NMC
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Palisades Nuclear Plant
Operated by Nuclear Management Company, LLC

March 29, 2005

10 CFR 50.36a
Technical Specification 5.6.3

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

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

2004 Annual Radioactive Effluent Release and Waste Disposal Report

Enclosed is the Nuclear Management Company, LLC, (NMC) 2004 Annual Radioactive Effluent Release and Waste Disposal Report for the Palisades Nuclear Plant. This report is submitted in accordance with 10 CFR 50.36a(a)(2) and Palisades Technical Specification 5.6.3.

This report provides a summary of the quantities of radioactive liquid and gaseous effluent releases and solid radioactive waste processed during the period of January 1, 2004, through December 31, 2004.

Summary of Commitments

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

W. Shamoun 3/29/05
FOR DAN MALONE

Daniel J. Malone
Site Vice President, Palisades Nuclear Plant
Nuclear Management Company, LLC

Enclosure (1)
Attachments (8)

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ENCLOSURE 1
2004 ANNUAL RADIOACTIVE EFFLUENT RELEASE
AND WASTE DISPOSAL REPORT
JANUARY 2004 – DECEMBER 2004

This report provides information relating to radioactive effluent releases and solid radioactive waste shipments at the Palisades Nuclear Plant (PNP) during the period of January 1, 2004, through December 31, 2004. The report is required by 10 CFR 50.36a(a)(2) and Technical Specification 5.6.3. The report format is detailed in the Offsite Dose Calculation Manual (ODCM), Appendix A.

2004 Plant Operating History

PNP was in service until August 10, 2004, when the plant was taken off line to replace seals on control rod drive mechanisms. The unit returned to service on August 17, 2004. PNP was taken off line on September 19, 2004, for the refueling outage. The unit was returned to service on November 17, 2004, and was in service for the remainder of the year.

1. Supplemental Information

   A. Batch Releases

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

   B. Abnormal Releases

      None.

   C. Lower Limits of Detection (LLDs) for gaseous and liquid effluents are provided in Attachment 5, "Lower Limits of Detection for Palisades Effluents."

   D. Results of the 2004 Radiochemistry Cross Check Program with Analytics are shown in Attachment 6. Results were in agreement for all isotopes on all three detectors. There were a total of 271 measurements made.

   E. Radioactive Effluent Monitoring Instrumentation

      The ODCM, Appendix A, requires that any gaseous or liquid effluent monitor out of service for greater than 30 days be included in this effluent report. In 2004, there were no radioactive effluent monitoring instrument channels inoperable for more than 30 days. However, RIA-2323, "B" main steam safety and dump valve discharge line, was out of service for greater than seven days. As a result of this inoperability, a special report was required to be submitted to the NRC detailing the cause of the event. This report was sent on January 10, 2005.

2. Gaseous Effluents

Attachment 2, "Gaseous Effluents – Summation of Releases," lists and summarizes all gaseous radioactive effluents released during the reporting period. The unidentified beta was 9.01E-06% of the total release.

Gaseous effluents (noble gases) and resultant beta and gamma doses to site boundary in 2004, were approximately half that of the previous year. The total fission product and activation gases released in 2004, were also half that of 2003.

There were no fuel failures during fuel cycle 17, which resulted in lower gaseous effluent releases in 2004.

Organ dose (long lived particulates and iodine) was 1.77 times higher in 2004, as compared to 2003, due to several factors. During 2004, the methodology for calculations involving radioiodine from the plant stack, and gaseous tritium releases from the spent fuel pool, were changed as described below.

In July 2004, the collection efficiency for radioiodine released from the plant stack effluent pathway was reduced from 90% to 63%. The change in the collection efficiency was based on a technical report by Stewart Bland, of Chesapeake Nuclear Services, Inc, titled, "Evaluation of Radioiodine and Particulate Deposition for the Radioactive Gaseous Effluent Monitoring System (RGEM) Sample Line." The report is contained in Attachment 8.

The collection efficiency for radioiodine has been 90% since the RGEM system was placed in service in the early nineteen eighties. An evaluation was made of the organ dose impact, had iodine releases been reported with a 43% increase. The highest radioiodine (I-131 & I-133) release year since RGEM has been in service was 1985. The total radioiodine release for 1985, was 4.89E-02 curies. The resultant total organ dose was 1.59E-01 millirem, or 1.06% of the 15 millirem annual limit. With the reevaluation of the 1985 radioiodine release increased by 43%, the organ dose could have increased to 2.27E-01 millirem or 1.51% of the annual limit. Based on this evaluation, the past annual radioactive release reports will not be amended, as the dose impact is negligible.

In 2004, the methodology for calculating gaseous tritium effluent was changed. Prior to 2004, the gaseous tritium calculations were based on "Tritium Inventory Analysis," performed in 1972, by Southern Nuclear Engineering, Inc. During a NMC fleet sponsored chemistry self-assessment (#04-0034), it was determined that this methodology was under reporting the gaseous tritium being released.

A new calculation methodology was implemented in August 2004, that was based on spent fuel pool and reactor cavity evaporation rates, gallons released, and known tritium concentrations. Prior calculations (Jan-July) were revised using the

new methodology. The total calculated gaseous tritium curies released for 2004, increased by a factor of four over 2003. The first quarter 2004, organ dose results were compared using the old and new gaseous tritium methodologies. Organ dose results increased from 7.11E-02% to 3.17E-01% of the organ dose limit. Based on this low fractional rise in dose, past annual radioactive release reports will not be amended, as the dose impact is negligible. (Note: per review of historical tritium release data, the tritium concentrations in the spent fuel pool are at their highest concentration at approximately 0.400 uci/ml).

As a result of the increased radioiodine and gaseous tritium release, the resultant organ doses increased by a factor of 1.77 (as previously stated) in 2004, as compared to 2003. The total organ dose for 2004 was 1.02E-01 millirem, which is 0.68% of the annual 15 millirem limit. Because the dose impact is negligible, past annual effluent reports will not be amended.

3. Liquid Effluents

Attachment 3, "Liquid Effluents – Summation of Releases," lists and summarizes all liquid radioactive effluents released during the reporting period. The unidentified beta was 1.48E-05% of the total release.

Overall, whole body and organ dose from liquid effluents released during 2004, were 30% and 70% respectively lower than that of 2003. Total fission and activation product release curies were 5% lower than that of 2003. Dilution water and liquid release volumes were also slightly lower than that of 2003.

The decreased dose and curies released for 2004, are a result of further cleanup of liquid effluents, by recirculation through the polishing demineralizer prior to release.

4. Estimate of Uncertainty

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

5. Solid Waste

Attachment 4, "Solid Waste," summarizes all solid radwaste classification, sources, volume shipped, curie, and nuclide content. Radwaste shipments were made either to Barnwell Waste Management Facility, in Barnwell, South Carolina, or to Envirocare of Utah, Inc. In 2004, the waste volume was lower than that of 2003, but the actual curies shipped were higher than that of 2003. Much of the dry active waste was not shipped off site for processing in 2004, accounting for the

lower values in volume. Total curie increase was due to resin waste that was generated both in 2003 and 2004 that was processed and shipped in 2004.

6. Summary of Radiological Impact on Man

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

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

First Quarter -	9.28E-05 millirem (Adult)
Second Quarter-	1.40E-04 millirem (Adult)
Third Quarter -	1.95E-04 millirem (Adult)
Fourth Quarter -	6.12E-04 millirem (Teen)

The maximum organ dose was:

First Quarter -	1.09E-04 millirem (Adult Bone)
Second Quarter-	1.40E-04 millirem (Adult Thyroid)
Third Quarter -	1.97E-04 millirem(Adult GI-LLI)
Fourth Quarter -	6.33E-04 millirem (Teen GI-LLI)

B. The offsite air doses at site boundary (0.48 miles south-south east (SSE)) due to noble gases was:

First Quarter -	7.46E-05 millirad beta and 2.51E-05 millirad gamma
Second Quarter -	5.61E-05 millirad beta and 1.89E-05 millirad gamma
Third Quarter -	1.94E-03 millirad beta and 6.82E-04 millirad gamma
Fourth Quarter -	2.07E-05 millirad beta and 6.92E-06 millirad gamma

The maximum noble gas offsite air dose to the nearest residence (0.50 miles south) for beta and gamma occurred during the third quarter, 1.26E-03 millirad and 4.44E-04 millirad, respectively.

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

First Quarter -	2.38E-02 millirem (child thyroid)
Second Quarter -	1.20E-02 millirem (child thyroid)
Third Quarter	2.52E-02 millirem (child thyroid)
Fourth Quarter -	4.09E-02 millirem (child thyroid)

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

First Quarter -	9.02E-04 person-rem and 6.83E-07 millirem
Second Quarter-	1.63E-03 person-rem and 1.23E-06 millirem
Third Quarter -	2.20E-03 person-rem and 1.67E-06 millirem
Fourth Quarter -	2.10E-03 person-rem and 1.59E-06 millirem

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

First Quarter -	8.88E-02 person-rem and 6.73E-05 millirem
Second Quarter-	4.46E-02 person-rem and 3.38E-05 millirem
Third Quarter -	9.18E-02 person-rem and 6.95E-05 millirem
Fourth Quarter -	1.53E-01 person-rem and 1.16E-04 millirem

7. Process Control Program

There were no changes made to the Process Control Program in 2004.

8. Offsite Dose Calculation Manual

Attachment 7 contains the ODCM, Revision 19, along with the change review documentation per the requirements of Technical Specification 5.5.1.c.3.

Revision 19 to the ODCM involved the following changes as a result of use of the 2003 Land Use Survey:

1. Update of Table 1.1, "Palisades Gaseous and Liquid Source Terms, Curies/Year (1)
2. Update of Table 1.4, "2003 Palisades Land Use Census"
3. Update of Table 1.4a, "2003 Palisades Land Use Census – Critical Receptor Items"
4. Update of Table 1.9, "Palisades Gaseous Design Objective Annual Quantities"
5. Added Attachment 1, "Offsite Dose Calculation Manual Change Reviews"

Attachment 7 also contains the ODCM, Appendix A, Revision 11, along with the change review documentation, per the requirements of Technical Specification 5.5.1.c.3.

Revision 11 to the ODCM, Appendix A, involved the following changes to the Environmental Monitoring Program:

1. Elimination of well sampling from the Environmental Monitoring Program.
2. Changed the lower limit of detection for Cesium-134 – food products.
3. Changed the distance requirements for milk sample locations.

ATTACHMENT 1
RADIOACTIVE EFFLUENT RELEASE REPORT
BATCH RELEASES
JANUARY – DECEMBER 2004

TABLE HP 10.5-1

GASEOUS	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
Number of Releases	N/A	3	3	15	18
Total Release Time	Minutes	396	224	1532	2101
Maximum Release Time	Minutes	139	81	142	346
Average Release Time	Minutes	132	75	102	117
Minimum Release Time	Minutes	120	69	53	59

LIQUID	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
Number of Releases	N/A	1	1	1	1
Total Release Time	Minutes	505	577	1457	1443
Maximum Release Time	Minutes	505	577	1457	1443
Average Release Time	Minutes	505	577	1457	1443
Minimum Release Time	Minutes	505	577	1457	1443

ATTACHMENT 2
RADIOACTIVE EFFLUENT RELEASE REPORT
GASEOUS EFFLUENTS – SUMMATION OF RELEASES
JANUARY – DECEMBER 2004

A. FISSION & ACTIVATION GASES	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Est Total Error %
1. Total Release	Ci	1.05E+00	7.87E-01	2.68E+01	2.90E-01	
2. Average release rate for Period	uCi/sec	1.33E-01	1.00E-01	3.37E+00	3.65E-02	4.01
3. Percent of annual ave EC**	%	5.82E-05	4.42E-05	1.56E-03	1.58E-05	
B. IODINES						
1. Total Iodine *	Ci	2.98E-04	2.24E-04	6.15E-04	2.10E-04	
2. Average release rate for Period	uCi/sec	3.80E-05	2.85E-05	7.75E-05	2.64E-05	14.50
3. Percent of annual ave EC**	%	1.66E-05	1.28E-05	4.76E-05	2.18E-05	
C. PARTICULATES						
1. Particulates with half-life > than 8 days	Ci	1.72E-06	1.71E-06	1.20E-05	1.92E-05	17.53
2. Average release rate for Period	uCi/sec	2.19E-07	2.18E-07	1.50E-06	2.42E-06	
3. Percent of annual ave EC**	%	7.82E-06	7.79E-06	2.46E-05	2.02E-05	
4. Gross ALPHA Radioactivity	Ci	5.97E-07	1.12E-06	9.63E-07	4.62E-07	
D. TRITIUM						
1. Total release	Ci	2.34E+01	1.17E+01	2.38E+01	4.03E+01	
2. Average release rate for Period	uCi/sec	2.98E+00	1.49E+00	2.99E+00	5.07E+00	
3. Percent of annual ave EC**	%	6.33E-03	3.17E-03	6.37E-03	1.08E-02	
E. SITE BOUNDARY DOSE						
1. Beta Airdose at Site Boundary Due to Noble Gases (ODCM App A III.C)	mrads	7.46E-05	5.61E-05	1.94E-03	2.07E-05	
2. Percent limit	%	7.46E-04	5.61E-04	1.94E-02	2.07E-04	
3. Gamma Airdose at Site Boundary Due to Noble Gases (ODCM App A III.C)	mrads	2.51E-05	1.89E-05	6.82E-04	6.92E-06	
4. Percent limit	%	5.02E-04	3.78E-04	1.36E-02	1.38E-04	
F. ORGAN DOSE						
1. Maximum Organ Dose to Public Based on Critical Receptors (ODCM App A III.D)	mrem	2.38E-02	1.20E-02	2.52E-02	4.09E-02	
2. Percent limit	%	3.17E-01	1.60E-01	3.36E-01	5.45E-01	

* **NOTE**: Data is reported for I-131 and I-133 only.
** EC = Effluent Concentration

ATTACHMENT 2
RADIOACTIVE EFFLUENT RELEASE REPORT
GASEOUS EFFLUENTS
JANUARY – DECEMBER 2004

1. FISSION GASES	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
Krypton-85	Ci	1.02E-02	7.19E-03	3.85E-02	2.60E-03
Krypton-85m	Ci	<LLD	<LLD	6.11E-03	<LLD
Krypton-88	Ci	<LLD	<LLD	1.53E-03	<LLD
Xenon-131m	Ci	<LLD	1.81E-04	4.12E-02	4.55E-03
Xenon-133	Ci	1.03E+00	7.75E-01	2.62E+01	2.81E-01
Xenon-133m	Ci	<LLD	<LLD	2.92E-02	5.22E-04
Xenon-135	Ci	1.85E-03	1.59E-03	4.44E-01	6.63E-04
Xenon-135m	Ci	3.72E-03	3.27E-03	1.52E-03	1.04E-03
Argon-41	Ci	<LLD	<LLD	2.15E-04	<LLD
Total for Period	Ci	1.05E+00	7.87E-01	2.68E+01	2.90E-01

2. IODINES	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
Iodine-131	Ci	7.93E-05	6.26E-05	2.90E-04	1.51E-04
Iodine-132	Ci	<LLD	<LLD	5.06E-03	6.65E-04
Iodine-133	Ci	2.19E-04	1.61E-04	3.25E-04	5.88E-05
Iodine-135	Ci	<LLD	<LLD	<LLD	<LLD
Total for Period	Ci	2.98E-04	2.24E-04	5.68E-03	8.75E-04

ATTACHMENT 2
RADIOACTIVE EFFLUENT RELEASE REPORT
GASEOUS EFFLUENTS
JANUARY – DECEMBER 2004

3. PARTICULATES*	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
Chromium-51	Ci	<LLD	<LLD	<LLD	<LLD
Manganese-54	Ci	<LLD	<LLD	<LLD	<LLD
Cobalt-58	Ci	<LLD	<LLD	5.60E-06	1.46E-05
Cobalt-60	Ci	<LLD	<LLD	9.45E-07	1.83E-07
Strontium-89	Ci	<LLD	<LLD	<LLD	<LLD
Strontium-90	Ci	<LLD	7.55E-07	4.40E-07	4.15E-07
Cesium-134	Ci	<LLD	<LLD	<LLD	<LLD
Cesium-137	Ci	<LLD	<LLD	8.10E-08	<LLD
Net unidentified beta	Ci	1.72E-06	9.55E-07	4.89E-06	3.98E-06
Total for Period	Ci	1.72E-06	1.71E-06	1.20E-05	1.92E-05

* Particulates with half-lives > 8 days

ATTACHMENT 3
RADIOACTIVE EFFLUENT RELEASE REPORT
LIQUID EFFLUENTS – SUMMATION OF RELEASES
JANUARY – DECEMBER 2004

A. FISSION & ACTIVATION PRODUCTS	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Est Total Error %
1. Total release (not including tritium, gases, alpha)	Ci	5.26E-05	5.18E-07	1.37E-04	1.93E-03	
2. Average release rate for Period	uCi/ml	1.35E-12	1.35E-14	4.17E-12	8.71E-11	6.72
3. Percent of EC*	%	2.70E-04	2.70E-06	1.09E-04	1.37E-03	
B. TRITIUM						
1. Total Release	Ci	4.95E+01	1.03E+02	1.17E+02	7.22E+01	
2. Average diluted concentration during period	uCi/ml	1.27E-06	2.68E-06	3.56E-06	3.25E-06	
3. Percent of EC*	%	1.27E-01	2.68E-01	3.56E-01	3.25E-01	4.01
C. DISSOLVED & ENTRAINED GASES						
1. Total Release	Ci	0.000	0.000	0.000	0.000	
2. Average diluted concentration during period	uCi/ml	N/A	N/A	N/A	N/A	N/A
3. Percent of EC*	%	N/A	N/A	N/A	N/A	
D. GROSS ALPHA RADIOACTIVITY (Total Release)	Ci	<LLD	2.04E-07	4.26E-07	7.62E-07	
E. VOLUME OF WASTE RELEASED (Prior to Dilution)	Liters	1.56E+05	1.85E+05	1.85E+05	1.70E+05	
F. VOLUME OF DILUTION WATER USED DURING PERIOD	Liters	3.90E+10	3.84E+10	3.29E+10	2.22E+10	
G. MAXIMUM DOSE COMMITMENT – WHOLE BODY	mrem	9.28E-05	1.40E-04	1.95E-04	6.12E-04	
Percent of ODCM App A III. H limit	%	6.19E-03	9.33E-03	1.30E-02	4.08E-02	
H. MAXIMUM DOSE COMMITMENT – ORGAN	mrem	1.09E-04	1.40E-04	1.97E-04	6.33E-04	
Percent of ODCM App A III. H limit	%	2.18E-03	2.80E-03	3.94E-03	1.27E-02	

*EC = Effluent Concentration

ATTACHMENT 3
RADIOACTIVE EFFLUENT RELEASE REPORT
LIQUID EFFLUENTS
JANUARY – DECEMBER 2004

NUCLIDES RELEASED	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
Manganese-54	Ci	<LLD	<LLD	<LLD	<LLD
Cobalt-58	Ci	<LLD	<LLD	3.67E-05	1.21E-03
Cobalt-60	Ci	<LLD	<LLD	1.00E-04	7.23E-04
Zirconium-95	Ci	<LLD	<LLD	<LLD	<LLD
Silver-110m	Ci	<LLD	<LLD	<LLD	<LLD
Strontium-89	Ci	<LLD	<LLD	<LLD	<LLD
Strontium-90	Ci	1.87E-06	5.18E-07	3.33E-07	9.69E-07
Cesium-134	Ci	<LLD	<LLD	<LLD	<LLD
Cesium-137	Ci	<LLD	<LLD	<LLD	<LLD
Iodine-131	Ci	<LLD	<LLD	<LLD	<LLD
Antimony-125	Ci	<LLD	<LLD	<LLD	<LLD
Net unidentified beta	Ci	5.07E-05	<LLD	<LLD	<LLD
Fission & Activation Products Total	Ci	5.26E-05	5.18E-07	1.37E-04	1.93E-03
Tritium	Ci	4.95E+01	1.03E+02	1.17E+02	7.22E+01
Grand Total	Ci	4.95E+01	1.03E+02	1.17E+02	7.22E+01

ATTACHMENT 4
RADIOACTIVE EFFLUENT RELEASE REPORT
SOLID WASTE
JANUARY – DECEMBER 2004

Waste Class	Source of Waste	Solidification Agent	Container Type	Volume (ft^3)	Total Curies	Principal Radionuclides
AS	Evaporator Bottoms	N/A	High Integrity Container	307.2	2.81	Co-60, CS-137, Sb-125, Ni-63, Cs-134, Mn-54, Co-58, Fe-55, Ag-110m, Ru-106
B	Other Reformed Residue (Resin)	N/A	High Integrity Container	2.7	3.246	Co-60, Cs-137, Sb-125, Ni-63, Sr-90, Mn-54, Co-58, Fe-55, Cs-134, Zn-65, H-3
C	Other Reformed Residue (Resin)	N/A	High Integrity Container	42.5	41.2	Co-60, Ag-110m, Mn-54, Cs-137, Cs-134, Ni-63, Fe-55, H-3
AU	Dry Active Waste	N/A	Low Specific Activity	143.8	0.606	Co-60, Cs-137, Sb-125, Ni-63, Sr-90, Mn-54, Co-58, Fe-55, Ru-106, Pu-241
			TOTAL	**496.2 ft^3**	**47.862 Ci**	

ATTACHMENT 5
RADIOACTIVE EFFLUENT RELEASE REPORT
LOWER LIMITS OF DETECTION FOR PALISADES EFFLUENTS
JANUARY – DECEMBER 2004

Gaseous Effluents	Nuclide	LLD (uCi/cc)
	Mn-54	3.83E-14
	Co-58	2.03E-14
	Fe-59	5.66E-14
	Co-60	3.32E-14
04-003-ST	Zn-65	4.60E-14
04-045-ST	Zr-95	5.09E-14
04-004-G	Mo-99	1.70E-13
04-040-G	I-131	6.46E-14
	I-133	3.44E-13
	Cs-134	3.85E-14
	Cs-137	3.16E-14
	Ce-141	2.41E-14
	Ce-144	1.07E-13
	Kr-87	8.13E-07
	Kr-88	1.09E-06
	Xe-133	5.21E-07
	Xe-133m	2.00E-06
	Xe-135	2.85E-07
	Xe-138	3.42E-06

Liquid Effluents	Nuclide	LLD (Uci/ml)
	Mn-54	1.15E-07
	Co-58	1.39E-07
	Fe-59	1.32E-07
	Co-60	2.61E-07
	Zn-65	1.37E-07
Liquid Batch Release	Mo-99	7.32E-07
04-003-R	I-131	1.33E-07
04-012-R	Cs-134	1.53E-07
	Cs-137	1.08E-07
	Ce-141	1.09E-07
	Ce-144	4.96E-07

ATTACHMENT 6

RADIOACTIVE EFFLUENT RELEASE REPORT
RESULTS OF 2004 RADIOCHEMISTRY CROSS CHECK PROGRAM

NOTE: THERE WAS NO CROSS CHECK PROGRAM PERFORMED FOR THE FIRST QUARTER 2004

14 Pages Follow

ANALYTICS

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RESULTS OF RADIOCHEMISTRY

CROSS CHECK PROGRAM

NUCLEAR MANAGEMENT CO., LLC

PALISADES NUCLEAR PLANT

Second Quarter 2004

9-7-04

Daniel M. Montgomery, QA Manager

SAMPLE	ANALYSIS	PALISADES VALUE microCi	ANALYTICS VALUE microCi	RATIO PALISADES: ANALYTICS	RESOLUTION	COMPARISON
A18152-66	Ce-141	6.14E-05	6.06E-05	1.01	20	AGREEMENT
SOLID	Cr-51	9.60E-05	9.98E-05	0.96	20	AGREEMENT
1 LITER	Cs-134	1.81E-05	1.95E-05	0.93	20	AGREEMENT
BOTTLE	Cs-137	2.89E-05	2.92E-05	0.99	20	AGREEMENT
LIQUID	Co-58	1.19E-05	1.21E-05	0.98	20	AGREEMENT
VOL.	Mn-54	1.49E-05	1.42E-05	1.05	20	AGREEMENT
1000 mL	Fe-59	1.48E-05	1.41E-05	1.04	20	AGREEMENT
DET. 1	Zn-65	2.11E-05	2.05E-05	1.03	20	AGREEMENT
	Co-60	3.27E-05	3.25E-05	1.00	20	AGREEMENT
A18152-66	Ce-141	5.74E-05	6.06E-05	0.95	20	AGREEMENT
SOLID	Cr-51	9.60E-05	9.98E-05	0.96	20	AGREEMENT
1 LITER	Cs-134	1.88E-05	1.95E-05	0.96	20	AGREEMENT
BOTTLE	Cs-137	2.79E-05	2.92E-05	0.95	20	AGREEMENT
LIQUID	Co-58	1.26E-05	1.21E-05	1.04	20	AGREEMENT
VOL.	Mn-54	1.49E-05	1.42E-05	1.05	20	AGREEMENT
1000 mL	Fe-59	1.46E-05	1.41E-05	1.03	20	AGREEMENT
DET. 2	Zn-65	1.98E-05	2.05E-05	0.97	20	AGREEMENT
	Co-60	3.21E-05	3.25E-05	0.99	20	AGREEMENT
A18152-66	Ce-141	5.60E-05	6.06E-05	0.92	20	AGREEMENT
SOLID	Cr-51	9.03E-05	9.98E-05	0.90	20	AGREEMENT
1 LITER	Cs-134	1.80E-05	1.95E-05	0.92	20	AGREEMENT
BOTTLE	Cs-137	2.83E-05	2.92E-05	0.97	20	AGREEMENT
LIQUID	Co-58	1.06E-05	1.21E-05	0.87	20	AGREEMENT
VOL.	Mn-54	1.32E-05	1.42E-05	0.93	20	AGREEMENT
1000 mL	Fe-59	1.39E-05	1.41E-05	0.98	20	AGREEMENT
DET. 3	Zn-65	1.96E-05	2.05E-05	0.96	20	AGREEMENT
	Co-60	3.11E-05	3.25E-05	0.96	20	AGREEMENT

SAMPLE	ANALYSIS	PALISADES VALUE microCi	ANALYTICS VALUE microCi	RATIO PALISADES: ANALYTICS	RESOLUTION	COMPARISON
A18153-66	Ce-141	6.31E-05	6.04E-05	1.04	20	AGREEMENT
SIMULATED	Cr-51	1.07E-04	9.95E-05	1.08	20	AGREEMENT
1 LITER	Cs-134	1.87E-05	1.95E-05	0.96	20	AGREEMENT
BOTTLE	Cs-137	3.27E-05	2.91E-05	1.12	20	AGREEMENT
GAS	Co-58	1.27E-05	1.21E-05	1.05	20	AGREEMENT
VOL.	Mn-54	1.53E-05	1.42E-05	1.08	20	AGREEMENT
1000 cc	Fe-59	1.35E-05	1.41E-05	0.96	20	AGREEMENT
DET. 1	Zn-65	2.23E-05	2.04E-05	1.09	20	AGREEMENT
	Co-60	3.34E-05	3.24E-05	1.03	20	AGREEMENT
A18153-66	Ce-141	6.36E-05	6.04E-05	1.05	20	AGREEMENT
SIMULATED	Cr-51	1.08E-04	9.95E-05	1.09	20	AGREEMENT
1 LITER	Cs-134	1.92E-05	1.95E-05	0.98	20	AGREEMENT
BOTTLE	Cs-137	3.21E-05	2.91E-05	1.10	20	AGREEMENT
GAS	Co-58	1.30E-05	1.21E-05	1.07	20	AGREEMENT
VOL.	Mn-54	1.52E-05	1.42E-05	1.07	20	AGREEMENT
1000 cc	Fe-59	1.42E-05	1.41E-05	1.01	20	AGREEMENT
DET. 2	Zn-65	2.20E-05	2.04E-05	1.08	20	AGREEMENT
	Co-60	3.35E-05	3.24E-05	1.03	20	AGREEMENT
A18153-66	Ce-141	5.86E-05	6.04E-05	0.97	20	AGREEMENT
SIMULATED	Cr-51	9.09E-05	9.95E-05	0.91	20	AGREEMENT
1 LITER	Cs-134	1.89E-05	1.95E-05	0.97	20	AGREEMENT
BOTTLE	Cs-137	2.91E-05	2.91E-05	1.00	20	AGREEMENT
GAS	Co-58	1.15E-05	1.21E-05	0.95	20	AGREEMENT
VOL.	Mn-54	1.43E-05	1.42E-05	1.00	20	AGREEMENT
1000 cc	Fe-59	1.39E-05	1.41E-05	0.98	20	AGREEMENT
DET. 3	Zn-65	2.01E-05	2.04E-05	0.98	20	AGREEMENT
	Co-60	3.11E-05	3.24E-05	0.96	20	AGREEMENT

SAMPLE	ANALYSIS	PALISADES VALUE microCi	ANALYTICS VALUE microCi	RATIO PALISADES: ANALYTICS	RESOLUTION	COMPARISON
A18154-66	Ce-141	5.21E-04	5.09E-04	1.02	20	AGREEMENT
SOLID	Cr-51	8.75E-04	8.39E-04	1.04	20	AGREEMENT
50 mL	Cs-134	1.65E-04	1.64E-04	1.00	20	AGREEMENT
BOTTLE	Cs-137	2.66E-04	2.45E-04	1.08	20	AGREEMENT
LIQUID	Co-58	1.05E-04	1.02E-04	1.03	20	AGREEMENT
VOL.	Mn-54	1.29E-04	1.20E-04	1.08	20	AGREEMENT
50 mL	Fe-59	1.29E-04	1.19E-04	1.08	20	AGREEMENT
DET. 1	Zn-65	1.86E-04	1.72E-04	1.08	20	AGREEMENT
	Co-60	2.74E-04	2.73E-04	1.00	20	AGREEMENT
A18154-66	Ce-141	5.14E-04	5.09E-04	1.01	20	AGREEMENT
SOLID	Cr-51	8.76E-04	8.39E-04	1.04	20	AGREEMENT
50 mL	Cs-134	1.71E-04	1.64E-04	1.04	20	AGREEMENT
BOTTLE	Cs-137	2.69E-04	2.45E-04	1.10	20	AGREEMENT
LIQUID	Co-58	1.01E-04	1.02E-04	0.99	20	AGREEMENT
VOL.	Mn-54	1.25E-04	1.20E-04	1.05	20	AGREEMENT
50 mL	Fe-59	1.29E-04	1.19E-04	1.08	20	AGREEMENT
DET. 2	Zn-65	1.81E-04	1.72E-04	1.05	20	AGREEMENT
	Co-60	2.73E-04	2.73E-04	1.00	20	AGREEMENT
A18154-66	Ce-141	4.34E-04	5.09E-04	0.85	20	AGREEMENT
SOLID	Cr-51	7.07E-04	8.39E-04	0.84	20	AGREEMENT
50 mL	Cs-134	1.54E-04	1.64E-04	0.94	20	AGREEMENT
BOTTLE	Cs-137	2.42E-04	2.45E-04	0.99	20	AGREEMENT
LIQUID	Co-58	9.38E-05	1.02E-04	0.92	20	AGREEMENT
VOL.	Mn-54	1.19E-04	1.20E-04	0.99	20	AGREEMENT
50 mL	Fe-59	1.23E-04	1.19E-04	1.03	20	AGREEMENT
DET. 3	Zn-65	1.36E-04	1.72E-04	0.79	20	AGREEMENT
	Co-60	2.52E-04	2.73E-04	0.92	20	AGREEMENT

SAMPLE	ANALYSIS	PALISADES VALUE microCi	ANALYTICS VALUE microCi	RATIO PALISADES: ANALYTICS	RESOLUTION	COMPARISON
A18155-66	Ce-141	6.12E-02	5.85E-02	1.05	20	AGREEMENT
FILTER	Cr-51	9.86E-02	9.63E-02	1.02	20	AGREEMENT
4 CM	Cs-134	1.79E-02	1.88E-02	0.95	20	AGREEMENT
VOL.	Cs-137	3.02E-02	2.82E-02	1.07	20	AGREEMENT
1 cc	Co-58	1.26E-02	1.17E-02	1.08	20	AGREEMENT
DET. 1	Mn-54	1.49E-02	1.37E-02	1.08	20	AGREEMENT
	Fe-59	1.52E-02	1.36E-02	1.11	20	AGREEMENT
	Zn-65	2.20E-02	1.98E-02	1.11	20	AGREEMENT
	Co-60	3.23E-02	3.14E-02	1.03	20	AGREEMENT
A18155-66	Ce-141	6.26E-02	5.85E-02	1.07	20	AGREEMENT
FILTER	Cr-51	1.02E-01	9.63E-02	1.06	20	AGREEMENT
4 CM	Cs-134	1.93E-02	1.88E-02	1.02	20	AGREEMENT
VOL.	Cs-137	3.17E-02	2.82E-02	1.13	20	AGREEMENT
1 cc	Co-58	1.33E-02	1.17E-02	1.13	20	AGREEMENT
DET. 2	Mn-54	1.59E-02	1.37E-02	1.16	20	AGREEMENT
	Fe-59	1.54E-02	1.36E-02	1.13	20	AGREEMENT
	Zn-65	2.32E-02	1.98E-02	1.17	20	AGREEMENT
	Co-60	3.43E-02	3.14E-02	1.09	20	AGREEMENT
A18155-66	Ce-141	5.53E-02	5.85E-02	0.95	20	AGREEMENT
FILTER	Cr-51	9.01E-02	9.63E-02	0.94	20	AGREEMENT
4 CM	Cs-134	1.70E-02	1.88E-02	0.90	20	AGREEMENT
VOL.	Cs-137	2.82E-02	2.82E-02	1.00	20	AGREEMENT
1 cc	Co-58	1.16E-02	1.17E-02	0.99	20	AGREEMENT
DET. 3	Mn-54	1.42E-02	1.37E-02	1.03	20	AGREEMENT
	Fe-59	1.42E-02	1.36E-02	1.04	20	AGREEMENT
	Zn-65	2.07E-02	1.98E-02	1.05	20	AGREEMENT
	Co-60	3.02E-02	3.14E-02	0.96	20	AGREEMENT

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RESULTS OF RADIOCHEMISTRY

CROSS CHECK PROGRAM

NUCLEAR MANAGEMENT CO., LLC

PALISADES PLANT

AMENDED REPORT
THIRD QUARTER 2004

10-29-2004

Evgeny Taskaev, QA Manager, Alternate

SAMPLE	ANALYSIS	PALISADES VALUE microCi	ANALYTICS VALUE microCi	RATIO PALISADES: ANALYTICS	RESOLUTION	COMPARISON
A18427-66	Ce-141	7.10E-02	6.86E-02	1.03	20	AGREEMENT
CARTRIDGE	Cr-51	6.88E-02	6.78E-02	1.01	20	AGREEMENT
VOL = 25 cc	Cs-134	1.44E-02	1.53E-02	0.94	20	AGREEMENT
DET. 1	Cs-137	3.52E-02	3.33E-02	1.06	20	AGREEMENT
	Co-58	1.99E-02	1.91E-02	1.04	20	AGREEMENT
	Mn-54	3.18E-02	2.87E-02	1.11	20	AGREEMENT
	Fe-59	2.36E-02	2.15E-02	1.10	20	AGREEMENT
	Zn-65	3.17E-02	2.97E-02	1.07	20	AGREEMENT
	Co-60	1.94E-02	1.95E-02	0.99	20	AGREEMENT
A18427-66	Ce-141	6.17E-02	6.86E-02	0.90	20	AGREEMENT
CARTRIDGE	Cr-51	6.22E-02	6.78E-02	0.92	20	AGREEMENT
VOL = 25 cc	Cs-134	1.32E-02	1.53E-02	0.87	20	AGREEMENT
DET. 2	Cs-137	3.17E-02	3.33E-02	0.95	20	AGREEMENT
	Co-58	1.77E-02	1.91E-02	0.93	20	AGREEMENT
	Mn-54	2.88E-02	2.87E-02	1.00	20	AGREEMENT
	Fe-59	2.07E-02	2.15E-02	0.96	20	AGREEMENT
	Zn-65	2.87E-02	2.97E-02	0.97	20	AGREEMENT
	Co-60	1.81E-02	1.95E-02	0.93	20	AGREEMENT
A18427-66	Ce-141	6.64E-02	6.86E-02	0.97	20	AGREEMENT
CARTRIDGE	Cr-51	6.68E-02	6.78E-02	0.98	20	AGREEMENT
VOL = 25 cc	Cs-134	1.43E-02	1.53E-02	0.94	20	AGREEMENT
DET. 3	Cs-137	3.42E-02	3.33E-02	1.03	20	AGREEMENT
	Co-58	1.97E-02	1.91E-02	1.03	20	AGREEMENT
	Mn-54	3.07E-02	2.87E-02	1.07	20	AGREEMENT
	Fe-59	2.32E-02	2.15E-02	1.08	20	AGREEMENT
	Zn-65	3.03E-02	2.97E-02	1.02	20	AGREEMENT
	Co-60	1.93E-02	1.95E-02	0.99	20	AGREEMENT

SAMPLE	ANALYSIS	PALISADES VALUE microCi	ANALYTICS VALUE microCi	RATIO PALISADES: ANALYTICS	RESOLUTION	COMPARISON
A18428-66	Ce-141	1.26E-03	1.31E-03	0.96	20	AGREEMENT
SIMULATED	Cr-51	1.23E-03	1.29E-03	0.95	20	AGREEMENT
GAS VIAL	Cs-134	2.58E-04	2.91E-04	0.89	20	AGREEMENT
VOL = 1 cc	Cs-137	6.25E-04	6.35E-04	0.98	20	AGREEMENT
DET. 1	Co-58	3.58E-04	3.64E-04	0.98	20	AGREEMENT
	Mn-54	5.76E-04	5.48E-04	1.05	20	AGREEMENT
	Fe-59	4.19E-04	4.11E-04	1.02	20	AGREEMENT
	Zn-65	5.63E-04	5.67E-04	0.99	20	AGREEMENT
	Co-60	3.59E-04	3.73E-04	0.96	20	AGREEMENT
A18428-66	Ce-141	1.23E-03	1.31E-03	0.94	20	AGREEMENT
SIMULATED	Cr-51	1.20E-03	1.29E-03	0.93	20	AGREEMENT
GAS VIAL	Cs-134	2.57E-04	2.91E-04	0.88	20	AGREEMENT
VOL = 1 cc	Cs-137	6.07E-04	6.35E-04	0.96	20	AGREEMENT
DET. 2	Co-58	3.50E-04	3.64E-04	0.96	20	AGREEMENT
	Mn-54	5.64E-04	5.48E-04	1.03	20	AGREEMENT
	Fe-59	4.08E-04	4.11E-04	0.99	20	AGREEMENT
	Zn-65	5.42E-04	5.67E-04	0.96	20	AGREEMENT
	Co-60	3.42E-04	3.73E-04	0.92	20	AGREEMENT
A18428-66	Ce-141	1.19E-03	1.31E-03	0.91	20	AGREEMENT
SIMULATED	Cr-51	1.23E-03	1.29E-03	0.95	20	AGREEMENT
GAS VIAL	Cs-134	2.58E-04	2.91E-04	0.89	20	AGREEMENT
VOL = 1 cc	Cs-137	6.16E-04	6.35E-04	0.97	20	AGREEMENT
DET. 3	Co-58	3.46E-04	3.64E-04	0.95	20	AGREEMENT
	Mn-54	5.53E-04	5.48E-04	1.01	20	AGREEMENT
	Fe-59	4.16E-04	4.11E-04	1.01	20	AGREEMENT
	Zn-65	5.57E-04	5.67E-04	0.98	20	AGREEMENT
	Co-60	3.52E-04	3.73E-04	0.94	20	AGREEMENT

SAMPLE	ANALYSIS	PALISADES VALUE microCi	ANALYTICS VALUE microCi	RATIO PALISADES: ANALYTICS	RESOLUTION	COMPARISON
A18429-66	Ce-141	6.55E-05	6.43E-05	1.02	20	AGREEMENT
SAND	Cr-51	6.19E-05	6.36E-05	0.97	20	AGREEMENT
1 LITER	Cs-134	1.35E-05	1.43E-05	0.94	20	AGREEMENT
VOL = 1000g	Cs-137	3.16E-05	3.12E-05	1.01	20	AGREEMENT
DET. 1	Co-58	1.83E-05	1.78E-05	1.03	20	AGREEMENT
	Mn-54	2.86E-05	2.69E-05	1.06	20	AGREEMENT
	Fe-59	2.03E-05	2.02E-05	1.01	20	AGREEMENT
	Zn-65	2.74E-05	2.78E-05	0.98	20	AGREEMENT
	Co-60	1.83E-05	1.83E-05	1.00	20	AGREEMENT
A18429-66	Ce-141	6.14E-05	6.43E-05	0.95	20	AGREEMENT
SAND	Cr-51	5.83E-05	6.36E-05	0.92	20	AGREEMENT
1 LITER	Cs-134	1.37E-05	1.43E-05	0.96	20	AGREEMENT
VOL = 1000g	Cs-137	3.07E-05	3.12E-05	0.99	20	AGREEMENT
DET. 2	Co-58	1.75E-05	1.78E-05	0.98	20	AGREEMENT
	Mn-54	3.21E-05	2.69E-05	1.19	20	AGREEMENT
	Fe-59	1.97E-05	2.02E-05	0.98	20	AGREEMENT
	Zn-65	2.59E-05	2.78E-05	0.93	20	AGREEMENT
	Co-60	1.82E-05	1.83E-05	1.00	20	AGREEMENT
A18429-66	Ce-141	6.05E-05	6.43E-05	0.94	20	AGREEMENT
SAND	Cr-51	6.09E-05	6.36E-05	0.96	20	AGREEMENT
1 LITER	Cs-134	1.35E-05	1.43E-05	0.94	20	AGREEMENT
VOL = 1000g	Cs-137	2.99E-05	3.12E-05	0.96	20	AGREEMENT
DET. 3	Co-58	1.69E-05	1.78E-05	0.95	20	AGREEMENT
	Mn-54	2.63E-05	2.69E-05	0.98	20	AGREEMENT
	Fe-59	1.95E-05	2.02E-05	0.97	20	AGREEMENT
	Zn-65	2.60E-05	2.78E-05	0.93	20	AGREEMENT
	Co-60	1.72E-05	1.83E-05	0.94	20	AGREEMENT

SAMPLE	ANALYSIS	PALISADES VALUE microCi	ANALYTICS VALUE microCi	RATIO PALISADES: ANALYTICS	RESOLUTION	COMPARISON
A18430-66	Ce-141	6.63E-02	6.56E-02	1.01	20	AGREEMENT
CARTRIDGE	Cr-51	6.57E-02	6.48E-02	1.01	20	AGREEMENT
LAPEL	Cs-134	1.37E-02	1.46E-02	0.94	20	AGREEMENT
VOL = 1 cc	Cs-137	3.38E-02	3.18E-02	1.06	20	AGREEMENT
DET. 1	Co-58	1.90E-02	1.82E-02	1.04	20	AGREEMENT
	Mn-54	3.07E-02	2.74E-02	1.12	20	AGREEMENT
	Fe-59	2.28E-02	2.06E-02	1.11	20	AGREEMENT
	Zn-65	3.10E-02	2.84E-02	1.09	20	AGREEMENT
	Co-60	1.91E-02	1.86E-02	1.02	20	AGREEMENT
A18430-66	Ce-141	6.26E-02	6.56E-02	0.95	20	AGREEMENT
CARTRIDGE	Cr-51	6.49E-02	6.48E-02	1.00	20	AGREEMENT
LAPEL	Cs-134	1.35E-02	1.46E-02	0.93	20	AGREEMENT
VOL = 1 cc	Cs-137	3.19E-02	3.18E-02	1.00	20	AGREEMENT
DET. 2	Co-58	1.80E-02	1.82E-02	0.99	20	AGREEMENT
	Mn-54	2.92E-02	2.74E-02	1.06	20	AGREEMENT
	Fe-59	2.20E-02	2.06E-02	1.07	20	AGREEMENT
	Zn-65	2.92E-02	2.84E-02	1.03	20	AGREEMENT
	Co-60	1.78E-02	1.86E-02	0.95	20	AGREEMENT
A18430-66	Ce-141	6.40E-02	6.56E-02	0.98	20	AGREEMENT
CARTRIDGE	Cr-51	6.21E-02	6.48E-02	0.96	20	AGREEMENT
LAPEL	Cs-134	1.36E-02	1.46E-02	0.93	20	AGREEMENT
VOL = 1 cc	Cs-137	3.28E-02	3.18E-02	1.03	20	AGREEMENT
DET. 3	Co-58	1.82E-02	1.82E-02	1.00	20	AGREEMENT
	Mn-54	2.96E-02	2.74E-02	1.08	20	AGREEMENT
	Fe-59	2.17E-02	2.06E-02	1.06	20	AGREEMENT
	Zn-65	2.87E-02	2.84E-02	1.01	20	AGREEMENT
	Co-60	1.81E-02	1.86E-02	0.97	20	AGREEMENT

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RESULTS OF RADIOCHEMISTRY

CROSS CHECK PROGRAM

NUCLEAR MANAGEMENT CO. , LLC

PALISADES PLANT

FOURTH QUARTER 2004

DM. Mont 1-28-05

Daniel M. Montgomery, QA Manager

SAMPLE	ANALYSIS	PALISADES VALUE microCi	ANALYTICS VALUE microCi	RATIO PALISADES ANALYTICS	RESOLUTION	COMPARISON
A18705-66	Ce-141	3.63E-02	3.53E-02	1.03	20	AGREEMENT
CARTRIDGE	Cr-51	1.00E-01	9.56E-02	1.05	20	AGREEMENT
RGEM	Cs-134	2.14E-02	2.23E-02	0.96	20	AGREEMENT
DET. 1	Cs-137	1.83E-02	1.62E-02	1.13	20	AGREEMENT
	Co-58	2.62E-02	2.44E-02	1.07	20	AGREEMENT
	Mn-54	2.13E-02	1.85E-02	1.15	20	AGREEMENT
	Fe-59	2.77E-02	2.37E-02	1.17	20	AGREEMENT
	Zn-65	3.05E-02	2.71E-02	1.12	20	AGREEMENT
	Co-60	2.32E-02	2.29E-02	1.01	20	AGREEMENT
A18705-66	Ce-141	3.48E-02	3.53E-02	0.99	20	AGREEMENT
CARTRIDGE	Cr-51	9.65E-02	9.56E-02	1.01	20	AGREEMENT
RGEM	Cs-134	2.10E-02	2.23E-02	0.94	20	AGREEMENT
DET. 2	Cs-137	1.74E-02	1.62E-02	1.08	20	AGREEMENT
	Co-58	2.57E-02	2.44E-02	1.05	20	AGREEMENT
	Mn-54	2.03E-02	1.85E-02	1.10	20	AGREEMENT
	Fe-59	2.53E-02	2.37E-02	1.07	20	AGREEMENT
	Zn-65	2.96E-02	2.71E-02	1.09	20	AGREEMENT
	Co-60	2.23E-02	2.29E-02	0.97	20	AGREEMENT
A18705-66	Ce-141	3.49E-02	3.53E-02	0.99	20	AGREEMENT
CARTRIDGE	Cr-51	9.55E-02	9.56E-02	1.00	20	AGREEMENT
RGEM	Cs-134	2.09E-02	2.23E-02	0.94	20	AGREEMENT
DET. 3	Cs-137	1.77E-02	1.62E-02	1.09	20	AGREEMENT
	Co-58	2.58E-02	2.44E-02	1.06	20	AGREEMENT
	Mn-54	2.06E-02	1.85E-02	1.11	20	AGREEMENT
	Fe-59	2.55E-02	2.37E-02	1.08	20	AGREEMENT
	Zn-65	2.90E-02	2.71E-02	1.07	20	AGREEMENT
	Co-60	2.27E-02	2.29E-02	0.99	20	AGREEMENT

SAMPLE	ANALYSIS	PALISADES VALUE microCi/cc	ANALYTICS VALUE microCi/cc	RATIO PALISADES ANALYTICS	RESOLUTION	COMPARISON
A18706-66	Ce-141	9.12E-04	8.56E-04	1.06	20	AGREEMENT
SOLID	Cr-51	2.41E-03	2.32E-03	1.04	20	AGREEMENT
7.2 mL	Cs-134	5.42E-04	5.42E-04	1.00	20	AGREEMENT
BOMB	Cs-137	4.02E-04	3.92E-04	1.03	20	AGREEMENT
DET. 1	Co-58	6.05E-04	5.92E-04	1.02	20	AGREEMENT
	Mn-54	4.65E-04	4.48E-04	1.04	20	AGREEMENT
	Fe-59	6.43E-04	5.75E-04	1.12	20	AGREEMENT
	Zn-65	6.47E-04	6.57E-04	0.98	20	AGREEMENT
	Co-60	5.38E-04	5.56E-04	0.97	20	AGREEMENT
A18706-66	Ce-141	7.40E-04	8.56E-04	0.86	20	AGREEMENT
SOLID	Cr-51	2.65E-03	2.32E-03	1.14	20	AGREEMENT
7.2 mL	Cs-134	5.04E-04	5.42E-04	0.93	20	AGREEMENT
BOMB	Cs-137	3.39E-04	3.92E-04	0.86	20	AGREEMENT
DET. 2	Co-58	5.44E-04	5.92E-04	0.92	20	AGREEMENT
	Mn-54	4.55E-04	4.48E-04	1.02	20	AGREEMENT
	Fe-59	5.02E-04	5.75E-04	0.87	20	AGREEMENT
	Zn-65	6.55E-04	6.57E-04	1.00	20	AGREEMENT
	Co-60	5.52E-04	5.56E-04	0.99	20	AGREEMENT
A18706-66	Ce-141	7.73E-04	8.56E-04	0.90	20	AGREEMENT
SOLID	Cr-51	2.23E-03	2.32E-03	0.96	20	AGREEMENT
7.2 mL	Cs-134	5.20E-04	5.42E-04	0.96	20	AGREEMENT
BOMB	Cs-137	4.15E-04	3.92E-04	1.06	20	AGREEMENT
DET. 3	Co-58	6.31E-04	5.92E-04	1.07	20	AGREEMENT
	Mn-54	4.63E-04	4.48E-04	1.03	20	AGREEMENT
	Fe-59	6.49E-04	5.75E-04	1.13	20	AGREEMENT
	Zn-65	6.24E-04	6.57E-04	0.95	20	AGREEMENT
	Co-60	5.14E-04	5.56E-04	0.93	20	AGREEMENT

SAMPLE	ANALYSIS	PALISADES VALUE microCi/cc	ANALYTICS VALUE microCi/cc	RATIO PALISADES ANALYTICS	RESOLUTION	COMPARISON
A18708-66 LIQUID COUNT 1	Tritium TECH: EGM	1.60E-03	1.40E-03	1.14	12.5	AGREEMENT
A18708-66 LIQUID COUNT 2	Tritium TECH: EGM	1.60E-03	1.40E-03	1.14	12.5	AGREEMENT
A18708-66 LIQUID PACKARD TRICARB	Tritium	1.60E-03	1.40E-03	1.14	12.5	AGREEMENT

ATTACHMENT 7

RADIOACTIVE EFFLUENT RELEASE REPORT
OFFSITE DOSE CALCULATION MANUAL

182 Pages Follow

OFFSITE DOSE CALCULATION MANUAL CHANGE REVIEW

1. Description:

Provide a brief description of the change.

1. Table 1.4 2003 Palisades Land Use Census

Changes include the following:

Beef Cattle are no longer present in NE sector at 3.2 mi
Beef Cattle are no longer present in E, sector at 3.5 mi
Beef Cattle are no longer present in ESE sector at 4.0 mi
Goats are no longer present in the NE sector at 3.2 mi
Goats are no longer present at the ESE/SE sector at 2.0 mi
Goats were added to the ENE sector at 1.8 mi
Goats were added to the E sector at 3.5 mi

2. Table 1.4a 2003 Palisades Land Use Census – Critical Receptor Items

The critical receptor for goat milk changed from SE sector at 2.0 mi (no longer present) to the NE sector at 1.8 mi

3. Table 1.9 Palisades Gaseous Design Basis Objective Annual Quantities

The design Basis Objective Annual Quantity (DBQ) Ci limit increased for Cs-136 and I-131 (15%) due to the change in the goat milk critical receptor.

4. Added Section IV. To the ODCM, "Revisions to the Offsite Dose Calculation Manual.

This section provides the format for all changes to the ODCM.

2. Evaluation:

Provide sufficient information to support the change, with appropriate analyses or evaluations justifying the change if needed.

Table 1.4 lists the nearest residence, garden, dairy/beef cattle and goat out to 5 miles in each of the nine sectors surrounding Palisades. The changes to Table 1.4 were based on Annual Land Use Census conducted in August of this year.

Table 1.4a lists the Critical Receptor Items (site boundary, residence, garden, beef/dairy, and goat). This information is also obtained from the Annual Land Use Census conducted in August 2003. The change in the critical receptor location for goats results in re-calculation of the design objective annual

quantities for gaseous effluents. This information will be updated in the GASPAR computer code for 2004 gaseous effluent releases.

Table 1.9 lists the DBQ for all gaseous nuclides. The DBQ is a very conservative estimate of activity which could give doses at Appendix I limits. DBQ typically overestimates dose by a factor of five due to organ doses or different people being summed together. Each gaseous nuclide DBQ Curie limit is based on a specific critical receptor. Cs-136 and I-131 DBQ's are the only gaseous nuclides based on the on goat critical receptor.

ODCM Section IV was added based on an area for improvement noted in a self-assessment. This will ensure all the Technical Specification requirements for documentation of ODCM changes is met, and included with the revision traveler.

3. **Determination:**

Answer the following questions:

a. Does the proposed change maintain the level of radioactive effluent control required by 10 CFR 20.1302? (Compliance with dose limits for individual members of the public, where annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the values specified in table 2 of appendix B part 20)

☑ Yes

☐ No

Changes to the Land Use Census Tables, and DBQ's do not result in any changes to Plant procedures or controls of radioactive effluent releases. There is no impact on annual average concentrations of radioactive material in gaseous and liquid effluents in the unrestricted area.

b. Does the proposed change maintain the level of radioactive effluent control required by 40 CFR 190? (Total dose uranium fuel cycle – less than or equal to 25 mrem total body or any organ, or less than or equal to 75 mrem thyroid)

☑ Yes

☐ No

Changes to the Land Use Census Tables, and DBQ's do not result in any changes to Plant procedures or controls for dose calculations. The calculation/requirements for the Uranium Fuel Cycle Dose per section III A. of the ODCM is unchanged.

c. Does the proposed change maintain the level of radioactive effluent control required by 10 CFR 50.36a? (Technical specifications on effluents from nuclear power reactors, where the Offsite Dose Calculation Manual is the document where the effluent controls are specified, and all the requirements of this regulation are demonstrated)

☑ Yes

☐ No

The requirements for the annual Land Use Census and the use of DBQ's are detailed in the ODCM. Changes to the Land Use Census Tables, and DBQ's do not result in any changes to the controls of effluent being released from the facility.

d. Does the proposed change maintain the level of radioactive effluent control required by 10 CFR 50, Appendix I? (Numerical guides for design objectives and limiting conditions for operation to meet the criterion "as low as reasonably achievable" for radioactive material in light-water-cooled nuclear power reactor effluents, lists the annual dose commitments to unrestricted areas for liquid and gaseous effluents)

☑ Yes

☐ No

The DBQ's have increased for Cs-136 and I-131 due to the change of the critical receptor for goat milk (based on land use survey). The critical receptor changed from 2.0 mi SE (no longer present) to 1.8 mi NE, however, the deposition value changed in a non-conservative direction, from 1.58E-09 per m^2 to 1.37E-09 per m^2. Critical receptor data will be updated in the GASPAR computer code (gaseous effluent dose calculations) for all 2004 gaseous releases. Changing the DBQ's based on the land use census is by definition maintaining the level of radioactive effluent control described by this regulation.

e. Does the proposed change adversely impact the accuracy or reliability of effluent calculations?

☐ Yes

☑ No

Changes to the Land Use Census Tables and DBQ's does not adversely impact the accuracy or reliability of effluent calculations. Changing the DBQ's for Cs-136 and I-131 based on the land use census ensures the accuracy of gaseous effluent calculations.

f. Does the proposed change adversely impact the accuracy or reliability of dose calculations?

☐ Yes

☑ No

Changes to the Land Use Census Tables and DBQ's does not adversely impact the accuracy or reliability of effluent calculations. Changing the critical receptor data in the GASPAR computer code based on the land use census ensures the accuracy of dose calculations.

g. Does the proposed change adversely impact the accuracy or reliability of setpoint calculations?

☐ Yes

☑ No

The Land Use Census Tables, and DBQ's are not used in setpoint calculations.

4. Conclusion:

Changes to the ODCM were made in accordance to the provisions of Technical Specification 5.5.1 section c.

Prepared By: _____ / 12/22/03
Date

Reviewed By: _____ / 12/22/03
Date

PALISADES NUCLEAR PLANT
OFFSITE DOSE CALCULATION MANUAL

TITLE: OFFSITE DOSE CALCULATION MANUAL

MLGrogan	/	1/8/04
Procedure Sponsor		Date
JLBeer	/	12/22/03
Technical Reviewer		Date
GASturm	/	12/23/03
User Reviewer		Date
RRemus	/	1/12/04
Plant Manager		Date

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1-13-04

I. GASEOUS EFFLUENTS

A. ALARM/TRIP SETPOINT METHOD

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

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

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

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

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

1. Allowable Concentration

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

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

If gaseous tritium and noble gasses are not present then:

$R_{(k)} \leq 10$

where:

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

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

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

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

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

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

2. Monitor Response

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

a. Normal Release (aged fission gasses)

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

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

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.

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

      1) Assumptions

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

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

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

         d) Basic radionuclide data are given in Table 1.2.

         e) All releases are treated as ground-level.

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

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

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

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

j) A semi-infinite cloud model is used.

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

l) Radioactive decay is considered for the plume.

m) Building wake effects on effluent dispersion are considered.

n) A sector-average dispersion equation is used.

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

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

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

q) Terrain effects are not considered.

2) Equations

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

For determining the air concentration of any radionuclide:

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

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 $\mu Ci/m^3$ (Table 1.5).

For determining the skin dose rate:

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

where:

D_s = Skin dose rate, mrem/y.

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

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

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

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

For determining dose rate to a point in air:

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

where:

D_a = Air dose rate, mrad/yr.

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

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

1) Assumptions

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

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

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

d) Basic radionuclide data are given in Table 1.2.

e) All releases are treated as ground-level.

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

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

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

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

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

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

l) Building wake effects on effluent dispersion are considered.

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

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

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

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

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

2) Equations

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

a) Inhalation

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

For determining the organ dose rate:

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

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 (Table 1.7).

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

1×10^6 = pCi/μCi conversion factor.

b) Ground Contamination

For determining the ground concentration of any nuclide;

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

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.

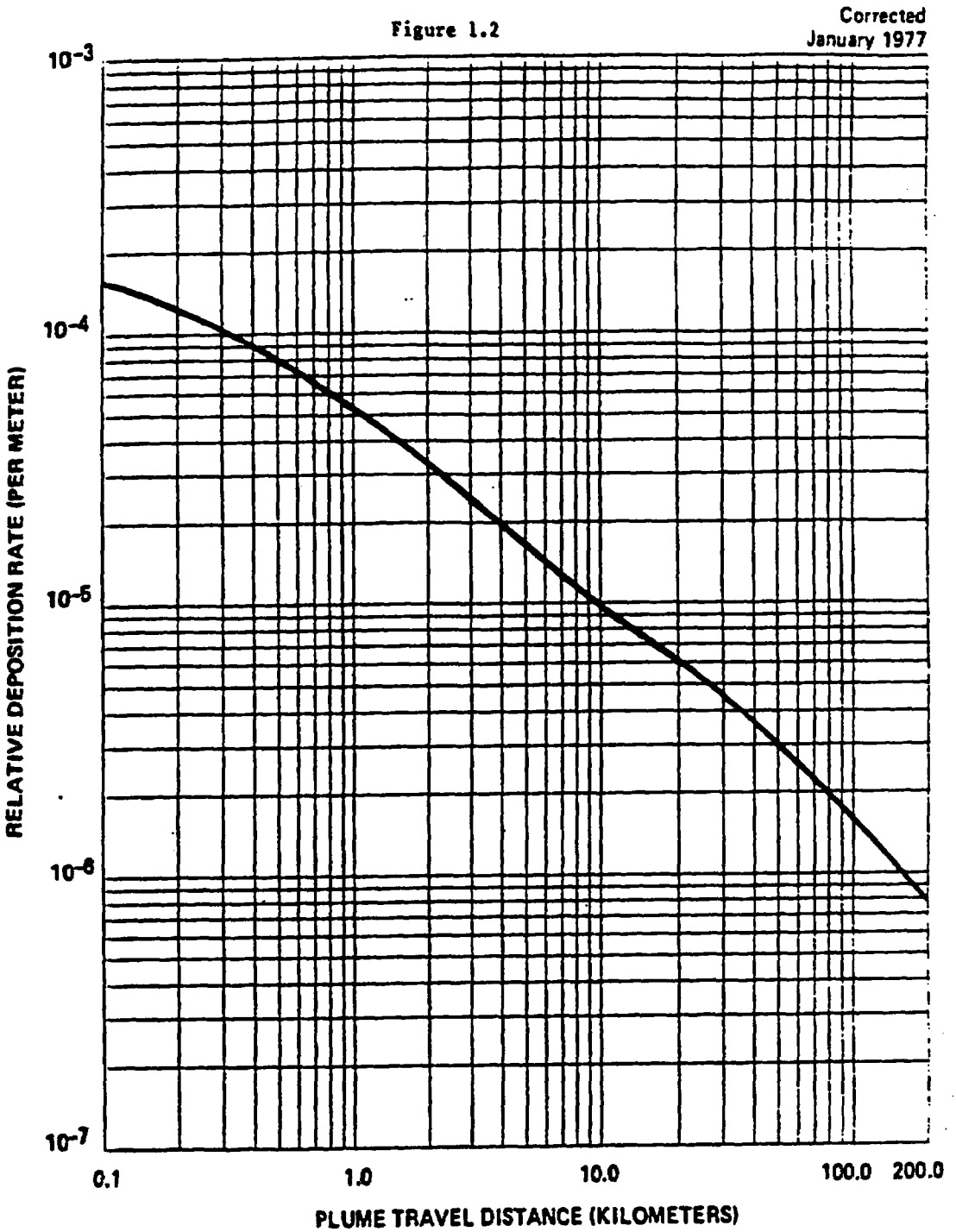

Figure 7. Relative Deposition for Ground Level Releases (All Atmospheric Stability Classes)

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 (Table 1.8).

8,760 = Occupation time, h/y.

1×10^6 = pCi/μCi conversion factor.

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

c) Milk and Vegetation Ingestion

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

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

where:

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

k = Stability class.

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

Q_i	=	Average release rate of radionuclide i, μCi/s.
DR	=	Relative deposition rate, m^{-1} (Figure 1.2).
x	=	Downwind distance, m.
n	=	Number of sectors, 16.
$2\pi x/n$	=	Sector width at point of interest, m.
r	=	Fraction of deposited activity retained on vegetation (1.0 for iodines, 0.2 for particulates).
λEi	=	Effective removal rate constant, $\lambda Ei = \lambda_i + \lambda_w$, where λ_i is the radioactive decay coefficient, h^{-1}, and λ_w is a measure of physical loss by weathering ($\lambda_w = 0.0021\ h^{-}$).
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 (Table 1.6).
λ_i	=	Radioactive decay coefficient of radionuclide i, h^{-1}.
t_b	=	Time for buildup of radionuclides on the ground, 1.31×10^5 h (15Y).
p	=	Effective surface density of soil, 240 kg/m^2.
3,600	=	s/h conversion factor.
t_h	=	Holdup time between harvest and consumption of food (2,160 hours for stored food).

For determining the concentration of C-14 in vegetation:

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

where:

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

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

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

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

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

For determining the concentration of H-3 in vegetation:

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

where:

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

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

0.75 = Fraction of total Plant mass that is water.

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

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

$1x10^3$ = 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 (Table 1.6).

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

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

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

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

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

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 (Table 2.1).

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

1×10^{6} = pCi/μCi conversion factor.

d) Meat Ingestion (Beef)

To calculate the concentration of a nuclide in animal flesh:

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

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 (Table 1.6).

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

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

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

To determine the organ dose from ingestion of beef:

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

where:

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

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

e) Organ Dose Rates

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

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

where:

D = Total organ dose rate, mrem/y.

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

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

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

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

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

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

c. Design Basis Quantities

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

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

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

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

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

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

where:

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

D_c = Calculated dose (mrem or mrad).

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

DBQ = Design Basis Quantity (Ci).

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

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

d. Land Use Census and DBQ Changes

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

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

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

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

1. Batch Releases

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

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

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

2. Continuous Releases

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

3. Exceeding DBQ Limits

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

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

4. Releasing Radionuclides Not Listed in Table 1.9

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

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

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

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

D. OPTIONAL QUARTERLY DOSE CALCULATIONS

1. Methodology for Optional Quarterly Dose Calculations

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

a. Simplified Conservative Approach

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

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

1) Assumptions

a) All assumptions of Section 1.1 are utilized.

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

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

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

2) Equations

For determining gaseous effluent dose:

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

where:

D_G = Dose from gaseous effluents (mrad).

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

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

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

For determining tritium, particulate and iodine dose to organs:

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

where:

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

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

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

b. Realistic Calculation

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

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

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

E. GASEOUS RADWASTE TREATMENT SYSTEM OPERATION

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

1. System Description

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

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

2. Determination of Satisfactory Operation

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

F. RELEASE RATE FOR OFFSITE EC

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

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

G. PARTICULATE AND IODINE SAMPLING

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

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

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

H. NOBLE GAS SAMPLING

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

I. TRITIUM SAMPLING

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

J. FIGURES AND TABLES

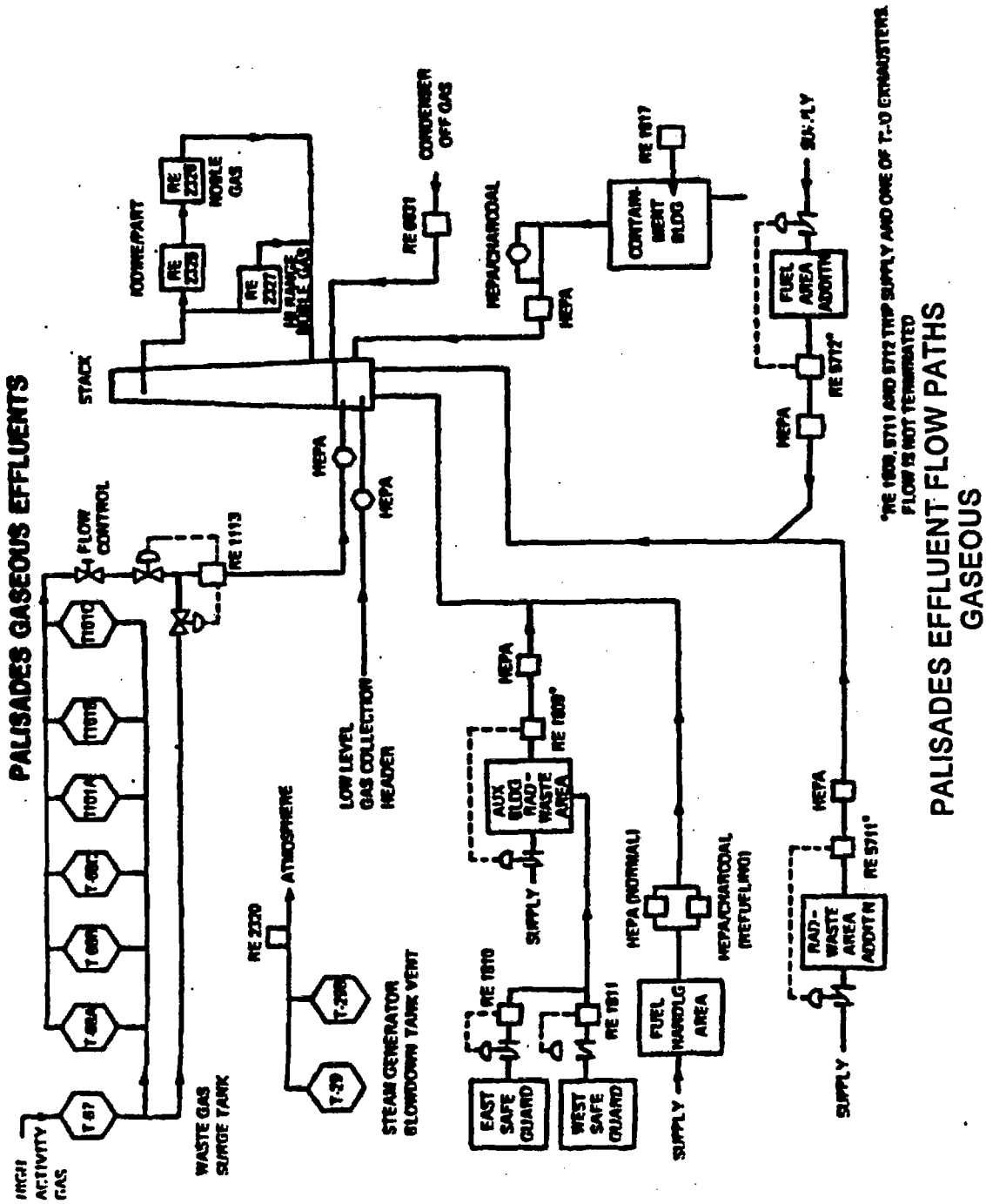

TABLE 1.1
PALISADES GASEOUS AND LIQUID SOURCE TERMS, CURIES/YEAR (1)

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

1-13-04

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

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

TABLE 1.2
BASIC RADIONUCLIDE DATA

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

TABLE 1.2 (continued)
BASIC RADIONUCLIDE DATA

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

TABLE 1.3

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

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

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

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

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

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

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

VENT AND BUILDING PARAMETERS:

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

ALL GROUND LEVEL RELEASES.

TABLE 1.3

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

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

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

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

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

TABLE 1.3

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

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

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

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

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

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

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

VENT AND BUILDING PARAMETERS:

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

ALL GROUND LEVEL RELEASES.

TABLE 1.3

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

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

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

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

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

TABLE 1.3

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

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

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

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

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

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

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

VENT AND BUILDING PARAMETERS:

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

ALL GROUND LEVEL RELEASES.

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

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

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

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

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

TABLE 1.3

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

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

GROUND LEVEL RELEASE - TOP OF CONTAINMENT BUILDING

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

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

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

TABLE 1.3

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

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

GROUND LEVEL RELEASE - TOP OF CONTAINMENT BUILDING

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

SEGMENT BOUNDARIES IN MILES

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

VENT AND BUILDING PARAMETERS:

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

ALL GROUND LEVEL RELEASES.

TABLE 1.3

TABLE 1.3

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

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

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

RELEASE ID	TYPE OF LOCATION	DIRECTION FROM SITE	DISTANCE (MILES)	DISTANCE (METERS)	X/Q (SEC/CUB.METER) NO DECAY UNDEPLETED	X/Q (SEC/CUB.METER) 2.260 DAY DECAY UNDEPLETED	X/Q (SEC/CUB.METER) 8.000 DAY DECAY DEPLETED	D/Q (PER SQ.METER)
A	SITE BOUNDARY	NNE	0.50	805.	1.72E-06	1.71E-06	1.57E-06	8.19E-09
A	SITE BOUNDARY	NE	0.65	1046.	1.22E-06	1.22E-06	1.10E-06	9.30E-09
A	SITE BOUNDARY	ENE	0.87	1400.	5.99E-07	5.98E-07	5.29E-07	4.58E-09
A	SITE BOUNDARY	E	0.82	1320.	7.28E-07	7.27E-07	6.45E-07	5.86E-09
A	SITE BOUNDARY	ESE	0.76	1223.	7.85E-07	7.83E-07	6.98E-07	7.04E-09
A	SITE BOUNDARY	SE	0.63	1014.	1.18E-06	1.18E-06	1.06E-06	1.14E-08
A	SITE BOUNDARY	SSE	0.48	772.	2.13E-06	2.12E-06	1.95E-06	1.86E-08
A	SITE BOUNDARY	S	0.42	676.	1.78E-06	1.78E-06	1.64E-06	1.16E-08
A	SITE BOUNDARY	SSW	0.48	772.	1.16E-06	1.15E-06	1.06E-06	6.26E-09
A	GARDEN	NNE	1.60	2575.	3.06E-07	3.04E-07	2.58E-07	1.15E-09
A	GARDEN	NE	1.20	1931.	4.96E-07	4.95E-07	4.28E-07	3.29E-09
A	GARDEN	ENE	2.70	4345.	1.15E-07	1.14E-07	9.20E-08	6.45E-10
A	GARDEN	E	2.20	3541.	1.70E-07	1.69E-07	1.40E-07	1.07E-09
A	GARDEN	ESE	2.30	3701.	1.51E-07	1.50E-07	1.23E-07	1.05E-09
A	GARDEN	SE	1.80	2897.	2.45E-07	2.44E-07	2.04E-07	1.91E-09
A	GARDEN	SSE	1.60	2575.	3.55E-07	3.53E-07	2.99E-07	2.44E-09
A	GARDEN	S	1.50	2414.	2.78E-07	2.77E-07	2.36E-07	1.38E-09
A	BEEF COW	NE	2.90	4667.	1.38E-07	1.36E-07	1.09E-07	7.06E-10
A	BEEF COW	ENE	4.00	6437.	6.51E-08	6.43E-08	4.98E-08	3.20E-10
A	BEEF COW	E	3.50	5633.	8.64E-08	8.56E-08	6.73E-08	4.71E-10
A	BEEF COW	ESE	4.00	6437.	6.70E-08	6.63E-08	5.13E-08	3.93E-10
A	BEEF COW	SSE	3.00	4828.	1.41E-07	1.40E-07	1.12E-07	8.11E-10
A	DAIRY COW	SE	4.30	6920.	6.83E-08	6.75E-08	5.18E-08	4.09E-10
A	GOAT	NE	3.20	5150.	1.19E-07	1.18E-07	9.39E-08	5.93E-10
A	GOAT	ESE	3.00	4828.	1.02E-07	1.01E-07	8.10E-08	6.55E-10

VENT AND BUILDING PARAMETERS:

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

ALL GROUND LEVEL RELEASES.

TABLE 1.3

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

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

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

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

VENT AND BUILDING PARAMETERS:

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

ALL GROUND LEVEL RELEASES.

TABLE 1.4

2003 PALISADES LAND USE CENSUS

1-13-04

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

SECTOR	RESIDENCE	GARDEN	BEEF CATTLE	DAIRY COW	GOAT
NNE	1.1 mi	1.7 mi	>5 mi	>5 mi	>5 mi
NE	1.2 mi	1.2 mi	>5 mi	>5 mi	>5 mi
ENE	1.3 mi	1.6 mi	4.0 mi	>5 mi	1.8 mi
E	1.0 mi	2.1 mi	>5 mi	>5 mi	3.5 mi
ESE	1.0 mi	*1.0 mi	>5 mi	>5 mi	>5 mi
SE	1.0 mi	*1.0 mi	2.2 mi	4.3 mi	>5 mi
SSE	0.7 mi	1.6 mi	>5 mi	>5 mi	>5 mi
S	0.5 mi	4.0 mi	>5 mi	>5 mi	4.7 mi
SSW	0.7 mi	>5.0 mi	>5 mi	>5 mi	>5 mi

1-13-04

1-13-04

TABLE 1.4a

2003 PALISADES LAND USE CENSUS

1-13-04

Critical Receptor Items

Sector	Distance Miles	Location/Description	Item	*X/Q (sec/m^3)
SSE	0.48	Site Boundary	N/A	2.13E-06
S	0.50	Residence, Palisades Park; 1/2 mile west of 29th Avenue and Blue Star intersection	Residence	1.38E-06
SE	1.0	77550 28th Avenue	Garden	5.87E-07
SE	2.2	76th Street, 0.3 miles N of 34th East side of road	Beef Cattle	1.86E-07
SE	4.3	72401 36th Ave	Dairy Cow	6.83E-08
ENE	1.8	NW Corner of 26th and 72nd	Goat	2.14E-07

1-13-04

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

TABLE 1.5

DOSE FACTORS FOR SUBMERSION IN NOBLE GASES*

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

1. mrem/y per $\mu Ci/m^3$
2. mrad/y per $\mu Ci/m^3$
3. $1.17(+3) = 1.17 \times 10^3$

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

TABLE 1.6

STABLE ELEMENT TRANSFER DATA

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

TABLE 1.7

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

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

Includes a 50% increase to account for percutaneous transpiration.

TABLE 1.7 (continued)

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

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

TABLE 1.7 (continued)

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

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

TABLE 1.7 (continued)

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

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

TABLE 1.7 (continued)

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

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

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

TABLE 1.7 (continued)

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

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

TABLE 1.7 (continued)

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

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

TABLE 1.7 (continued)

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

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

TABLE 1.7 (continued)

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

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

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

TABLE 1.7 (continued)

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

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

TABLE 1.7 (continued)

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

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

TABLE 1.7 (continued)

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

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

TABLE 1.7 (continued)

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

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

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

TABLE 1.7 (continued)

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

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

TABLE 1.7 (continued)

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

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

TABLE 1.7 (continued)

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

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

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

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

TABLE 1.8 (continued)

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

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

TABLE 1.9
PALISADES GASEOUS DESIGN OBJECTIVE ANNUAL QUANTITIES

Nuclide	Organ	Dose Factor Mrem/Ci	Design Objective Annual Quantity Ci
Ag-110m	GI-Tract-T	2.13E+00	7.04E+00
Ar-41	Total Body	3.64E - 04	1.37E+04
Ba-139	GI Tract-C	2.97E - 03	5.05E+03
Ba-140	Lung-T	1.26E - 01	1.19E+02
Br-82	total Body-C	4.97E - 03	1.01E+03
C-14	Bone-C	1.48E - 01	1.01E+02
Ce-141	GI Tract-T	1.34E - 01	1.12E+02
Ce-144	GI Tract-T	3.37E+00	4.45E+00
Co-57	GI Tract-T	8.53E - 02	1.76E+02
Co-58	GI Tract-T	2.59E - 01	5.79E+01
Co-60	GI Tract-T	6.86E+00	2.19E+00
Cr-51	GI Tract-A	3.75E - 03	1.33E+03
Cs-134	Liver-C	8.77E+00	1.71E+00
Cs-136	Liver-I	4.62E-01	3.25E+01
Cs-137	Bone-C	9.58E+00	1.57E+00
Cs-138	Total body-C	1.00E - 01	5.00E+01
Fe-55	Bone-C	2.06E - 01	7.28E+01
Fe-59	GI Tract-T	3.20E - 01	4.69E+01
H-3	Total Body-C	2.19E - 04	2.28E+04
I-129	Thyroid-A	3.66E+02	4.10E - 02
I-131	Thyroid-I	1.71E+01	8.77E - 01
I-132	Thyroid-C	1.12E - 02	1.34E+03
I-133	Thyroid-C	2.46E - 01	6.11E+01
I-134	Thyroid-C	2.45E - 03	6.12E+03
I-135	Thyroid-C	4.93E - 02	3.04E+02

1-13-c

1-13-04

TABLE 1.9
PALISADES GASEOUS DESIGN OBJECTIVE ANNUAL QUANTITIES

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

TABLE 1.9
PALISADES GASEOUS DESIGN OBJECTIVE ANNUAL QUANTITIES

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

II. LIQUID EFFLUENTS

A. CONCENTRATION

1. Requirements

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

2. Prerelease Analysis

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

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

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

where:

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

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

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

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

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

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 analysis requirements of Appendix A, Table D-1. In the event that a compositor is not operational, effluent releases via this pathway may continue provided that grab samples are collected and analyzed for gross beta or gamma radioactivity at least once per 24 hours per Appendix A, Table C-1, Action 3.

3. Post-Release Analysis

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

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

C. DOSE

1. RETS Requirement

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

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

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

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

2. Release Analysis

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

$$\sum_i A_i / C_i \leq 0.5 \qquad (2.5)$$

where:

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

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

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

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

a. Water Ingestion

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

$$D_j \sum_{i=1}^{i} (DCF)_{ij} \times I_i \qquad (2.6)$$

where:

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

j = The organ of interest.

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

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

I_i is described by:

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

where:

365 = Days per year.

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

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

d = Dilution water flow for year, ml.

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

1E06 = Conversion μCi to pCi.

The dose equation then becomes:

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

b. Fish Ingestion

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

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

where:

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

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

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

15 = Dispersion factor from discharge to fish exposure point.

d = Dilution water flow for year, ml.

1E09 = Conversion of μCi and Kgm to gross.

Substitution of Equation 2.9 into Equation 2.6 gives:

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

c. Annual Analysis

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

$$D_j = \sum_{i=1}^{m} D_{ij}\ \text{mrem} \qquad (2.11)$$

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

where:

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

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

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

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

I_i for water ingestion is described by:

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

and for fish ingestion I_i is described by:

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

where:

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

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

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

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

d = Dilution water volume (ml).

B_i = Fish concentration factor of the i^{th} radionuclide, Table 2.0, $\frac{\mu Ci/gm}{\mu Ci/ml}$

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

D. OPERABILITY OF LIQUID RADWASTE EQUIPMENT

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

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

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

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

F. FIGURES AND TABLES

Figure 2-1

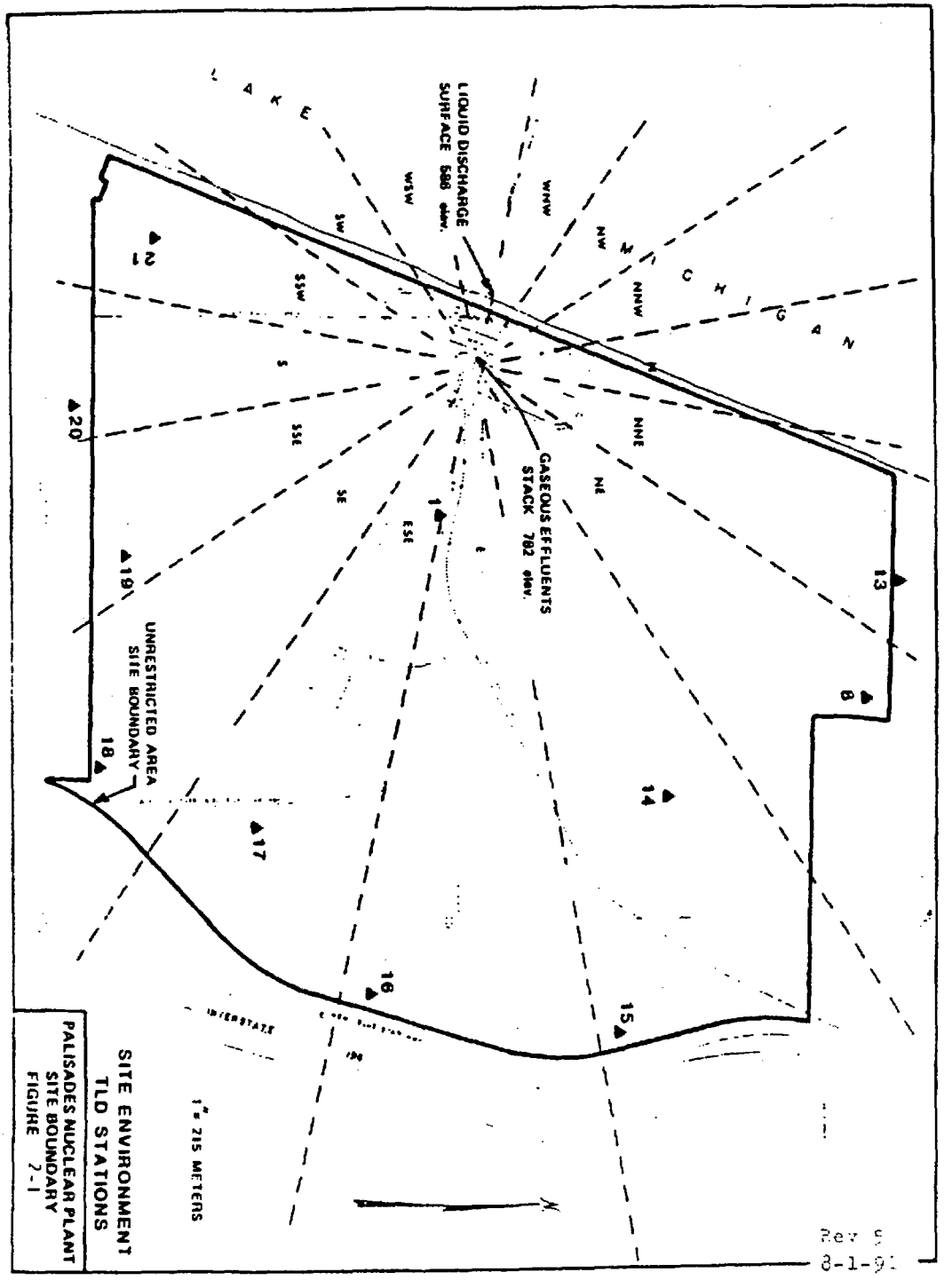

Figure 2-2

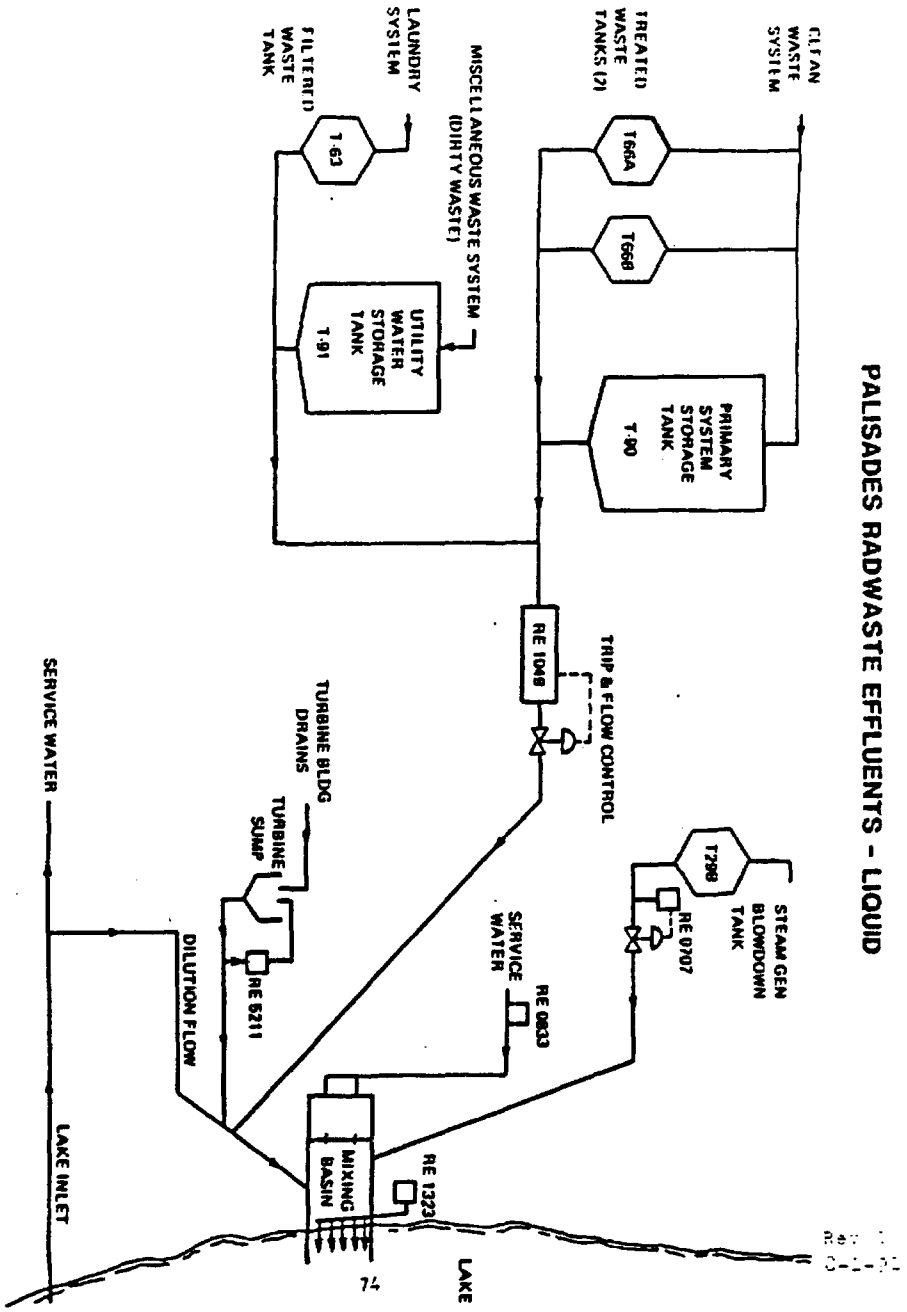
PALISADES RADWASTE EFFLUENTS - LIQUID
CLEAN WASTE SYSTEM
TREATED WASTE TANKS (2)
T66A
T66B
PRIMARY SYSTEM STORAGE TANK T-90
MISCELLANEOUS WASTE SYSTEM (DIRTY WASTE)
UTILITY WATER STORAGE TANK T-91
LAUNDRY SYSTEM
FILTERED WASTE TANK
T-63
RE 1048
TRIP & FLOW CONTROL
T29B
STEAM GEN BLOWDOWN TANK
RE 0707
SERVICE WATER
RE 0833
TURBINE BLDG DRAINS
TURBINE SUMP
RE 5211
DILUTION FLOW
SERVICE WATER
MIXING BASIN
RE 1323
LAKE INLET
LAKE
74

TABLE 2.0

BIOACCUMULATION FACTORS
µCi/gm per µCi/ml

ELEMENT	FRESHWATER FISH
H	9.0E-01
C	4.6E 03
NA	1.0E 02
P	1.0E 05
CR	2.0E 02
MN	4.0E 02
FE	1.0E 02
CO	5.0E 01
NI	1.0E 02
CU	5.0E 01
ZN	2.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

TABLE 2.1

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

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

TABLE 2.1

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

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

TABLE 2.1

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

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

TABLE 2.1

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

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

TABLE 2.1

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

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

TABLE 2.1

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

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

TABLE 2.1

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

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

TABLE 2.1

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

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

TABLE 2.1

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

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

TABLE 2.1

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

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

TABLE 2.1

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

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

TABLE 2.1

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

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

TABLE 2.1

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

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

TABLE 2.1

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

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

TABLE 2.1

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

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

TABLE 2.1

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

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

TABLE 2.2

PALISADES
Liquid Effluent

Design Objective Annual Quantity

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

TABLE 2.2 (continued)

PALISADES
Liquid Effluent

Design Objective Annual Quantity

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

III. URANIUM FUEL CYCLE DOSE

A. SPECIFICATION

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

B. ASSUMPTIONS

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

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

C. DOSE CALCULATION

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

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

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. REVISIONS TO THE OFFSITE DOSE CALCULATION MANUAL

A. REQUIREMENTS

1. For all revisions to the Offsite Dose Calculation Manual, complete Attachment 1.

1-13-04

OFFSITE DOSE CALCULATION MANUAL CHANGE REVIEWS

1. **Description:**

Provide a brief description of the change.

2. **Evaluation:**

Provide sufficient information to support the change, with appropriate analyses or evaluations justifying the change if needed.

3. **Determination:**

Answer the following questions:

a. Does the proposed change maintain the level of radioactive effluent control required by 10 CFR 20.1302? (Compliance with dose limits for individual members of the public, where annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the values specified in Table 2 of Appendix B Part 20.)

☐ Yes

☐ No

1-13-04

OFFSITE DOSE CALCULATION MANUAL CHANGE REVIEWS

b. Does the proposed change maintain the level of radioactive effluent control required by 40 CFR 190? (Total dose uranium fuel cycle - less than or equal to 25 mrem total body or any organ, or less than or equal to 75 mrem thyroid.)

☐ Yes

☐ No

c. Does the proposed change maintain the level of radioactive effluent control required by 10 CFR 50.36a? (Technical Specifications on effluents from nuclear power reactors, where the Offsite Dose Calculation Manual is the document where the effluent controls are specified, and all the requirements of this regulation are demonstrated.)

☐ Yes

☐ No

d. Does the proposed change maintain the level of radioactive effluent control required by 10 CFR 50, Appendix I? (Numerical guides for design objectives and limiting conditions for operation to meet the criterion "as low as reasonably achievable," for radioactive material in light-water-cooled nuclear power reactor effluents, lists the annual dose commitments to unrestricted areas for liquid and gaseous effluents.)

☐ Yes

☐ No

1-2-04

OFFSITE DOSE CALCULATION MANUAL CHANGE REVIEWS

e. does the proposed change adversely impact the accuracy or reliability of effluent calculations?

☐ Yes

☐ No

f. Does the proposed change adversely impact the accuracy or reliability of dose calculations?

☐ Yes

☐ No

g. Does the proposed change adversely impact the accuracy or reliability of setpoint calculations?

☐ Yes

☐ No

1-13-04

OFFSITE DOSE CALCULATION MANUAL CHANGE REVIEWS

4. Conclusion:

Changes to the ODCM were made in accordance to the provisions of Technical Specification 5.5.1, Section c.

Prepared By: _____ / _____
Date

Reviewed By: _____ / _____
Date

1-13-04

OFFSITE DOSE CALCULATION MANUAL "APPENDIX A" CHANGE REVIEW

1. Description:

Provide a brief description of the change:

Table E-1 Radiological Environmental monitoring Program
(1) Eliminate Well (drinking) from 3. (b) WATERBORNE Section.
(2) Reverse the Type of Frequency of Analysis for Fish and broad leaf vegetation; broad leaf should be "Gamma isotopic and I-131 analysis" and fish should be "Gamma isotopic analysis on edible portions"
(3) Changed the sampling and collection frequency for broad leaf vegetation from "at time of harvest", to "monthly when available"

Table E-3 Detection Capabilities for Environmental Sample Analysis,
(4) Changed the lower limit of detection for Cs-134 – Food Products from 80 pCi/kg to 60 pCi/kg.

2. Evaluation:

Provide sufficient information to support the change, with appropriate analyses or evaluations justifying the change if needed.

(1) Well water sampling consisted of monthly samples from the Plant, State Park, and Covert Township Park wells for drinking water. Over the past two years these samples have been eliminated, as the city of South Haven treated water service area has expanded to supply drinking water to all three locations. There are no longer any groundwater samples near the Palisades facility being utilized for drinking or irrigation purposes. The Branch Technical Position states that groundwater samples should be taken from one or two sources if likely to be affected, samples should be taken when this source is tapped for drinking or irrigation purposes in areas where the hydraulic gradient or recharge properties are suitable for contamination. The Plant site, State Park, and Covert Township well samples collections/analysis were based on drinking water. There are no sources of ground water being used for irrigation purposes adjacent to the Plant site.

(2&3) During the revision 9 change to the ODCM Appendix A the type of frequency of Analysis and the collection frequency was inadvertently changed to the present wording. I-131 analysis is not required for fish samples, and the collection frequency for broad leaf vegetation is monthly when available.

(4) Changing the lower limit of detection for Cs-134 – Food Products from 80 pCi/kg to 60 pCi/kg. Table E-3 of the ODCM Appendix A and Table 2 of the

Branch Technical Position of An Acceptable Radiological Environmental Monitoring Program, both list lower limit of detection (LLD) values for the various isotopes and sample types. The only discrepancy between the two tables is Cs-134 – food products. Changing this LLD to 60 pCi/kg eliminates the discrepancy.

3. **Determination:**

Answer the following questions:

a. Does the proposed change maintain the level of radioactive effluent control required by 10 CFR 20.1302? (Compliance with dose limits for individual members of the public, where annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the values specified in table 2 of appendix B part 20)

☑ Yes

☐ No

The elimination of well sampling, the changes related to fish and broad leaf vegetation sampling parameters, and the lowering of the LLD for Cs-134 are all changes to the radiological environmental monitoring program. They have no impact on annual average concentrations of radioactive material in gaseous and liquid effluents in the unrestricted area.

b. Does the proposed change maintain the level of radioactive effluent control required by 40 CFR 190? (Total dose uranium fuel cycle – less than or equal to 25 mrem total body or any organ, or less than or equal to 75 mrem thyroid)

☑ Yes

☐ No

The elimination of well sampling, the changes related to fish and broad leaf vegetation sampling parameters, and the lowering of the LLD for Cs-134 are all changes to the radiological environmental monitoring program. They have no impact on and are not used in total dose calculations.

c. Does the proposed change maintain the level of radioactive effluent control required by 10 CFR 50.36a? (Technical specifications on effluents from nuclear power reactors, where the Offsite Dose Calculation Manual is the document where the effluent controls are specified, and all the requirements of this regulation are demonstrated)

☑ Yes

☐ No

The elimination of well sampling, the changes related to fish and broad leaf vegetation sampling parameters, and the lowering of the LLD for Cs-134 are all changes to the radiological environmental monitoring program. The environmental program requirements are included in the Technical Specifications (ODCM); however, these changes do not affect procedures that control effluent releases or regulatory limits.

d. Does the proposed change maintain the level of radioactive effluent control required by 10 CFR 50, Appendix I? (Numerical guides for design objectives and limiting conditions for operation to meet the criterion "as low as reasonably achievable" for radioactive material in light-water-cooled nuclear power reactor effluents, lists the annual dose commitments to unrestricted areas for liquid and gaseous effluents)

☑ Yes

☐ No

The elimination of well sampling, the changes related to fish and broad leaf vegetation sampling parameters, and the lowering of the LLD for Cs-134 are all changes to the radiological environmental monitoring program. They have no impact on and are not used to determine annual dose commitments to unrestrictive areas for liquid or gaseous effluents.

e. Does the proposed change adversely impact the accuracy or reliability of effluent calculations?

☐ Yes

☑ No

The elimination of well sampling, the changes related to fish and broad leaf vegetation sampling parameters, and the lowering of the LLD for Cs-134 are all changes to the radiological environmental monitoring program. These parameters are not used in any effluent calculations; they cannot impact the reliability or accuracy of effluent calculations.

f. Does the proposed change adversely impact the accuracy or reliability of dose calculations?

The elimination of well sampling, the changes related to fish and broad leaf vegetation sampling parameters, and the lowering of the LLD for Cs-134 are all changes to the radiological environmental monitoring program. These parameters are not used in any dose calculations; they cannot impact the reliability or accuracy of such.

☐ Yes

☑ No

g. Does the proposed change adversely impact the accuracy or reliability of setpoint calculations?

☐ Yes

☑ No

The elimination of well sampling, the changes related to fish and broad leaf vegetation sampling parameters, and the lowering of the LLD for Cs-134 are all changes to the radiological environmental monitoring program. These parameters are not used in monitor setpoint calculations.

4. **Conclusion:**

Changes to the ODCM Appendix A were made in accordance to the provisions of Technical Specification 5.5.1 section c.

Prepared By: _____ 12/22/03
Date

Reviewed By: _____ 12/22/03
Date

OFFSITE DOSE CALCULATION MANUAL "APPENDIX A" CHANGE REVIEW

1. **Description:**

   Provide a brief description of the change:

   Table E-1 Radiological Environmental monitoring Program
   (1) Added a **NOTE** before the milk requirements in the Sample Locations section.

   (2) Changed the distance requirements for milk samples in the sample location section from 5-13 km, to 5-8 km.

2. **Evaluation:**

   Provide sufficient information to support the change, with appropriate analyses or evaluations justifying the change if needed.

   (1) NOTE was added to provide information regarding the Palisades milk-sampling program. This NOTE simply states that there are no dairy farms within a 5-8 km distance of the Plant, and that milk samples will be collected whenever available from farms within 15 km distance of the Plant. Milk sample analysis is the preferred method of analysis for the ingestion pathway (versus broad leaf vegetation sampling/analysis). This is not a change to the environmental program, as there have not been any dairy farms within 5-8 km distance of the Plant for many years.

   (2) The change from 5-13 km to 5-8 km for milk sampling locations was made to be consistent with the distances listed in the Branch Technical Position of An Acceptable Radiological Environmental Monitoring Program recommendations.

3. **Determination:**

   Answer the following questions:

   a. Does the proposed change maintain the level of radioactive effluent control required by 10 CFR 20.1302? (Compliance with dose limits for individual members of the public, where annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the values specified in table 2 of appendix B part 20)

d. Does the proposed change maintain the level of radioactive effluent control required by 10 CFR 50, Appendix I? (Numerical guides for design objectives and limiting conditions for operation to meet the criterion "as low as reasonably achievable" for radioactive material in light-water-cooled nuclear power reactor effluents, lists the annual dose commitments to unrestricted areas for liquid and gaseous effluents)

☑ Yes

☐ No

Milk samples continue to be collected and analyzed from the nearest dairy farms to the site. The milk sampling program changes are part of the radiological environmental monitoring program, and are administrative in nature. These changes have no impact on and are not used to determine annual dose commitments to unrestrictive areas for liquid or gaseous effluents.

e. Does the proposed change adversely impact the accuracy or reliability of effluent calculations?

☐ Yes

☑ No

Milk samples continue to be collected and analyzed from the nearest dairy farms to the site. The milk sampling program changes are part of the radiological environmental monitoring program, and are administrative in nature. Milk sample analysis results are not used in any effluent calculations; they cannot impact the reliability or accuracy of effluent calculations.

f. Does the proposed change adversely impact the accuracy or reliability of dose calculations?

☐ Yes

☑ No

d. Does the proposed change maintain the level of radioactive effluent control required by 10 CFR 50, Appendix I? (Numerical guides for design objectives and limiting conditions for operation to meet the criterion "as low as reasonably achievable" for radioactive material in light-water-cooled nuclear power reactor effluents, lists the annual dose commitments to unrestricted areas for liquid and gaseous effluents)

☑ Yes

☐ No

Milk samples continue to be collected and analyzed from the nearest dairy farms to the site. The milk sampling program changes are part of the radiological environmental monitoring program, and are administrative in nature. These changes have no impact on and are not used to determine annual dose commitments to unrestrictive areas for liquid or gaseous effluents.

e. Does the proposed change adversely impact the accuracy or reliability of effluent calculations?

☐ Yes

☑ No

Milk samples continue to be collected and analyzed from the nearest dairy farms to the site. The milk sampling program changes are part of the radiological environmental monitoring program, and are administrative in nature. Milk sample analysis results are not used in any effluent calculations; they cannot impact the reliability or accuracy of effluent calculations.

f. Does the proposed change adversely impact the accuracy or reliability of dose calculations?

☐ Yes

☑ No

Milk samples continue to be collected and analyzed from the nearest dairy farms to the site. The milk sampling program changes are part of the radiological environmental monitoring program, and are administrative in nature. Milk sample results are not used in any dose calculations; they cannot impact the reliability or accuracy of such.

g. Does the proposed change adversely impact the accuracy or reliability of setpoint calculations?

☐ Yes

☑ No

Milk samples continue to be collected and analyzed from the nearest dairy farms to the site. The milk sampling program changes are part of the radiological environmental monitoring program, and are administrative in nature. Milk sample locations/analysis results are not used in monitor setpoint calculations.

4. **Conclusion:**

Changes to the ODCM Appendix A were made in accordance to the provisions of Technical Specification 5.5.1 section c.

Prepared By: _____, 1/21/04
Date

Reviewed By: _____, 3/15/04
Date

PALISADES NUCLEAR PLANT
OFFSITE DOSE CALCULATION MANUAL

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

MLGrogan	/	3/17/04
Procedure Sponsor		Date
JLBeer	/	12/4/03
Technical Reviewer		Date
WWDoolittle	/	12/2/03
User Reviewer		Date
RRemus	/	1/12/04
Plant Manager		Date

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

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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.

1-13-04

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	3
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.)

1-13-04

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

1-13-04

* 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.

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

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 500mrems/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] (I-131, Others)	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)

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.

*Ten times the LLD because of low gamma yields.

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.

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 up to 60 days.

2. Action

a. If a waste gas decay tank is required to be released with less than 60 days holdup time, the system waste gas tank contents shall be evaluated and the waste gas decay tank with the lowest Xe-133 content 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.

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

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 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.

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

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	5×10^{-8}
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:

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

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).

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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 of Frequency of Analysis
1. DIRECT RADIATION[b]	21 routine monitoring stations either with two or more dosimeters or with one instrument for measuring and recording dose rate continuously, placed as follows: An inner ring of stations, one in each overland meteorological sector (9) in the general area of the Site Boundary. 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

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Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations[a]	Sampling and Collection Frequency	Type of 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 (2.4 km-SSW, 5.6 km-ESE, and 1.6 km-N). 1 sample from the vicinity of a community having the highest calculated annual average ground level D/Q (Covert-5.6 km-SE). 1 sample from a control location in the least prevalent wind direction[c] (Grand Rapids 89 km-NNE).	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 analysis[e] if gross beta >1.0 pCi/m^3.
3. WATERBORNE			
a. Lake (surface)	Plant lake water inlet.	Composite sample over 1-month period[f].	Gross beta (>10 pCi/l requires gamma) and tritium monthly.
b. Lake (drinking)	1 sample of South Haven drinking water supply.	Composite sample over 1-month period[f].	Gross beta (>10 pCi/l requires gamma) and tritium monthly.
c. 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 analysis[e] semiannually.

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Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations[a]	Sampling and Collection Frequency	Type of Frequency of Analysis
4. INGESTION	NOTE: Currently there are no dairy farms within a distance of 5-8 km from the Plant; however, milk samples will be obtained at 3 locations within a distance of 15 km whenever available. When milk samples are collected, broad leaf vegetation sampling is not required.		
a. Milk	Samples from milking animals in 3 locations between 5-8 km distance.	Monthly	Gamma isotopic[e] and I-131 analysis monthly.
	1 sample from milking animals at a control location, 15-30 km distance.		
	NOTE: 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.)	Sample in season or semiannually if they are not seasonal.	Gamma isotopic[e] and I-131 analysis.
	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. (SSW or S sectors.)	Monthly when available	Gamma isotopic[e] and I-131 analysis.
b. 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 influence by Plant discharge.	Sample in season or semiannually if they are not seasonal.	Gamma isotopic analysis[e] on edible portions.
c. Food Products	1 sample each of two principal fruit crops (blueberries and apples).	At time of harvest[g]	Gamma Isotopic[e] and I-131 analysis.

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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.

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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.

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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, 60	15		130			
Zn-65	30		260			
Zr-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-La-140	15			15		

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

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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:

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

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
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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)

K. SIRW OR TEMPORARY LIQUID STORAGE TANK

1. Requirement

The concentration of radioactive material 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.

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

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.

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IV. REPORTING REQUIREMENTS

A. RADIOLOGICAL EFFLUENT RELEASE REPORT

The Radioactive Effluent Release Report shall be submitted in accordance with 10CFR 50.36a by March 31 of each year. The report shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit. The material provided shall be (1) consistent with the objectives outlined in the ODCM and Process Control Program and (2) in conformance with 10CFR 50.36a and Section IV.B.1 of Appendix I to 10CFR 50.

The report shall include an estimate of the uncertainty associated with the measurement of radioactive effluents. This error term is included to provide an estimate of the uncertainty and is not to be considered the absolute error associated with the measurements or to be used in determining compliance with these requirements.

These estimates will be based on a statistical analysis of a series of sample results (weighed appropriately for counting statistics) taken once a year from a minimum of one typical gaseous waste tank and from a minimum of one typical liquid waste tank. For noble gases released to the atmosphere from other than the waste gas system the error term will be estimated (and weight-averaged with the waste gas tank error) based on a statistical analysis of a series of sample results taken once a year (or the stack gas monitor counting statistics taken over one release per year) from each source contributing more than 10% of the total annual release.

The error term for iodine and particulates released to the atmosphere will be based on the counting statistics for one stack gas sample taken during the year.

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

The report shall include an estimate of the lower level of detection (in µCi/ml) if the unidentified portion of the release exceeds 10% of the total annual releases. This estimate of the lower level of detection will be made for those gamma emitting isotopes listed in Appendix B of Regulatory Guide 1.21 (June 1974) and will be provided based on a typical background gamma spectrum.

The report shall provide the following specific terms:

1. Supplemental Information

a. Batch Releases:

The report should provide information relating to batch releases of liquid and gaseous effluents which are discharged to the environment. This information should include the number of releases, total time period for batch releases, and the maximum, mean, and minimum time period of release.

b. Abnormal Releases

The number of abnormal releases of radioactive material to the environment should be reported. The total curies of radioactive materials released as a result of abnormal releases should be included.

2. Gaseous Effluents

a. Gases

(1) Total curies of fission and activation gases releases.

(2) Average release rates (µCi/s) of fission and activation gases for the quarterly periods covered by the report.

(3) Percent of limit for releases of fission and activation gases.

(4) Quarterly sums of total curies for each of the radionuclides determined to be released, based on analyses of fission and activation gases.

b. Iodines

(1) Total curies of each of the isotopes, Iodine-131, Iodine-133, and Iodine-135 determined to be released.

(2) Average release rate (µCi/s) of Iodine-131/133.

(3) Percent of limit for Iodine-131/133.

c. Particulates

(1) Total curies of radioactive material in particulate form with half-lives greater than 8 days determined to be released.

(2) Average release rate (µCi/s) of radioactive material in particulate form with half-lives greater than 8 days.

(3) Percent of limit for radioactive material in particulate form with half-lives greater than 8 days.

(4) Total curies for each of the radionuclides in particulate form determined to be released based on analyses performed.

(5) Total curies of gross alpha radioactivity determined to be released.

d. Tritium

(1) Total curies of tritium determined to be released in gaseous effluents.

(2) Average release rate (µCi/s) of tritium.

(3) Percent of applicable limits for tritium.

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

3. Liquid Effluents

a. Mixed Fission and Activation Products

(1) Total curies of radioactive material determined to be released in liquid effluents (not including tritium, dissolved and/or entrained gases, and alpha-emitting material).

(2) Average concentrations (μCi/ml) of mixed fission and activation products released to unrestricted areas, averaged over the quarterly periods covered by the report.

(3) Percent of applicable limit of average concentrations released to unrestricted areas.

(4) Quarterly sums of total curies for each of the radionuclides determined to be released in liquid effluents based on analyses performed.

b. Tritium

(1) Total curies of tritium determined to be released in liquid effluents.

(2) Average concentrations (μCi/ml) of tritium released in liquid effluents to unrestricted areas, averaged over the quarterly periods covered by the report.

(3) Percent of applicable limit of average concentrations released to unrestricted areas.

c. Dissolved and/or Entrained Gases

(1) Total curies of gaseous radioactive material determined to be released in liquid effluents.

(2) Average concentrations (μCi/ml) of dissolved and/or entrained gaseous radioactive material released to unrestricted areas, averaged over the quarterly periods covered by the report.

(3) Percent of applicable limit of average concentrations released to unrestricted areas.

(4) Total curies for each of the radionuclides determined to be released as dissolved and/or entrained gases in liquid effluents.

d. Alpha Radioactivity

Total curies of gross alpha-emitting material determined to be released in liquid effluents.

e. Volumes

(1) Total measured volume (liters), prior to dilution, of liquid effluent released.

(2) Total determined volume, in liters, of dilution water used during the period of the report.

4. Radiological Impact on Man

The Radioactive Effluent Release Report shall include potential doses to individuals and populations calculated using measured effluent and averaged meteorological data in accordance with the methodologies in the ODCM.

a. Total body and significant organ doses (greater than 1 millirem to individuals in unrestricted areas from receiving water-related exposure pathways.

b. The maximum offsite air doses (greater than 1 millirad) due to beta and gamma radiation at locations near ground level from gaseous effluents.

c. Organ doses (greater than 1 millirem) to individuals in unrestricted areas from radioactive iodine and radioactive material in particulate form from the major pathways of exposure.

d. Total body doses (greater than 1 manrem) to the population and average doses (greater than 1 millirem) to individuals in the population from receiving water-related pathways to a distance of 50 miles from the site.

e. Total body doses (greater than 1 manrem) to the population and average doses (greater than 1 millirem) to individuals in the population from gaseous effluents to a distance of 50 miles from the site.

5. ODCM Changes

The Radiological Effluent Release Report shall include any changes made during the reporting period to the Offsite Dose Calculation Manual (ODCM), as well as a listing of new locations for dose calculations and/or environmental monitoring identified by the land use census pursuant to III.J.3.c.

B. RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

The Radiological Environmental Operating Report covering the operation of the unit during the previous calendar year shall be submitted before May 1 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.

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

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.

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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 β 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.

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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 Plant General Manager.

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.

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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.

ATTACHMENT 8

RADIOACTIVE EFFLUENT RELEASE REPORT
EVALUATION OF RADIOIODINE AND PARTICULATE DEPOSITION FOR THE RADIOACTIVE GASEOUS EFFLUENT MONITORING SYSTEM (RGEMS) SAMPLE LINE

8 Pages Follow

CHESAPEAKE NUCLEAR SERVICES, INC.

A J. STEWART BLAND COMPANY

Evaluation of Radioiodine and Particulate Deposition for the Radioactive Gaseous Effluent Monitoring System (RGEMS) Sample Line

Palisades Nuclear Plant

May 26, 2004

Chesapeake Nuclear Services, Inc.

788 Sonne Drive • Annapolis, MD 21401 • 410-266-9174

Evaluation of Radioiodine and Particulate Deposition for the Radioactive Gaseous Effluent Monitoring System (RGEMS) Sample Line

I. Summary and Conclusion

An evaluation was performed of the radioiodine and particulate deposition/transmission for the Radioactive Gaseous Effluent Monitoring System (RGEMS) sample line. The particulate deposition/transmission was modeled using the computer code DEPOSITION (Ref 1)[1]. This deposition modeling (and code development) was performed at Texas A&M under contract to NRC. The radioiodine deposition/transmission was modeled using an empirical model developed by Kabot (Ref. 2), which models deposition as a function of radioiodine chemical species.

Based on these models, the DEPOSITION calculations yielded particulate deposition of approximately 3.4% (transmission of 96.6%), using a geometric mean particle size of 1 micometer AED[2]. The Kabot model calculation for overall radioiodine deposition was approximately 33% (transmission of 67%) for worst case condition (97% relative humidity and a chemically cleaned sample line). The relative abundances of the three chemical forms for radioiodine (elemental, hypoiodious, and organic) were based on average values for PWR's from studies performed by EPRI (Ref. 3).

II. Particulate Deposition

In order to quantify particulate radioactive material releases, the potential deposition in the sample line needs to be considered. For particulate material, the NRC's code DEPOSITION (Ref. 1) represents an acceptable modeling methodology (as endorsed by NRC Regulatory Guide 8.25).

Sample line configuration was taken from Palisades Plant Dwg. No. HC-43, Stack Sample Routing Radioactive Gaseous Effluent Monitoring System. Additional measurements of sample line length were taken on March 25th, 2004, for the section of the line leading up to the monitor/sample chamber located inside the post accident sample room. A total of thirty-nine (39) line segments were incorporated in the modeling, including an isokinetic sample probe, eight (8) 90 degree bends, eleven (11) 45 degree bends, and 37.2 meters of sample line length (horizontal and vertical). This segmentation of the line for the calculation is presented in the DEPOSITION output file that is included in Attachment 1. The bending radius of the line was assumed to be 2.5 diameters based on the notes in Dwg. HC-43.

A log normal particle size distribution with a mean value of 1 micrometer AED and a geometric standard deviation of 1.56 was assumed based on data for typical atmospheric particles from Ref. 5 (Table 13-8). The use of the default value of 1 g/ml particle density is substantiated by data presented in Ref. 5 showing that typical particle densities are in the 0.35 to 1.27 g/ml range for most metal oxide and chloride particles (Ref. 5, Table 13-9). These assumptions are considered conservative since the sample point is downstream of HEPA filtration. However, it is recognized that the diffusion behavior of small particles leads to coagulation into larger particles (particles stick together when they collide). Therefore, coagulation could increase particle size in the

[1] The 2001a version was used for this study.
[2] AED – aerodynamic equivalent diameter

effluents downstream of the HEPA filters; assuming a 1 micrometer AED particle size (consistent with ambient air) provides a reasonable conservative assumption.

The total deposition was calculated to be 3.4% with a corresponding 96.6% penetration (transmission).

III. Radioiodine Deposition

In order to quantify radioiodine releases, the deposition of the radioiodines in the sample line needs to be evaluated. For radioiodines, there is not an NRC endorsed method, but the modeling performed by Kabot (Ref. 2), has been used for similar evaluations at other nuclear plants.

The Kabot model is based on an empirically derived deposition per unit length as a function of flow velocity (or unit residence time). The modeled deposition velocity is a function of chemical form – elemental, hypoiodious (HOI), or organic – with the HOI and organic forms being significantly less than the elemental. The following equation presents the empirical model:

$$D_L = 1 - e^{-D_u * L}$$

where

$$D_u = \frac{A_u}{Vol_u} * V_g * R_u$$

Where:

1. D_L = total fractional deposition for sample line length L
2. D_u = fractional deposition of iodine per unit length of sample line
3. L = sample line length
4. A_u = internal surface area per unit length
5. Vol_u = internal volume per unit length
6. R_u = residence time per unit length
7. V_g = deposition velocity

(Specific values for the above are presented in the attached Calculation Work Sheet.)

Sample line configuration was taken from Palisades Plant Dwg. No. HC-43. The total sample line was modeled as 37.2 meters of Schedule 40s ½ inch sample line with an internal diameter of 0.622 inches (1.58 cm).

Deposition velocities as a function of iodine chemical form, relative humidity, and sample line conditioning were taken from Kabot. Examining the summary data in Appendix 2, deposition is highly dependent on the chemical form and relative humidity. Deposition velocities for the elemental iodine is significantly greater than that for the hypoiodious (HOI) with organic species (CH_3I) being relatively minor. Increasing humidity increases the deposition velocity, with elemental iodine deposition velocity increasing by almost a factor of 9 as the relative humidity increases from 5% to 97% for non-cleaned stainless sample line surfaces.

There are no site-specific radioiodine species data for the Palisades Plant. However, studies performed by EPRI (Ref. 3) provide data on iodine species for three (3) PWR's with an NRC study (Ref. 4) providing data for two (2) additional PWR's. The EPRI data showed some relatively minor variation in species as a function of release point (auxiliary building, containment). For auxiliary building releases, the elemental iodine abundances ranged from 12% to 37%; HOI from 17% to 43%, and organic from 27% to 52%. Average auxiliary building releases for power operation were 30% I_2, 30% HOI, and 35% organic (Table 2-3 of Ref. 3). For containment releases, the elemental iodine abundances ranged from 14% to 46%; HOI from 25% to 70%, and organic from 13% to 40% (Table 2-5, Ref. 3). Average containment releases were 25% I_2, 45% HOI, and 25% organic. The overall annual average species distribution provided in the EPRI report were 2% particulate, 27% elemental, 40% HOI and 31% organic.

The NRC's study identified similar abundances but with a lower elemental fraction. The average elemental iodine abundance for auxiliary building ventilation releases was 14% with HOI being 18% and organic 66% (Table 5.3 of Ref. 4). Containment atmosphere measurements showed a very high abundance of organic iodine (typically > 80%) with elemental being less than 10% (Table 6.3 of Ref. 4).

Examining the range of values in both the EPRI and NRC studies, it appears reasonable to use the EPRI average values for this study. The average abundances of 29% elemental (includes 2% particulate), 40% HOI, and 31% organic were used in the application of the Kabot model for calculating radioiodine sample line deposition.

Calculations of sample line deposition using the Kabot model are presented in Attachment 2. For elemental iodine, the calculated deposition ranged from 38% (non-cleaned surface and 5% humidity) to 99% (chemically cleaned surface and 97% humidity). For the HOI and organic iodines, the deposition values are much lower, ranging from 0.018% (organic iodine for chemically clean surface and 5% humidity) to 11% (HOI iodine for chemically cleaned surface and 97% humidity). Considering the deposition values, weighted by chemical form abundance, and a high relative humidity, a reasonable value to assume for total radioiodine deposition is <33%, or a transmission factor of >67%.

References

1. NUREG/GR-0006, "DEPOSITION: Software to Calculate Particle Penetration Through Aerosol Transport Systems," Anand, N. K., et al, , April 1993.

2. M. J. Kabot, "Deposition of Airborne Radioiodine Species on Surfaces of Metals and Plastics," 17th DOE Air Cleaning Conference.

3. EPRI NP-939, "Sources of Radioiodine at Pressurized Water Reactors," Final Report, November 1978, Electric Power Research Institute, Palo Alto, CA.

4. NUREG/CR-1992, "In-Plant Source Term Measurements at Four PWR's," August 1981.

5. Air Pollution Handbook, Chapter 13, Table 13-8, Paul, L. et. al., editors, McGraw-Hill, 1956.

Attachment 1

DEPOSITION Calculation

DEPOSITION Input Parameters

RGEMS Sample Line Particulate Deposition Evaluation		
System Design Parameters		
Sample line length (L)	37.62	meters
Sample line diameter (D)	1.58	cm
Flow rate (FR)	1.5	scfm
Calculated Inputs to DEPOSITION Equations:		
Flow Rate (cm^3/min) = (2.54 cm/in * 12 in/ft)^3 * FR scfm		
Cross Sectional Area (cm^2) = 3.1416*(D/2)^2 cm^2		
Free Stream Velocity (cm/min) = Flow Rate/Cross Sectional Area cm/min		
Calcs:		
Flow Rate	4.25E+04	cm^3/min
	42.48	liters/min
Cross Sectional Area	1.96	cm^2
Free Stream Velocity	2.17E+04	cm/min
	3.61E+00	m/sec

DEPOSITION Calculation Output

```
-----------------------------------------------------------------

Deposition 4.0. Thu Apr 01 12:04:16 2004
-----------------------------------------------------------------


                        Total
 Stokes #  Reynolds # Penetration
---------- ---------- -----------
    0.0091       3643       96.6%


Element # Element         Penetration   Notes
---------- ----------     -----------   -----
        1. Probe                99.3%
        2. Bend                100.0%   Bend angle: 90.000 degrees.
        3. Tube                 99.9%   Length: 1.000 m, At 0.000 degrees from horizontal.
```

4.	Bend	100.0%	Bend angle: 90.000 degrees.
5.	Tube	99.7%	Length: 14.500 m, At 90.000 degrees from horizontal.
6.	Bend	100.0%	Bend angle: 45.000 degrees.
7.	Tube	100.0%	Length: 0.508 m, At 45.000 degrees from horizontal.
8.	Bend	100.0%	Bend angle: 45.000 degrees.
9.	Tube	99.9%	Length: 0.990 m, At 0.000 degrees from horizontal.
10.	Bend	100.0%	Bend angle: 45.000 degrees.
11.	Tube	99.9%	Length: 0.890 m, At 0.000 degrees from horizontal.
12.	Bend	100.0%	Bend angle: 45.000 degrees.
13.	Tube	99.7%	Length: 2.540 m, At 0.000 degrees from horizontal.
14.	Bend	100.0%	Bend angle: 90.000 degrees.
15.	Tube	99.9%	Length: 1.210 m, At 0.000 degrees from horizontal.
16.	Bend	100.0%	Bend angle: 45.000 degrees.
17.	Tube	99.9%	Length: 0.711 m, At 0.000 degrees from horizontal.
18.	Bend	100.0%	Bend angle: 45.000 degrees.
19.	Tube	99.7%	Length: 2.740 m, At 0.000 degrees from horizontal.
20.	Bend	100.0%	Bend angle: 45.000 degrees.
21.	Tube	99.9%	Length: 0.559 m, At 0.000 degrees from horizontal.
22.	Bend	100.0%	Bend angle: 45.000 degrees.
23.	Tube	99.5%	Length: 4.080 m, At 0.000 degrees from horizontal.
24.	Bend	100.0%	Bend angle: 45.000 degrees.
25.	Tube	99.9%	Length: 0.965 m, At 0.000 degrees from horizontal.
26.	Bend	100.0%	Bend angle: 45.000 degrees.
27.	Tube	99.8%	Length: 2.130 m, At 0.000 degrees from horizontal.
28.	Bend	100.0%	Bend angle: 90.000 degrees.
29.	Tube	99.9%	Length: 0.760 m, At 0.000 degrees from horizontal.
30.	Bend	100.0%	Bend angle: 90.000 degrees.
31.	Tube	99.9%	Length: 0.508 m, At 0.000 degrees from horizontal.
32.	Bend	100.0%	Bend angle: 90.000 degrees.
33.	Tube	100.0%	Length: 0.711 m, At 90.000 degrees from horizontal.
34.	Bend	100.0%	Bend angle: 90.000 degrees.
35.	Tube	99.9%	Length: 0.787 m, At 0.000 degrees from horizontal.
36.	Bend	100.0%	Bend angle: 45.000 degrees.
37.	Tube	100.0%	Length: 0.178 m, At 0.000 degrees from horizontal.
38.	Bend	100.0%	Bend angle: 90.000 degrees.
39.	Tube	100.0%	Length: 1.550 m, At 90.000 degrees from horizontal.

Ambient temperature (deg.C)	:	25.0
Ambient pressure (mm Hg)	:	760.0
Flow rate (L/min)	:	42.5
Free stream velocity (m/s)	:	3.6

Lognormal particle distribution

Mean diameter (µm)	:	1.0
Standard deviation	:	1.6

Attachment 2

Radioiodine Deposition Calculation Summary

RGEMS Sample Line Radioiodine Deposition Evaluation

Sample line length (L)	37.62	meters
Sample line diameter	1.58	cm
Flow rate	1.5	scfm
Surface Area per unit length (Au)	4.96	cm2
Volume per unit length (VOLu)	1.96	cm3
Residence time per unit length (Ru)	2.77E-03	seconds

Kabot Model DL=1-exp(-Du*L)
where Du=(Au/VOLu)*Vg*Ru
DL=total fractional plate-out for sample line length L
Vg=plate-out rate

Iodine Form	Abundance	Relative Humidity	Surface Conditioning*	Deposition Velocity (m/s)	Fractional Deposition	Abundance Weighted Deposition
I2 (elemental)	29%	5%	N.Cl.	1.8E-04	3.8E-01	1.1E-01
			Ch.Cl.	8.7E-04	9.0E-01	2.6E-01
		97%	N.Cl.	1.6E-03	9.9E-01	2.9E-01
			Ch.Cl.	2.0E-03	9.9E-01	2.9E-01
HOI (hypoiodious)	40%	5%	N.Cl.	4.0E-06	1.1E-02	4.2E-03
			Ch.Cl.	3.3E-05	8.3E-02	3.3E-02
		97%	N.Cl.	1.8E-05	4.6E-02	1.9E-02
			Ch.Cl.	4.4E-05	1.1E-01	4.4E-02
CH3I (organic)	31%	5%	N.Cl.	1.0E-07	2.6E-04	8.2E-05
			Ch.Cl.	7.0E-08	1.8E-04	5.7E-05
		97%	N.Cl.	8.0E-08	2.1E-04	6.5E-05
			Ch.Cl.	8.0E-08	2.1E-04	6.5E-05

* N.Cl. - non-cleaned surface stainless steel
Ch.Cl. - chemically cleaned surface stainless steel

Total Deposition

N.Cl.@5% Relative Humidity	**11%**
Ch.Cl.@5% Relative Humidity	**29%**
N.Cl.@97% Relative Humidity	**30%**
Ch.Cl.@97% Relative Humidity	**33%**