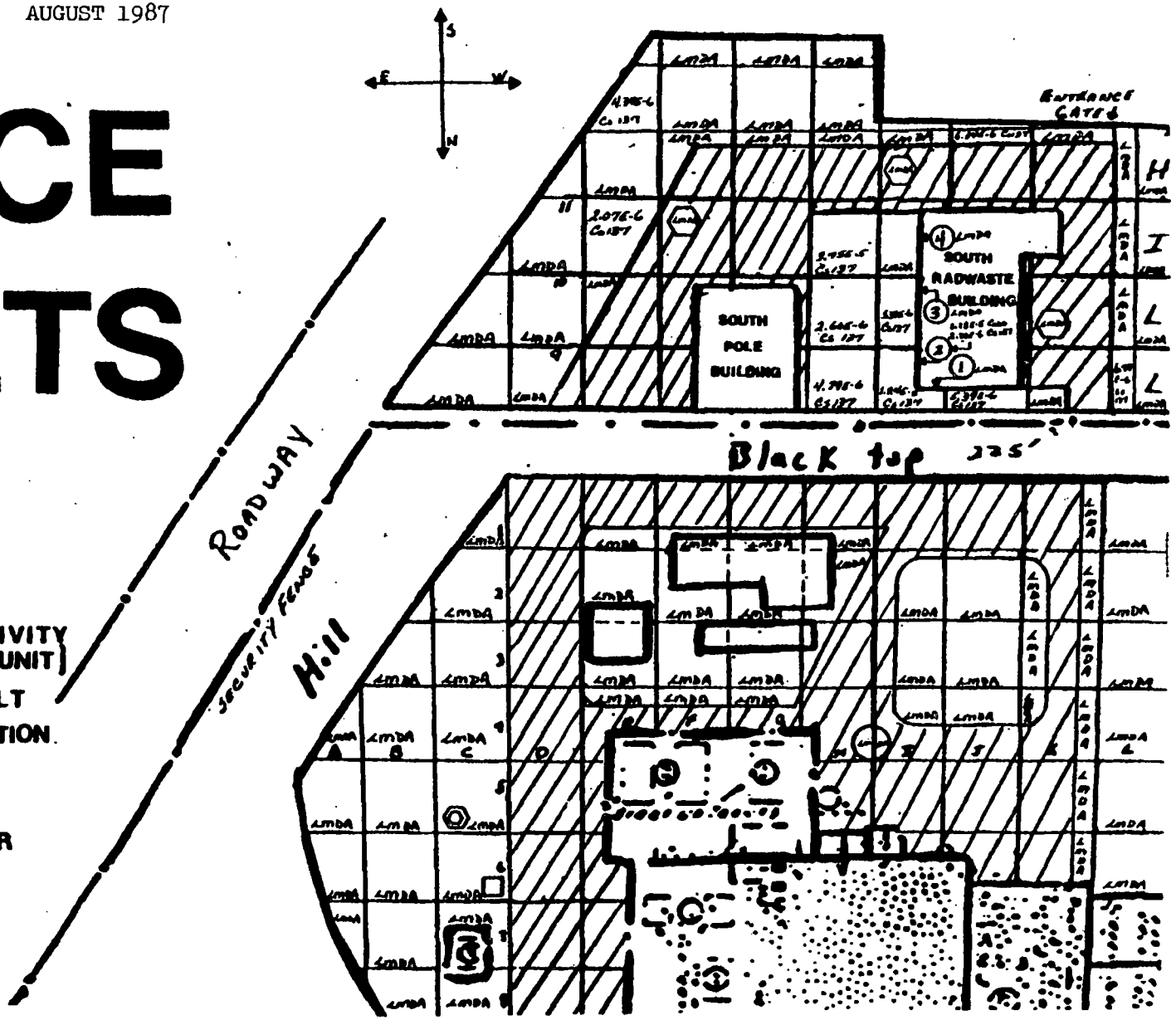
37

Rev 0
8-1-91

AUGUST 1987

FIGURE 2

SURFACE RESULTS



LEGEND

- ∠MINIMUM DETECTABLE ACTIVITY (1.00E-6 µCi/UNIT)
- SURFACE AREA UNDER ASPHALT CORE SAMPLE UNDER FOUNDATION
- SURFACE ACTIVITY OF SECTOR
- ASPHALT AREAS

*EXAMPLE ONLY

Rev 0
8-1-91

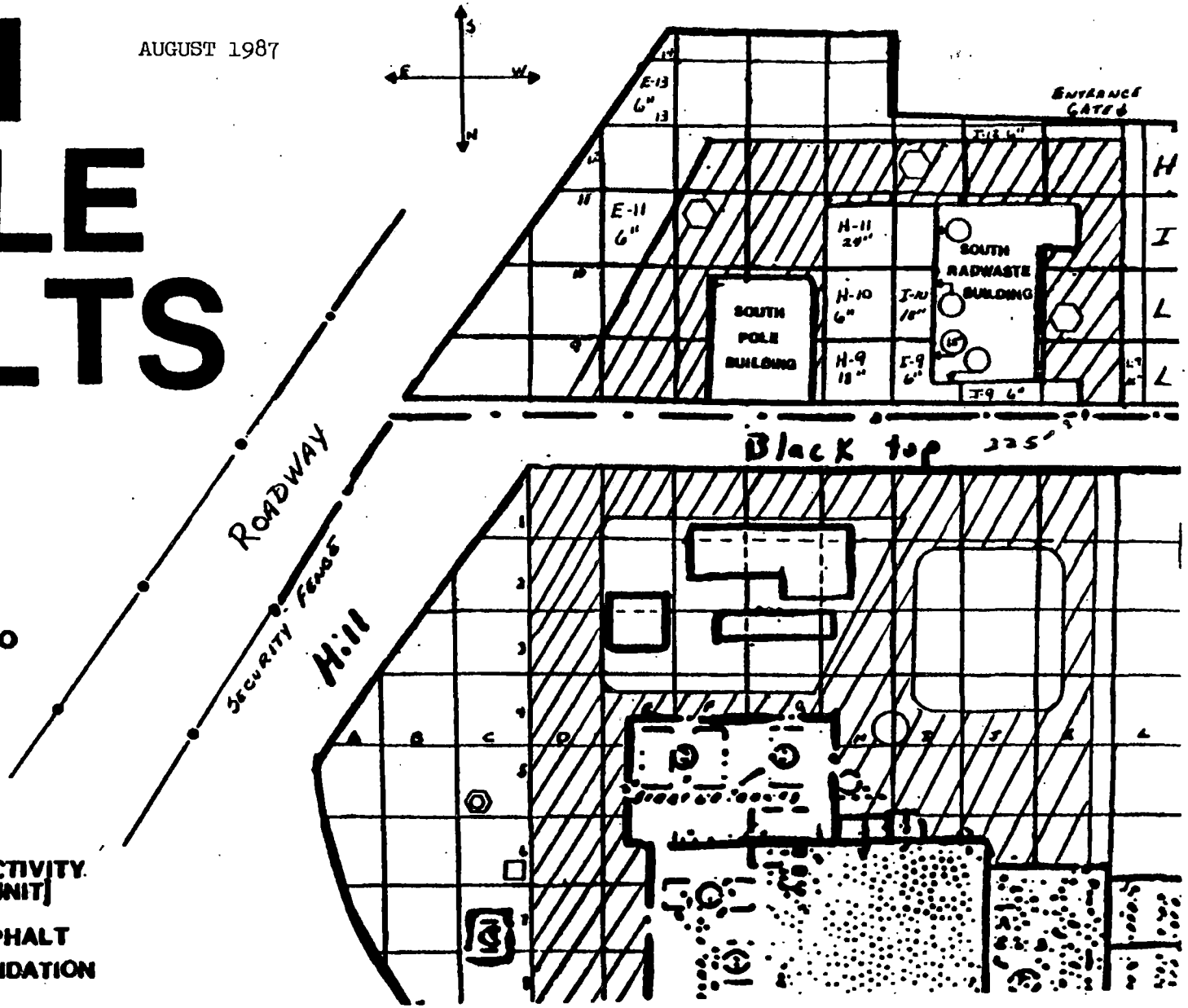
FIGURE 3

DEPTH SAMPLE RESULTS

AUGUST 1987

LEGEND

- D-4 — LETTER (D) = COLUMN, NUMBER (4) = ROW
- 6" — DEPTH LEVEL AT WHICH NO ACTIVITY WAS DETECTED
- ASPHALT AREAS
- 4 MINIMUM DETECTABLE ACTIVITY [1.00 E-6 µCi/UNIT]
- SURFACE AREA UNDER ASPHALT CORE SAMPLE UNDER FOUNDATION



ATTACHMENT 1

Consumers Power Company
Palisades Plant
Docket 50-255

MICROSHIELD CODE OUTPUT

November 12, 1987

8 Pages

****** CASE TITLE ******
CONTAMINATED SOIL @ H-11 LOCATION @ 10'-6" DEEP

****** GEOMETRY: Centimeters ******

RECTANGULAR VOLUME.....SLAB

Locating dimensions	Source dimensions	Shields
y = 60.96	thickness = 15.24	Tank = 45.72
	height = 335.28	
	width = 762	

Integration parameters
radial increment = 2
horiz. intervals = 5
vert. intervals = 5

Source volume (cubic centimeters) = 3.884E+06

****** SHIELD MATERIAL DENSITIES (g/cc) ******
(Buildup is based on the properties of shield 1.)

Material	Source	Shield 1
Water	1.000	
Air	0.00129	0.00129
Carbon	1.700	

Page : [illegible] File Ref: ________
File : [illegible]
[illegible] [illegible]
: 03-26-1987

****** CASE TITLE ******

CONTAMINATED SOIL @ [illegible] LOCATION [illegible] DEEP

****** SOURCE STRENGTH ******

Isotope	Activity (microCuries/cc)
Ba 137m	3.750E-05

****** RESULTS ******

Photon group energy (MEV)	Activity (photons/sec)	Dose point flux (MEV/sq cm/sec)	Dose rate (R/hr)
0.10 - 0.20			
0.20 - 0.30			
0.30 - 0.40			
0.40 - 0.55			
0.55 - 0.75	4.808E+06	4.208E+00	8.752E-06
0.75 - 0.90			
0.90 - 1.10			
1.10 - 1.35			
1.35 - 1.60			
1.60 - 1.80			
1.80 - 2.00			
2.00 - 2.20			
2.20 - 2.40			
2.40 - 2.60			
2.60 - 2.80			
2.80 - 3.20			
3.20 - 4.00			
4.00 - 5.00			
5.00 - 6.00			
6.00 - 7.20			
7.20 - 10.00			
Totals:	4.808E+06	[illegible]	8.752E-06

\+ 9.446E-11 (page 4)

= 8.75 E-06 Total

3745 0267

Rev 0
8-1-91

****** MICROSHIELD 5.00 ******

Page : 1 of 1
File : BOILER .01
Saved: 09:02:08
: 08-28-1997

File Ref: _____
Date: __ __ __
By: _____
Checked: _____

****** CASE TITLE ******
CONTAMINATED SOIL @ HP11 LOCATION 24 INCHES DEEP

****** GEOMETRY centimeters ******

RECTANGULAR VOLUME.....SLAB

Locating dimensions	Source dimensions	Shields
X = 106.68	thickness = 15.24	t 1 = 45.72
	height = 335.28	t 2 = 45.72
	width = 762	

Integration parameters
radial increment = 5
horiz. intervals = 5
vert. intervals = 5

Source volume (cubic centimeters) = 3.894E+06

****** SHIELD MATERIAL DENSITIES (g/cc) ******
(Buildup is based on the properties of shield 1.)

Material	Source	Shield 1	Shield 2
Water	1.000	1.000	
Air	0.00129	0.00129	0.00129
Carbon	1.700	1.700	

****** MICROSHIELD 5.02 ******

Page : 1 of 2 File Ref: _____
File : [illegible].MS7
Date: 09/23/93
: 09-23-1987

****** CASE TITLE ******
CONTAMINATED SOIL @ PIT LOCATION IN [illegible]

****** SOURCE STRENGTH ******

Isotope	Activity, microCuries
Sr-90	8.490E-05

****** RESULTS ******

Photon group energy, MEV	Activity, photons/sec	Dose point flux, MEV/sq cm/sec	Dose rate R/hr
0.00 - 0.20			
0.20 - 0.30			
0.30 - 0.40			
0.40 - 0.55			
0.55 - 0.75	1.083E-06	4.541E-05	8.446E-11
0.75 - 0.90			
0.90 - 1.10			
1.10 - 1.35			
1.35 - 1.60			
1.60 - 1.80			
1.80 - 2.00			
2.00 - 2.20			
2.20 - 2.40			
2.40 - 2.60			
2.60 - 2.80			
2.80 - 3.20			
3.20 - 4.00			
4.00 - 5.00			
5.00 - 6.00			
6.00 - 7.20			
7.20 - 10.00			
Totals:	1.083E+06	4.541E-05	8.446E-11

3745 2269

****** MICROSHIELD 3.02 ******

Page : 1 of 2
File : SOILS .OUT
Run date: 08:05:15
. 09-09-1987

File Ref: ____________
Date: ___ ___ ___
By: ____________
Checked: ____________

****** CASE TITLE ******

CONTAMINATED SOIL @ I-8 LOCATION, 6 INCHES DEEP

****** GEOMETRY (centimeters) ******

RECTANGULAR VOLUME....................SLAB

Locating dimensions	Source dimensions	Shields
x = 50.35	thickness = 15.24	t 1 = 45.72
	height = [illegible]	
	width = 752	

Integration parameters
radial increment = [illegible]
horiz. intervals = 5
vert. intervals = 5

Source volume (cubic centimeters) = 3.394E+[illegible]

****** SHIELD MATERIAL DENSITIES (g/cc) ******
(Buildup is based on the properties of shield 1.)

Material	Source	Shield 1
Water	1.000	
Air	0.00129	0.00129
Carbon	1.700	

3745 1270

Rev 0
8-1-91

Attachment 1

****** MICROSHIELD 5.01 ******

File Ref: _____

Page : 1 of 1
File : [illegible] .SHT
Saved: 23:25:19
: 09-23-1987

****** CASE TITLE ******
CONTAMINATED SOIL @ 1-8 LOCATION 8 INCHES DEEP

****** SOURCE STRENGTH ******

Isotope	Activity (microCuries)
Ba 137m	2.800E-06
Co 60	1.120E-05

****** RESULTS ******

Photon group energy (MEV)	Activity (photons/sec)	Dose point flux (MEV/sq cm/sec)	Dose rate (R/hr)
0.10 - 0.20			
0.20 - 0.30			
0.30 - 0.40			
0.40 - 0.55			
0.55 - 0.75	3.590E+05	3.142E-01	6.503E-07
0.75 - 0.90	1.613E+02	1.593E-04	3.385E-10
0.90 - 1.10			
1.10 - 1.35	3.225E+06	4.988E+00	9.173E-06
1.35 - 1.60			
1.60 - 1.80			
1.80 - 2.00			
2.00 - 2.20			
2.20 - 2.40			
2.40 - 2.60			
2.60 - 2.80			
2.80 - 3.20			
3.20 - 4.00			
4.00 - 5.00			
5.00 - 6.00			
6.00 - 7.20			
7.20 - 10.00			
Totals:	3.584E+06	5.303E-00	9.833E-06
		+	3.280E-07 (page 8)
		=	1.02 E-05 (Total)

3745 2271

Rev 0
8-1-91

Page : 1 of 2
File : SOIL.MS5
Saved: 09:04:05
: 09-23-1987

File Ref: _____
Date: __ __ __
By: _____
Checked: _____

****** CASE TITLE ******
CONTAMINATED SOIL @ I-8 LOCATION - 10 INCHES DEEP

****** GEOMETRY centimeters ******

RECTANGULAR VOLUME.....Volume-3

Locating dimensions	Source dimensions	Shields
X = 76.2	thickness = 15.24	t 1 = 15.24
	height = 335.28	t 2 = 45.72
	width = 762	

Integration parameters
radial increment = 2
horiz. intervals = 5
vert. intervals = 5

Source volume (cubic centimeters) = 3.894E+06

****** SHIELD MATERIAL DENSITIES (g/cc) ******
(Buildup is based on the properties of shield 2.)

Material	Source	Shield 2	Shield 3
Water	1.000	1.000	
Air	0.00123	0.00123	0.00123
Carbon	1.700	1.700	

****** VISIPLAN 3.00 ******

Page : 1 of 2
File : [illegible]
Saved: 09:04:05
: 09-23-1987

File Ref: _____

****** CASE TITLE ******
CONTAMINATED SOIL @ I-8 LOCATION, 12 INCHES DEEP

****** SOURCE STRENGTH ******

Isotope	Activity (microCuries)
Co 60	5.300E-09

****** RESULTS ******

Photon group energy (MEV)	Activity (photons/sec)	Dose point flux (MEV/sq cm/sec)	Dose rate (R/hr)
0.10 - 0.20			
0.20 - 0.30			
0.30 - 0.40			
0.40 - 0.55			
0.55 - 0.75			
0.75 - 0.90	9.356E+01	4.299E-06	8.593E-12
0.90 - 1.10			
1.10 - 1.35	1.570E+06	1.732E-01	3.230E-07
1.35 - 1.60			
1.60 - 1.80			
1.80 - 2.00			
2.00 - 2.20			
2.20 - 2.40			
2.40 - 2.60			
2.60 - 2.80			
2.80 - 3.20			
3.20 - 4.00			
4.00 - 5.00			
5.00 - 6.00			
6.00 - 7.20			
7.20 - 10.00			
Totals:	1.670E+06	1.732E-01	3.230E-07

ATTACHMENT 2

Consumers Power Company
Palisades Plant
Docket 50-255

FSAR SECTION 2.2 - SITE HYDROLOGY

November 12, 1987

10 Pages

2.2 HYDROLOGY

The Palisades Plant site is surrounded on the north, east and south sides by sand dunes. The west side of the site is the Lake Michigan shoreline. As a result of this local topography, the site drainage is independent of the Brandywine Creek drainage basin which drains the hinterland. All surface water runoff drains directly to the lake and the percolating runoff also discharges to the lake (see Reference 3). There are no data available to verify the amount of surface runoff from the site; however, the flow from the Brandywine Creek drainage basin should be useful for the purpose of comparison.

Data obtained to establish base flow figures for Van Buren County streams indicate that the Brandywine Creek drainage basin is about 17 square miles (see Reference 4). The average annual rainfall for the area is 34 inches. During the period September 1962 to October 1963, the base flow measurements varied from a minimum of 0.90 cubic feet per second (ft^3/s) to a maximum of 11.4 ft^3/s. This resulted in a mean annual 7-day minimum flow of 1.6 ft^3/s or 0.094 $ft^3/s/sq$ mi (cubic feet per second per square mile). The period of stream measurements was representative of drought conditions.

The deposits of Brandywine Creek drainage basin are of low permeability which results in a nearly total runoff to Lake Michigan. This runoff probably occurs soon after precipitation. Minor groundwater storage in the old beach and reworked older sandy lake deposits observed on the surface to the east of the site area probably maintain Brandywine Creek during periods of low rainfall.

2.2.1 GROUNDWATER

Almost all the water used in Van Buren County is obtained from wells. Exceptions are the City of South Haven that obtains its municipal supply from Lake Michigan and some irrigation supplies that are obtained from streams, lakes and local ditches (see Reference 4).

The glacial drift is the only known source of fresh groundwater in the county. All the glacial deposits are capable of yielding some water to wells, but the sand and gravel outwash deposits yield the largest quantities (see Reference 4).

The area of sand dunes along Lake Michigan is not generally favorable for obtaining large supplies of groundwater. Probably most of the dune sand is above the water table and most wells must be drilled into the underlying lake deposits (see Reference 4).

1. General

Groundwater levels were established by the 1966 Geology and Groundwater Investigation conducted by Bechtel Company for Consumers Power Company (see Reference 3). The results of the investigation are shown on Figure 2-9. It is readily apparent that subsurface drainage is generally westward

toward the lake (see Profile A-A). Minor variations; ie, flow toward surface streams, may exist but are not considered significant.

An average hydraulic gradient toward the lake of about 13 feet per mile was obtained along Profile A-A as shown on Figure 2-9. This gradient represents only the upper surface of unconfined groundwater. Water released on the surface would move toward the lake at an estimated rate of 650 feet per year (see Reference 3).

The nearest domestic wells to the site are located one-half mile to the east and south. The data indicates that groundwater in the vicinity of the eastern wells is flowing west toward the site. Local groundwater in the area of the southern wells is also flowing west toward the lake, perpendicular to the shoreline.

There are no major sources of groundwater withdrawal, eg, large-scale industrial or agricultural pumping, that might reverse the direction of groundwater flow and cause groundwater to flow from the Plant area toward any existing domestic wells. Without such pumping, it is difficult to envision a condition which would cause sufficient groundwater lowering at any of the domestic wells such that the direction of flow might be reversed.

2. Plant Site

Groundwater levels in the vicinity of the site are shown on Figure 2-9. The water table generally slopes toward the lake. During the site investigations, groundwater elevations averaged 580 feet MSL beneath the building site. This elevation corresponds to the approximate mean level of Lake Michigan. As shown by water levels measured during drilling, groundwater levels rise to the east to approximately 604 feet MSL beneath the switchyard and 601 feet MSL near the eastern site boundary (see Reference 3).

Field permeability tests performed during the 1965 exploratory drilling yielded values ranging from 30 to 1,720 feet per year in the site area, Table 2-11. In Drill Hole 5, located approximately 500 feet northwest of the containment building, the permeability values ranged from 30.4 feet per year to 143 feet per year. In Drill Hole 7, located approximately 650 feet south of the containment building, the permeability values ranged from 156 feet per year to 1,720 feet per year.

3. Groundwater Movement

An unconfined aquifer is present in the dune area with groundwater levels controlled by the level of Lake Michigan. The rate of movement of groundwater downward into material underlying the dunes appears to be very slow. Nine samples from Drill Hole 22 in the site area were tested for sodium absorption ratio (SAR), Table 2-12. A high SAR indicates poor downward percolation of water due to sodium deposition on and between soil particles. At the Plant site, the SAR is considered to be high between elevations 596 and 566 feet MSL and low between 566 and 555 feet MSL (see Reference 3).

Groundwater levels and permeability data from the sandy lake deposits underlying the dunes indicate a slow rate of discharge into Lake Michigan.

4. Conclusions

a. Groundwater in the unconfined aquifer moves westerly from the Brandywine Creek basin to Lake Michigan.

b. The hydraulic gradient is approximately 13 feet per mile and flow is essentially perpendicular to the shoreline.

c. Water discharged on the ground surface at the Plant site will percolate downward at a slow rate and mix with groundwater moving toward Lake Michigan.

d. Infiltration of surface water from the site to domestic wells offsite does not appear to be possible under present groundwater conditions.

2.2.2 GENERAL LAKE HYDROLOGY

1. Lake Levels

The level of Lake Michigan is cyclic and is expected to fluctuate with time and is dependent on long-term above-normal or below-normal amounts of precipitation. The highest monthly mean stage of Lake Michigan was 583.68 feet MSL in 1886. Subsequent modifications in the St Clair River and the opening of the diversion out of the basin at Chicago have tended to reduce the maximum level attainable. During the recent period of record (1900 to present), the highest recorded monthly mean stage was 582.6 feet MSL in July 1974, and the lowest monthly mean stage was 576.91 feet MSL in March and April 1964 (see Reference 5). Great Lakes levels are reported using International Great Lakes Datum which is converted to MSL at the Palisades site by adding 1.558 feet. The 1.558-foot correction factor is taken from the reference point at St Joseph, Michigan.

Short-time variations in lake levels (seiches), caused by meteorological factors and measured in hours rather than days, occur occasionally. The greatest level change of this type on record over a 105-year period involved a sudden rise of 6 feet at Michigan City, Indiana (8:10 AM, June 26, 1954) and a rise of 8 feet at Montrose Harbor, Chicago (9:30 AM on the same date) (see Reference 6). These seiches were reported in the "Science" article by Ewing, Press and Donn (Vol 120, Page 684). On passing into the shallow water at Michigan City, the wave was reflected and refracted to reach the Chicago shore of the lake. The US Lake Survey gauge at Holland, Michigan, which is 30 miles north of the Palisades site and has similar lake geometry to the site, indicated no surge on June 26, 1954.

As part of the Systematic Evaluation Program (SEP Topic II-3.B), the maximum probable surge elevation was reevaluated. The offshore surge value was reevaluated to produce an onshore surge height of 10.9 feet. The maximum monthly mean level was also reduced from 583.6 feet MSL to 582.6 feet MSL.

This resulted in a probable maximum flood protection level for the Palisades Plant of 593.5 feet MSL.

The service water pump motors at 594.7 feet MSL provide the basis for determining the minimum flood protection requirements for the Plant. Therefore, the resultant wave surges from Lake Michigan do not present a problem at Palisades.

2. Water Movements

Conclusions from a study of lake hydrology in the Palisades Park, Michigan area by Dr J L Hough (see Reference 6) indicate that surface currents generated by wind conditions and modified by the earth's rotation and lake configuration will provide adequate mixing of Plant liquid effluents into the lake. The study included actual measurements of lake water movement in the area near the Plant site, and water mixing where the Black River enters Lake Michigan at South Haven.

A summary of the study is as follows:

> Lake water is almost constantly moving past the Palisades site, with an appreciable velocity of flow, under the influence of winds. It is estimated, on the basis of wind records, that an alongshore current flows northward about 33% of the time and an alongshore current flows southward about 23% of the time. Offshore drift of surface water should occur about 38% of the time, according to frequency of offshore winds, but these would have a minimal effect close to shore, which is bordered by a high dune ridge. It is likely, therefore, that the alongshore currents would tend to persist, once set up, while offshore winds were blowing. Thus, the frequency of alongshore current flow is probably greater than the 33% and 23% based on wind directions.
>
> Under the procedure of taking water from a depth of about 20 feet, 3,500 feet offshore, raising its temperature as it is used for service water and dilution of cooling tower blowdown, and returning the effluent to the lake near shore, the effluent water will almost always be warmer than the lake water into which it is discharged. This is because a single Lake Michigan water mass is involved during most of the year. When the effluent is warmer, it will tend to float at the surface, to drift with the surface current, and to be mixed by surface turbulence due to wave action. On rare occasions, during the spring warming period when the upper layer of lake water is less than 20 feet deep, and during the summer when strong offshore winds cause a thinning of the normally deep surface mass to less than 20 feet, the intake water coming from a colder layer may not be warmed in the Plant sufficiently to have a temperature higher than that of the surface lake water. At such times, the effluent water will tend to sink to the thermocline and it will not be subject to vigorous turbulence caused by surface wave action. It will tend to mix more slowly.
>
> Surveys of the performance of Black River water, entering Lake Michigan at South Haven under various weather conditions, have indicated that

the river water is diluted rapidly, reaching a concentration of about only 1% in the lake within a mile of the river mouth.

The discharge of the Black River was evaluated because the rate was determined to be nearly the same as the discharge rate from the Palisades Plant with once-through cooling. Since the Plant is now operated with cooling towers, the discharge to the lake has been reduced to approximately 60,000 gpm or about 1/7 the original rate. The mixing and dilution factors are considered to be as great as during the higher discharge periods and the discharge concentrations should be diluted at least 1,000 times by the time the discharge could reach the public water intake at South Haven, Michigan.

3. Conclusions

a. The level of Lake Michigan is cyclic; however, the recorded high of 1886 is unlikely to be exceeded. High lake levels are not expected to present a problem at the Plant site.

b. There is no recorded evidence of short-time variations in lake levels (seiches) along the eastern shore of Lake Michigan which would be expected to affect the Plant site.

c. Surface currents generated by wind conditions and modified by the earth's rotation and lake configuration will provide adequate mixing of Plant liquid effluents into the lake.

TABLE 2-11

FIELD PERMEABILITY TEST RESULTS

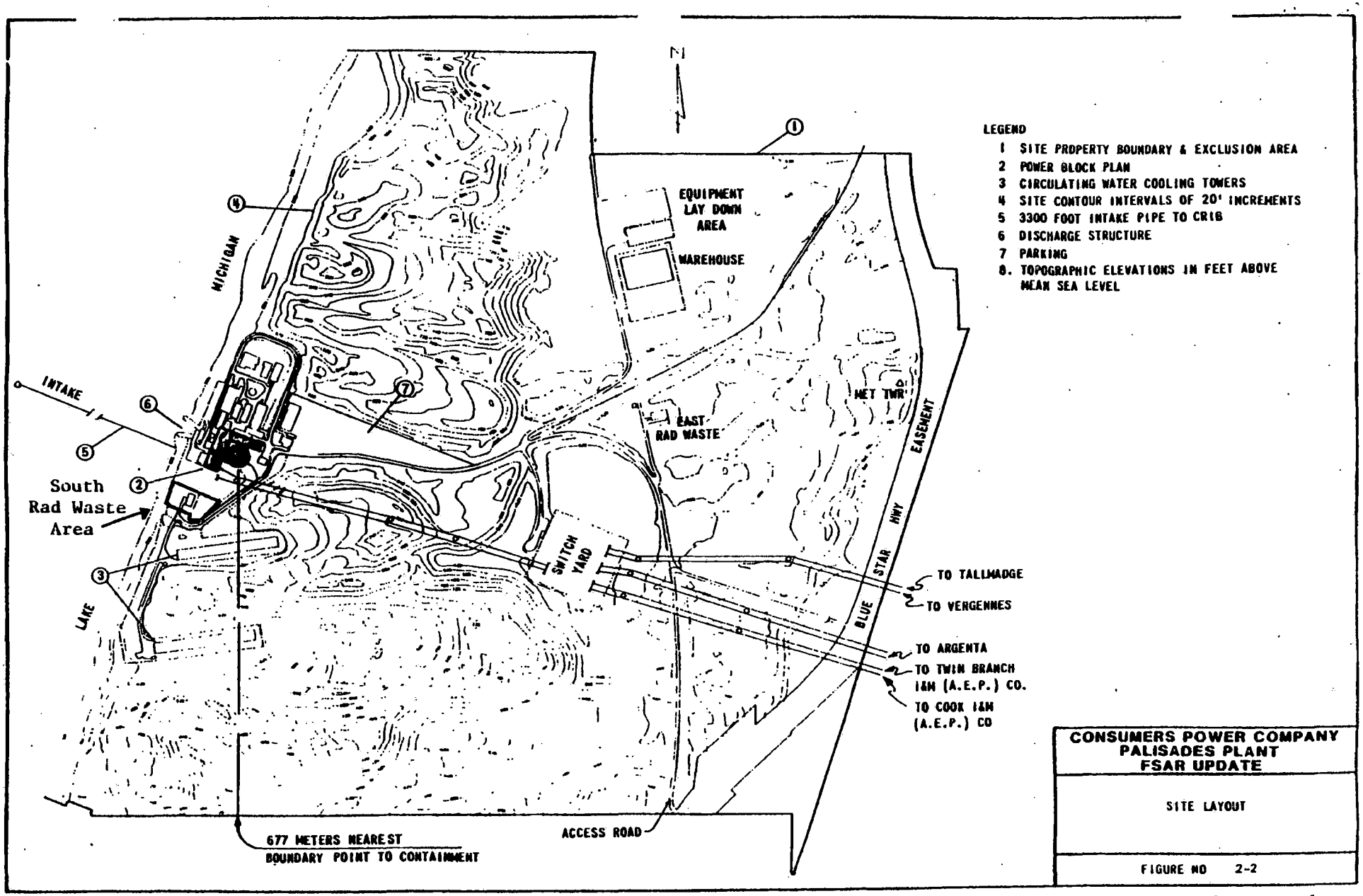
Drill Hole Number	Elevation of Test	Flow "Q" (Gpm)	Head "H" (Feet)		Permeability, "K" (ft/Yr)	Permeability, "K" (cm^3/s)
5	576	0.0029	12.3		30.4	0.3×10^{-4}
	570	0.0101	12.3		106.0	1.1×10^{-4}
	565	0.0088	12.3		92.0	0.89×10^{-4}
	560	0.0035	12.3		36.8	0.36×10^{-4}
	555	0.0136	12.3		143.0	1.4×10^{-4}
	550	0.0064	12.3		67.0	0.65×10^{-4}
	545	0.0033	12.3		34.6	0.34×10^{-4}
				Average	72.8	0.72×10^{-4}
7	580	0.0303	25		156	1.5×10^{-4}
	575	0.0477	25		246	2.4×10^{-4}
	570	0.0588	25		303	2.9×10^{-4}
	565	0.0588	25		303	2.9×10^{-4}
	560	0.0834	25		430	4.2×10^{-4}
	550	0.3333	25		1,720	16.7×10^{-4}
	545	0.0677	25		350	3.4×10^{-4}
	540	0.2500	25		1,290	12.5×10^{-4}
	535	0.2000	25		1,035	10.1×10^{-4}
				Average	648	6.3×10^{-4}

TABLE 2-12

ANALYSES OF SOIL SAMPLES

Sample No	pH	Saturation Extract Values Milliequivalents per Liter ECe	Calcium	Magnesium	Sodium	SAR	Sample Description
1	8.25	1.2	0.5	Trace	11.7	23.5	DH 22 El 596
2	8.4	1.4	0.5	Trace	13.0	26	DH 22 El 591
3	8.3	1.3	0.5	Trace	12.3	24.5	DH 22 El 586
4	8.45	1.4	0.5	Trace	14.4	29	DH 22 El 581
5	8.5	1.5	0.5	0.1	14.8	27	DH 22 El 576
6	8.3	1.5	0.5	Trace	14.8	29.5	DH 22 El 571
7	8.5	1.3	0.5	0.05	12.7	24	DH 22 El 566
8	8.2	0.5	3.0	0.4	1.1	1	DH 22 El 561
9	8.1	0.6	3.4	0.7	2.4	1.5	DH 22 El 555

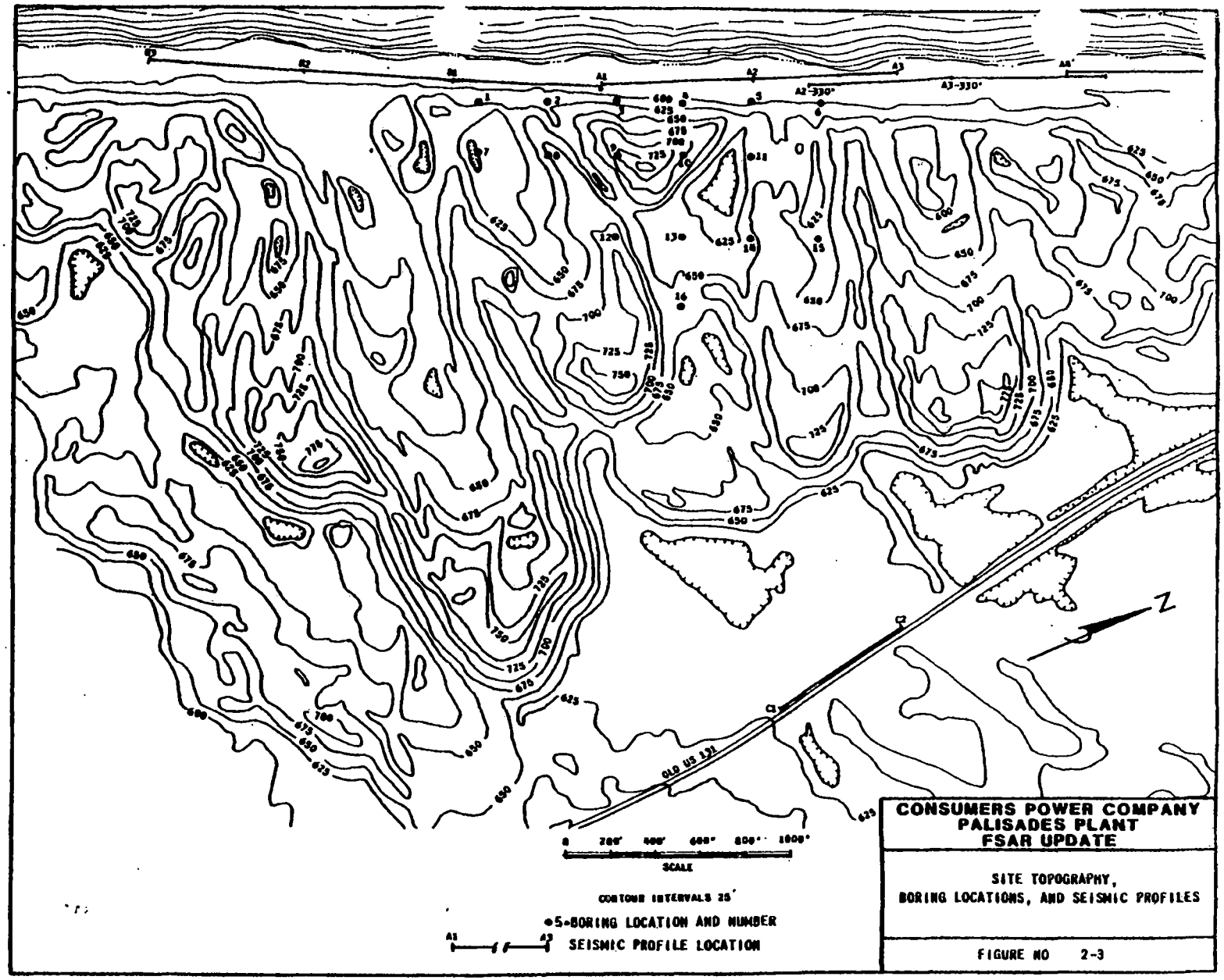
ECe = Millimhos per centimeter
SAR = Sodium adsorption ratio on saturation extract



3745 02822

Rev 0
8-1-91

ATTACHMENT 2



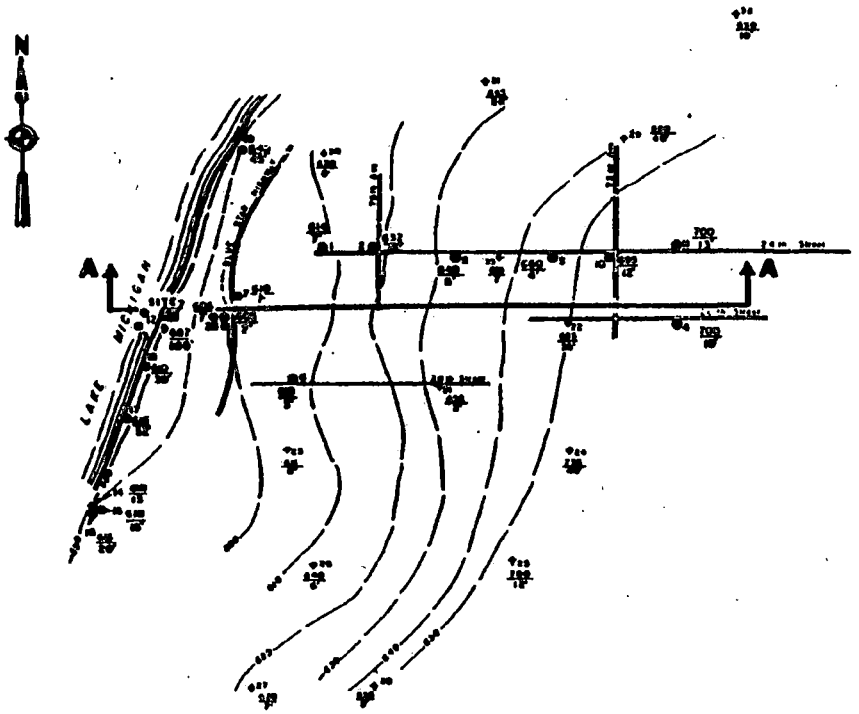
CONSUMERS POWER COMPANY
PALISADES PLANT
FSAR UPDATE

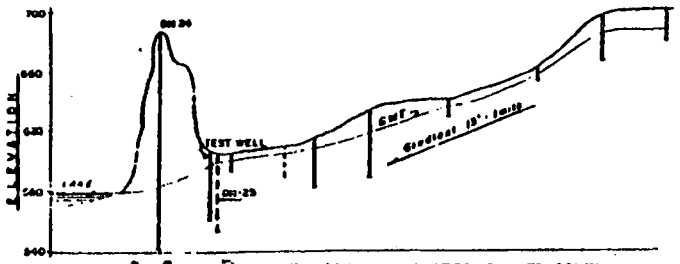
SITE TOPOGRAPHY,
BORING LOCATIONS, AND SEISMIC PROFILES

FIGURE NO 2-3

REVISION NO 0

ATTACHMENT 2





EXPLANATION

WATER SAMPLE LOCATION AND NUMBER — 610 / 7' = ELEVATION OF WELL COLLAR / DEPTH TO WATER

OBSERVATION WELL AND NUMBER — 633 / 8' = ELEVATION OF COLLAR / DEPTH TO WATER

600 — GROUND WATER CONTOUR

HORIZONTAL

VERTICAL

SCALES

CONSUMERS POWER COMPANY
PALISADES PLANT
FSAR UPDATE

GROUNDWATER ELEVATIONS
AND AREA GRADIENTS

FIGURE NO 2-9

REVISION NO 0

Rev 0
8-1-91

ATTACHMENT 2

Consumers Power
POWERING MICHIGAN'S PROGRESS
General Offices: 1945 West Parnall Road, Jackson, MI 49201 • (517) 788-0550

January 25, 1988

Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

DOCKET 50-255 - LICENSE DPR-20 - PALISADES PLANT -
SUPPLEMENT - REQUEST TO RETAIN SOIL IN ACCORDANCE WITH 10CFR20.302

Consumers Power Company letter dated November 12, 1987, requested authorization to dispose of soil in place as specified by 10CFR20.302. The letter included the results of a survey and evaluation performed in August, 1987. Following submittal of that letter, a cooling tower overflow on November 13, 1987 again flooded the South Radwaste Building. The flooding caused additional activity that necessitated Consumers Power Company to request placing our November 12, 1987 request on hold until further evaluation and surveys could be completed. This letter includes the results of our evaluation and survey of the November 13, 1987 flooding incident and is intended to supplement our original November 12, 1987 request.

Following the cooling tower overflow, a survey indicated additional activity had been released from the building. The building was being maintained in a non-contaminated condition to prevent this type of occurrence; however, during this period a destructive testing program on waste packages was being conducted in a small area of the building. The survey clearly showed the release of activity from the building adjoining the testing area. The top six inches of soil from the sectors adjoining the building were removed and packaged (588 cubic feet) to prevent additional dispersion of radioactivity. The area was then completely resurveyed.

An evaluation of the August 1987 and November 1987 (post packaging) activities is attached. The survey indicates a drop of 49% in activities between the August and November surveys. We propose the activities specified in the November 12, 1987 submittal be used as justification for the request because they are conservative. In addition since the November 13, 1987 flooding and following the most recent survey the area was subject to heavy rains which could have diluted some activities to below minimum detectable activity (MDA is nominally 1E-06 µCi/g).

The one non-conservative value from our August survey and evaluation is the maximum dose rate at 18 inches above the surface. The November survey value from MICROSHIELD is 1.17 mR/hr as opposed to 1.02 mR/hr. This small increase only slightly changes the radiation workers' conservative dose estimate from 4.08 mR/year to 4.7 mR/year.

Following approval of this application, it is proposed to account for the most conservative values of activity, which was stated in the November 12, 1987 submittal, as an abnormal release in the semi-annual report. In order to prevent recurrence of these releases to the environment, Consumers Power Company is also committing to transfer radwaste activities from this area, except for high level vault use which is not a potential flooding release problem.

Relocation of these activities to a new radwaste facility is currently scheduled to be completed in 1988.

A check in the amount of $150.00 was attached to our November 12, 1987 submittal pursuant to 10CFR170.12(c).

Thomas C Bordine (Signed)

Thomas C Bordine
Administrator, Nuclear Licensing

CC Administrator, Region III, NRC
NRC Resident Inspector - Palisades

Attachment

Attachment A

Consumers Power Company
Palisades Nuclear Plant
Docket 50-255

Evaluation and Survey Results Comparison Post November
Flood and Packaging Versus the November 12, 1987 Submittal

'A' Cooling Tower - South Radwaste Flood

In August of 1987, a resurvey was conducted of the soil at the South Radwaste Building and its adjacent areas. The resurvey was conducted to verify the location of ground contamination and if any contamination migrated further into the ground since the 1986 survey.

After submittal of the 1987 soil results and request to retain, in accordance with 10CFR20.302, 'A' Cooling Tower Basin overflowed again flooding the South Radwaste Building and outlying areas. Immediately following the occurrence, one liter sample was taken with no activity detected on the Multi-Channel Analyzer (MCA). Then, another complete survey was conducted which included at least two surface samples and core samples in every sector (Figures 1 and 2).

Surface sample results showed that activities have increased as well as new sectors contaminated. The most heavily affected sectors were I-10, I-11, J-9 and K-9 (Figure 1A). To keep these areas from spreading, the top 6" of each of these sectors was removed and placed in 6 LSA boxes (approx. 588 cu.ft) and stored for disposition at a later date.

After removal of soil, the sectors were resurveyed (Figure 1B) and core samples were taken in each sector in 6-inch increments. Core samples were taken as far down as in the 1986 and August 1987 surveys, and in some instances even further in this survey. Results showed that no activity was detected below 6 inches as shown in Figure 2.

Table 1 and Table 2 show comparisons between the August and November 1987 soil surveys. Table 1 compares the depths, the activities, the total cu.ft. and total µCi per sector. After the removal of soil, the November 1987 soil survey results showed approximately a 49.3% drop in total contaminated soil (cu.ft.) and a 51.1% drop in total µCi in comparison to the August 1987 survey results. In Table 2 the comparison is between sectors affected in each survey and the depth at which each of these sectors were sampled. No activity was detected past 6 inches in the November 1987 soil survey, in comparison to that of 18 inches detected in August 1987.

Direct dose to an individual working in the affected areas was calculated using the MICROSHIELD code. The activities from sectors H-9 and J-9 were used for a dose at 18" inches above the surface. The dose rates from H-9 and J-9 are 9.97E-6 R/hr and 1.17E-5 R/hr, respectively. Therefore, a 50-hour occupancy in one week could result in a maximum exposure of .59 millirem. Normal occupancy of this area is on an "as needed basis" and averages less than 8 hours/week per individual in contact with the contaminated soil.

In reviewing the soil results between August and November 1987, the August 1987 soil survey remains more conservative based on the information shown on Tables 1 and 2. Therefore, the August 1987 soil survey is still valid in support of our request to retain the soil in accordance with 10CFR20.302.

Table 1

Comparison Table Between Total Cu. Ft. and Total µCi

August 1987

Sector #	Sq.ft.	X	Depth	=	ft^3	X	q/ft^3	X	µCi/q	=	Total µCi
E-11	375		0.5		187.5		48144		2.07E-6		18.7
E-13	375		0.5		187.5		48144		4.39E-6		39.6
H-9	625		1.5		937.5		48144		4.79E-6		216.2
H-10	625		0.5		312.5		48144		2.60E-6		39.1
H-11	625		2.0		1250*		48144		3.75E-5		2256.8
I-9	527		0.5		263.5		48144		1.24E-5		157.3
I-10	275		1.5		412.5		48144		5.39E-6		107.0
J-9	450		0.5		225		48144		5.39E-6		58.4
J-12	200		0.5		100		48144		6.39E-6		30.8
L-9	150		1.0		150		48144		6.77E-6		48.9
I-9 East	98		1.5		147		48144		1.40E-5		99.1
	4325				4173						3071.9
					*1250		=				*2256.8 = 73.5% of total activity

November 1987

E-11	375	0.5	187.5	48144	1.80E-6		16.25
H-9	625	0.5	312.5	48144	4.35E-5		654.46
H-10	625	0.5	312.5	48144	3.20E-6		48.14
H-11	625	0.5	312.5	48144	3.22E-5		484.45
H-12	250	0.5	125	48144	2.20E-6		13.24
I-9	527	0.5	263.5	48144	6.79E-6		86.14
I-12	220	0.5	110	48144	3.0E-6		15.89
J-9	450	0.5	225	48144	2.05E-5		222.06
J-12	200	0.5	100	48144	2.60E-6		12.52
K-9	216	0.5	108	48144	3.39E-6		17.63
	4113		2056.5				1570.78

Table 2

Survey Comparison Between August and November 1987 Soil Surveys

Sector	August 1987 / November 1987 Surface	6"	12"	18"	24"	30"	36"	42"
E-11	2.07E-6	<MDA	<MDA	<MDA				
	1.80E-6	<MDA	<MDA	<MDA				
E-13	4.39E-6	<MDA	<MDA	<MDA				
	<MDA	N/A	<MDA	<MDA				
H-9	4.19E-6	<MDA	4.79E-6	<MDA	<MDA	<MDA		
	4.35E-5	<MDA	<MDA	<MDA	<MDA	<MDA		
H-10	2.60E-6	<MDA	<MDA					
	3.20E-6	<MDA	<MDA					
H-11	3.75E-5	<MDA	<MDA	8.45E-6	<MDA	<MDA	<MDA	
	3.22E-5	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
H-12	<MDA	N/A						
	2.20E-6	N/A						
I-9	1.24E-5	<MDA	<MDA					
	6.79E-6	<MDA	<MDA					
I-10	<MDA	<MDA	5.39E-6	<MDA	<MDA	<MDA	<MDA	<MDA
	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
I-11	<MDA	N/A						
	<MDA	<MDA	<MDA	<MDA				
I-12	<MDA	N/A						
	3.00E-6	N/A						
J-9	5.39E-6	<MDA	<MDA					
	2.05E-5	<MDA	<MDA					
J-12	6.39E-6	<MDA	<MDA					
	2.60E-6	N/A	<MDA					
K-9	<MDA	N/A						
	3.39E-6	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	
L-9	<MDA	6.77E-6	<MDA	<MDA				
	<MDA	N/A	<MDA	<MDA				

Microshield 3.02
==========

(Consumer's Power Company - #037)

Page : 1
File : SOIL1.MSH
Run date: January 18, 1988
Run time: 4:17 p.m.

CASE: CONTAMINATED SOIL @ H-9 LOCATION (6 INCHES DEEP)

GEOMETRY 11: Rectangular solid source - slab shields

Distance to detector.....	X	60.960	cm.
Source width.....	W	762.	"
Source length.....	L	762.	"
Rectangular solid, thickness toward dose pt..	T1	15.240	"
Thickness of second shield.....	T2	45.720	"

Source Volume: 8.84901e+6 cubic centimeters

MATERIAL DENSITIES (g/cc):

Material	Source	Shield 2
Air	.001220	.001220
Aluminum		
Carbon	1.70	
Concrete		
Hydrogen		
Iron		
Lead		
Lithium		
Nickel		
Tin		
Titanium		
Tungsten		
Urania		
Uranium		
Water	1.0	
Zirconium		

CASE: CONTAMINATED SOIL @ H-9 LOCATION (6 INCHES DEEP)

BUILDUP FACTOR: based on TAYLOR method.
Using the characteristics of the materials in shield 1.

INTEGRATION PARAMETERS:

Number of lateral angle segments (Ntheta).....	5
Number of azimuthal angle segments (Npsi).....	5
Number of radial segments (Nradius).....	5

SOURCE NUCLIDES:

Ba-137m: 3.8493e-04 curies

RESULTS:

Group #	Energy (MeV)	Activity (photons/sec)	Dose point flux MeV/(sq cm)/sec	Dose rate (mr/hr)
1	.664	1.282e+07	4.808e+00	9.969e-03
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
		---	---	---
	TOTALS:	1.282e+07	4.808e+00	9.969e-03

Microshield 3.02
==========

(Consumer's Power Company - #037)

Page : 1
File : SOIL2.MSH
Run date: January 18, 1988
Run time: 4:26 p.m.

CASE: CONTAMINATED SOIL @ J-9 LOCATION (6 INCHES DEEP)

GEOMETRY 11: Rectangular solid source - slab shields

Distance to detector.....	X	60.960	cm.
Source width.....	W	762.	"
Source length.....	L	548.640	"
Rectangular solid, thickness toward dose pt..	T1	15.240	"
Thickness of second shield.....	T2	45.720	"

Source Volume: 6.37129e+6 cubic centimeters

MATERIAL DENSITIES (g/cc):

Material	Source	Shield 2
Air	.001220	.001220
Aluminum		
Carbon	1.70	
Concrete		
Hydrogen		
Iron		
Lead		
Lithium		
Nickel		
Tin		
Titanium		
Tungsten		
Urania		
Uranium		
Water	1.0	
Zirconium		

Rev 0
8-1-91

CASE: CONTAMINATED SOIL @ J-9 LOCATION (6 INCHES DEEP)

BUILDUP FACTOR: based on TAYLOR method.
Using the characteristics of the materials in shield 1.

INTEGRATION PARAMETERS:

Number of lateral angle segments (Ntheta).....	5
Number of azimuthal angle segments (Npsi).....	5
Number of radial segments (Nradius).....	5

SOURCE NUCLIDES:

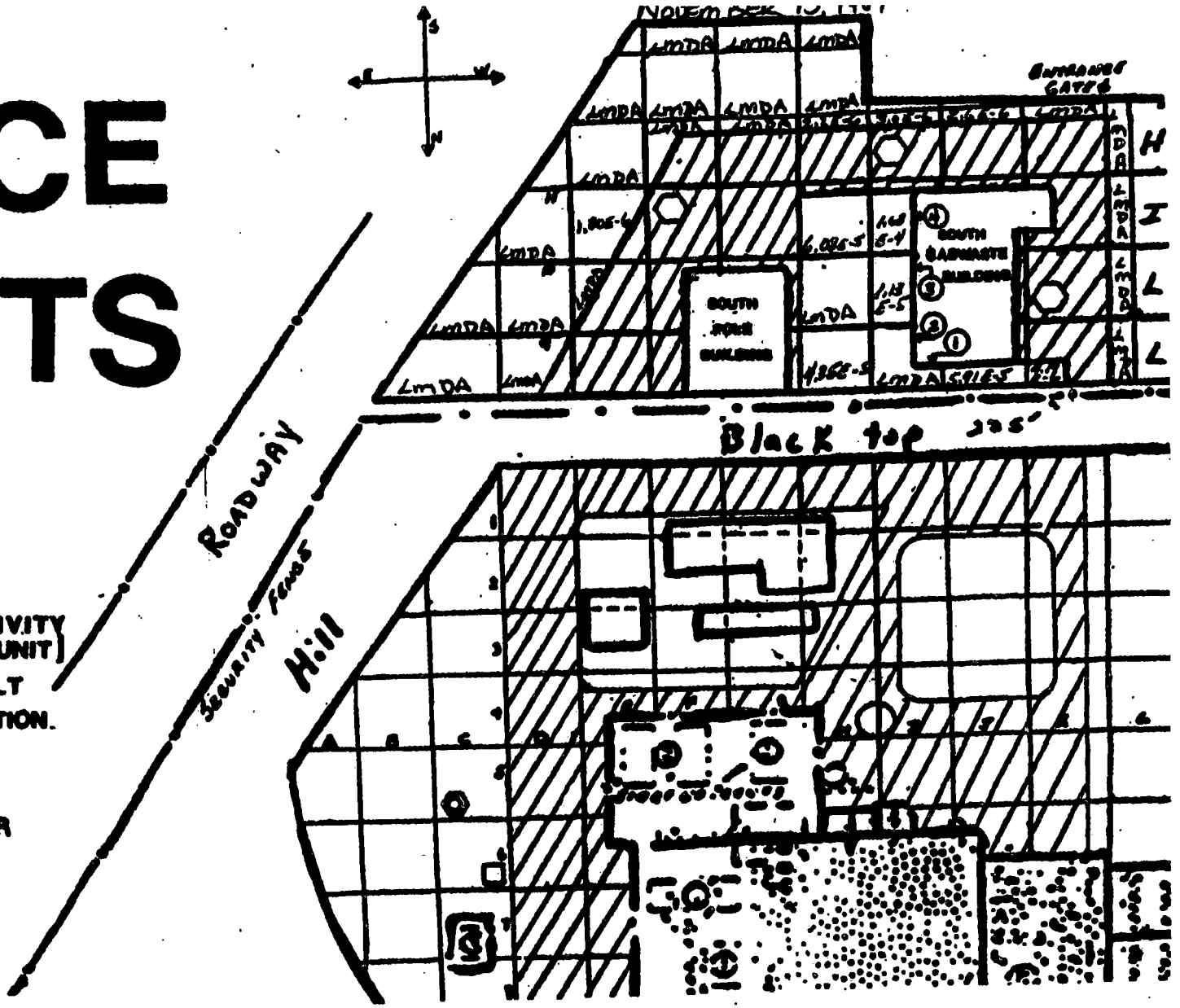
Co-60: 8.9198e-05 curies

RESULTS:

Group #	Energy (MeV)	Activity (photons/sec)	Dose point flux MeV/(sq cm)/sec	Dose rate (mr/hr)
1	1.336	3.300e+06	3.411e+00	6.155e-03
2	1.180	3.300e+06	2.958e+00	5.497e-03
3	.695	5.383e+02	2.889e-04	5.950e-07
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
TOTALS:		6.601e+06	6.370e+00	1.165e-02

FIGURE 1A

SURFACE RESULTS



LEGEND

- ∠MINIMUM DETECTABLE ACTIVITY (1.00E-6 µCi/UNIT)
- SURFACE AREA UNDER ASPHALT CORE SAMPLE UNDER FOUNDATION.
- SURFACE ACTIVITY OF SECTOR
- ASPHALT AREAS

*EXAMPLE : ONLY

Rev 0
8-1-91

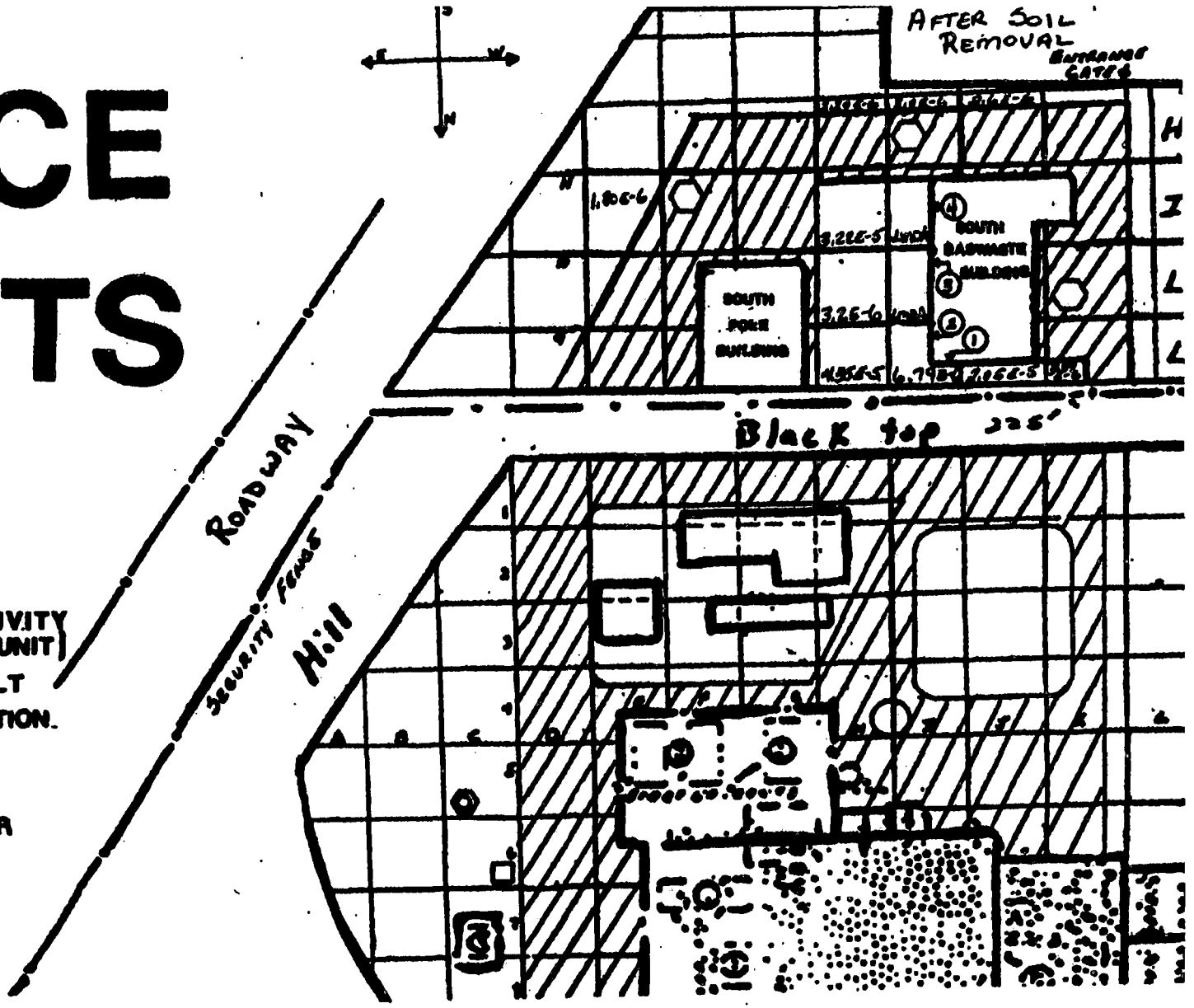
FIGURE 1B

SURFACE RESULTS

LEGEND

- MINIMUM DETECTABLE ACTIVITY (1.00E-6 µCi/UNIT)
- SURFACE AREA UNDER ASPHALT
- CORE SAMPLE UNDER FOUNDATION.
- SURFACE ACTIVITY OF SECTOR
- ASPHALT AREAS

*EXAMPLE : ONLY



Rev 0
8-1-91

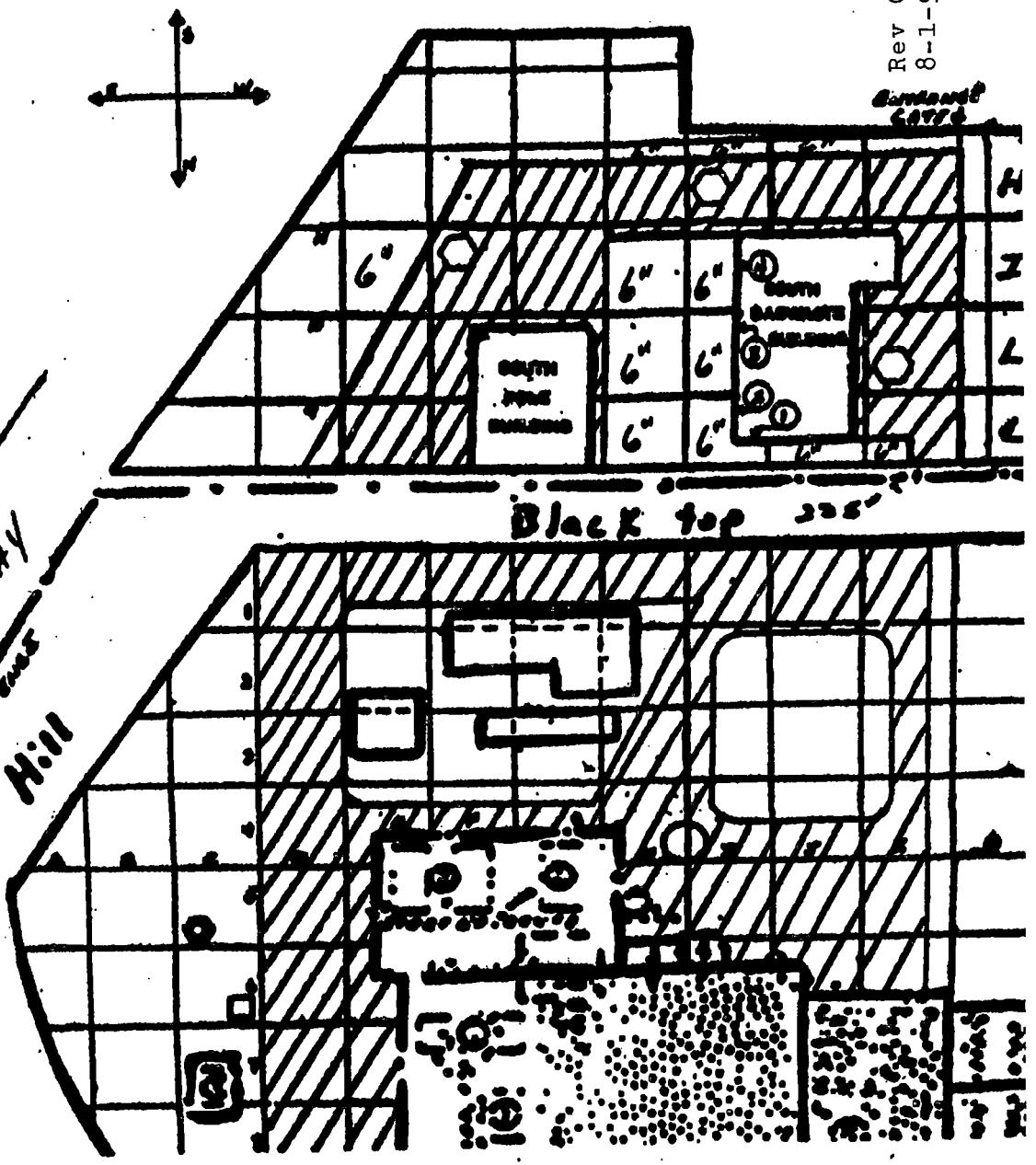
Rev 0
8-1-91

FIGURE 2

DEPTH SAMPLE RESULTS

LEGEND

- LETTER (B) = COLUMN, NUMBER (4) = ROW
- DEPTH LEVEL AT WHICH NO ACTIVITY WAS DETECTED
- ASPHALT AREAS
- MINIMUM DETECTABLE ACTIVITY [1.00 E-6 µCi/UNIT]
- SURFACE AREA UNDER ASPHALT
- CORE SAMPLE UNDER FOUNDATION



ODCM - APPENDIX B
REFERENCE 2

PW031588B

RECEIVED
MAR 18 1988
NUCLEAR LICENSING

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

March 15, 1988

Docket No. 50-255

Mr. Kenneth W. Berry
Director, Nuclear Licensing
Consumers Power Company
1945 West Parnall Road
Jackson, Michigan 49201

Dear Mr. Berry:

SUBJECT: PALISADES PLANT - REQUEST TO RETAIN CONTAMINATED SOIL IN ACCORDANCE WITH 10 CFR 20.302 (TAC NO. 67408)

The subject request submitted by Consumers Power Company by letter dated November 12, 1987 and supplemented by information forwarded by letter dated January 25, 1988 contains detailed information evaluating the radiation doses via the liquid pathways for very low levels of contamination presently in areas of soil near the Palisades Plant South Radwaste Building. Detailed evaluations are also presented of potential occupational doses from this contaminated soil.

One additional dose pathway should, however, be evaluated to complete the analysis of the impact viz., the inhalation pathway. In your submittals, you have presented diagrams showing areas in which contamination has been detected. It appears that for some of these areas 6" of soil has been removed, others are now covered by black top, and still others have not been disturbed. In order for the staff to complete the evaluation under 10 CFR 20.302, we ask that you submit a diagram indicating all contaminated soil surface areas included in this request, the condition of this soil surface, and an evaluation of the radiation doses via the inhalation pathway associated with these soil surfaces. The request in this letter affects fewer than ten respondents; therefore, OMB clearance is not required under PL 96-511.

Sincerely,

Thomas V. Wambach

Thomas V. Wambach, Project Manager
Project Directorate III-1
Division of Reactor Projects - III, IV, V
& Special Projects

cc: See Next Page

DCC: 42*40*50
24*34

Rev 0
8-1-91

Mr. Kenneth W. Berry
Consumers Power Company

Palisades Plant

cc:
M. I. Miller, Esquire
Isham, Lincoln & Beale
51st Floor
Three First National Plaza
Chicago, Illinois 60602

Mr. Thomas A. McNish, Secretary
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Judd L. Bacon, Esquire
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Regional Administrator, Region III
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Jerry Sarno
Township Supervisor
Covert Township
36197 M-140 Highway
Covert, Michigan 49043

Office of the Governor
Room 1 - Capitol Building
Lansing, Michigan 48913

Mr. David P. Hoffman
Plant General Manager
Palisades Plant
27780 Blue Star Memorial Hwy.
Covert, Michigan 49043

Resident Inspector
c/o U.S. Nuclear Regulatory Commission
Palisades Plant
27782 Blue Star Memorial Hwy.
Covert, Michigan 49043

Nuclear Facilities and
Environmental Monitoring
Section Office
Division of Radiological
Health
P.O. Box 30035
Lansing, Michigan 48909

LC# 500089

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

January 12, 1990

Docket No. 50-255
Serial No. PAL 90-002

Mr. Kenneth W. Berry
Director, Nuclear Licensing
Consumers Power Company
1945 West Parnall Road
Jackson, Michigan 49201

Dear Mr. Berry:

SUBJECT: PALISADES PLANT - REQUEST TO RETAIN SOIL IN ACCORDANCE WITH 10 CFR 20.302 (TAC NO. 67408)

By letters dated November 12, 1987 and January 25, 1988, Consumers Power Company requested authorization under the provisions of 10 CFR 20.302 to dispose contaminated soil in place. The NRC staff replied with a request for additional information which was forwarded to you on March 15, 1988.

By letter dated June 27, 1988, Consumers Power Company provided additional information in response to our request. However, in that response, CPCo expanded the original request to include the entire South Radwaste area as a contingency against future spread of contamination and to obviate the need for additional requests under 10 CFR 20.302. For the staff to complete its review of this request, additional specific information is required. This is because NRC approval under 10 CFR 20.302 is for the disposal of specifically identified and characterized slightly contaminated material by the applicant.

We request that you provide a revised submittal describing the licensed material for disposal and the analysis and evaluation called for under 10 CFR 20.302. The attached request for additional information provides additional detail for the content of the revised submittal.

The reporting and/or recordkeeping requirements of this letter affect fewer than ten respondents; therefore, OMB clearance under PL 96-511 is not required.

Sincerely,

Albert W. De Agazio

Albert W. De Agazio, Sr. Project Manager
Project Directorate III-1
Division of Reactor Projects - III,
IV, V & Special Projects
Office of Nuclear Reactor Regulation

cc: See next page

42*40*50
24*32

Rev 0
8-1-91

Mr. Kenneth W. Berry
Consumers Power Company

Palisades Plant

cc:

M. I. Miller, Esquire
Sidley & Austin
54th Floor
One First National Plaza
Chicago, Illinois 60603

Mr. Thomas A. McNish, Secretary
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Judd L. Bacon, Esquire
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Regional Administrator, Region III
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Jerry Sarno
Township Supervisor
Covert Township
36197 M-140 Highway
Covert, Michigan 49043

Office of the Governor
Room 1 - Capitol Building
Lansing, Michigan 48913

Mr. Gerald B. Slade
Plant General Manager
Palisades Plant
27780 Blue Star Memorial Hwy.
Covert, Michigan 49043

Resident Inspector
c/o U.S. Nuclear Regulatory Commission
Palisades Plant
27782 Blue Star Memorial Hwy.
Covert, Michigan 49043

Nuclear Facilities and
Environmental Monitoring
Section Office
Division of Radiological
Health
P.O. Box 30035
Lansing, Michigan 48909

ENCLOSURE

SECOND REQUEST FOR ADDITIONAL INFORMATION (RAI) ON THE CONSUMERS POWER COMPANY PALISADES PLANT REQUEST TO RETAIN SOIL IN ACCORDANCE WITH 10 CFR 20.302

The subject request submitted by Consumers Power Company (licensee) by letter dated November 12, 1987 and supplemented by information forwarded by letter dated January 25, 1988 contained detailed information evaluating the radiation doses via the liquid pathways for very low levels of contamination presently in areas of soil near the Palisades Plant South Radwaste Building. Detailed evaluations were also presented of potential occupational doses from this contaminated soil.

Three significant questions arose during the staff evaluation of this request:

1. The inhalation pathway for doses from the contaminated soil was not addressed.

2. The proposals contain no delineation of the specific contaminated areas covered by the disposal request.

3. The licensee's Technical Specifications for radiological environmental monitoring require an LLD of 2×10^{-7} µCi/gm for ^{137}Cs determinations in sediment - yet all of the measurements reported in the request were made with equipment 5 to 10 times less sensitive for these gamma radiations.

By letter dated June 27, 1988 the licensee submitted additional information in response to the staff's RAI of March 15, 1988. This submittal was unacceptable in that it addressed potentially contaminated areas and hypothetical maximum contamination parameters rather than measured licensed material to be disposed of under the regulations.

It is requested that the licensee submit a complete, revised 20.302 request incorporating the dose evaluation information of the measured contamination considered in the November 12, 1987 and January 25, 1988 submissions and updated if appropriate with dose evaluations of the inhalation pathway based on the same measured contamination. As part of the proposal the licensee should record exactly what areas of measured contamination are covered by the request for which disposal under 10 CFR 20.302 is proposed.

Consumers Power
POWERING MICHIGAN'S PROGRESS
General Offices: 1945 West Parnall Road, Jackson, MI 49201 • (517) 788-0550

June 27, 1988

Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

DOCKET 50-255 - LICENSE DPR-20 - PALISADES PLANT -
SUPPLEMENT - REQUEST TO RETAIN SOIL IN ACCORDANCE WITH 10CFR20.302

Consumers Power Company correspondence dated November 12, 1987 and January 25, 1988 requested authorization to dispose contaminated soil inplace as specified by 10 CFR 20.302. The area, known as the South Radwaste Area, has been contaminated by numerous cooling tower overflows and redistributed by heavy rain showers. Although the majority of the radioactive material has been packaged for waste shipment, a large volume of very low activity radioactive material remains. This volume of material would be very expensive to ship as waste. The NRC, by letter of March 15, 1988 to Consumers Power Company, requested additional inhalation dose information and clarification of the contaminated area.

A generic inhalation dose evaluation is described in Attachment A. Conservative assumptions have been made to get the maximum organ dose possible from inhalation of contaminated soil. The inhalation doses are not significant.

Consumers Power Company requests to expand this 10 CFR 20.302 request to include the entire South Radwaste Area. Periodic cooling tower overflows and occasional heavy rains have caused redistribution of radioactive material to areas which were below Lower Limits of Detection (LLD) during previous evaluations. Expanding the area would eliminate the need for a new 10 CFR 20.302 submittal if radioactive material is redistributed within the South Radwaste Area. The South Radwaste Area is completely fenced and located directly South of the Plant South Security fence. Area fence is shown in dark outline on Figure 1.

As described in our January 25, 1988, letter we intend to transfer the radwaste activities which caused the contamination of soil from the South Radwaste Area, except for the high level vault use which is not a potential flooding release problem.

Consumers Power Company requests approval to dispose of inplace low level radioactive materials which meet the following conditions without further 10 CFR 20.302 submittals.

1. Material contained in the fenced area described as South Radwaste Area.

2. Direct dose to a radiation worker would not exceed 5E-02 mRem/hour from contaminated soil.

3. Average gross beta/gamma concentration not to exceed 5E-05 µCi/gm so inhalation doses to a radiation worker or at the site boundary would not exceed the values contained in Attachment 1.

4. Additional radioactive material releases shall be identified in liquid Semi-Annual Effluents Reports as an 'Abnormal Release'.

Sampling, analyses and Semiannual Effluent Report inclusions of 'Abnormal Release' will be performed only when further flooding of the area occurs.

James L Kuemin (Signed)

James L Kuemin
Staff Licensing Engineer

CC Administrator, Region III, NRC
NRC Resident Inspector - Palisades

Attachment

Attachment 1

The inhalation doses have been calculated on a generic worst case basis. A generic basis has been selected to compensate for the elevated Lower Limit of Detection (LLD) in analysis and also to address movement of radioactivity within the South Radwaste Area. The assumptions made are the worst case Dose Conversion Factor (DCF) used (see Table 3), a total average activity concentration of 5E-05 µCi/gram and the entire area (500 m^2) used instead of the indicated contaminated area (117 m^2).

Increasing the area is self-explanatory. The total average activity concentration is being used instead of actual to account for dose important isotopes which may be present near the analysis LLD of 1E-06 µCi/gm, but not detected. The worst case DCF is used to demonstrate a maximum organ dose. A variation in isotope mixes could shift the maximum dose to a different organ but could not exceed the dose indicated.

Radworker and site boundary inhalation dose calculations are attached.

Table 1

Inhalation Dose From Contaminated Soil - Adult Radiation Worker

$$DW = C_S \cdot f_{18} \cdot f_{14} \cdot f_{15} \cdot E_f \cdot DCF_i$$

Where: C_S = concentration of waste: 5.0E04 pCi/Kg.

E_f = occupancy factor: 2080 worker hours ÷ 8760 hrs/yr = 0.237

f_{18} = areal mass available for resuspension (top 1 cm of soil): 16 Kg/m^2

f_{14} = resuspension factor: 8.5E-9/m

f_{15} = adult annual inhalation rate: 7300 m^3 (RG 1.109)

DCF_i = 7.46E-04 mRem/(50 yr . pCi): adult lung (RG 1.109)

Substituting:

D_W = 8.78E-03 mRem/50 yr: maximum organ dose

Reference: AIF/NESP-035 Evaluation of the Potential for De-Regulated Disposal of Very Low Level Wastes From Nuclear Power Plants

Table 2

Inhalation Dose At Site Boundary -
Infant Most Limiting

$$D_{SB} = C_S \cdot f_{18} \cdot f_{14} \cdot f_{16} \cdot X/Q \cdot \mu \cdot A \cdot DCF_i$$

Where: Terms are identified in Table 1 and

F_{16} = 2045 m^3: infant annual breathing rate (RG 1.109)

X/Q = 1.4 E-6 sec/m^3: actual 5 year site average

μ = 3.8 m/sec average wind speed: actual 1986

A = 500 m^2: contaminated area

DCF_i = 3.22E-03 mR/(50 yr . pCi): infant lung (RG 1.109)

Substituting

D_{SB} = 1.19E-04 mRem/50 yr: maximum organ dose

Table 3

Dose Conversion Factors for Inhalation: Committed dose (mRem) over 50 years per μCi inhaled, per Regulatory Guide 1.109.

Onsite - Radiation Worker

	Bone	Liver	Kidney	Lung	GI
Cs-134	4.66E-05	1.06E-04	3.59E-05	1.22E-05	1.30E-06
Cs-137	5.98E-05	7.76E-05	2.78E-05	9.40E-06	1.05E-06
Ba-140+D	4.88E-06	6.13E-09	2.09E-09	1.59E-04	2.73E-05
Sr-90*	1.24E-02	0.0	0.0	1.20E-03	9.02E-05
Co-60**	0.0	1.44E-06	0.0	7.46E-04	3.56E-05

* Sr-90 is a factor of 5E-03 lower than Cs-137 based upon 10 CFR 61 sampling analysis and cannot be limiting. Cs-137 was present in all samples where activity was identified.

** Given the concentration restriction on Sr-90 noted above, Co-60 lung dose is most limiting.

Offsite - Infant Most Limiting for Inhalation

Cs-134	2.83E-04	5.02E-04	1.36E-04	5.69E-05	9.53E-07
Cs-137	3.92E-04	4.37E-04	1.23E-04	5.09E-05	9.53E-07
Ba-140	4.00E-05	4.00E-08	9.59E-09	1.14E-03	2.74E-05
Sr-90*	2.92E-02	0.0	0.0	8.03E-03	9.36E-05
Co-60**	0.0	5.73E-06	0.0	3.22E-03	2.28E-5

* Sr-90 is a factor of 5E-03 lower than Cs-137 based upon 10 CFR 61 sampling analysis and cannot be limiting. Cs-137 was present in all samples where activity was identified.

** Given the concentration restriction on Sr-90 noted above, Co-60 lung dose is most limiting.

FIGURE 1

SURVEY GRID

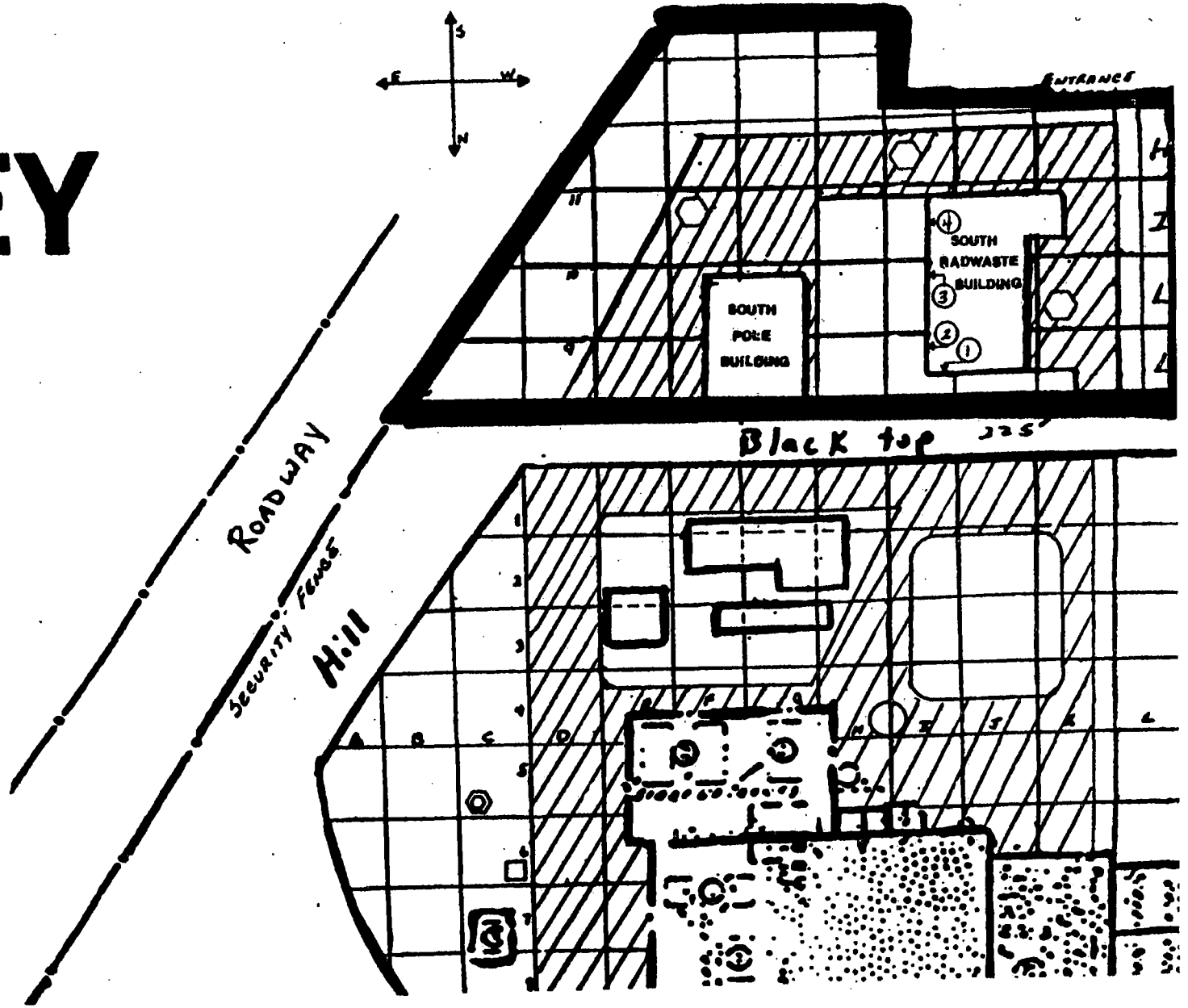
LEGEND

ASPHALT AREAS

25' x 25' SECTORS

AREA "B"

AREA "A"



Rev 0
8-1-91

ODCM - APPENDIX B
REFERENCE 4

Consumers Power
POWERING MICHIGAN'S PROGRESS
Palisades Nuclear Plant: 27780 Blue Star Memorial Highway, Covert, MI 49043

G B Slade
General Manager

August 31, 1990

Nuclear Regulatory Commission
Document Control Desk
Washington, D C 20555

DOCKET 50-255 - LICENSE DPR-20 - PALISADES PLANT
SUPPLEMENT - REQUEST TO RETAIN SOIL IN ACCORDANCE WITH 10CFR 20.302

Consumers Power Company correspondence dated November 12, 1987 and January 25, 1988 requested authorization to dispose of contaminated soil in place as specified by 10CFR 20.302. The area known as the South Radwaste Area has been contaminated by numerous cooling tower overflows and contamination was redistributed by heavy rain showers. Although the majority of the radioactive material has been packed for waste shipment, a large volume of very low activity radioactive material remains. This volume of material would be very expensive to ship as waste. The NRC, by letter of March 15, 1988 to Consumers Power Company, requested additional inhalation dose information and clarification of the contaminated area.

After discussions with the NRC reviewer, a supplement was submitted on June 27, 1988 which was based on generic approval. It proposed that further submittals would not be required if flooding moved activity from an identified to an unidentified sector. Subsequently, on January 12, 1990, the NRC Staff requested additional information. The information request required the licensee to submit a revised proposal incorporating the dose evaluation information of the measured contamination considered in the November 12, 1987 and January 25, 1988 submittals and updated, if appropriate, with dose evaluations of the inhalation pathway based on the same measured contamination. As part of the proposal, the licensee was asked to record exactly what areas of measured contamination are covered by the request for which disposal under 10CFR 20.302 is proposed.

The attached material supplies the requested information. The specific area contaminated is noted as Area B on the attached survey grid map. The entire area is fenced and is about 12,000 sq ft of soil exposed with the remainder buildings and asphalt. The inhalation pathway is for breathing suspended soil from this area. Table 2 addresses a radworker in Area B, and Table 3 addresses an infant on the site boundary. The radworker could receive 8.03E-04 mRem/50-year maximum organ (liver) dose and the infant could receive 3.16E-05 mRem/50-year maximum organ (liver) dose, both of which are insignif-icant.

Rev 0
8-1-91

When the flooding problem was discovered and planning for a formal survey was done, the environmental sediment LLD was not considered, as this was a nuclear plant site. We attempted to get the best LLD we could using our equipment and the number of samples we were going to have to run. With the hundreds of samples run, we felt 1E-06 uCi/gm was adequate. To be conservative, we expanded the August and November 1987 surveys to use 1.0E-06 uci/gm Cs-137 in any sector which showed LLD. This will increase the radioactivity to 5,006 uCi from 4,643 uCi, an increase of 8%. The activities are on Table 1 and 1A. If this submittal is approved, we will add the released activity to the Liquid Semi-annual Effluent Report as an abnormal release, and the approval to retain the soil in place will be documented in the FSAR.

In summation, Consumers Power Company requests approval to dispose of in place the low-level radioactive materials which are contaminated soil contained in the fenced area described as South Radwaste Area (Area B). Direct dose to a radiation worker would not exceed 1.7E-02 mRem/hour from this contaminated soil. Inhalation doses to a radiation worker or at the site boundary would not exceed 8.03E-04 mRem/50-year. Tables 1 and 1A radioactive material release shall be identified in liquid Semi-annual Effluent Reports as an 'abnormal release'. The disposal in place would be documented in the FSAR.

The radwaste activities which caused the contamination of the soil have been completely relocated to a new east radwaste area. The South Building has been deconned and is being used for non-radwaste activities. Some fixed contamination is present in floor cracks and vaults. This has been documented for plant decommissioning. No further contamination will be added to the south area from the South Radwaste Building.

Gerald B Slade (Signed)

Gerald B Slade
General Manager

pc: Administrator, Region III, USNRC
NRC Resident Inspector, Palisades

Attachment A

Consumers Power Company
Palisades Nuclear Plant
Docket 50-255

Tables 1 and 1A, Survey Results
Microshield Direct Dose Calculation
Table 2 - Radworker Inhalation Dose
Table 3 - Site Boundary Inhalation Dose
Figure 1 - Survey Grid
Figure 2 - Survey Results

Table 1

August 1987 Survey

Sector #	Sq.ft.	X	Depth	=	ft^3	X	g/ft^3	X	µCi/g	=	Total µCi
E-11	375		0.5		187.5		48144		2.07E-6		18.7
E-13	375		0.5		187.5		48144		4.39E-6		39.6
H-9	625		1.5		937.5		48144		4.79E-6		216.2
H-10	625		0.5		312.5		48144		2.60E-6		39.1
H-11	625		2.0		1250*		48144		3.75E-5		2256.8
I-9	527		0.5		263.5		48144		1.24E-5		157.3
I-10	275		1.5		412.5		48144		5.39E-6		107.0
J-9	450		0.5		225		48144		5.39E-6		58.4
J-12	200		0.5		100		48144		6.39E-6		30.8
L-9	150		1.0		150		48144		6.77E-6		48.9
I-9 East	98		1.5		147		48144		1.40E-5		99.1
Subtotals	4325				4173						3071.9
Remainder of Section	7613		0.5		3807		48144		1.0E-06		183
TOTAL	11,938										3,255.

Rev 0
8-1-91

Table 1A

November 1987 Survey

Sector #	Sq.ft.	X	Depth	=	ft^3	X	g/ft^3	X	µCi/g	=	Total µCi
B-9	125		0.5		62.5		48144		1E-06		3
C-9	625		0.5		312.5		48144		1E-06		15
C-10	500		0.5		250		48144		1E-06		12
D-9	500		0.5		250		48144		1E-06		12
D-10	625		0.5		312.5		48144		1E-06		15
D-11	550		0.5		275		48144		1E-06		13
D-12	75		0.5		37.5		48144		1E-06		2
E-10	125		0.5		62.5		48144		1E-06		3
E-11	375		0.5		187.5		48144		1.8E-06		16
E-12	625		0.5		312.5		48144		1.E-06		15
E-13	550		0.5		275		48144		1E-06		13
F-12	300		0.5		150		48144		1E-06		7
F-13	625		0.5		312.5		48144		1E-06		15
G-12	750		0.5		125		48144		1E-06		6
C-13	625		0.5		312.5		48144		1E-06		15
H-9	625		0.5		312.5		48144		4.4E-05		662
H-10	625		0.5		312.5		48144		3.2E-06		48
H-11	600		0.5		300		48144		3.2E-05		462
H-12	250		0.5		125		48144		2.2E-06		13
H-13	625		0.5		312.5		48144		1.0E-06		15
I-9	527		0.5		263.5		48144		6.8E-06		86
I-10	275		0.5		137.5		48144		1.0E-06		7
I-11	250		0.5		125		48144		1.0E-06		6
I-12	220		0.5		110		48144		3.0E-06		16
J-9	450		0.5		225		48144		2.1E-05		227
J-12	200		0.5		100		48144		2.6E-06		13
K-9	216		0.5		108		48144		3.4E-06		18
L-9	150		0.5		75		48144		1.0E-06		4
L-10	150		0.5		75		48144		1.0E-06		4
L-11	150		0.5		75		48144		1.0E-06		4
L-12	150		0.5		75		48144		1.0E-06		4
Subtotals	11,938 ft^2				5,969 ft^3		Maximum		4.4E-05		1751
							Average		6.1E-06		

Rev 0
8-1-91

Microshield 3.02

(Consumer's Power Company - #037)

Page : 1
File : SOIL1.MSH
Run date: January 18, 1988
Run time: 4:17 p.m.

CASE: CONTAMINATED SOIL @ H-9 LOCATION (6 INCHES DEEP)

GEOMETRY 11: Rectangular solid source - slab shields

Distance to detector.....	X	60.960	cm.
Source width.....	W	762.	"
Source length.....	L	762.	"
Rectangular solid, thickness toward dose pt..	T1	15.240	"
Thickness of second shield.....	T2	45.720	"

Source Volume: 8.84901e+6 cubic centimeters

MATERIAL DENSITIES (g/cc):

Material	Source	Shield 2
Air	.001220	.001220
Aluminum		
Carbon	1.70	
Concrete		
Hydrogen		
Iron		
Lead		
Lithium		
Nickel		
Tin		
Titanium		
Tungsten		
Urania		
Uranium		
Water	1.0	
Zirconium		

CASE: CONTAMINATED SOIL @ H-9 LOCATION - 5 INCHES DEEP

BUILDUP FACTOR: based on TAYLOR method.
Using the characteristics of the materials in shield 1.

INTEGRATION PARAMETERS:

Number of lateral angle segments (Ntheta).....	5
Number of azimuthal angle segments (Npsi).....	5
Number of radial segments (Nradius).....	5

SOURCE NUCLIDES:

Ba-137m: 3.8493e-04 curies — Actual 6.51E-04 Ci (4.4E-05 uCi/gm)

RESULTS:

Group #	Energy (MeV)	Activity (photons/sec)	Dose point flux MeV/(sq cm)/sec	Dose rate (mr/hr)
1	.664	1.282e+07	4.808e+00	9.969e-03
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
TOTALS:		1.282e+07	4.808e+00	9.969e-03

Ratio of $\frac{6.51 \text{ Ci}}{3.85 \text{ Ci}}$ = 1.69 x 9.969E-03 = 1.7E-02 mR/hr

Table 2

Inhalation Dose From Contaminated Soil -
Adult Radiation Worker

$D_W = C_S \cdot f_{18} \cdot f_{14} \cdot f_{15} \cdot E_f \cdot DCF_i$

Where: C_S = concentration of waste - 4.4E04 pCi/Kg Cs-137 (actual max concentration)

E_f = occupancy factor - 2080 worker hours ÷ 8760 hrs/yr = 0.237

f_{18} = a real/mass available for resuspension (top 1 cm of soil) - 16 Kg/m^2

f_{14} = resuspension factor - 8.5E-9/m

f_{15} = adult annual inhalation rate - 7300 m^3 (RG 1.109)

DCF_i = 7.76E-05 mRem/50 yr · pCi - Cs-137 adult liver (RG 1.109)

Substituting:

D_W = 8.03E-04 mRem/50 yr - maximum organ dose

Reference: AIF/NESP-035 Evaluation of the Potential for De-regulated Disposal of Very Low Level Wastes From Nuclear Power Plants

Rev 0
8-1-91

Table 3

Inhalation Dose At Site Boundary - Infant Most Limiting

$$D_{SB} = C_S \cdot f_{18} \cdot f_{14} \cdot f_{16} \cdot X/Q \cdot \mu \cdot A \cdot DCF_i$$

Where: Terms are identified in Table 1 and

F_{16} = 2045 m^3 - infant annual breathing rate (RG 1.109)

X/Q = 1.4 E-6 sec/m^3 - actual 5 year site average

μ = 3.8 m/sec average wind speed - actual 1986

A - 1110 m^2 - contaminated area

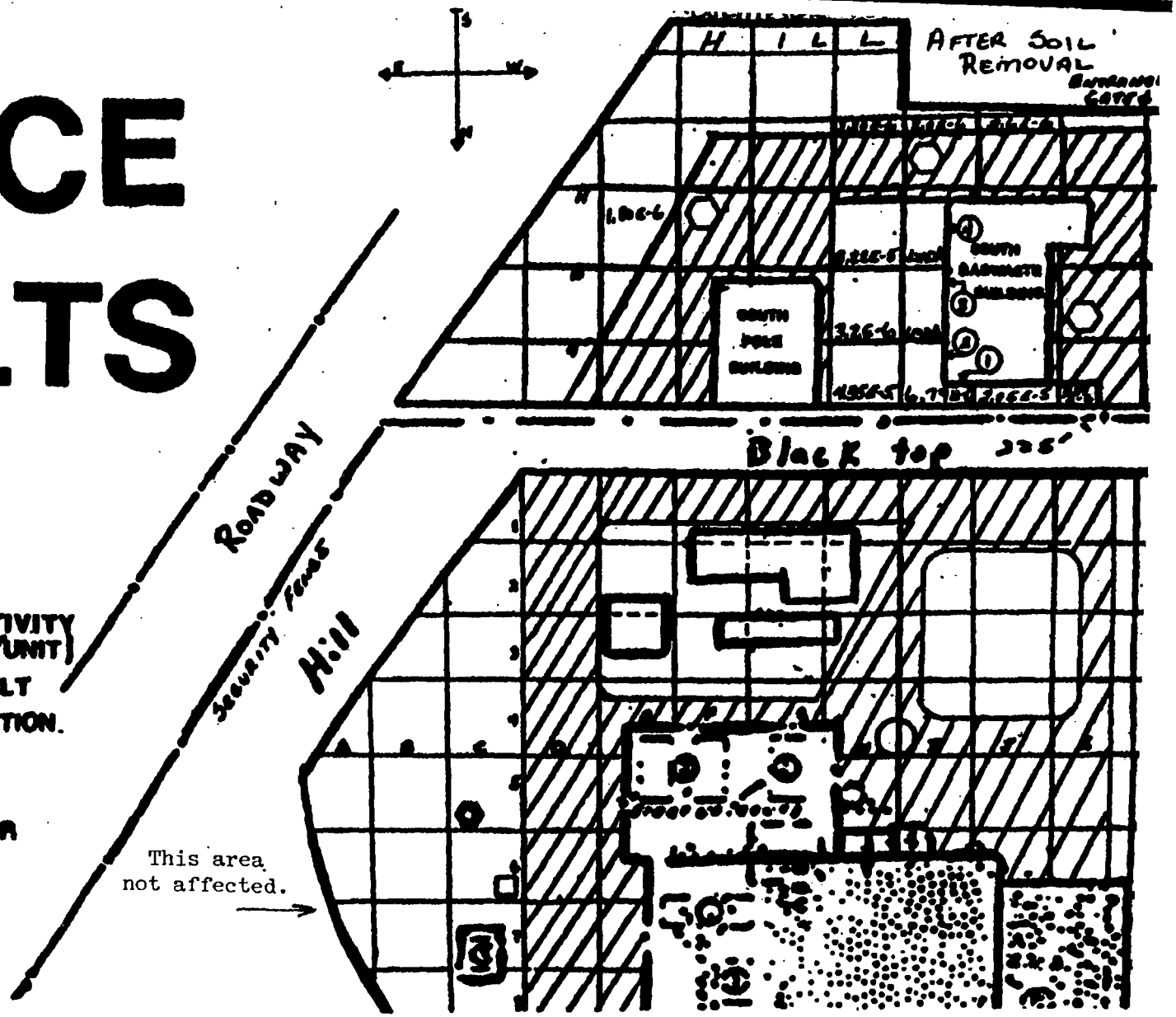
DCF_i - 4.37E-04 mR/50 yr · pCi - Cs-137 infant liver (RG 1.109)

›stituting:

D_{SB} = 3.16E-05 mRem/50 yr - maximum organ dose

FIGURE 1B

SURFACE RESULTS



LEGEND

All these sectors Assigned 1E-06 uCi/gm

MINIMUM DETECTABLE ACTIVITY (1.00E-6 µCi/UNIT)

SURFACE AREA UNDER ASPHALT

CORE SAMPLE UNDER FOUNDATION.

SURFACE ACTIVITY OF SECTOR

ASPHALT AREAS

*EXAMPLE ONLY

Rev 0
8-1-91

FIGURE 1

SURVEY GRID

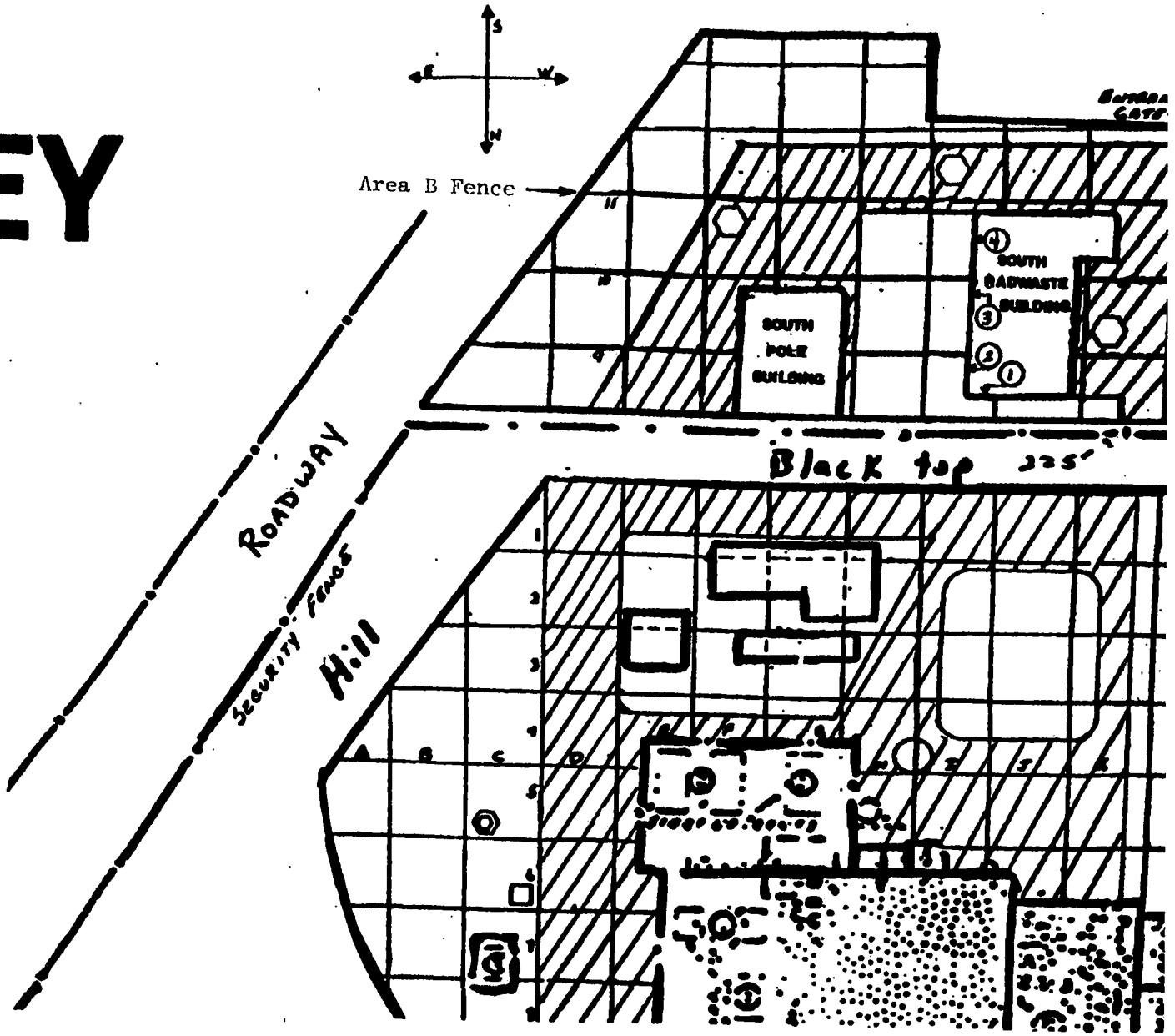
LEGEND

ASPHALT AREAS

25' x 25' SECTORS

Contaminated AREA "B"

AREA "A"



Rev 0
8-1-91

ODCM - APPENDIX B
REFERENCE 5

To BHolian

From TPNeal

Date October 23, 1990

Subject PALISADES PLANT-
10CFR20.302 SOIL SUBMITTAL

CC RLSmedley
KMHaas

CONSUMERS POWER COMPANY

TPN90*028

The following samples were obtained from sectors H-9 and J-9 on October 23, 1990.

Sample Location	uCi/gm
H9-1	3.92E-6
H9-2	3.70E-6
H9-3	1.26E-6
H9-4	<MDA
H9-5	<MDA
J9-1	1.90E-6
J9-2	<MDA
J9-3	<MDA
J9-4	2.28E-6
J9-5	5.86E-6

Sector H-9 was the highest reading in 1988 at 4.4E-05 uCi/gm and J-9, 2.1E-05. Both areas are now showing a factor of 10 drop in activity. Sector H-11 could not be resampled because of equipment stored in this location. The data indicates direct dose would be less than 2E-03 mR/hr. Occupancy in this area should not exceed 2 hours/week or 100 weeks/year, which is less than 1 mR/year. Sample and analysis by MAWillers and GStama, review by TPNeal.

Consumers Power
POWERING MICHIGAN'S PROGRESS
Palisades Nuclear Plant: 27780 Blue Star Memorial Highway, Covert, MI 49043

G B Slade
General Manager

April 24, 1991

Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

DOCKET 50-255 - LICENSE DPR-20 - PALISADES PLANT -
USE OF SOUTH STORAGE BUILDING AS AN INTERIM RADIOACTIVE WASTE STORAGE BUILDING

On November 10, 1990, radioactive waste generators in the State of Michigan were banned from the three currently active burial sites. As a result of this ban action must be taken to ensure that Palisades maintains the capability to store radioactive waste until such time as we are again able to gain access to the burial sites. We believe our actions are consistent with NRC guidance received in Generic Letter 90-09. Therefore, the South Storage Building will be utilized as an interim storage facility for low level radioactive waste (LLW).

The South Storage Building (then referred to as the South Radwaste Building) had been previously used for all processing and storing of radioactive waste produced at Palisades from 1976 to 1989. During that period several cooling tower overflows occurred which resulted in flooding this building and spreading contamination from the processing area to the surrounding soil. This spread in contamination resulted in NRC Open Items (85019-01 and 89025-01) which required implementation of actions to prevent future flooding. In 1988 it was decided to relocate the radwaste processing functions performed in the South Radwaste Building to a new addition at the East Radwaste Building to prevent the spread of contamination in the event of future cooling tower overflows. All radwaste processing equipment was relocated to the East Radwaste Building and the South Radwaste Building was decontaminated. The South Radwaste Building (then re-named the South Storage Building) has since been used for non-radiological material storage.

As a result of increases in radioactive waste, the South Storage Building is now needed to store low level radioactive waste (LLW). This LLW, in the form of dry active waste (DAW) will be packaged in metal boxes and labelled, ready for future shipment to burial sites. The DAW metal shipping boxes will be stored off the floor to prevent water damage. The metal shipping boxes are strong, tight containers designed to prevent any leakage of radioactive material during transportation. Incidental water contact will not result in the spread of contamination. Radioactive waste will not be processed in the

South Radwaste Building and the building will be maintained as a normally clean (radiologically) area.

The current Palisades Radwaste Storage Plan requires low dose-rate DAW boxes to be placed adjacent to the walls of the South Radwaste Building to limit dose rates outside the building. All DAW boxes and the storage building will be inspected quarterly in accordance with Palisades Health Physics Procedure HP 6.27. This procedure incorporates the storage and inventory guidelines contained in NRC Information Notice No. 90-09, "Extended Interim Storage of Low Level Radioactive Waste by Fuel Cycle and Material Licensee".

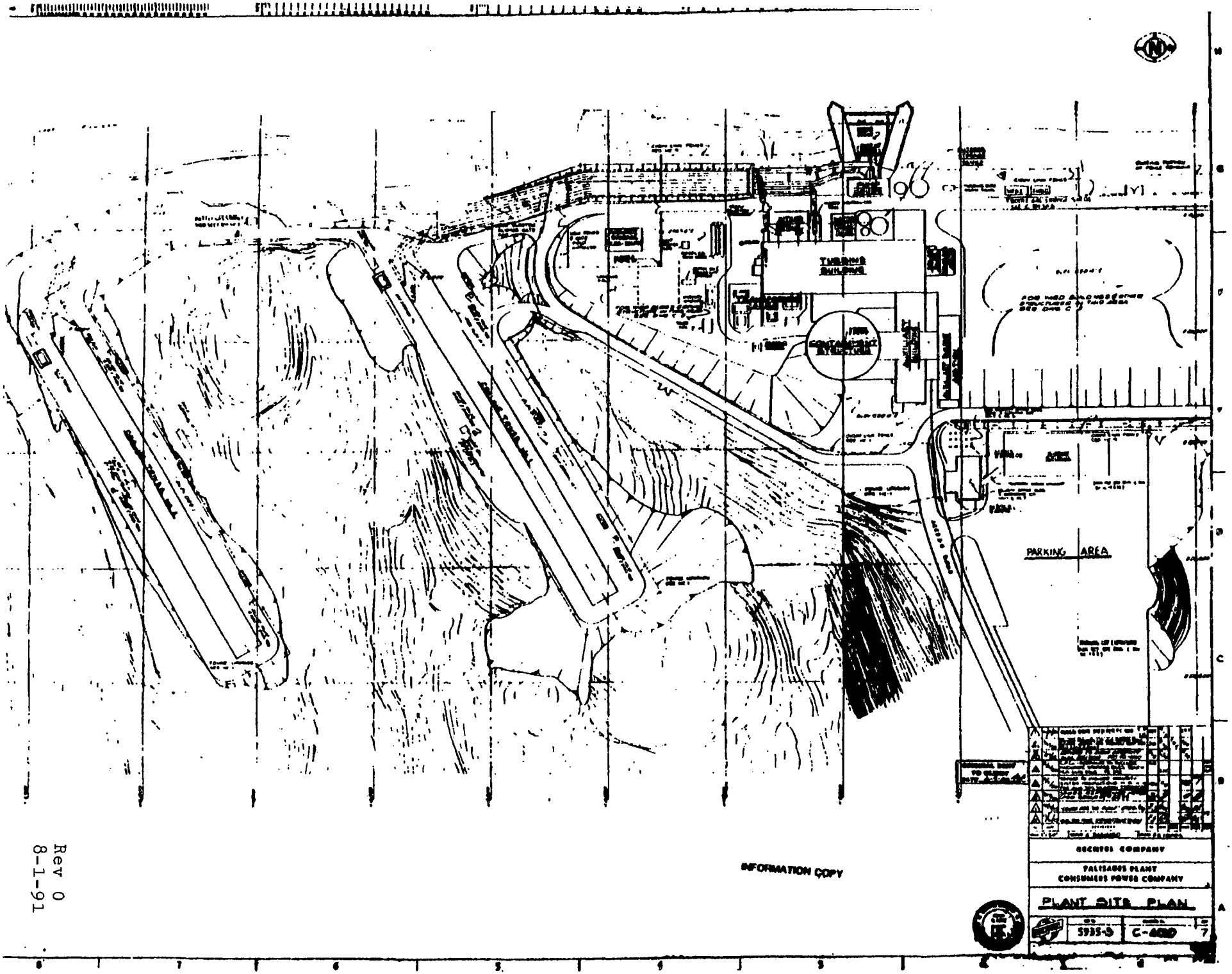
The same radiological and security controls currently in force at the East Radwaste Building will apply at the South Radwaste Building. The South Radwaste Building is surrounded by a locked fence and all building access doors will normally be locked, with keys controlled by Radiation Safety Department. All access to the building will be controlled through the Radiation Safety Office and the Palisades RWP/Dosimetry System. Building status sheets will be updated on a monthly basis or whenever radiological conditions change. Any areas outside the building reaching 5mr/hr or greater shall be posted in accordance with current HP Procedures.

Since the South Radwaste Building will be used for the storage of low level radioactive waste and not for radioactive waste processing, it is believed that the public health and safety will not be adversely affected.

It is Palisades' intent to continue to use the South Radwaste Building to store low level radioactive waste (LLW) until such time when radwaste generators in Michigan are again allowed to ship radioactive waste to the burial sites. Upon resumption of shipping to the burial sites the South Radwaste Building will be emptied, surveyed and returned to the plant for non-radiological material storage.

Gerald B Slade
General Manager

CC Administrator, Region III, USNRC
Resident Inspector, Palisades


TURBINE BUILDING
CONTAINMENT STRUCTURE
PARKING AREA
INFORMATION COPY
BECHTEL COMPANY
PALISADES PLANT
CONSUMERS POWER COMPANY
PLANT SITE PLAN
5935-9
C-4080

Rev 0
8-1-91

ODCM - APPENDIX B
REFERENCE 7

UNITED STATES
NUCLEAR REGULATORY COM
WASHINGTON, D.C. 20555

TPNeal, Pal

June 7, 1991

Docket No. 50-255

JUN 12 1991

Mr. Gerald B. Slade
Plant General Manager
Palisades Plant
Consumers Power Company
27780 Blue Star Memorial Highway
Covert, Michigan 49043

Dear Mr. Slade:

SUBJECT: REQUEST UNDER 10 CFR 20.302 TO RETAIN CONTAMINATED SOIL ONSITE AT PALISADES PLANT (TAC NO. 67408)

By letters dated November 12, 1987, and January 25, 1988, (Reference 1 of the enclosed Safety Evaluation (SE)), Consumers Power Company submitted a request pursuant to 10 CFR 20.302(a) for the disposal of contaminated soil onsite at the Palisades Plant. We have completed our review of the request and find your procedures (with commitments as documented in Reference 1) to be acceptable. This approval is granted provided that References 1-5 of the enclosed Safety Evaluation are permanently incorporated into your Offsite Dose Calculation Manual (ODCM) as an Appendix. Also, future modifications of these commitments shall be reported to the NRC in accordance with the applicable ODCM change protocol. We further find that the radiological environmental impact of the proposed action meets the staff criteria as reflected in Reference 6 of the enclosed Safety Evaluation.

Sincerely,

Brian Holian, Project Manager
Project Directorate III-1
Division of Reactor Projects III/IV/V
Office of Nuclear Reactor Regulation

Enclosure:
As stated

Rev 0
8-1-91

Mr. Gerald B. Slade
Consumers Power Company

Palisades Plant

cc:

M. I. Miller, Esquire
Sidley & Austin
54th Floor
One First National Plaza
Chicago, Illinois 60603

Mr. Thomas A. McNish, Secretary
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Judd L. Bacon, Esquire
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Regional Administrator, Region III
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Jerry Sarno
Township Supervisor
Covert Township
36197 M-140 Highway
Covert, Michigan 49043

Office of the Governor
Room 1 - Capitol Building
Lansing, Michigan 48913

Mr. Patrick M. Donnelly
Director, Safety and Licensing
Palisades Plant
27780 Blue Star Memorial Hwy.
Covert, Michigan 49043

Resident Inspector
c/o U.S. Nuclear Regulatory Commission
Palisades Plant
27782 Blue Star Memorial Hwy.
Covert, Michigan 49043

Nuclear Facilities and
Environmental Monitoring
Section Office
Division of Radiological
Health
P.O. Box 30035
Lansing, Michigan 48909

Gerald Charnoff, P.C.
Shaw, Pittman, Potts &
Trowbridge
2300 N. Street, N.W.
Washington, D.C. 20037

Mr. David L. Brannen
Vice President
Palisades Generating Company
c/o Bechtel Power Corporation
15740 Shady Grove Road
Gaithersburg, Maryland 20877

Roy W. Jones
Manager, Strategic Program
Development
Westinghouse Electric Corporation
4350 Northern Pike
Monroeville, Pennsylvania 15146

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION RELATED TO
THE PALISADES NUCLEAR PLANT
RETENTION OF CONTAMINATED SOIL ONSITE

INTRODUCTION

In reference (1), Consumers Power Company (CPCo) requested approval pursuant to Section 20.302 of Title 10 of the Code of Federal Regulations (CFR) for the disposal of licensed material not previously considered by the NRC in the Palisades Final Environmental Statement (FES), dated June 1972. The petition submitted contains a detailed description of the licensed material (i.e., contaminated soil) subject to this 10 CFR 20.302 request. The 6,000 cubic feet of onsite contaminated soil contains a total radionuclide inventory of 5.1 mCi, based on radioactive material that was deposited in the soil due to the flooding of the South Radwaste Building. The contaminated area is located inside the security fences, and is on company controlled land. This area (South Radwaste Area) is fenced in, within the plant's south security fences. Thus it is inaccessible to the public (see Figures 1 and 2).

In the submittals (References 1-5), the licensee addressed specific information requested in accordance with 10 CFR 20.302(a), provided a detailed description of the licensed material, thoroughly analyzed and evaluated the environmental effects relative to retention of the contaminated soil onsite, and committed to follow specific procedures to minimize the risk of unexpected exposures. Although the environmental impact of the proposed action is well within the dose criteria contained in the Commission's Below Regulatory Concern (BRC) Policy Statement, dated July 3, 1990, the licensee has not requested, and the staff has not considered, the actions described herein to be exempt from NRC regulation.

CPCo plans to dispose of the 6,000 cubic feet of contaminated soil onsite pursuant to 10 CFR 20.302. The area, known as the South Radwaste Area, has been contaminated by several cooling tower overflows (three times in an eight-year period), and has subsequently been redistributed by heavy rain showers. The cooling tower overflows were caused by instrument failures that opened the cooling tower bypass valve during normal operation. This valve is now electrically isolated during cooling tower operation. The licensee conducted a soil survey because the South Radwaste Building was in the main path of the water overflows from the cooling tower. Survey results indicated that radioactive material was deposited in the soil. Although the majority of the radioactive material has been packaged as radwaste and will be subsequently shipped offsite (16 boxes each having a volume of 98 cubic feet, containing 85% of the estimated activity), a large volume of low level contaminated soil is contained in the fenced area described as the South Radwaste Area.

The specific area contaminated is noted as Area B on the survey grid map (see Figure 2). The total activity of this area (5.1 mCi) is based on 6,000 cubic feet of soil contaminated with the spoils from the South Radwaste Building. Table 1 lists the principal nuclides identified in the contaminated soil. The activity in this table is based on measurements in 1987; see data from a recent submittal (Reference 5) shows that activity concentrations in the contaminated area have decreased by approximately 10 percent. The radionuclide half-lives, which are dominated by 30-year Cs-137, meet the staff's 10 CFR 20.302 guidelines (Reference 6, which applies to radionuclides with half-lives less than 35 years).

Table 1

Nuclide	Average Concentration (pCi/g)	Total Activity (mCi)
Co-60	0.05	0.079
Cs-137	30	5.0
	Total	5.079

RADIOLOGICAL IMPACTS

The licensee has evaluated the following potential exposure pathways to members of the general public from the radionuclides in the contaminated soil: (1) external exposure caused by direct radiation from radionuclides in the soil; and (2) internal exposure from inhalation of resuspended radionuclides. The staff has reviewed the licensee's calculational methods and assumptions and finds that they are consistent with NRC Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977. The staff finds the assessment methodology acceptable. The dose assessments are based on the following:

1. 5.1 mCi of contaminated soil distributed over 12,000 square foot planar source having a thickness of 0.5 feet (6000 cubic feet source volume).

2. Direct radiation exposure of 2000 hours per year.

3. Inhalation exposure based on 2000 hours per year is minimized due to six-inch layer of gravel (which inhibits wind erosion.)

4. Groundwater not considered because there are no domestic wells in the area down-gradient from the plant.

Doses calculated from these pathways are shown in Table 2. The total dose of 0.85 mrem per year is within the staff's guideline of 1 mrem per year (Reference 6).

Table 2

Pathway	Whole Body Dose Received by Maximally Exposed Individual (mrem/year)
Groundshine	0.85
Inhalation	0.00081
Groundwater Ingestion	0.0
TOTAL	0.85

The above doses are a small fraction of the 300 mrem received annually by members of the general public in the United States and Canada from sources of natural background radiation (Reference 7).

Based on our review of the proposed disposal of contaminated soil onsite, we conclude that:

(1) The radioactive material will be disposed in a manner such that it is unlikely that the material will be recycled;

(2) Doses to the total whole body and any body organ of a maximally exposed individual (a member of the general public or a non-occupationally exposed member) from the probable pathways of exposure to the disposed material will be less than 1 mrem per year;

(3) Doses to the total whole body and any body organ of an inadvertent intruder from the probable pathways of exposure will be less than 5 mrem per year since the burial location is on company-controlled land;

(4) The radiation exposures to the nuclear station workers are small compared to the routine occupational exposures at the Palisades Plant;

(5) The possible radiation risks to members of the general public as a result of such disposal are well below regulatory limits and small in comparison to the doses they receive each year from natural background radiation.

The licensee's procedures and commitments as documented in the submittal are acceptable, provided that they are permanently incorporated into the licensee Offsite Dose Calculation Manual (ODCM) as an Appendix, and that future modifications be reported to NRC in accordance with the applicable ODCM change protocol.

REFERENCES

(1) CPCo's letters, T. C. Bordine to NRC Document Control Desk, November 12, 1987 and January 25, 1988.

(2) Memorandum from L. J. Cunningham, DREP to T. R. Quay, T. V. Wambach, "Request for Additional Information (RAI)," March 15, 1988, April 7, 1989, and January 12, 1990.

(3) CPCo's supplement to Reference (1), J. L. Kuemin to NRC Document Control Desk, June 27, 1988.

(4) CPCo's supplement to References (1, 2), G. B. Slade to NRC Document Control Desk, August 31, 1990.

(5) CPCo's letter, T. P. Neal to B. Holian, October 13, 1990.

(6) E. F. Branagan, Jr. and F. J. Congel, "Disposal of Slightly Contaminated Radioactive Wastes from Nuclear Power Plants," presented at CONF-860203, Health Physics Considerations Decontamination Decommissioning, Knoxville, TN, February, 1986.

(7) National Council on Radiation Protection and Measurements, "Exposure of the Population in the United States and Canada from Natural Background Radiation," NCRP Report No. 94, Bethesda, MD. December 30, 1987.

Principal Contributor: J. L. Minns

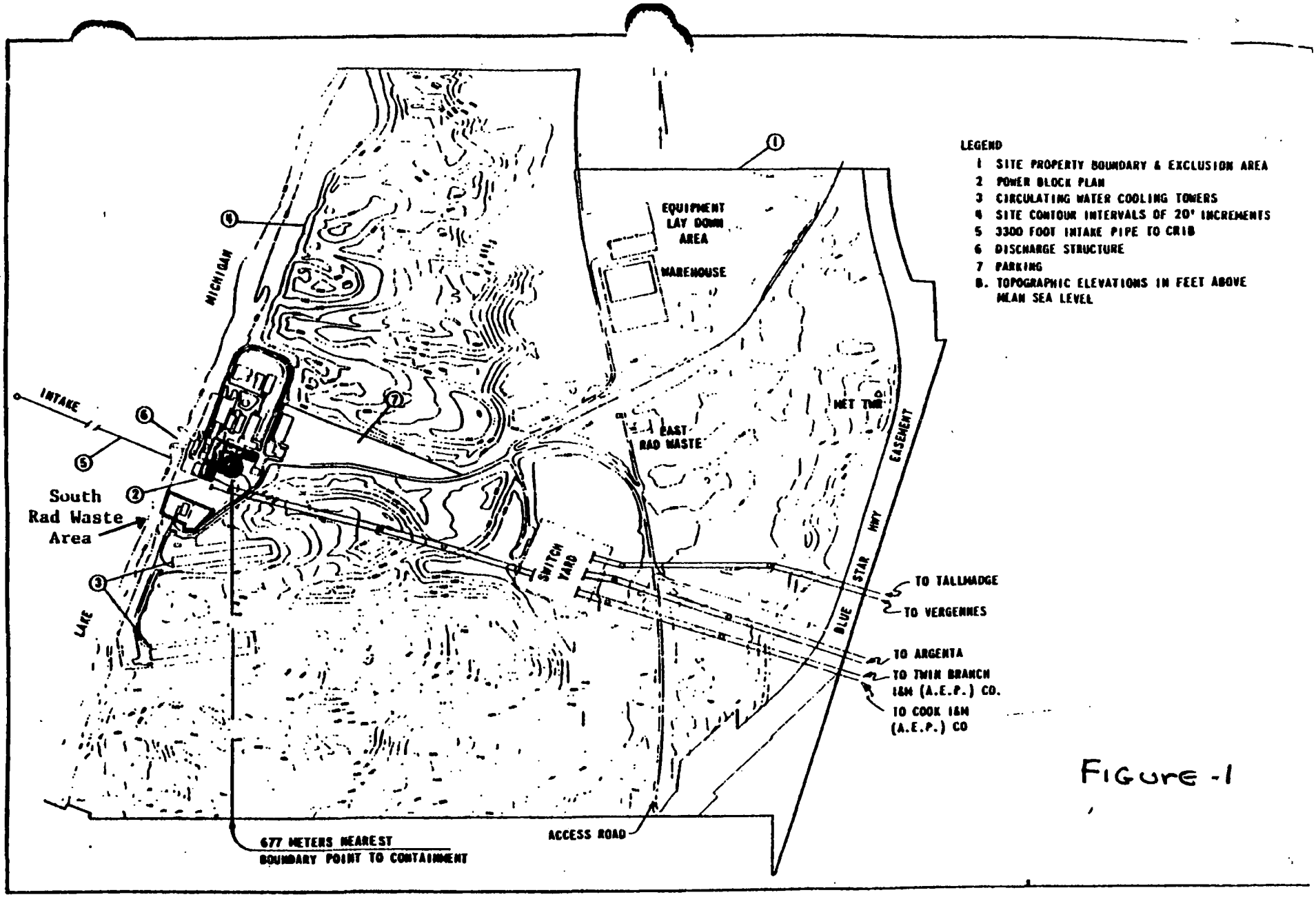


FIGURE -1

Rev 0
8-1-91

Rev 0
8-1-91

AUGUST 1987

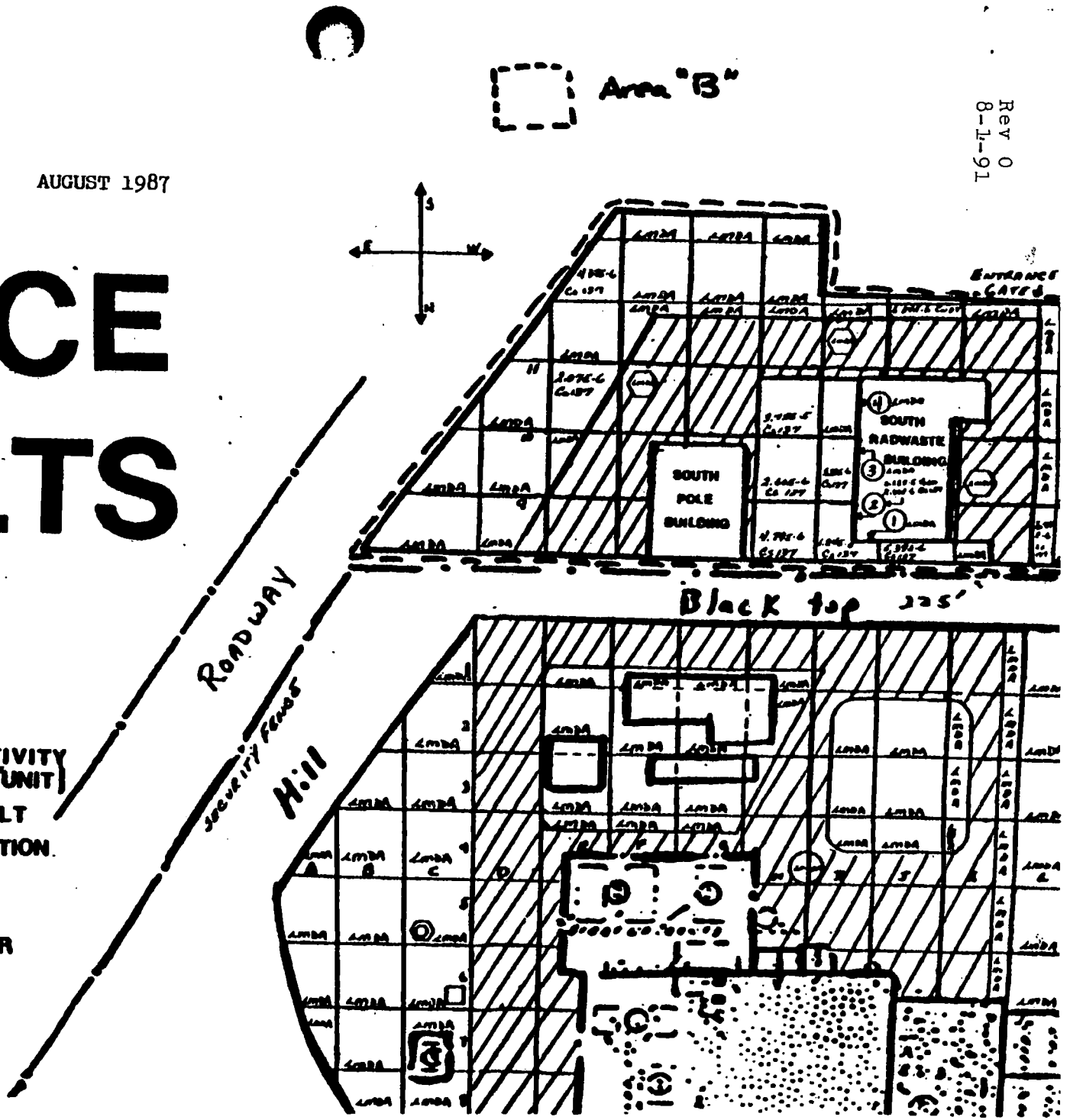
FIGURE 2

SURFACE RESULTS

LEGEND

- MINIMUM DETECTABLE ACTIVITY (1.00E-6 µCi/UNIT)
- SURFACE AREA UNDER ASPHALT CORE SAMPLE UNDER FOUNDATION
- 1.50E-6* SURFACE ACTIVITY OF SECTOR
- ASPHALT AREAS

*EXAMPLE ONLY



ATTACHMENT 2
BIG ROCK POINT INDEPENDENT SPENT FUEL STORAGE INSTALLATION
2015 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 2015. 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 2015.

2015 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 Plan[1]. On April 11, 2007, the license for BRP, DPR-06, was transferred to Entergy Nuclear Operations, Inc.

During 2015, 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 iodine 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 2015. 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 2015.

   C. Radioactive Effluent Monitoring Instrumentation

      BRP ODCM currently specifies required actions when less than the minimum numbers 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 2015, 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 2015. 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 2015.

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 2015, 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 2015.

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 2015.

TABLE 1
Big Rock Point
Batch Releases
January 1, 2015 to December 31, 2015

A. GASEOUS	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

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, 2015 to December 31, 2015

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	
2. Average release rate for period	µCi/sec	N/A	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	
2. Average release rate for period	µCi/sec	N/A	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	
2. Average release rate for period	µCi/sec	N/A	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, 2015 to December 31, 2015

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, 2015 to December 31, 2015

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, 2015 to December 31, 2015

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, 2015 to December 31, 2015

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	--	--	--	--