Consumers Energy

A CMS Energy Company

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Nuclear Regulatory Commission
Document Control Desk
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DOCKETS 50-155 AND 72-043 – LICENSE DPR-6, BIG ROCK POINT PLANT – ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT FOR THE PERIOD OF JANUARY 2001 – DECEMBER 2001

In accordance with the Big Rock Point Defueled Technical Specifications Section 6.7.3, attached is the Annual Radioactive Effluent Release Report for the period of January 1, 2001 to December 31, 2001. This report includes summaries of the quantities of radioactive liquid and gaseous effluents and solid waste released from the facility. The material provided is consistent with the objectives outlined in the Offsite Dose Calculation Manual and the process Control Program, and complies with Section IV.B.1of Appendix I 10 CFR 50 and 10 CFR 50.36(a).

Kurt M. Haas
Site General Manager

CC: Administrator, Region III, USNRC
NRC Decommissioning Inspector, Big Rock Point
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ATTACHMENTS

IE46

Consumers Energy Company
Big Rock Point Plant
Docket 50-155

BIG ROCK POINT
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

BIG ROCK POINT ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

January 1, 2001 to December 31, 2001

This report provides information relating to radioactive effluent releases and solid radioactive waste disposal at Big Rock Point for the year 2001. The report format is detailed in Big Rock Point Offsite Dose Calculation Manual, Section III, item 1.

The Big Rock Point Nuclear Plant ceased operations in August 1997. During 2001 site activities consisted of continued removal of decommissioned systems and equipment, construction of the Independent Spent Fuel Storage Installation (ISFSI), preparation for dry fuel storage, and some building demolition. The Defueled Technical Specifications refer to the Big Rock Point Offsite Dose Calculation Manual (ODCM) for applicable effluent discharge requirements. Big Rock Point maintains gaseous and liquid radioactive effluent programs similar to its operational period; however, the number and quantity of gaseous and liquid effluent releases has been significantly reduced since plant operations ceased. Due to the decay time since ceasing plant operations, short-lived radionuclides are neither expected nor reported. This includes iodines and noble gasses other than Krypton-85.

1. Supplemental Information

   A. Batch Releases

      Information relating to continuous and batch releases of gaseous and liquid effluents is provided in Table 1 (Attachment 1).

   B. Abnormal Releases

      There were no abnormal releases from Big Rock Point during 2001.

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

D. Radioactive Effluent Monitoring Instrumentation

Big Rock Point Offsite Dose Calculation Manual Section I requires that with less than the minimum number of radioactive effluent monitoring instrument channels operable, the action shown in Table I.A-1 be performed: "Exert best efforts to return the instruments to operable status within 30 days and, if unsuccessful, explain in the next Radioactive Effluent Report why the inoperability was not corrected in a timely manner."

No radioactive effluent monitoring instrument channels were inoperable for more than 30 days during this reporting period.

2. Gaseous Effluents

Table 2 (Attachment 2) lists and summarizes all gaseous radioactive effluents released during the reporting period. The unidentified beta was 4.1E-04% of the total release (particulates and tritium).

Gaseous Effluents did not result in any Airdose at the site boundary in 2001, as noble gases are no longer present/released from the site during the decommissioning activities. Overall, gaseous radioactivity released in 2001 (Particulates and Tritium) was approximately equivalent to 2000, with no noble gasses or iodines released. Whole body and organ doses for 2001 were also comparable to those calculated in 2000[1].

3. Liquid Effluents

Table 3 (Attachment 3) lists and summarizes all liquid radioactive effluents released during the reporting period. The unidentified beta was 3.6% of the total release (including fission & activation products and tritium). The maximum liquid effluent release concentration for 2001 occurred during the fourth quarter at 2.10E-07 μCi/ml. During the second quarter of 2001, no liquid batch releases from the site were conducted. A total of four liquid batch releases were performed during the first, third and fourth quarters.

Total Liquid effluent radioactivity, including tritium, released in 2001 was less than 2000 releases (3.03E-02 Ci vs. 2.72 E-01 Ci), due primarily to a decrease in the number of batch releases during 2001.

[1] Calculated organ doses for 2001 are higher than those for the plant prior to 2000. This is the result of a conservative decision (beginning in 2000) that all critical receptors are assumed to be located at the site boundary with the highest Chi/Q value.

4. Solid Waste

Table 4 (Attachment 4) summarizes all solid radwaste volume shipped, classification, processing employed, sources, curie and nuclide content. Radwaste shipments were made either to the Barnwell Waste Management Facility in Barnwell, South Carolina, or Envirocare of Utah via a radwaste processing facility. The total volume of material shipped during 2001 was significantly less than 2000 shipment volume; the total shipment radioactivity designated for burial in 2001 was also less than in 2000.

5. Summary of Radiological Impact on Man

The ODCM, Section III, Item 1.6 specifies that the Annual Effluent Release Report shall provide potential dose calculations based on measured effluent to liquid and gaseous pathways if estimates of dose exceed 1 millirem to an organ or total body of any individual or more that 1 person-rem to the population within 50 miles. During the year 2001 no quarterly or annual dose calculations exceeded 1 millirem or 1 person-rem from releases to either liquid or gaseous pathways. Although not required, potential doses to individuals and populations were calculated using NRCDose Version 2.3.2 computer code, LADTAPII and GASPARII modules[2]. The quarterly values for curies released were input for each nuclide and summarized as follows:

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

First Quarter	8.71E-03	millirem (adult)
Second Quarter	0.00	millirem
Third Quarter	3.08E-03	millirem (adult)
Fourth Quarter	4.49E-03	millirem (adult)

The maximum organ doses were:

First Quarter	1.60E-02	millirem (child bone)
Second Quarter	0.00	millirem
Third Quarter	7.46E-03	millirem (child bone)
Fourth Quarter	1.04E-02	millirem (child bone)

[2] Prior to 2001 Big Rock Point utilized mainframe versions of LADTAP and GASPAR to obtain offsite doses from liquid and gaseous effluents.

B. The offsite air dose at the site boundary (0.57 mi E) due to noble gases was:

0.00 millirad beta and 0.00 millirad gamma for all four quarters (no noble gasses released).

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

First Quarter	5.40E-04	millirem (child bone)
Second Quarter	3.66E-04	millirem (child bone)
Third Quarter	2.71E-04	millirem (child bone)
Fourth Quarter	2.16E-04	millirem (child bone)

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	4.09E-03	person-Rem and 2.05E-05	millirem
Second Quarter	0.00	person-Rem and 0.00	millirem
Third Quarter	1.79E-03	person-Rem and 9.18E-06	millirem
Fourth Quarter	2.41E-03	person-Rem and 1.24E-05	millirem

E. Integrated total body dose 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	6.14E-05	person-Rem and 3.15E-07	millirem
Second Quarter	6.64E-05	person-Rem and 3.41E-07	millirem
Third Quarter	5.48E-05	person-Rem and 2.81E-07	millirem
Fourth Quarter	5.54E-05	person-Rem and 2.84E-07	millirem

6. Offsite Dose Calculation Manual (ODCM)

The ODCM was revised in 2001 to incorporate revised dose conversion factors per Regulatory Guide 1.109, clarify definitions and calculation methodology, and correct minor typographical errors in formulas. These changes were reviewed in accordance with site procedures and have been determined not to reduce the accuracy or reliability of dose calculations or setpoint determinations. The current revision of the ODCM in provided in Attachment 6.

7. Process Control Program (PCP)

The Process Control Program describes solid waste processing and disposal methods utilized at the Big Rock Point site. The PCP was revised in 2001 to clarify program responsibilities and alter the document format to be more consistent with regulatory guidance. A copy of the current Process Control Program is provided in Attachment 7.

ATTACHMENT 1
1 Page

Consumers Energy
Big Rock Point

RADIOACTIVE EFFLUENT RELEASE REPORT

BATCH RELEASES

January - December 2001

TABLE 1

BIG ROCK POINT RADIOACTIVE EFFLUENT REPORT

SUMMATION OF ALL RELEASES

January 1, 2001 to December 31, 2001

A. GASEOUS - Continuous Release

B. LIQUID	Units	1ST QTR	2ND QTR	3RD QTR	4TH QTR
Number of Releases		2	0	1	1
Total Release Time	Minutes	420	N/A	250	180
Maximum Release Time	Minutes	222	N/A	250	180
Average Release Time	Minutes	210	N/A	250	180
Minimum Release Time	Minutes	198	N/A	250	180

ATTACHMENT 2
3 Pages

Consumers Energy
Big Rock Point

RADIOACTIVE EFFLUENT RELEASE REPORT

GASEOUS EFFLUENTS - SUMMATION OF RELEASES

January - December 2001

TABLE 2

BIG ROCK POINT RADIOACTIVE EFFLUENT REPORT

SUMMATION OF ALL RELEASES

GASEOUS EFFLUENTS

January 1, 2001 to December 31, 2001

A. FISSION AND ACTIVATION GASES	Units	1ST QTR	2ND QTR	3RD QTR	4TH QTR	Est Total Error %
1. Total release	Ci	0.00	0.00	0.00	0.00	N/A
2. Average release rate for period	µCi/sec	N/A	N/A	N/A	N/A	
3. Percent of annual avg EC	%	N/A	N/A	N/A	N/A	

B. IODINES						
1. Total Iodine	Ci	0.00	0.00	0.00	0.00	N/A
2. Average release rate for period	µCi/sec	N/A	N/A	N/A	N/A	
3. Percent of annual avg EC	%	N/A	N/A	N/A	N/A	

C. PARTICULATES						
1. Particulates with half-life >8 day	Ci	1.90E-05	8.35E-06	4.49E-06	5.28E-06	18.28
2. Average release rate for period	µCi/sec	2.44E-06	1.06E-06	5.64E-07	6.64E-07	
3. Percent of annual avg EC	%	6.39E-07	3.72E-07	3.00E-07	2.50E-07	
4. Gross alpha radioactivity	Ci	1.31E-07	3.82E-07	3.84E-07	2.10E-07	

D. TRITIUM					
1. Total Release	Ci	7.35E-01	7.43E-01	7.51E-01	7.51E-01
2. Average release rate for period	µCi/sec	9.44E-02	9.45E-02	9.44E-02	9.44E-02
3. Percent of annual avg EC	%	4.89E-06	4.90E-06	4.89E-06	4.89E-06

E. WHOLE BODY DOSE					
1. Beta Air dose at Site Boundary due to Noble Gases (ODCM Section I, 1.3.1 a (1) (2))	mrads	0.00	0.00	0.00	0.00
2. Percent limit	%	N/A	N/A	N/A	N/A
3. Gamma Air dose at Site Boundary due to Noble Gas (ODCM Section I, 1.3.1 a (1) (2))	mrads	0.00	0.00	0.00	0.00
4. Percent limit	%	N/A	N/A	N/A	N/A

F. ORGAN DOSE (ODCM Section I, 1.3.b (1) (2))					
1. Maximum organ dose to public based on Critical Receptors	mrem	5.40E-04	3.66E-04	2.71E-04	2.16E-04
2. Percent of limit (7.5 mrem/quarter)	%	6.72E-03	4.88E-03	3.61E-03	2.88E-03

TABLE 2

BIG ROCK POINT RADIOACTIVE EFFLUENT REPORT

SUMMATION OF ALL RELEASES

GASEOUS EFFLUENTS

January 1, 2001 to December 31, 2001

1. **FISSION GASES**	Units	1ST QTR	2ND QTR	3RD QTR	4TH QTR
Krypton-85m	Ci	0.00	0.00	0.00	0.00
Krypton-87	Ci	0.00	0.00	0.00	0.00
Krypton-88	Ci	0.00	0.00	0.00	0.00
Xenon-133	Ci	0.00	0.00	0.00	0.00
Xenon-133m	Ci	0.00	0.00	0.00	0.00
Xenon-135	Ci	0.00	0.00	0.00	0.00
Xenon-135m	Ci	0.00	0.00	0.00	0.00
Xenon-138	Ci	0.00	0.00	0.00	0.00
Total for Period	Ci	0.00	0.00	0.00	0.00

2. **IODINES**					
Iodine-131	Ci	0.00	0.00	0.00	0.00
Iodine-132	Ci	0.00	0.00	0.00	0.00
Iodine-133	Ci	0.00	0.00	0.00	0.00
Iodine-134	Ci	0.00	0.00	0.00	0.00
Iodine-135	Ci	0.00	0.00	0.00	0.00
Total for Period	Ci	0.00	0.00	0.00	0.00

TABLE 2

BIG ROCK POINT RADIOACTIVE EFFLUENT REPORT

SUMMATION OF ALL RELEASES

GASEOUS EFFLUENTS

January 1, 2001 to December 31, 2001

3. **PARTICULATES***	Units	1ST QTR	2ND QTR	3RD QTR	4TH QTR
Chromium-51	Ci	<LLD	<LLD	<LLD	<LLD
Manganese-54	Ci	<LLD	8.97E-08	<LLD	<LLD
Cobalt-58	Ci	<LLD	<LLD	<LLD	<LLD
Iron-59	Ci	<LLD	<LLD	<LLD	<LLD
Cobalt-60	Ci	2.55E-06	3.16E-06	9.23E-07	6.00E-07
Zinc-65	Ci	<LLD	<LLD	<LLD	<LLD
Silver-110m	Ci	<LLD	<LLD	<LLD	<LLD
Cesium-134	Ci	<LLD	<LLD	<LLD	<LLD
Cesium-137	Ci	1.11E-05	1.88E-06	6.59E-07	2.32E-06
Barium-140	Ci	<LLD	<LLD	<LLD	<LLD
Strontium-89	Ci	2.43E-07	3.06E-07	2.98E-07	2.24E-07
Strontium-90	Ci	1.94E-07	1.36E-07	1.27E-07	1.37E-07
Net unidentified beta	Ci	4.88E-06	2.78E-06	2.48E-06	2.00E-06
Total	Ci	1.90E-05	8.35E-06	4.49E-06	5.28E-06

* Particulates with half-life > 8 days

ATTACHMENT 3
2 Pages

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RADIOACTIVE EFFLUENT RELEASE REPORT

LIQUID EFFLUENTS - SUMMATION OF RELEASES

January - December 2001

TABLE 3

BIG ROCK POINT RADIOACTIVE EFFLUENT REPORT

SUMMATION OF ALL RELEASES

LIQUID EFFLUENTS

January 1, 2001 to December 31, 2001

A. **FISSION AND ACTIVATION PRODUCTS**	Units	1ST QTR	2ND QTR	3RDQTR	4TH QTR	Est Total Error %
1. Total release (not including tritium, gases, alpha)	Ci	2.62E-03	0.00E+00	1.52E-03	2.36E-03	5.25
2. Average diluted concentration during period	µCi/ml	2.61E-10	0.00E+00	1.19E-10	1.81E-10	
3. Percent of EC	%	2.57E-02	0.00E+00	5.90E-03	1.83E-02	
B. **TRITIUM**						
1. Total release	Ci	2.23E-02	0.00E+00	8.94E-04	5.72E-04	0.40
2. Average diluted concentration during period	µCi/ml	2.36E-09	0.00E+00	7.02E-11	4.39E-11	
3. Percent of EC	%	2.36E-04	0.00E+00	7.02E-06	4.39E-06	
C. **DISSOLVED AND ENTRAINED GASES**						
1. Total release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A
2. Average diluted concentration during period	µCi/ml	N/A	N/A	N/A	N/A	
3. Percent of EC	%	N/A	N/A	N/A	N/A	
D. **GROSS ALPHA RADIOACTIVITY**	Ci	1.31E-07	0.00E+00	4.57E-08	3.67E-08	
E. **VOLUME OF WASTE RELEASED** (Prior to dilution)	Liters	3.73E+04	0.00E+00	1.59E+04	1.42E+04	
F. **VOLUME OF DILUTION WATER USED DURING PERIOD**	Liters	9.47E+09	1.28E+10	1.27E+10	1.30E+10	
G. **MAXIMUM DOSE COMMITMENT WHOLEBODY**	mrem	8.71E-03	0.00E-00	3.80E-03	4.49E-03	
Percent of ODCM Section I, 2.3.1 a (1.5 mrem)	%	0.58	0.00	0.25	0.30	
H. **MAXIMUM DOSE COMMITMENT - ORGAN**	mrem	1.60E-02	0.00E-00	7.46E-03	1.04E-03	
Percent of ODCM Section I, 2.3.1 b (5.0 mrem)	%	0.32	0.00	0.15	0.21	

TABLE 3

BIG ROCK POINT RADIOACTIVE EFFLUENT REPORT

SUMMATION OF ALL RELEASES

LIQUID EFFLUENTS

January 1, 2001 to December 31, 2001

1. NUCLIDES RELEASED	Units	1ST QTR	2ND QTR	3RD QTR	4TH QTR
Chromium-51	Ci	<LLD	0.00	<LLD	<LLD
Manganese 54	Ci	1.28E-05	0.00	<LLD	<LLD
Cobalt-58	Ci	<LLD	0.00	<LLD	<LLD
Iron-59	Ci	<LLD	0.00	<LLD	<LLD
Cobalt-60	Ci	5.65E-04	0.00	3.41E-04	7.67E-04
Zinc-65	Ci	<LLD	0.00	<LLD	<LLD
Strontium-89	Ci	1.39E-07	0.00	4.96E-08	3.17E-08
Strontium-90	Ci	1.97E-06	0.00	1.56E-05	6.62E-06
Molybdenum-99	Ci	<LLD	0.00	<LLD	<LLD
Silver-110m	Ci	<LLD	0.00	<LLD	<LLD
Iodine-131	Ci	<LLD	0.00	<LLD	<LLD
Cesium-134	Ci	1.23E-05	0.00	<LLD	<LLD
Cesium-137	Ci	1.62E-03	0.00	9.28E-04	1.06E-03
Antimony-125	Ci	7.73E-05	0.00	<LLD	<LLD
Tin-113	Ci	<LLD	0.00	<LLD	<LLD
Net Unidentified Beta	Ci	3.27E-04	0.00	2.37E-04	5.25E-04
Fission & Activation Product Total	Ci	2.62E-03	0.00	1.52E-03	2.36E-03
Xenon-133	Ci	<LLD	0.00	<LLD	<LLD
Tritium	Ci	2.23E-02	0.00	8.94E-04	5.72E-04
Grand Total	Ci	2.49E-02	0.00	2.41E-03	2.93E-03

ATTACHMENT 4
1 Page

Consumers Energy
Big Rock Point

RADIOACTIVE EFFLUENT RELEASE REPORT

SOLID WASTE

January - December 2001

Table 4

BIG ROCK POINT RADIOACTIVE EFFLUENT REPORT

SOLID WASTE

January 1, 2001 to December 31, 2001

Waste Class	Source of Waste	Solidification Agent	Container Type	Volume (Cu. Ft.)	Total Curies*	Principal Radionuclides*
AU	DAW from plant demolition	N/A	Metal Box	44329.4	7.20 E+00	Co-60, H-3, Mn-54, Fe-55, Ni-63, Cs-137
C	Filters from water processing, sources	N/A	Steel Liner	90.3	3.93E+00	Co-60, Mn-54, Fe-55, Ni-63, Cs-137
			TOTAL	44419.7	1.11E+01	

* Gamma isotopes are measured quantities, all others are estimated from scaling factors.

ATTACHMENT 5
1 Page

Consumers Energy
Big Rock Point

RADIOACTIVE EFFLUENT RELEASE REPORT

LOWER LIMIT OF DETECTION FOR BIG ROCK EFFLUENTS

January - December 2001

TABLE 5

BIG ROCK POINT RADIOACTIVE EFFLUENT REPORT

LOWER LIMITS OF DETECTION FOR BIG ROCK POINT EFFLUENTS

Gaseous Effluents

Nuclide	LLD (μCi/cc)*
Mn-54	6 E-14
Co-58	5 E-14
Fe-59	2 E-13
Co-60	9 E-14
Zn-65	2 E-14
Nb-95	6 E-14
Zr-95	8 E-14
Ag-110m	5 E-14
Sb-125	2 E-14
Cs-134	5 E-14
Cs-137	6 E-14
Ce-144	3 E-13
Am-241	2 E-13

Liquid Effluents

Nuclide	LLD (μCi/ml)*
Mn-54	1 E-07
Co-58	2 E-07
Fe-59	1 E-07
Co-60	3 E-07
Zn-65	3 E-07
Nb-95	1 E-07
Zr-95	3 E-07
Ag-110m	2 E-07
Sb-125	2 E-07
Cs-134	2 E-07
Cs-137	2 E-07
Ce-144	5 E-07
Am-241	4 E-07

* Based on gamma isotopic analysis for a typical stack filter and typical liquid batch release.

ATTACHMENT 6
147 Pages

Consumers Energy
Big Rock Point

RADIOACTIVE EFFLUENT RELEASE REPORT

OFFSITE DOSE CALCULATION MANUAL

Revision 21

ODCM SECTION I

PROCEDURAL AND SURVEILLANCE REQUIREMENTS

(Relocated Technical Specifications)

1.0 GASEOUS EFFLUENTS

1.1 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

1.1.1 Requirement:

The radioactive gaseous effluent monitoring instrumentation channels shown in Table I.A-1 shall be Operable with their alarm/trip set points set to ensure that the limits of this Offsite Dose Calculation Manual (ODCM) Section I, Requirement 1.2.1 are not exceeded. The alarm/trip set points of these channels shall be determined and adjusted in accordance with the methodology and parameters of Section II, Part 1.1 of this ODCM.

1.1.2 Action:

a. With a gaseous radioactive effluent monitoring instrumentation channel alarm/trip set point less conservative than required by the above specification, suspend the release of radioactive effluent monitored by the affected channel or declare the channel inoperable, or change the set point so it is acceptably conservative.

b. With less than the minimum number of gaseous effluent monitoring instrumentation channels Operable, take the action shown in Table I.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.

1.1.3 Surveillance Requirements:

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

1.1.4 Basis:

The radioactive gaseous effluent instrumentation is provided to indicate and quantify releases of radioactive material during actual or potential releases of gaseous effluents such that controls may be applied, as applicable, to limit such releases. The alarm set points for these instruments shall be calculated and adjusted in accordance with the methodology and parameters of Section II, Part 1.1 of this ODCM to ensure that the alarm will occur prior to exceeding the limits of 10 CFR Part 20.

Beyond one year post shutdown (the time after which this ODCM is to replace the Operating Phase ODCM), dose significant iodines and all noble gasses other than Kr-85 have decayed to non-detectable levels. Core plus fuel pool inventory of gaseous and iodine fission products are not sufficient to activate the high range noble gas monitor or cause doses to exceed EPA Protective Action Guides beyond the Site Boundary. Thus, iodine monitoring instruments and high range noble gas monitors are not required by this ODCM. Normal range gaseous monitoring requirements are maintained.

Noble gas radioactivity monitoring will not be required after fuel is removed from the spent fuel pool. With the reactor inoperable and all fuel removed from the spent fuel pool, there will be no sources of noble gas present to require such monitoring.

TABLE I.A-1

GASEOUS RADIOACTIVE EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE[a]	ACTION
1. GROSS RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE		
None	NA	NA
2. STACK GAS EFFLUENT SYSTEM		
a. Noble Gas Activity Monitor[b]	(1)	1
b. Particulate Sampler	(1)	2
c. Sampler Flow Rate Monitor	(1)	2

[a] At all times unless otherwise noted
[b] Operation required when fuel is stored in spent fuel pool only

ACTION 1 - With Stack Noble Gas channel inoperable, effluent releases via this pathway may continue provided noble gas grab samples from containment air are analyzed by gamma spectrum analysis at a lower limit of detection of at least 1.0E-04 microcurie/ml at least once per 24 hours.

ACTION 2 - With the channel inoperable, effluent releases via this pathway may continue provided that response of reactor building and turbine building continuous air monitors (if present and operating) are evaluated, or particulate grab samples of air in the reactor building or turbine building, as appropriate, are taken and analyzed for particulate activity, at least once per 24 hours, for calculation of release quantities.

TABLE I.A-2

RADIOACTIVE GASEOUS
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				
None	NA	NA	NA	NA
2. STACK GAS EFFLUENT SYSTEM				
a. Noble Gas Activity Monitor[a]	D	M	A(2)	Q(1)
b. Particulate Sampler	W	NA	NA	NA
c. Sampler Flow Rate Monitor	D	NA	A	NA

Note: [a] Noble gas activity monitor required operable until all fuel is discharged from spent fuel pool

TABLE I.A-2

NOTATION

NOTATION	FREQUENCY
D	At least once per 24 hours
W	At least once per 7 days
M	At least once per 31 days
Q	At least once per 92 days
A	At least once per 12 months
NA	Not applicable

(1) The Channel Functional Test shall also demonstrate that monitoring station alarm annunciation occurs if the instrument indicates measured levels above the alarm set point.

(2) a. The initial Channel Calibration shall be performed using one or more of the reference standards traceable to the National Institute of Standards and Technology (NIST) 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 calibration specified in (2)a. may be used.

1.2 GASEOUS EFFLUENTS DOSE RATE

1.2.1 Requirement:

The dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the site boundary (see Figure 2.1) shall be limited to the following:

a. For noble gases: Less than or equal to 500 mrem/yr to the total body and less than or equal to 3000 mrem/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 mrem/yr to any organ.

1.2.2 Action:

With the dose rate averaged over a period of one hour exceeding the above limits (released radionuclide concentration hourly average greater than 10 times the Effluent Concentration (EC) values of 10CFR20 Appendix B, Table 2, Column 1), upon discovery, promptly restore the release rate to within the above limit(s).

1.2.3 Surveillance Requirements:

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

b. The dose rate due to 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 1.2.1 above by utilizing the methodology and parameters in Section II of this ODCM, with representative samples and analyses performed in accordance with the sampling and analysis program specified in Table I.E-1.

1.2.4 Bases:

This specification is provided to allow the Licensee operational flexibility in meeting the limits of 10 CFR 50, Appendix I. The instantaneous dose rates of this specification are higher than the implied dose rates of 10 CFR 20, Appendix B, Table 2, Column 1, Effluent Concentrations For Members of the Public. However, the Licensee is expected to implement the ALARA philosophy for atmospheric effluents to ensure doses to the public at and beyond the site boundary are minimized and less than the annual doses of 10 CFR 50, Appendix I.

For members of the public who may at times be within the site boundary, the occupancy of that member of the public will usually be sufficiently low to compensate for any increase in dose rate due to atmospheric dispersion above that for the site boundary.

Examples of calculations for such members of the public, with the appropriate occupancy factors, shall be given in this ODCM. The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to a member of the public at or beyond the site boundary to less than or equal to 500 mrem/yr to the total body or to less than or equal to 3000 mrem/yr to the skin. These release rate limits also restrict, at all times, the corresponding thyroid dose rate above background to a child via the inhalation pathway to less than or equal to 1500 mrem/yr.

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, J K, "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Hanford Company Report ARH-SA-215 (June 1975).

1.3 AIRBORNE RADIOACTIVITY DOSE

1.3.1 Requirements:

a. 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:

   1) 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

   2) 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.

b. The dose to a member of the public from iodine-131, iodine-133, tritium and all radionuclides in particulates form with half lives greater than 8 days in gaseous effluents released to areas at and beyond the site boundary (see Figure 2.1) shall be limited to the following:

1) During any calendar quarter: Less than or equal to 7.5 mrem to any organ, and

2) During any calendar year: Less than or equal to 15 mrem to any organ.

1.3.2 Actions:

a. With the calculated dose from the release of radioactive material exceeding any of the above limits, prepare and submit to the Commission within 30 days a Special Report that identifies the cause(s) for exceeding the limit 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.

b. With projected dose in the next 31 days >2% of the annual limits defined by 1.3.1.a.2) or 1.3.1.b.2) above, operate the containment effluent HEPA filter to reduce the containment portion of airborne release for as long as the potential to exceed 2% continues. Although not all release sources (those from turbine building, for example) will be reduced by this action, effluents will nevertheless be reduced to the extent allowed by installed effluent treatment systems.

1.3.3 Surveillance Requirement:

a. Cumulative and projected dose contributions for the current calendar quarter and current calendar year for radioactive materials shall be determined at least once per 31 days in accordance with the methodology and parameters in this ODCM at least once per 31 days.

b. Projected dose for the next 31 days shall be calculated at least once per 31 days.

1.3.4 Bases:

This specification is provided to implement the requirements of Section II.B, II.C, III.A and IV.A of Appendix I, 10 CFR Part 50. The requirements implement the guides set forth in Sections II.B and 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 material in airborne 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 Section II of this ODCM for calculating the doses due to the actual release rates of radioactive noble gases, and particulates in airborne effluents are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977 and Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, July 1977.

The ODCM equations provided for determining doses at the site boundary are based upon historical average atmospheric conditions.

2.0 LIQUID EFFLUENTS

2.1 RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

2.1.1 Requirement:

The radioactive liquid effluent monitoring instrumentation channels shown in Table I.D-1 shall be operable with their alarm/trip set points set to ensure that requirement 2.2.1 of ODCM Section I are not exceeded. The alarm/trip set points of these channels shall be determined and adjusted in accordance with the methodology and parameters of part 2.2, Section II of this ODCM.

2.1.2 Action:

a. With a liquid radioactive effluent monitoring instrumentation channel alarm/trip set point less conservative than specified by the above requirement, suspend the release of radioactive effluent monitored by the affected channel or declare the channel inoperable, or change the set point so it is acceptably conservative.

b. With less than the minimum number of liquid effluent monitoring instrumentation channels Operable, take the action shown in Table I.D-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.

2.1.3 Surveillance Requirements:

Each radioactive 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 I.D-2.

2.1.4 Basis:

The radioactive liquid effluent instrumentation is provided to indicate and quantify releases of radioactive material during actual or potential releases of liquid effluents such that controls may be applied, as applicable, to limit such releases. The alarm set points for these instruments shall be calculated and adjusted in accordance with the methodology and parameters in the ODCM to ensure that the alarm will occur prior to exceeding the limits of 10 CFR Part 20.

TABLE I.D-1

LIQUID RADIOACTIVE EFFLUENT MONITORING INSTRUMENTATION

	INSTRUMENT	MINIMUM CHANNELS OPERABLE	ACTION
1.	GROSS RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE		
	None	NA	NA
2.	GROSS BETA OR GAMMA RADIOACTIVITY MONITORS PROVIDING ALARM BUT NOT PROVIDING AUTOMATIC TERMINATION OF RELEASE		
	a. Liquid Radwaste Effluent	(1)	1
	b. Canal Discharge	(1)	2
3.	FLOW RATE INDICATING DEVICE		
	a. Liquid Radwaste Effluent Line	(1)[a]	3
4.	CANAL SAMPLE COLLECTION TANK		
	a. Discharge Sampler	(1)	2

[a] At all times that liquid radwaste discharge line is not isolated

ACTION 1 - With the channel inoperable effluent releases may continue via this pathway provided that prior to initiating a release:

a. At least two independent samples are analyzed in accordance with Table I.E-1, and

b. The release rate calculations and discharge line valving are verified by at least one technically qualified member of the Facility Staff.

ACTION 2 - With the channel inoperable, effluent releases via this pathway may continue provided that, at least once per 24 hours, grab samples are collected and analyzed for gross radioactivity (beta or gamma) at a lower limit of detection of at least 5×10^{-7} microcurie/ml (see Table I.E-1).

ACTION 3 - With the channel inoperable, effluent release 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.

TABLE I.D-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				
None	NA	NA	NA	NA
2. GROSS BETA OR GAMMA RADIOACTIVITY MONITORS PROVIDING ALARM BUT NOT PROVIDING AUTOMATIC TERMINATION OF RELEASE				
a. Liquid Radwaste Effluent	D(4)	SM	A(2)	Q(1)
b. Canal Discharge	D	M	A(2)	Q(1)
3. FLOW RATE INDICATING DEVICE				
a. Liquid Radwaste Effluent Line	D(3)	NA	A	NA
4. CANAL SAMPLE COLLECTION TANK	D(3)	NA	NA	NA

TABLE I.D-2

NOTATION

NOTATION	FREQUENCY
D	At least once per 24 hours
W	At least once per 7 days
SM	At least twice per 31 days
M	At least once per 31 days
Q	At least once per 92 days
A	At least once per 12 months
NA	Not applicable

(1) The Channel Functional Test shall also demonstrate that alarm annunciation occurs if the instrument indicates measured levels above the alarm set point.

(2) a. The initial Channel Calibration shall be performed using one or more of the reference standards traceable to the National Institute of Standards and Technology (NIST) 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 initial calibration may be used.

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

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

2.2 LIQUID EFFLUENTS CONCENTRATION

2.2.1 Requirement:

The concentration of radioactive material released in liquid effluents from the site to UNRESTRICTED AREAS (identified as the site boundary, see Figure 2.1) shall be limited to 10 times the concentration values specified in Appendix B, Table 2, Column 2 to 10 CFR 20.1001-20.2402 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the total activity concentration shall be limited to 2×10^{-4} microcurie/ml.

2.2.2 Action:

a. With liquid effluent concentrations in areas at or beyond the site boundary (see Figure 2.1) exceeding limits, upon discovery, promptly restore the concentration to within the above limits.

2.2.3 Surveillance Requirements:

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

b. The results of the radioactivity analyses shall be used in accordance with the methodology and parameters in this ODCM to assure that the concentrations at the point of release are maintained within the limits of 2.2.1 above.

2.2.4 Basis:

This requirement ensures 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 10 CFR 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 (1) the Section II.A. design objectives of Appendix I, 10 CFR Part 50, to a member of the public, and (2) the limits of 10 CFR Part 20.1301(e) to the population. Radionuclides which have decayed eight or more half-lives (Xe-133, Xe-133m, Xe-135, Fe-59, Co-58, Mo-99, and Ce-141) since the permanent shutdown of the plant in August 1997 are not expected to be present due to decay, and as such the LLDs need not be met for those isotopes.

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, L A, "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry," Anal Chem 40, 586-93 (1968), and Hartwell, J K. "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Hanford Company Report ARH-SA-215 (June 1975).

TABLE I.E-1

RADIOACTIVE WASTE SAMPLING AND ANALYSIS PROGRAM

Release Type	Sampling Frequency	Min Analysis Frequency	Type of Activity Analysis	(LLD)[a] (μCi/ml)
A. Liquid Batch Waste Release Tanks[b]	P Each Batch	P Each Batch	Principal Gamma Emitters[c]	5×10^{-7}
	P Each Batch	M Composite[d]	H-3	1×10^{-5}
			Gross Alpha	1×10^{-7}
	P Each Batch	Q Composite[d]	Sr-89, Sr-90	5×10^{-8}
B. Discharge Canal[e]	Continuous[f]	W Composite[f]	Principal Gamma Emitters[c]	5×10^{-7}
	Continuous[f]	M Composite[f]	H-3	1×10^{-5}
			Gross Alpha	1×10^{-7}
	Continuous[f]	Q Composite	Sr-89, Sr-90	5×10^{-8}
C. Reactor Bldg	Continuous[h]	W[i] Particulate	Principal Gamma Emitters[g]	1×10^{-11}
	Continuous[h]	Q Composite Particulate	Sr-89, Sr-90 and Gross Alpha	1×10^{-11}
	Continuous[h]	Continuous	Noble Gas Monitor Gross Beta or Gamma	1×10^{-5}

NOTATION	FREQUENCY
W	At least once per 7 days
M	At least once per 31 days
Q	At least once per 92 days
P	Completed prior to each release

Table I.E-1 Notation

a. The LLD is defined, for purposes of these specifications, as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal[1].

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

$$LLD = \frac{4.66 s_b}{E \bullet V \bullet 2.22 \times 10^6 \bullet Y \bullet e^{-\lambda \Delta t}}$$

Where:

LLD is the predetermined lower limit of detection as defined above, as microcuries 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,

2.22×10^6 is the number of disintegrations per minute per microcurie,

Y is the fractional radiochemical yield, when applicable,

λ is the radioactive decay constant for the particular radionuclide, and

Δt for plant effluents is the elapsed time between the midpoint of sample collection and time of counting.

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

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

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[1] NUREG-0473, Draft Radiological Technical Specifications for BWRs, November 1978.

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, Co-60, Zn-65, Cs-134, Cs-137, 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 pursuant to Section III, part 1 of this ODCM.

*(LLD = 5×10^{-6} 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; e.g., 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 continuously in proportion to the rate of flow of the effluent stream. 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.

g. The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Mn-54, Co-60, Zn-65, Cs-134, Cs-137, 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 pursuant to Section III, part 1 of this ODCM.

** (LLD = 1×10^{-10} because of low gamma yield)

h. The ratio of the sample flow to sampled stream flow rate shall be known for the time period covered by each dose or dose rate calculation made in accordance with requirements.

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

2.3 LIQUID EFFLUENT DOSE

2.3.1 Requirement:

The dose or dose commitment to a member of the public from radioactive materials in liquid effluents released to areas at and beyond the site boundary (see Figure 2.1) shall be limited:

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

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

2.3.2 Actions:

a. With the calculated dose from the release of radioactive material exceeding any of the above limits, prepare and submit to the Commission within 30 days a Special Report that identifies the cause(s) for exceeding the limit 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.

b. With projected dose in the next 31 days >2% of the annual limit of Requirement 2.3.1.b, assure that all appropriate portions of the liquid radwaste system are operable and used to reduce release levels, prior to further releases with potential to exceed the 2% level.

2.3.3 Surveillance Requirements:

a. Cumulative and projected dose contributions for the current calendar quarter and current calendar year for radioactive materials shall be determined in accordance with the methodology and parameters in this ODCM at least once per 31 days.

b. Projected dose for the next 31 days shall be calculated prior to each batch release, or at least once every 31 days if continuous release is in progress.

2.3.4 Bases:

This specification is provided to implement the requirements of Sections II.A, III.A and IV.A of Appendix I, 10 CFR Part 50. The requirement 2.3.1 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 fresh-water 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 40 CFR Part 141.

The dose calculation methodology and parameters in this ODCM implement the requirements in Section III.A of Appendix I that conformance be shown by calculational procedures based on models and data, such that the actual exposure 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 of Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October, 1977 and Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1977.

The requirement for use of appropriate installed radwaste processing equipment when effluents would result in exceeding 2% of the annual Appendix I guidelines in any 31 days, projected for each batch release, or every 31 days for continuous releases (when in progress), assures that installed systems will be effectively utilized to minimize effluent dose.

3.0 TOTAL FUEL CYCLE DOSE

3.1 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 mrem to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrem.

3.2 ACTION:

With the calculated doses from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Requirements 1.3.1.a.(1), 1.3.1.a.(2), 1.3.1.b.(1), 1.3.1.b.(2), 2.3.1.a, or 2.3.1.b of this section, calculations should be made including direct radiation contributions from fuel pool systems and from outside storage tanks to determine whether the limits of Requirement 3.1 above have been exceeded. If such is the case:

a. Prepare and submit to the Commission 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 10 CFR Part 20.2203(a)(4), 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.

3.3 SURVEILLANCE REQUIREMENTS:

a. Cumulative dose contributions from liquid and gaseous effluents shall be determined to comply with Requirement 3.1 above at a minimum of once per 31 days, and in accordance with the methodology and parameters described in Section II of this ODCM.

b. Cumulative dose contributions from direct radiation from spent fuel pool systems and from radwaste storage tanks shall be determined in accordance with the methodology and parameters in ODCM Section II, part 3.2, Assumptions and 3.3, Dose Calculations. This requirement is applicable only under conditions set forth in Action 3.2.

3.4 BASES:

This specification is provided to meet the dose limitations of 40 CFR Part 190 that have been incorporated into 10 CFR Part 20 by 46 FR 18525. The specification requires the preparation and submittal of a Special Report whenever the calculated doses from plant generated radioactive effluents and direct radiation exceed 25 mrem to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrem.

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 40 CFR 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 5 miles must be considered.

If the dose to any member of the public is estimated to exceed the requirements of 40 CFR Part 190, the Special Report with a request for a variance (provided the release conditions resulting in violation of 40 CFR Part 190 have not already been corrected), in accordance with the provisions of 40 CFR Part 190.11 and 10 CFR 20.2203(a)(4) is considered to be a timely request and fulfills the requirements of 40 CFR Part 190 until NRC staff action is completed. The requested variance relates only to the limits of 40 CFR Part 190 and shall not apply in any way to the other requirements for dose limitation of 10 CFR Part 20, as addressed in Specifications.

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.

4.0 RADIOLOGICAL ENVIRONMENTAL MONITORING

4.1 REQUIREMENT:

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

4.2 ACTION:

a. With the radiological environmental monitoring program not being conducted as specified in Table I.H-1, prepare and submit to the Commission, in the Annual Radiological Environmental Operating Report required by Section III, Part 1 of this ODCM, 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 I.H-2 when averaged over any calendar quarter, prepare and submit to the Commission 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 I.H-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 I.H-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 Requirements 1.3.1 or 2.3.1. of ODCM Section I. 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.

4.3 SURVEILLANCE REQUIREMENTS:

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

b. The land use census conducted in the final year of plant operation (or later, if applicable) shall identify the nearest milk animal and the nearest resident in each overland sector to a distance of 8 km (5 miles). No land use census shall be required in years following plant shutdown as long as no residents are present, and no farm operations undertaken, within the site boundary (minimum distance of 0.5 miles of the shutdown reactor). If residential or farming use of the site occurs, evaluate and add appropriate samples to monitoring program.

c. Analytical Accuracy

Records of instrument calibrations and quality control data for the instrumentation used for environmental analyses shall be maintained. Interlaboratory comparison participation shall be required for offsite environmental sample analyses. Environmental TLD readouts will be performed by a NVLAP-accredited facility.

4.4 BASES:

a. Monitoring Program

The radiological environmental monitoring program required by this specification 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 to members of the public resulting from post-operational conditions. This monitoring program implements Section IV.B.2 of Appendix I to 10 CFR Part 50 and thereby supplements the radiological effluent monitoring program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements, low effluent levels due to the defueled conditions and the modeling of the environmental exposure pathways.

b. Basis, Radiological Monitoring

The iodine source term for the defueled facility is negligible at one year post shutdown, and gaseous/particulate source term is thousands of times lower than during power operation. Consequently, offsite sampling of the food chain, and offsite air particulate and iodine sampling for radionuclides normally linked to atmospheric releases have been deleted from the ODCM. Liquid releases during initial stages of decommissioning, although much smaller than during power operation, will continue to be monitored for food chain uptake at the most sensitive indicator location: the discharge canal and adjacent lake shoreline east and west of the plant discharge.

Guidance for this monitoring program is provided by the Radiological Assessment Branch Technical Position on Environmental Monitoring. 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 I.H-3 are considered optimum for routine environmental measurements in industrial laboratories.

The LLD is a predetermined limit representing the capability of a measurement system and not as an after the fact limit for a particular measurement. Detailed discussion of the LLD, and other detection limits, can be found in HASL Procedures Manual, HASL-300 (revised annually), Currie, L A, "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry, Anal Chem 40, 586-93 (1968), and Hartwell, J K, "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Hanford Company Report ARH-SA-214 (June 1975).

c. Land Use Census

A land use census in the final year of plant operation is required to confirm the conservative nature of the GASPAR input parameters listed in ODCM Section II, Table 1.4, for assessment of dose beyond the site boundaries. Use of an assumed garden and milk animal at the site boundary in the downwind sector of highest D/Q, per ODCM Section II, Table 1.4, is conservative with respect to any actual garden and milk animal locations.

d. Analytical Accuracy

Participation in an approved Interlaboratory Comparison Program is required for offsite environmental monitoring sample analyses. Analytical accuracy of radioactive material in effluent and other onsite samples is documented in routine calibration and quality control checks in order to demonstrate that the results are valid for the purposes of Section IV.B.2 of Appendix I to 10 CFR Part 50. TLD readouts are performed by a NVLAP Accredited laboratory in order to assure analytical reliability and accuracy.

TABLE I.H-1 Page 1 of 2

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations[a]	Sampling and Collection Frequency	Type and Frequency of Analysis
1. DIRECT RADIATION[b]	13 monitoring stations either with two or more TLD's or one instrument for measuring and recording dose rate continuously, placed as follows[e]: a) Miscellaneous site locations (4) b) A ring of stations, (6) at or near the SITE BOUNDARY c) Balance of stations (3) placed to serve as control stations.	Quarterly	Gamma dose quarterly
2. WATERBORNE			
a. Lake	1 sample from Plant Lake Water Inlet (service water from intake bay).	Composite sample over 1-month period[c]	Tritium and gamma isotopic[d] monthly
b. Well (drinking) and groundwater monitoring wells	1 sample from Plant well, and 1 sample from minimum of 6 out of 9 monitor wells.	Semiannual (grab) Semiannual (grab)	Tritium and gamma isotopic semiannually
3. BIOTA			
a. Marine	1 fish or invertebrate sample at or near plant discharge.	Semiannual (grab) Apr-Nov	Gamma Isotopic Semiannually

TABLE I.H-1 Page 2 of 2

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations[a]	Sampling and Collection Frequency	Type and Frequency of Analysis
4. LAKE SEDIMENT			
a. Discharge Canal	1 sample in immediate vicinity of discharge	Semiannual (grab) Apr-Nov	Gamma Isotopic Semiannually
b. Shoreline	1 sample each side of discharge, within ~ ½ mile	Semiannual (grab) Apr-Nov	Gamma Isotopic Semiannually

TABLE NOTATION TABLE I.H-1

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 pursuant to the Reporting Requirements of ODCM Section III. Alternative media and locations may be chosen for any particular pathway if designated locations or media are not available, and appropriate substitutions are 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 of, or in addition to, integrating dosimeters. The background dosimetry requirement also may be met through use of dosimeters shared with another facility, or from data provided by another entity, such as the State of Michigan, as appropriate for this site.

c. A liquid composite sample is one in which the quantity of liquid sampled 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).

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

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

TABLE I.H-2

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

	Reporting Level	
Analysis	Water (Pci/ℓ)	Fish (Pci/kg)
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	-
Cs-134	30	1,000
Cs-137	50	2,000
Ba-La-140**	200	-

*For drinking water samples. This is the 40 CFR Part 141 value.
**Short halflives of Ba-La-140 and I-131 preclude presence due to plant effluents, but these nuclides may be observed from weapons testing.

TABLE I.H-3 Page 1 of 2

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS [a]

LOWER LIMIT OF DETECTION (LLD) [b,c]

Analysis	Water (Pci/ℓ)	Fish (Pci/kg, wet)	Sediment (Pci/kg, dry)
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]	-	-
Cs-134	15	130	150
Cs-137	18	150	180
Ba-La-140*	15	-	-

*Short halflives of Ba-La-140 and I-131 preclude presence due to plant effluents, but these nuclides may be observed from weapons testing.

TABLE I.H-3 Page 2 of 2

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 pursuant to the Reporting Requirements of ODCM Section III.

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

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

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

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

Where:

LLD is the predetermined 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,

[2] NUREG-0473, Draft Radiological Technical Specifications for BWRs, November 1978.

λ is the radioactive decay constant for the particular radionuclide, and

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.

d. LLD for drinking water samples.

5.0 TEMPORARY LIQUID STORAGE IN OUTSIDE TANKS

5.1 REQUIREMENT:

The concentration of radioactive material contained in any unprotected outside tank* used for temporary liquid radwaste storage shall be limited such that the mixture of radionuclides do not exceed 8000 times the effluent concentration (EC) as listed in 10CFR20, Appendix B, Table 2, Column 2.

$$\frac{C_a}{EC_a} + \frac{C_b}{EC_b} \cdots + \frac{C_i}{EC_i} = <8000$$

5.2 ACTION:

With the quantity of radioactive material in any of the 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.

5.3 SURVEILLANCE REQUIREMENT:

The concentration of radioactive material contained in each tank 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.

5.4 BASES:

This requirement will provide reasonable assurance that in the event of an uncontrolled release of the tanks' contents, the resulting concentrations, averaged over not more than one year, would be less than the limits of 10CFR20, Appendix B, Table 2, Column 2, at the nearest potable water supply and the nearest surface water supply in the Unrestricted Area (the dilution between Big Rock Point and the Charlevoix drinking water supply has been established as 800). Such an uncontrolled release would not exceed the 10 CFR 20 annual dose limits for the public or 10CFR50 Appendix I guidelines due to the short interval over which that any such release would occur.

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* An outdoor unprotected liquid storage tank is any vessel intended for fixed installation, which does not have dikes or walls capable of holding the vessel contents, or does not have overflows or drains which route leaks, overflows or other losses back to the radwaste treatment system. A vessel or container that is intended for use as a containment system or packaging is not considered an outdoor unprotected storage tank.

6.0 DEFINITIONS AND SURVEILLANCE REQUIREMENT TIME INTERVALS

6.1 REQUIREMENT:

Terms shall be as defined in Defueled Technical Specification 1.0. Unless otherwise specified, each surveillance requirement shall be performed with time extensions not to exceed 25% as defined in Defueled Technical Specification 4.0.2.

6.2 ACTION:

A surveillance not performed within the defined interval (including the allowable extension) shall constitute noncompliance with the operability requirements. Surveillance requirements do not apply to inoperable equipment.

6.3 SURVEILLANCE REQUIREMENT:

NA

6.4 BASIS:

Terms and Surveillance interval extensions are as defined in Defueled Technical Specifications.

ODCM SECTION II

METHODOLOGIES FOR REQUIREMENTS IMPLEMENTATION

1.0 GASEOUS EFFLUENTS

1.1 ALARM/TRIP SET POINT METHOD

This section of the ODCM describes the methodology that will be used to determine the set points defined by ODCM Section I, Requirement 1.1.

The method for determining alarm/trip set points 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.

1.1.1 Allowable Concentration

The total EC-fraction (R) for the stack release point will be calculated by the relationship defined by Note 1 of Appendix B, 10 CFR 20.

$$R = \left(\frac{X}{Q}\right)(F) \sum_{i} \frac{A_i}{EC_i} = \leq 10 \qquad (I.1)$$

where:

A_i = The measured or calculated concentration, at ambient temperature and pressure, of nuclide i (μCi/cc) at the stack.

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

R = The total EC-fraction for the stack release point.

X/Q = Most conservative sector site boundary dispersion (4.91E-08 sec/m^3 from Table 1.4).

F = Release flow rate (39,000 cfm = 18.4 m^3/sec) for stack monitor considerations; variable for other monitors.

1.1.2 Monitor Response

Normal radioactivity releases during decommissioning consist predominantly of long lived particulate activity with potential for Kr-85 release in the event of an accident involving fuel. Radioiodines and noble gasses other than Kr-85 are of significant potential only for a short interval post-shutdown.

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

b. Under non-accident conditions, radionuclide 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 (Equation I.1) times the measured concentration (c):

$$s = b \times c \qquad (I.2)$$

1.2 DOSE CALCULATION

1.2.1 Dose Pathway Analyses

Doses are calculated for radionuclides detected in accordance with the analytical requirements of ODCM Section I, including (1) noble gases and (2) iodines (not expected to be detected when defueled and more than one year beyond shutdown) and particulates. Doses as defined in this section are based on 10 CFR 50, Appendix I limits of millirem per quarter and millirem per year. All dose pathways of major importance in the Big Rock Point environs are considered.

a. Assumptions for calculating doses from noble gases are as follows:

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

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

3) Historically observed source terms are given in Table 1.1.

4) Basic radionuclide data are given in Table 1.2.

5) All releases are treated as elevated at 73 m. Appropriate modifications will be made if other than a 73 meter release path is utilized in the later phases of decommissioning (such as when the stack is being dismantled).

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

7) Raw meteorological data consist of wind speed and direction measurements at 71 m.

8) Dose is to be evaluated at the offsite exposure points where maximum concentrations are expected to exist.

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

10) A semi-infinite cloud model is used.

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

12) Radioactive decay is considered for the plume.

13) A sector-average dispersion equation is used.

14) 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	-

15) 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.

16) Terrain effects are not considered, and no open terrain recirculation factors are applied.

b. Equations for Noble Gas Dose

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

For determining the air concentration of any radionuclide:

$$X_i = \sum_{j=1}^{7} \sum_{k=1}^{7} \left(\frac{2}{\pi}\right)^{1/2} \frac{f_{jk} Q_i P}{\Sigma_{zk} u_j (2\pi x/n)} \exp\left(-\lambda_i \frac{x}{u_j}\right) \exp\left(\frac{-h^2}{2\sigma_{zk}^2}\right) \quad \text{(I.3)}$$

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.

h = Stack height (73 meters).

σ_{zk}^2 = Vertical dispersion coefficient of stability class k.

For determining the total body dose:

$$D_{TB} = \sum_i X_i \, DF\beta_i \qquad (I.4)$$

where:

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

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

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

For determining the skin dose:

$$D_S = \sum_i X_i \, (DFS_i + 1.11 \, DF\gamma_i) \qquad (I.5)$$

where:

D_S = Skin dose 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.

$DF\gamma_i$ = 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:

$$D_{a\beta} = \sum_{1} X_i \, (DF\beta_i) \qquad \text{(I.6a)}$$

$$D_{a\gamma} = \sum_{1} X_i \, (DF\gamma_i) \qquad \text{(I.6b)}$$

where:

$D_{a\beta}$ = Beta air dose mrad/y.

$D_{a\gamma}$ = Gamma air dose mrad/y.

$DF\beta_i$ = Air dose factor for beta radiation, mrem/yr per $\mu Ci/m^3$, (Table 1.5).

$DF\gamma_i$ = Air dose factor for gamma radiation, mrem/yr per Ci/m^3, (Table 1.5).

c. Assumptions for Radioiodine and Particulate Doses

1) 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).

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

3) The radioiodine and particulate mix is based on analyses of activity released over the period of interest. The historically observed source term is given in Table 1.1.

4) Basic radionuclide data are given in Table 1.2.

5) All releases are treated as elevated (73 m).

6) Annual average X/Qs are given in Table 1.3; value used as maximum is from Table 1.4.

7) Raw meteorological data for elevated releases consist of wind speed and direction measurements which were obtained at 71 m.

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

9) Actual or conservative cow, goat and garden locations are used.

10) Potential maximum exposure points are described in Table 1.4.

11) Terrain effects are not considered.

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

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

14) 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.

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

d. Equations For Iodine and Particulate Doses

To calculate the dose for any one of the potential maximum-exposure points, the equations I.7 through I.10 and I.12 through I.16 are used.

1) Inhalation

Equation for calculating air concentration, X, is the same as Noble Gas (Equation I.3).

For determining the organ dose rate:

$$D_I = 1 \times 10^6 \sum_i X_i \; DFI_i \; BR \qquad (I.7)$$

where:

D_I = Organ dose 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 1,400 m^3/y, infant; 3,700 m^3/y, child; or 8,000 m^3/y, adult and teen.

1×10^6 = Pci/μCi conversion factor.

2) Ground Contamination

For determining the ground concentration of any nuclide:

$$G_i = 3.15 \times 10^7 \sum_{k=1}^{7} \frac{f_k Q_i DR_k}{(2\pi x/n)\ \lambda_i} [1 - \exp - (\lambda_i\ t_b)] [\exp (\frac{-h^2}{2\sigma^2_{zk}})] \quad (I.8)$$

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_k = Relative deposition rate, 1/m.

x = Downwind distance, m.

n = Number of sectors, 16.

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

λ_1 = 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.

h = Stack height (73 m).

σ^2_{zk} = Vertical dispersion coefficient (m^2) of stability class.

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

$$D_G = (8,760)(1 \times 10^6)(0.7) \sum_i G_i \, DFG_i \qquad (I.9)$$

where:

D_G = Dose 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 = $pCi/\mu Ci$ conversion factor.

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

3) Milk and Vegetation Ingestion

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

$$CV_i = 3,600 \sum_{k=1}^{7} \frac{f_k Q_i DR_k}{(2\pi x/n)} \left(\frac{r[1 - \exp(-\lambda_{Ei} t_e)]}{Y_v \lambda_{Ei}} + \right. \qquad (I.10)$$

$$\left. \frac{B_{iv}[1 - \exp(-\lambda_i t_b)]}{P\lambda_i} \exp\left(\frac{-h^2}{2\sigma^2_{zk}}\right) \exp(-\lambda_i t_h) \right)$$

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_k = Relative deposition rate as a function of wind speed, stability class and downwind distance, m^{-1} (Figures 7 through 10 of Regulatory Guide 1.111).

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).

λ_{Ei} = 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 ($\lambda_w = .0021\ h^{-1}$).

t_e = Period over which deposition occurs, 720 h.

Y_v = Agricultural yield, 0.7 kg/m^2.

B_{iv} = Transfer factor from soil to vegetation of radionuclide i (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.

h = Stack height (73 m).

σ_{zk} = Vertical dispersion coefficient (m).

t_h = Holdup time between harvest and consumption of food, 0 h for pasture grass or 2,160 h for storage feed.

For determining the concentration of C-14 in vegetation:

$$CV_{14} = 1 \times 10^3 \, X_{14} \, (0.11/0.16) \qquad (I.11)$$

where:

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

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

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

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

1×10^3 = g/kg conversion factor.

For determining the concentration of H-3 in vegetation:

$$CV_T = 1 \times 10^3 \, X_T \, (0.75)(0.5/H) \qquad (I.11a)$$

where:

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

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

0.75 = Fraction of total plant mass that is water.

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

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

1×10^3 = g/kg conversion factor.

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

$$CM_i = CV_i \, FM_i \, Q_f \exp(-\lambda_i \, t_f) \qquad (I.12)$$

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, cow - 50 kg/d, goat - 6 kg/d.

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

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

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

$$D = 1 \times 10^6 \sum_i CM_i \, DF_i \, UM \qquad (I.13)$$

where:

D = Organ dose 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 - infant and child, 400 l/y - teen, and 310 1/y - adult.

Ingestion rate for vegetables, 26 kg/y - child, 42 kg/y - teen, and 64 kg/y - adult.

1×10^6 = Pci/μCi conversion factor.

4) Meat Ingestion (Beef)

To calculate the concentration of a nuclide in animal flesh:

$$C_{fi} = F_{fi}\ CV_i\ Q_f \exp(-\lambda_i\ t_s) \qquad (I.14)$$

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 I.10).

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

λ_i = Radioactive delay coefficient or Radionuclide i, d^{-1}

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

To determine the organ dose from ingestion of beef:

$$D_F = \sum_i C_{fi}\ D_{fi}\ U_f \qquad (I.15)$$

where:

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

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).

5) Organ Dose Rates

For determining the total body, organ and/or thyroid dose rate from iodines and particulates:

$$D = D_I + D_G + D_M + D_V + D_F \quad (I.16)$$

where:

D = Total organ dose, mrem/y.

D_I = Dose due to inhalation, mrem/y.

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

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

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

D_F = Dose due to meat ingestion, mrem/y.

The maximum organ dose rate, maximum total body dose rate, maximum skin dose rate plus beta and gamma air doses are used to calculate design basis quantities as described in Section II, part 1.2.2, as follows.

1.2.2 Design Basis Quantities

The design basis quantity (DBQ) 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:

a. The 10CFR50 Appendix I limit of 15 millirems to any organ of an individual from iodines and particulates with half life greater than 8 days.

b. 15-millirad air dose for beta radiation from noble gas (This is conservatively less than the 10CFR50 Appendix I limit of 20 millirad).

c. 5-millirad air dose for gamma radiation from noble gas (This is conservatively less than the 10CFR50 Appendix I limit of 10 millirad).

DBQ values corresponding to the above annual limits are provided in Table 1.9. Design basis quantity (Ci) is the smallest value for each nuclide, calculated by dividing the dose limits (as indicated in a. through c. above) by the appropriate dose calculated in Section 1.2; the result then is multiplied by the amount of radionuclide (Ci) used to conservatively estimate the doses as listed in Table 1.1 (or assumed a hypothetical 1 Ci/year for nuclides not actually present):

$$DBQ = \frac{D_{AI}}{D_C} (C_C) \qquad (I.17)$$

where:

D_{AI} = Appendix I dose limit for organ dose (mrem) and conservative values less than the Appendix I limits as specified in b. and c. above for beta and gamma air dose (mrad).

D_C = Calculated dose from Equations I.6a and I.6b of Section 1.2 (mrem or mrad).

C_C = Quantity of nuclide resulting in dose D_C (Ci).

DBQ = Design Basis Quantity (Ci). The limiting values for Design Basis Quantities for radionuclides released to the atmosphere are given in Table 1.9.

The inverse of the ratio C_C/D_C in the above equation (ie, D_C/C_C) is a useful value, since it represents the most limiting dose per unit quantity of each nuclide released.

1.3 DESIGN BASIS QUANTITY (DBQ) LIMITS

1.3.1 Design Basis Quantity Fraction

Per Specification 2.3 of ODCM Section I, the cumulative DBQ fraction for nuclides released is summed at least every 31 days to assure that the sum of the fractions of all nuclides released does not exceed 1.0 year to date or 0.5 in any calendar quarter, and forecast not to exceed 0.02 over the next 31 days. Forecasts should be based on historical performance, consideration of upcoming scheduled tasks and operational parameters, or a combination of factors based upon professional judgement of the evaluator. The equation for forecasting the cumulative dose is provided below.

$$\sum_i \frac{A_i}{(DBQ)_i} < 1.0 \text{ Annual, } <0.5 \text{ Quarter, } <0.02 \text{ Next 31 day} \qquad (I.18)$$

Where: A_1 = Acitivity of nuclide i
DBQ_i = Design Basis Quantity of nuclide i

1.3.2 Exceeding DBQ Limits

The DBQ is a very conservative estimate of activity which could give doses at 10 CFR 50, 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 the DBQ fraction exceed 1.0 for year to date, 0.5 for the quarter, or 0.02 forecast for the following 31 days, requirements probably still would not be exceeded. However, further discretionary releases should be deferred until an accurate assessment of dose is made by use of the NRC GASPAR computer code (either by running the code or by normalizing a prior run's dose output on a nuclide by nuclide basis). The computer run will utilize the annual average joint frequency meteorological data based on not less than 3 years of meteorological measurement. 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. If GASPAR is not utilized to determine accurate doses, Actions of Specifications 2.3 or 3.3, ODCM Section I, shall be performed based on the conservative DBQ fraction results of Equation I.18.

1.3.3 Releasing Radionuclides Not Listed in Table 1.9

Table 1.9 contains all nuclides identified to date as routine constituents of gaseous releases at Big Rock Point Plant, plus those common to boiling water reactors in general, even if not previously detected at Big Rock Point. 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.

1.4 GASEOUS RADWASTE TREATMENT SYSTEM OPERATION

1.4.1 System Description

The gaseous radwaste system consists of ventilation fans, dampers and ducting leading to a 73 m stack, plus a limited flow through a hood vent. A flow diagram of gaseous waste release paths is shown in Figure 1-1. The hood vent contains a HEPA filter, and a HEPA filter unit also is available for treatment of containment exhaust during intervals that decommissioning activities which could cause release of significant air particulate activity are ongoing in containment.

Decommissioning releases will consist primarily of containment ventilation and to a lesser degree, radwaste system vents. These sources will be ducted to the stack for release or released via other monitored pathways, depending on the phase of decommissioning in progress.

It is recognized that the containment exhaust HEPA will not reduce effluents originating form locations other than containment. However, most activities with high potential for release will occur within containment, so this HEPA will allow for significant reduction in potential airborne activity release over the duration of decommissioning.

1.4.2 System Operability

Use of the optional containment exhaust HEPA filter is required by Specification 1.3.2, ODCM Section I, only when dose for the following 31 days is projected to exceed 2% of the guidelines of Specification 1.3.1, ODCM Section I. Use of the containment exhaust HEPA requires closure of the HEPA bypass valves and activation of the HEPA booster fans. This HEPA unit is considered operable at any time it is valved in to accept full containment exhaust flow, with HEPA filters in place and booster fans in operation.

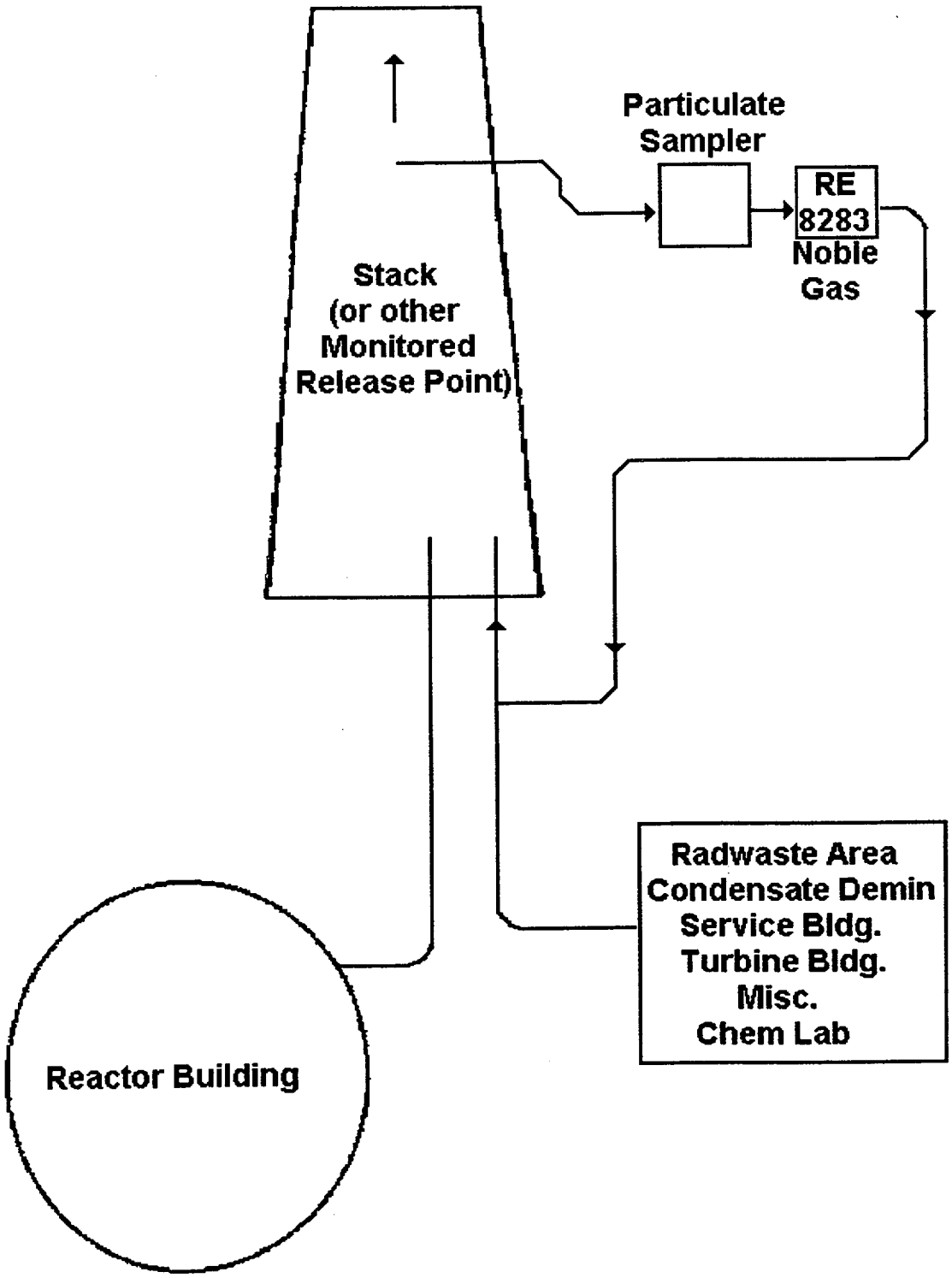
1.5 OFFSITE RELEASE RATE

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 release quantities of material at higher rates than a small percentage of 10 CFR 20 limits but not exceeding those limits under unusual operating conditions. Appendix I to 10 CFR 50 provides the numerical guidelines on limiting conditions for operation to meet the as low as reasonably achievable requirement.

The GASPAR code has been run to determine a conservative relationship between release rate in Ci/sec and annual dose due to external radiation and inhalation. The source term used is listed in Table 1.1. Dose using annual average meteorology, to the individual with most limiting offsite dose (whole body) assumed to be residing at the residence with highest X/Q, is 0.105 mrem for one year. The release rate which would result in a dose equivalent of 500 mrem/y (using the total body limit upon which ODCM Section I Requirement 3.1 is based) is the Curies/Year given in Table 1.1 (1.29E04) multiplied by 500/.105 or 1.95 Ci/sec.

The above is a one-time calculation and is informational only. Exposure calculations for specific releases over specific periods are described in Section II, part 1.2.

FIGURE 1-1
BIG ROCK POINT GASEOUS EFFLUENT FLOW PATHS



1.6 PARTICULATE SAMPLING

Particulate samples are obtained from the continuous sample stream pulled from the plant stack or from other alternative release points utilized through the course of decommissioning. Samples typically are obtained to represent the integrated release from the plant.

Gamma, beta and alpha counting is performed on the particulate filters. Beta yields of the gamma isotopes detected on particulate filters are applied to determine "identified" beta, and 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 an optional analysis specific to Sr-90 (from a quarterly composite of filters) are obtained. Similarly, alpha activity not identified as natural radium, thorium or their daughters is assumed as Pu-239 until optional results of quarterly composite analysis are available.

Monitoring for radioiodine is not required because this ODCM does not go into effect until at least 93 days post-shutdown when Iodine-131 has decayed a minimum of 11.6 halflives.

1.7 NOBLE GAS MONITORING AND SAMPLING

While spent fuel is present in the spent fuel pool, noble gas release rates will either be monitored by the noble gas monitor or be estimated by means of periodic containment air analyses of concentrations times volume of air exhausted from containment over the appropriate interval. With fuel present, there is potential for low levels of noble gas release. However, after the first few months of shutdown, only Kr-85 would be present in detectable quantities.

1.8 TRITIUM SAMPLING

Tritium has a low dose consequence to the public because of the very small fraction of allowable quantity which is available for release. The major contributors to tritium effluents are evaporation from the fuel pool and reactor cavity (when flooded). Because of the low dose impact, and due to the continuous reduction in tritium source term with tritium production due to reactor operation ceased, gaseous tritium sampling will not be required. Gaseous tritium release will be estimated using conservative evaporation rate calculations from the fuel pool and reactor cavity during intervals that water containing tritium is utilized.

TABLE 1.1

BIG ROCK POINT GASEOUS AND LIQUID SOURCE TERMS, CURIES/YEAR(1)

Nuclide	Gaseous(2)	Liquid(2)
H-3	1.21E+01	8.63E+00
N-13	1.53E+03	NA
Na-24	3.52E-04	1.12E-06
Cr-51	2.82E-04	6.84E-03
Mn-54	5.50E-05	2.60E-02
Mn-56	1.70E-04	NA
Co-58	1.65E-06	6.17E-04
Fe-59	2.81E-06	9.05E-03
Co-60	1.89E-04	4.21E-02
Zn-65	3.16E-05	9.01E-04
Br-82	8.11E-03	NA
Kr-83m	2.61E+02	NA
Kr-85	9.55E-01	NA
Kr-85m	3.12E+02	NA
Kr-87	1.19E+03	NA
Kr-88	7.80E+02	NA
Kr-89	6.96E+02	NA
Sr-89	NA	2.27E-04
Kr-90	7.76E+02	NA
Sr-90	NA	2.22E-03
Kr-91	6.68E+00	NA
Sr-91	5.61E-03	NA
Sr-92	NA	1.54E-06
Nb-95	1.91E-06	NA
Mo-99	3.10E-05	NA
Ag110m	1.57E-05	6.88E-05
Sb-124	NA	4.01E-04
I-131	1.94E-03	1.57E-04
Xe-131m	4.38E-01	NA
I-132	8.07E-03	NA
I-133	1.99E-02	NA
Xe-133	2.01E+02	8.86E-05
Xe-133m	6.00E+00	NA
Cs-134	4.04E-07	1.75E-02
I-134	1.24E-02	NA
I-135	3.00E-02	NA
Xe-135	1.11E+03	NA
Xe-135m	1.15E+03	NA
Cs-136	4.74E-05	NA
Cs-137	1.51E-04	2.04E-01
Xe-137	1.11E+03	NA
Cs-138	3.17E-01	NA
Xe-138	6.03E+03	NA
Ba-139	1.32E-03	NA
Xe-139	1.04E+03	NA
Ba-140	1.86E-03	NA
La-140	7.80E-03	5.04E-05
Xe-140	7.23E+01	NA
Hg-203	1.32E-06	NA
Np-239	1.44E-04	NA
Unidentified Beta	2.42E-03	6.76E-02

(1) Data derived from taking the effluents released during Jan-June 1980 through July-December 1983 and dividing by 4.

(2) Historic (operating) source term. Values listed as NA have not been observed at detectable levels in these waste streams.

TABLE 1.2 Page 1 of 2

BASIC RADIONUCLIDE DATA

	NUCLIDE	HALF-LIFE (days)	LAMBDA (1/s)	[1] BETA (MEV/DIS)	[1] GAMMA (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	1.273-05	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-2	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

TABLE 1.2 Page 2 of 2

BASIC RADIONUCLIDE DATA

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

[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, D. C. Kocher, May 1980.

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 940629
**** BIG ROCK POINT XOQDOQ82 *** USING 01/01/89 - 12/31/93 MET DATA ****
ELEVATED RELEASE - 240' STACK

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	1.622E-08	2.278E-08	2.181E-08	2.523E-08	3.221E-08	3.376E-08	3.263E-08	3.055E-08	2.827E-08	2.607E-08	2.405E-08
SSW	1.108E-08	1.837E-08	2.036E-08	2.326E-08	2.729E-08	2.735E-08	2.571E-08	2.362E-08	2.153E-08	1.962E-08	1.793E-08
SW	1.451E-09	3.735E-09	6.197E-09	9.996E-09	1.617E-08	1.839E-08	1.846E-08	1.765E-08	1.654E-08	1.538E-08	1.427E-08
WSW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
W	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
WNW	0.000E+00	0.000E+00	9.790E-30	7.312E-22	2.710E-15	1.615E-12	4.919E-11	3.936E-10	1.556E-09	4.068E-09	8.195E-09
NW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
N	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNE	1.742E-09	6.368E-09	1.629E-08	2.768E-08	4.150E-08	4.474E-08	4.348E-08	4.073E-08	3.765E-08	3.468E-08	3.195E-08
NE	1.191E-08	2.817E-08	3.802E-08	4.400E-08	4.637E-08	4.265E-08	3.778E-08	3.322E-08	2.929E-08	2.600E-08	2.324E-08
ENE	2.041E-08	3.354E-08	4.267E-08	4.986E-08	5.331E-08	4.903E-08	4.327E-08	3.788E-08	3.327E-08	2.942E-08	2.620E-08
E	2.734E-08	4.924E-08	5.329E-08	5.445E-08	5.101E-08	4.409E-08	3.754E-08	3.210E-08	2.771E-08	2.418E-08	2.131E-08
ESE	2.341E-08	4.274E-08	4.371E-08	4.257E-08	3.840E-08	3.285E-08	2.790E-08	2.386E-08	2.062E-08	1.801E-08	1.589E-08
SE	2.155E-08	3.271E-08	3.285E-08	3.400E-08	3.415E-08	3.100E-08	2.731E-08	2.394E-08	2.107E-08	1.867E-08	1.667E-08
SSE	1.167E-08	2.173E-08	2.610E-08	3.085E-08	3.595E-08	3.531E-08	3.262E-08	2.954E-08	2.663E-08	2.404E-08	2.179E-08

Data in sectors WSW through N are not valid. Refer to note at the end of Table 1.3.

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 940629
**** BIG ROCK POINT XOQDOQ82 *** USING 01/01/89 - 12/31/93 MET DATA ****
ELEVATED RELEASE - 240' STACK

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	2.224E-08	1.575E-08	1.193E-08	7.828E-09	5.723E-09	4.459E-09	3.624E-09	3.035E-09	2.600E-09	2.267E-09	2.004E-09
SSW	1.644E-08	1.130E-08	8.402E-09	5.390E-09	3.892E-09	3.005E-09	2.426E-09	2.020E-09	1.723E-09	1.496E-09	1.318E-09
SW	1.325E-08	9.465E-09	7.184E-09	4.707E-09	3.430E-09	2.664E-09	2.159E-09	1.803E-09	1.541E-09	1.340E-09	1.182E-09
WSW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
W	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
WNW	1.387E-08	5.328E-08	8.642E-08	1.119E-07	1.096E-07	9.946E-08	8.828E-08	7.802E-08	6.912E-08	6.154E-08	5.512E-08
NW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
N	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNE	2.951E-08	2.080E-08	1.572E-08	1.030E-08	7.524E-09	5.862E-09	4.766E-09	3.994E-09	3.423E-09	2.985E-09	2.640E-09
NE	2.093E-08	1.354E-08	9.701E-09	5.946E-09	4.172E-09	3.156E-09	2.507E-09	2.061E-09	1.738E-09	1.495E-09	1.306E-09
ENE	2.352E-08	1.501E-08	1.066E-08	6.454E-09	4.491E-09	3.376E-09	2.669E-09	2.186E-09	1.838E-09	1.576E-09	1.374E-09
E	1.897E-08	1.180E-08	8.260E-09	4.926E-09	3.410E-09	2.556E-09	2.017E-09	1.650E-09	1.386E-09	1.188E-09	1.035E-09
ESE	1.417E-08	8.872E-09	6.237E-09	3.748E-09	2.611E-09	1.966E-09	1.557E-09	1.278E-09	1.076E-09	9.247E-10	8.073E-10
SE	1.500E-08	9.690E-09	6.938E-09	4.252E-09	2.988E-09	2.263E-09	1.800E-09	1.481E-09	1.251E-09	1.077E-09	9.421E-10
SSE	1.985E-08	1.334E-08	9.770E-09	6.145E-09	4.376E-09	3.344E-09	2.677E-09	2.215E-09	1.878E-09	1.622E-09	1.423E-09

VENT AND BUILDING PARAMETERS:

RELEASE HEIGHT	(METERS)	73.10	REP. WIND HEIGHT	(METERS)	71.3
DIAMETER	(METERS)	1.14	BUILDING HEIGHT	(METERS)	31.4
EXIT VELOCITY	(METERS)	18.21	BLDG.MIN.CRS.SEC.AREA	(SQ.METERS)	1000.0
			HEAT EMISSION RATE	(CAL/SEC)	0.0

ALL ELEVATED RELEASES

Data in sectors WSW through N are not valid. Refer to note at the end of Table 1.3.

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 940629
**** BIG ROCK POINT XOQDOQ82 *** USING 01/01/89 - 12/31/93 MET DATA ****
ELEVATED RELEASE - 240' STACK

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	3.420E-10	1.846E-10	1.019E-10	6.491E-11	4.430E-11	2.037E-11	6.875E-12	3.168E-12	2.087E-12	1.592E-12
SSW	3.468E-10	1.824E-10	9.959E-11	6.325E-11	4.315E-11	1.987E-11	6.719E-12	3.049E-12	1.905E-12	1.351E-12
SW	1.015E-10	6.439E-11	3.817E-11	2.475E-11	1.694E-11	7.759E-12	2.583E-12	1.144E-12	7.065E-13	5.054E-13
WSW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
W	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
WNW	2.658E-09	2.850E-09	1.961E-09	1.317E-09	9.073E-10	4.130E-10	1.348E-10	5.622E-11	3.152E-11	2.038E-11
NW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
N	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNE	3.167E-10	2.392E-10	1.482E-10	9.669E-11	6.613E-11	3.002E-11	9.778E-12	4.199E-12	2.521E-12	1.775E-12
NE	8.955E-10	5.397E-10	3.047E-10	1.933E-10	1.314E-10	5.961E-11	1.945E-11	8.397E-12	4.942E-12	3.313E-12
ENE	9.358E-10	5.731E-10	3.297E-10	2.111E-10	1.440E-10	6.560E-11	2.160E-11	9.408E-12	5.596E-12	3.800E-12
E	1.054E-09	5.749E-10	3.155E-10	1.998E-10	1.361E-10	6.229E-11	2.077E-11	9.226E-12	5.576E-12	3.806E-12
ESE	8.940E-10	4.518E-10	2.376E-10	1.485E-10	1.008E-10	4.620E-11	1.547E-11	6.959E-12	4.263E-12	2.934E-12
SE	6.733E-10	3.611E-10	1.945E-10	1.220E-10	8.284E-11	3.778E-11	1.251E-11	5.570E-12	3.426E-12	2.402E-12
SSE	4.472E-10	2.569E-10	1.453E-10	9.294E-11	6.343E-11	2.906E-11	9.708E-12	4.367E-12	2.764E-12	2.022E-12

VENT AND BUILDING PARAMETERS:

RELEASE HEIGHT	(METERS)	73.10	REP. WIND HEIGHT (METERS)	71.3	
DIAMETER	(METERS)	1.14	BUILDING HEIGHT (METERS)	31.4	
EXIT VELOCITY	(METERS)	18.21	BLDG.MIN.CRS.SEC.AREA	(SQ.METERS)	1000.0
			HEAT EMISSION RATE	(CAL/SEC)	0.0

ALL ELEVATED RELEASES

Data in sectors WSW through N are not valid. Refer to note at the end of Table 1.3.

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 940629
**** BIG ROCK POINT XOQDOQ82 *** USING 01/01/89 - 12/31/93 MET DATA ****
ELEVATED RELEASE - 240' STACK

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

DIRECTION	DISTANCES IN MILES										
FROM SITE	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
S	5.619E-10	4.414E-10	3.474E-10	2.883E-10	1.834E-10	1.337E-10	1.022E-10	8.055E-11	6.490E-11	5.320E-11	4.424E-11
SSW	5.881E-10	4.557E-10	3.524E-10	2.882E-10	1.806E-10	1.309E-10	9.979E-11	7.853E-11	6.323E-11	5.182E-11	4.309E-11
SW	1.397E-10	1.162E-10	1.022E-10	9.367E-11	6.506E-11	4.925E-11	3.840E-11	3.059E-11	2.478E-11	2.036E-11	1.693E-11
WSW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
W	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
WNW	2.016E-10	1.209E-09	2.575E-09	3.445E-09	2.987E-09	2.449E-09	1.986E-09	1.615E-09	1.322E-09	1.091E-09	9.073E-10
NW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
N	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNE	2.582E-10	2.925E-10	3.194E-10	3.269E-10	2.463E-10	1.901E-10	1.494E-10	1.194E-10	9.683E-11	7.954E-11	6.608E-11
NE	1.100E-09	1.037E-09	9.169E-10	8.088E-10	5.464E-10	4.002E-10	3.055E-10	2.403E-10	1.933E-10	1.581E-10	1.312E-10
ENE	1.216E-09	1.083E-09	9.518E-10	8.501E-10	5.792E-10	4.299E-10	3.311E-10	2.618E-10	2.112E-10	1.731E-10	1.438E-10
E	1.630E-09	1.338E-09	1.074E-09	8.957E-10	5.733E-10	4.156E-10	3.161E-10	2.484E-10	1.997E-10	1.635E-10	1.358E-10
ESE	1.482E-09	1.191E-09	9.155E-10	7.297E-10	4.470E-10	3.165E-10	2.375E-10	1.852E-10	1.483E-10	1.212E-10	1.006E-10
SE	1.016E-09	8.583E-10	6.899E-10	5.683E-10	3.605E-10	2.580E-10	1.946E-10	1.521E-10	1.219E-10	9.961E-11	8.269E-11
SSE	6.714E-10	5.503E-10	4.540E-10	3.907E-10	2.573E-10	1.897E-10	1.458E-10	1.152E-10	9.295E-11	7.621E-11	6.335E-11

DIRECTION	DISTANCES IN MILES										
FROM SITE	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
S	3.723E-11	1.962E-11	1.251E-11	6.635E-12	4.237E-12	3.131E-12	2.485E-12	2.078E-12	1.797E-12	1.584E-12	1.435E-12
SSW	3.628E-11	1.914E-11	1.222E-11	6.495E-12	4.135E-12	3.024E-12	2.345E-12	1.897E-12	1.581E-12	1.345E-12	1.171E-12
SW	1.423E-11	7.468E-12	4.742E-12	2.491E-12	1.573E-12	1.130E-12	8.693E-13	7.026E-13	5.878E-13	5.030E-13	4.417E-13
WSW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
W	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
WNW	7.608E-10	3.974E-10	2.508E-10	1.297E-10	8.053E-11	5.540E-11	4.069E-11	3.128E-11	2.486E-11	2.028E-11	1.689E-11
NW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
N	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNE	5.546E-11	2.887E-11	1.816E-11	9.393E-12	5.874E-12	4.136E-12	3.134E-12	2.504E-12	2.076E-12	1.766E-12	1.543E-12
NE	1.102E-10	5.731E-11	3.603E-11	1.869E-11	1.172E-11	8.308E-12	6.256E-12	4.914E-12	3.981E-12	3.300E-12	2.791E-12
ENE	1.208E-10	6.310E-11	3.986E-11	2.080E-11	1.308E-11	9.309E-12	7.044E-12	5.565E-12	4.537E-12	3.785E-12	3.225E-12
E	1.143E-10	5.995E-11	3.805E-11	2.004E-11	1.268E-11	9.151E-12	6.987E-12	5.551E-12	4.539E-12	3.792E-12	3.232E-12
ESE	8.471E-11	4.446E-11	2.825E-11	1.493E-11	9.484E-12	6.912E-12	5.315E-12	4.246E-12	3.488E-12	2.925E-12	2.500E-12
SE	6.955E-11	3.634E-11	2.297E-11	1.205E-11	7.621E-12	5.519E-12	4.245E-12	3.410E-12	2.826E-12	2.392E-12	2.071E-12
SSE	5.328E-11	2.797E-11	1.777E-11	9.361E-12	5.937E-12	4.317E-12	3.361E-12	2.750E-12	2.327E-12	2.012E-12	1.786E-12

Data in sectors WSW through N are not valid. Refer to note at the end of Table 1.3.

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 940629
**** BIG ROCK POINT XOQDOQ82 *** USING 01/01/89 - 12/31/93 MET DATA ****
ELEVATED RELEASE - 240' STACK

8.000 DAY DECAY, DEPLETED

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

DIRECTION FROM SITE	SEGMENT BOUNDARIES IN MILES FROM THE SITE									
	.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	2.315E-08	3.081E-08	3.151E-08	2.749E-08	2.342E-08	1.505E-08	7.499E-09	4.238E-09	2.857E-09	2.113E-09
SSW	2.082E-08	2.585E-08	2.469E-08	2.079E-08	1.730E-08	1.070E-08	5.097E-09	2.798E-09	1.855E-09	1.356E-09
SW	7.250E-09	1.562E-08	1.790E-08	1.618E-08	1.399E-08	9.099E-09	4.556E-09	2.568E-09	1.725E-09	1.273E-09
WSW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
W	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
WNW	3.224E-22	6.933E-13	1.638E-10	2.003E-09	8.150E-09	4.868E-08	7.625E-08	6.192E-08	4.304E-08	3.013E-08
NW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
N	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNE	1.902E-08	3.951E-08	4.220E-08	3.684E-08	3.131E-08	2.004E-08	9.986E-09	5.667E-09	3.841E-09	2.857E-09
NE	3.794E-08	4.329E-08	3.624E-08	2.818E-08	2.229E-08	1.279E-08	5.572E-09	2.882E-09	1.848E-09	1.320E-09
ENE	4.324E-08	4.965E-08	4.148E-08	3.195E-08	2.506E-08	1.413E-08	5.991E-09	3.035E-09	1.921E-09	1.359E-09
E	5.198E-08	4.742E-08	3.577E-08	2.635E-08	2.013E-08	1 095E-08	4.446E-09	2.191E-09	1.363E-09	9.504E-10
ESE	4.217E-08	3.580E-08	2.657E-08	1.960E-08	1.503E-08	8.251E-09	3.405E-09	1.702E-09	1.068E-09	7.489E-10
SE	3.274E-08	3.191E-08	2.610E-08	2.018E-08	1.591E-08	9.093E-09	3.934E-09	2.023E-09	1.290E-09	9.165E-10
SSE	2.681E-08	3.390E-08	3.143E-08	2.582E-08	2.113E-08	1.273E-08	5.863E-09	3.141E-09	2.052E-09	1.484E-09

Data in sectors WSW through N are not valid. Refer to note at the end of Table 1.3.

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 940629
**** BIG ROCK POINT XOQDOQ82 *** USING 01/01/89 - 12/31/93 MET DATA ****
ELEVATED RELEASE - 240' STACK

8.000 DAY DECAY, DEPLETED

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED)

	DISTANCES 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	1.622E-08	2.255E-08	2.139E-08	2.478E-08	3.168E-08	3.319E-08	3.203E-08	2.995E-08	2.768E-08	2.549E-08	2.349E-08
SSW	1.107E-08	1.819E-08	1.996E-08	2.278E-08	2.671E-08	2.673E-08	2.508E-08	2.299E-08	2.092E-08	1.903E-08	1.735E-08
SW	1.450E-09	3.700E-09	6.108E-09	9.883E-09	1.601E-08	1.819E-08	1.824E-08	1.741E-08	1.630E-08	1.514E-08	1.404E-08
WSW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
W	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
WNW	0.000E+00	0.000E+00	9.731E-30	7.253E-22	2.652E-15	1.558E-12	4.679E-11	3.694E-10	1.441E-09	3.719E-09	7.398E-09
NW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
N	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNE	1.741E-09	6.326E-09	1.616E-08	2.750E-08	4.116E-08	4.428E-08	4.296E-08	4.018E-08	3.709E-08	3.412E-08	3.141E-08
NE	1.191E-08	2.793E-08	3.745E-08	4.331E-08	4.547E-08	4.166E-08	3.675E-08	3.220E-08	2.831E-08	2.505E-08	2.233E-08
ENE	2.040E-08	3.324E-08	4.205E-08	4.914E-08	5.233E-08	4.790E-08	4.208E-08	3.669E-08	3.210E-08	2.827E-08	2.510E-08
E	2.734E-08	4.877E-08	5.231E-08	5.334E-08	4.972E-08	4.274E-08	3.619E-08	3.078E-08	2.644E-08	2.296E-08	2.014E-08
ESE	2.341E-08	4.233E-08	4.285E-08	4.159E-08	3.731E-08	3.177E-08	2.686E-08	2.286E-08	1.966E-08	1.711E-08	1.504E-08
SE	2.154E-08	3.239E-08	3.223E-08	3.330E-08	3.333E-08	3.015E-08	2.646E-08	2.311E-08	2.027E-08	1.790E-08	1.594E-08
SSE	1.167E-08	2.152E-08	2.565E-08	3.033E-08	3.531E-08	3.463E-08	3.194E-08	2.886E-08	2.597E-08	2.341E-08	2.118E-08

Data in sectors WSW through N are not valid. Refer to note at the end of Table 1.3.

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 940629
**** BIG ROCK POINT XOQDOQ82 *** USING 01/01/89 - 12/31/93 MET DATA ****
ELEVATED RELEASE - 240' STACK

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED)

	DISTANCES 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	2.170E-08	1.529E-08	1.154E-08	7.519E-09	5.464E-09	4.234E-09	3.425E-09	2.855E-09	2.434E-09	2.112E-09	1.858E-09
SSW	1.588E-08	1.084E-08	8.012E-09	5.091E-09	3.644E-09	2.792E-09	2.238E-09	1.853E-09	1.570E-09	1.356E-09	1.186E-09
SW	1.302E-08	9.265E-09	7.012E-09	4.571E-09	3.316E-09	2.565E-09	2.071E-09	1.724E-09	1.468E-09	1.273E-09	1.118E-09
WSW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
W	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
WNW	1.237E-08	4.502E-08	6.958E-08	8.259E-08	7.482E-08	6.314E-08	5.229E-08	4.324E-08	3.592E-08	3.024E-08	2.538E-08
NW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
N	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNE	2.898E-08	2.035E-08	1.534E-08	1.001E-08	7.288E-09	5.662E-09	4.591E-09	3.838E-09	3.281E-09	2.856E-09	2.519E-09
NE	2.005E-08	1.284E-08	9.127E-09	5.522E-09	3.831E-09	2.870E-09	2.260E-09	1.843E-09	1.542E-09	1.318E-09	1.143E-09
ENE	2.245E-08	1.415E-08	9.946E-09	5.924E-09	4.065E-09	3.019E-09	2.362E-09	1.915E-09	1.595E-09	1.357E-09	1.172E-09
E	1.785E-08	1.091E-08	7.521E-09	4.374E-09	2.962E-09	2.177E-09	1.688E-09	1.358E-09	1.123E-09	9.493E-10	8.136E-10
ESE	1.336E-08	8.232E-09	5.712E-09	3.355E-09	2.290E-09	1.693E-09	1.318E-09	1.065E-09	8.827E-10	7.480E-10	6.427E-10
SE	1.430E-08	9.123E-09	6.467E-09	3.896E-09	2.696E-09	2.014E-09	1.582E-09	1.287E-09	1.074E-09	9.156E-10	7.912E-10
SSE	1.926E-08	1.286E-08	9.369E-09	5.841E-09	4.126E-09	3.131E-09	2.491E-09	2.049E-09	1.726E-09	1.483E-09	1.292E-09

VENT AND BUILDING PARAMETERS:

RELEASE HEIGHT	(METERS)	73.10	REP. WIND HEIGHT (METERS)	71.3	
DIAMETER	(METERS)	1.14	BUILDING HEIGHT (METERS)	31.4	
EXIT VELOCITY	(METERS)	18.21	BLDG.MIN.CRS.SEC.AREA	(SQ.METERS)	1000.0
			HEAT EMISSION RATE	(CAL/SEC)	0.0

ALL ELEVATED RELEASES

Data in sectors WSW through N are not valid. Refer to note at the end of Table 1.3.

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 940629
**** BIG ROCK POINT XOQDOQ82 *** USING 01/01/89 - 12/31/93 MET DATA ****
ELEVATED RELEASE - 240' STACK

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	2.344E-08	3.120E-08	3.191E-08	2.787E-08	2.375E-08	1.527E-08	7.592E-09	4.268E-09	2.859E-09	2.101E-09
SSW	2.112E-08	2.630E-08	2.515E-08	2.122E-08	1.769E-08	1.097E-08	5.226E-09	2.859E-09	1.886E-09	1.371E-09
SW	7.319E-09	1.573E-08	1.802E-08	1.630E-08	1.410E-08	9.161E-09	4.563E-09	2.549E-09	1.696E-09	1.239E-09
WSW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
W	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
WNW	3.158E-22	6.786E-13	1.602E-10	1.955E-09	7.931E-09	4.587E-08	6.623E-08	4.773E-08	2.868E-08	1.710E-08
NW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
N	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNE	1.912E-08	3.978E-08	4.258E-08	3.724E-08	3.168E-08	2.030E-08	1.009E-08	5.699E-09	3.839E-09	2.837E-09
NE	3.841E-08	4.407E-08	3.711E-08	2.900E-08	2.304E-08	1.333E-08	5.862E-09	3.052E-09	1.960E-09	1.400E-09
ENE	4.373E-08	5.049E-08	4.247E-08	3.293E-08	2.597E-08	1.479E-08	6.362E-09	3.256E-09	2.071E-09	1.468E-09
E	5.274E-08	4.851E-08	3.691E-08	2.741E-08	2.109E-08	1.163E-08	4.836E-09	2.431E-09	1.532E-09	1.079E-09
ESE	4.285E-08	3.671E-08	2.744E-08	2.039E-08	1.572E-08	8.733E-09	3.672E-09	1.867E-09	1.184E-09	8.382E-10
SE	3.321E-08	3.257E-08	2.678E-08	2.081E-08	1.648E-08	9.493E-09	4.152E-09	2.152E-09	1.377E-09	9.806E-10
SSE	2.716E-08	3.441E-08	3.196E-08	2.632E-08	2.157E-08	1.304E-08	6.020E-09	3.224E-09	2.101E-09	1.516E-09

Data in sectors WSW through N are not valid. Refer to note at the end of Table 1.3.

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 940629
**** BIG ROCK POINT XOQDOQ82 *** USING 01/01/89 - 12/31/93 MET DATA ****
ELEVATED RELEASE - 240' STACK

2.260 DAY DECAY, UNDEPLETED

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCES 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	1.620E-08	2.267E-08	2.170E-08	2.513E-08	3.207E-08	3.359E-08	3.244E-08	3.035E-08	2.806E-08	2.585E-08	2.383E-08
SSW	1.107E-08	1.829E-08	2.028E-08	2.317E-08	2.717E-08	2.720E-08	2.555E-08	2.344E-08	2.135E-08	1.944E-08	1.7743-08
SW	1.450E-09	3.723E-09	6.181E-09	9.971E-09	1.612E-08	1.832E-08	1.837E-08	1.754E-08	1.643E-08	1.526E-08	1.415E-08
WSW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
W	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
WNW	0.000E+00	0.000E+00	9.582E-30	7.106E-22	2.596E-15	1.525E-12	4.580E-11	3.613E-10	1.408E-09	3.629E-09	7.207E-09
NW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
N	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNE	1.741E-09	6.362E-09	1.627E-08	2.764E-08	4.142E-08	4.463E-08	4.334E-08	4.058E-08	3.749E-08	3.451E-08	3.178E-08
NE	1.190E-08	2.811E-08	3.794E-08	4.391E-08	4.625E-08	4.252E-08	3.763E-08	3.306E-08	2.914E/08	2.584E-08	2.308E-08
ENE	2.039E-08	3.344E-08	4.257E-08	4.975E-08	5.316E-08	4.886E-08	4.308E-08	3.770E-08	3.308E-08	2.922E-08	2.601E-08
E	2.732E-08	4.908E-08	5.313E-08	5.429E-08	5.082E-08	4.389E-08	3.734E-08	3.189E-08	2.750E-08	2.397E-08	2.110E-08
ESE	2.339E-08	4.260E-08	4.358E-08	4.244E-08	3.825E-08	3.269E-08	2.774E-08	2.369E-08	2.045E-08	1.785E-08	1.573E-08
SE	2.153E-08	3.258E-08	3.272E-08	3.388E-08	3.400E-08	3.085E-08	2.715E-08	2.377E-08	2.090E-08	1.851E-08	1.651E-08
SSE	1.166E-08	2.166E-08	2.602E-08	3.076E-08	3.583E-08	3.517E-08	3.247E-08	2.939E-08	2.647E-08	2.388E-08	2.162E-08

Data in sectors WSW through N are not valid. Refer to note at the end of Table 1.3.

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 940629
**** BIG ROCK POINT XOQDOQ82 *** USING 01/01/89 - 12/31/93 MET DATA ****
ELEVATED RELEASE - 240' STACK

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED)

	DISTANCES 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	2.202E-08	1.552E-08	1.171E-08	7.614E-09	5.518E-09	4.264E-09	3.437E-09	2.856E-09	2.427E-09	2.100E-09	1.842E-09
SSW	1.625E-08	1.111E-08	8.220E-09	5.220E-09	3.732E-09	2.854E-09	2.282E-09	1.883E-09	1.591E-09	1.369E-09	1.196E-09
SW	1.313E-08	9.332E-09	7.051E-09	4.579E-09	3.307E-09	2.546E-09	2.046E-09	1.694E-09	1.435E-09	1.238E-09	1.083E-09
WSW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
W	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
WNW	1.202E-08	4.300E-08	6.495E-08	7.288E-08	6.189E-08	4.870E-08	3.748E-08	2.872E-08	2.206E-08	1.702E-08	1.322E-08
NW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
N	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNE	2.933E-08	2.061E-08	1.554E-08	1.012E-08	7.350E-09	5.694E-09	4.603E-09	3.836E-09	3.269E-09	2.835E-09	2.494E-09
NE	2.077E-08	1.339E-08	9.558E-09	5.815E-09	4.050E-09	3.040E-09	2.397E-09	1.956E-09	1.637E-09	1.398E-09	1.212E-09
ENE	2.333E-08	1.483E-08	1.049E-08	6.299E-09	4.347E-09	3.241E-09	2.542E-09	2.065E-09	1.722E-09	1.466E-09	1.268E-09
E	1.877E-08	1.162E-08	8.083E-09	4.767E-09	3.263E-09	2.419E-09	1.887E-09	1.527E-09	1.269E-09	1.077E-09	9.285E-10
ESE	1.401E-08	8.726E-09	6.100E-09	3.623E-09	2.496E-09	1.858E-09	1.455E-09	1.181E-09	9.840E-10	8.366E-10	7.229E-10
SE	1.484E-08	9.533E-09	6.789E-09	4.116E-09	2.861E-09	2.143E-09	1.687E-09	1.374E-09	1.148E-09	9.790E-10	8.479E-10
SSE	1.968E-08	1.317E-08	9.613E-09	6.000E-09	4.239E-09	3.215E-09	2.554E-09	2.097E-09	1.765E-09	1.514E-09	1.381E-09

VENT AND BUILDING PARAMETERS:

RELEASE HEIGHT	(METERS)	73.10	REP. WIND HEIGHT	(METERS)	71.3
DIAMETER	(METERS)	1.14	BUILDING HEIGHT	(METERS)	31.4
EXIT VELOCITY	(METERS)	18.21	BLDG.MIN.CRS.SEC.AREA	(SQ.METERS)	2000.0
			HEAT EMISSION RATE	(CAL/SEC)	0.0

ALL ELEVATED RELEASES

Data in sectors WSW through N are not valid. Refer to note at the end of Table 1.3.

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 940629
**** BIG ROCK POINT XOQDOQ82 *** USING 01/01/89 - 12/31/93 MET DATA ****
ELEVATED RELEASE - 240' STACK

NO 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	2.355E-08	3.135E-08	3.210E-08	2.808E-08	2.398E-08	1.550E-08	7.804E-09	4.462E-09	3.038E-09	2.268E-09
SSW	2.121E-08	2.642E-08	2.531E-08	2.140E-08	1.788E-08	1.115E-08	5.393E-09	3.010E-09	2.023E-09	1.497E-09
SW	7.338E-09	1.579E-08	1.812E-08	1.641E-08	1.422E-08	9.293E-09	4.690E-09	2.666E-09	1.805E-09	1.341E-09
WSW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
W	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
WNW	3.250E-22	7.185E-13	1.743E-10	2.181E-09	9.074E-09	5.925E-08	1.052E-07	9.768E-08	7.756E-08	6.141E-08
NW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
N	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNE	1.915E-08	3.987E-08	4.271E-08	3.740E-08	3.186E-08	2.048E-08	1.027E-08	5.867E-09	3.997E-09	2.987E-09
NE	3.849E-08	4.419E-08	3.725E-08	2.916E-08	2.320E-08	1.347E-08	5.992E-09	3.167E-09	2.065E-09	1.497E-09
ENE	4.384E-08	5.064E-08	4.265E-08	3.312E-08	2.616E-08	1.497E-08	6.516E-09	3.391E-09	2.191E-09	1.579E-09
E	5.290E-08	4.870E-08	3.711E-08	2.762E-08	2.129E-08	1.182E-08	4.993E-09	2.568E-09	1.654E-09	1.190E-09
ESE	4.299E-08	3.686E-08	2.760E-08	2.055E-08	1.588E-08	8.878E-09	3.796E-09	1.975E-09	1.281E-09	9.261E-10
SE	3.333E-08	3.272E-08	2.695E-08	2.098E-08	1.665E-08	9.648E-09	4.287E-09	2.271E-09	1.485E-09	1.079E-09
SSE	2.724E-08	3.453E-08	3.211E-08	2.648E-08	2.174E-08	1.320E-08	6.164E-09	3.352E-09	2.218E-09	1.624E-09

Data in sectors WSW through N are not valid. Refer to note at the end of Table 1.3.

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ, VERSION 2.0 RUN DATE: 940629
**** BIG ROCK POINT XOQDOQ82 *** USING 01/01/89 - 12/31/93 MET DATA ****
ELEVATED RELEASE - 240' STACK

AVERAGE EFFECTIVE STACK HEIGHT IN METERS FOR EACH SEGMENT

DIRECTION FROM SITE	.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	8.573E+01	8.574E+01	8.574E+01	8.574E+01	8.574E+01	8.574E+01	8.574E+01	8.574E+01	8.574E+01	8.574E+01
SSW	8.831E+01	8.833E+01	8.833E+01	8.833E+01	8.833E+01	8.833E+01	8.833E+01	8.833E+01	8.833E+01	8.833E+01
SW	8.604E+01	8.604E+01	8.604E+01	8.604E+01	8.604E+01	8.604E+01	8.604E+01	8.604E+01	8.604E+01	8.604E+01
WSW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
W	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
WNW	3.817E+02	3.853E+02	3.853E+02	3.853E+02	3.853E+02	3.853E+02	3.853E+02	3.853E+02	3.853E+02	3.853E+02
NW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNW	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
N	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNE	8.296E+01	8.296E+01	8.296E+01	8.296E+01	8.296E+01	8.296E+01	8.296E+01	8.296E+01	8.296E+01	8.296E+01
NE	8.487E+01	8.487E+01	8.487E+01	8.487E+01	8.487E+01	8.487E+01	8.487E+01	8.487E+01	8.487E+01	8.487E+01
ENE	8.562E+01	8.563E+01	8.563E+01	8.563E+01	8.563E+01	8.563E+01	8.563E+01	8.563E+01	8.563E+01	8.563E+01
E	8.863E+01	8.865E+01	8.865E+01	8.865E+01	8.865E+01	8.865E+01	8.865E+01	8.865E+01	8.865E+01	8.865E+01
ESE	8.846E+01	8.848E+01	8.848E+01	8.848E+01	8.848E+01	8.848E+01	8.848E+01	8.848E+01	8.848E+01	8.848E+01
SE	8.756E+-1	8.759E+01	8.759E+01	8.759E+01	8.759E+01	8.759E+01	8.759E+01	8.759E+01	8.759E+01	8.759E+01
SSE	8.506E+01	8.506E+01	8.506E+01	8.506E+01	8.506E+01	8.506E+01	8.506E+01	8.506E+01	8.506E+01	8.506E+01

Data in sectors WSW through N are not valid. Refer to note at the end of Table 1.3.

TABLE 1.3

USNRC COMPUTER CODE - XOQDOQ. VERSION 2.0 RUN DATE: 940629
**** BIG ROCK POINT XOQDOQ82 **** USING 01/01/89 - 12/31/93 MET DATA ****
ELEVATED RELEASE - 240' STACK
SPECIFIC POINTS OF INTEREST

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RELEASE ID	TYPE OF LOCATION	DIRECTION	DISTANCE FROM SITE (MILES)	(METERS)	X/Q (SEC/M^3) NO DECAY UNDEPLETED	X/Q (SEC/M^3) 2.26 D DECAY UNDEPLETED	X/Q (SEC/M^3) 8.0 D DECAY DEPLETED	D/Q (PER SQ.METER)
A	SITE BOUNDARY	E	0.57	917.	4.91E-08	4.90E-08	4.85E-08	1.25E-09
A	SITE BOUNDARY	ESE	0.52	837.	4.11E-08	4.10E-08	4.07E-08	1.16E-09
A	SITE BOUNDARY	SE	0.55	885.	3.09E-08	3.08E-08	3.05E-08	8.19E-10
A	SITE BOUNDARY	SSE	0.58	933.	2.25E-08	2.24E-08	2.22E-08	5.12E-10
A	SITE BOUNDARY	S	0.68	1094.	2.07E-08	2.06E-08	2.03E-08	3.68E-10
A	SITE BOUNDARY	SSW	0.71	1143.	1.95E-08	1.94E-08	1.91E-08	3.65E-10
A	SITE BOUNDARY	SW	0.50	805.	3.58E-09	3.57E-09	3.55E-09	1.16E-10
A	MAXIMUM CHI/Q	S	2.00	3219.	3.37E-08	3.35E-08	3.31E-08	1.34E-10
A	MAXIMUM CHI/Q	SSW	2.00	3219.	2.73E-08	2.71E-08	2.67E-08	1.31E-10
A	MAXIMUM CHI/Q	SW	2.50	4023.	1.85E-08	1.84E-08	1.82E-08	3.84E-11
A	MAXIMUM CHI/Q	WSW	50.00	80467.	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A	MAXIMUM CHI/Q	W	50.00	80467.	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A	MAXIMUM CHI/Q	WNW	15.00	24140.	1.12E-07	7.29E-08	8.26E-08	1.30E-10
A	MAXIMUM CHI/Q	NW	50.00	80467.	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A	MAXIMUM CHI/Q	NNW	50.00	80467.	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A	MAXIMUM CHI/Q	N	50.00	80467.	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A	MAXIMUM CHI/Q	NNE	2.00	3219.	4.47E-08	4.46E-08	4.43E-08	1.90E-10
A	MAXIMUM CHI/Q	NE	1.50	2414.	4.63E-08	4.62E-08	4.54E-08	5.46E-10
A	MAXIMUM CHI/Q	ENE	1.50	2414.	5.32E-08	5.30E-08	5.22E-08	5.79E-10
A	MAXIMUM CHI/Q	E	1.00	1609.	5.40E-08	5.39E-08	5.30E-08	8.96E-10
A	MAXIMUM CHI/Q	ESE	0.75	1207.	4.29E-08	4.28E-08	4.21E-08	9.15E-10
A	MAXIMUM CHI/Q	SE	1.50	2414.	3.40E-08	3.38E-08	3.32E-08	3.60E-10
A	MAXIMUM CHI/Q	SSE	1.50	2414.	3.59E-08	3.58E-08	3.52E-08	2.57E-10

VENT AND BUILDING PARAMETERS:
RELEASE HEIGHT (METERS) 73.10 REP. WIND HEIGHT (METERS) 71.3

Note: Big Rock Point meteorological data was gathered from sensors mounted on the 73 meter stack. Sensor were mounted into the prevailing wind direction. Because of interference to the wind flow by the stack when winds were from the 71° to 159° (flowing towards Lake Michigan), the meteorological data recorded in these sectors are considered invalid. For dose calculational purposes, this effectively invalidates six (6) lakeward sectors (WSW, W, WNW, NW, NNW, and N). Therefore zeros are recorded in Table 1.3 for these sectors. However, the program which calculates the annual average Chi/Q requires input of the full years met data. Any data recorded for these six sectors are input in the WNW sector to satisfy the program. Values of Chi/Q listed in the WNW sector are invalid.

TABLE 1.4
CONSERVATIVE BIG ROCK POINT GASPAR INPUT PARAMETERS

Critical Receptors

Location	Sector	Distance (miles)	X/Q (sec/m³)	X/Q Decay (sec/m³)	X/Q Decay and Dep (sec/m³)	D/Q (1/m²)
Residence/Garden	E	0.57	4.91E-08	4.90E-08	4.85E-08	1.25E-09
Site Boundary	E	0.57	4.91E-08	4.90E-08	4.85E-08	1.25E-09
Beef Cattle	E	0.57	4.91E-08	4.90E-08	4.85E-08	1.25E-09
Dairy Cow	E	0.57	4.91E-08	4.90E-08	4.85E-08	1.25E-09

Final (1998) Land Use Census illustrates actual land use:

Sector	Residence	Garden	Dairy Cow	Beef Cattle	Goat
WSW	2.5 mi	>5 mi	>5 mi	>5 mi	>5 mi
SW	1.1 mi	2.7 mi	>5 mi	>5 mi	>5 mi
SSW	1.3 mi	>5 mi	>5 mi	>5 mi	>5 mi
S	1.9 mi	2.1 mi	>5 mi	>5 mi	>5 mi
SSE	1.7 mi	1.7 mi	>5 mi	1.7 mi	>5 mi
SE	1.8 mi	1.8 mi	4.5 mi	1.7 mi	>5 mi
ESE	1.5 mi	1.8 mi	>5 mi	3.2 mi	>5 mi
E	1.4 mi	2.4 mi	3.5 mi	3.2 mi	>5 mi
ENE	2.3 mi	>5 mi	>5 mi	>5 mi	>5 mi

TABLE 1.5

DOSE FACTORS FOR SUBMERSION IN NOBLE GASES*

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

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

*Dose factors for exposure to a semi-infinite cloud of noble gases. Values for doses in this table, Table 1.7 and Table 1.8 are dose equivalent (DE) values, and were obtained from US NRC Regulatory Guide 1.109, Revision 1 (October 1977). These factors convert to somewhat different values from those used in emergency planning, which are obtained from EPA-400 (May 1992), primarily because the EPA internal doses represent total effective dose equivalent (TEDE) rather than DE, and the EPA ground shine conversions are based on concentration with meteorologically independent deposition velocity assumptions and integrated exposure time of only 96 hours.

TABLE 1.6

STABLE ELEMENT TRANSFER DATA

Element	F_m - Milk (d/L) (Cow)	F_m - Milk (d/L) (Goat)	F_f - Meat (d/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
Eu	5.0E-06	5.0E-06	4.8E-03	2.5E-03
Ta	2.5E-02	2.5E-02	1.6E+00	6.3E-03

TABLE 1.7

INFANT INHALATION DOSE COMMITMENT FACTORS
(MREM/50y PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.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

INFANT INHALATION DOSE COMMITMENT FACTORS
(MREM/50y PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.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

INFANT INHALATION DOSE COMMITMENT FACTORS
(MREM/50y PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.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

INFANT INHALATION DOSE COMMITMENT FACTORS
(MREM/50y PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.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

CHILD INHALATION COMMITMENT DOSE FACTORS
(MREM/50y PER PCI INHALED IN FIRST YEAR)

NUCLIDE	BONE	LIVER	T.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

CHILD INHALATION COMMITMENT DOSE FACTORS
(MREM/50y PER PCI INHALED IN FIRST YEAR)

NUCLIDE	BONE	LIVER	T.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

CHILD INHALATION COMMITMENT DOSE FACTORS
(MREM/50y PER PCI INHALED IN FIRST YEAR)

NUCLIDE	BONE	LIVER	T.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

CHILD INHALATION COMMITMENT DOSE FACTORS
(MREM/50y PER PCI INHALED IN FIRST YEAR)

NUCLIDE	BONE	LIVER	T.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

TEEN INHALATION DOSE COMMITMENT FACTORS
(MREM/50y PER PCI INHALED IN FIRST YEAR)

NUCLIDE	BONE	LIVER	T.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

TEEN INHALATION DOSE COMMITMENT FACTORS
(MREM/50y PER PCI INHALED IN FIRST YEAR)

NUCLIDE	BONE	LIVER	T.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

TEEN INHALATION DOSE COMMITMENT FACTORS
(MREM/50y PER PCI INHALED IN FIRST YEAR)

NUCLIDE	BONE	LIVER	T.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

TEEN INHALATION DOSE COMMITMENT FACTORS
(MREM/50y PER PCI INHALED IN FIRST YEAR)

NUCLIDE	BONE	LIVER	T.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

ADULT INHALATION DOSE COMMITMENT FACTORS
(MREM/50y PER PCI INHALED IN FIRST YEAR)

NUCLIDE	BONE	LIVER	T.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

ADULT INHALATION DOSE COMMITMENT FACTORS
(MREM/50y PER PCI INHALED IN FIRST YEAR)

NUCLIDE	BONE	LIVER	T.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

ADULT INHALATION DOSE COMMITMENT FACTORS
(MREM/50y PER PCI INHALED IN FIRST YEAR)

NUCLIDE	BONE	LIVER	T.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

ADULT INHALATION DOSE COMMITMENT FACTORS
(MREM/50y PER PCI INHALED IN FIRST YEAR)

NUCLIDE	BONE	LIVER	T.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 CONTAMINATED GROUND
(mrem/hr per pCi/m^2)

Nuclide	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
Ru-103	3.60E-09	4.20E-09

TABLE 1.8
EXTERNAL DOSE FACTORS FOR STANDING ON CONTAMINATED GROUND
(mrem/hr per pCi/m^2)

Nuclide	Total Body	Skin
EU-154	7.8E-09	9.0E-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
BIG ROCK POINT GASEOUS DESIGN OBJECTIVE ANNUAL
QUANTITIES BASED ON TABLE 1.4 CRITICAL RECEPTORS

Nuclide	Organ	Dose Factor mrem/Ci	Design Objective Annual Quantity (Ci)
H-3	Total Body - C	1.06E-05	4.72E+05
C-14	Bone - C	8.70E-03	1.72E+03
Cr-51	GI Tract - T	7.03E-04	2.13E+04
Mn-54	GI Tract - T	9.00E-02	1.67E+02
Fe-55	Bone - C	4.15E-02	3.61E+02
Co-58	GI Tract - T	4.25E-02	3.53E+02
Fe-59	GI Tract - T	7.37E-02	2.04E+02
Co-60	GI Tract - T	1.00E+00	1.50E+01
Zn-65	Total Body - C	2.82E-01	1.77E+01
Sr-89	Bone - C	1.42E+00	1.06E+01
Sr-90	Bone - C	5.55E+01	2.70E-01
Zr-95	GI Tract - T	8.85E-02	1.69E+02
Sb-124	GI Tract - T	1.59E-01	9.43E+01
Ar-41	Total Body	9.07E-06	5.51E+05
Kr-83m	Skin	2.20E-08	6.82E+08
Kr-85	Skin	2.21E-06	6.79E+06
Kr-85m	Total Body	1.24E-06	4.03E+06
Kr-87	Skin	2.07E-05	7.25E+05
Kr-88	Total Body	1.54E-05	3.25E+05
Kr-89	Total Body	2.27E-06	2.20E+06
Xe-131m	Skin	9.29E-07	1.16E+07
Xe-133	Total Body	3.20E-07	1.56E+07
Xe-133m	Skin	1.94E-06	7.73E+06
Xe-135	Total Body	1.95E-06	2.56E-06
Xe-135m	Total Body	2.22E-06	2.25E+06
Xe-137	Skin	3.80E-06	3.95E+06
Xe-138	Total Body	6.02E-06	8.31E+05
I-131	Thyroid - I	1.11E+01	1.35E+00
I-133	Thyroid - I	1.08E-01	1.39E+02
Cs-134	Liver - C	2.10E+00	7.14E+00
Cs-136	Total Body - I	5.04E-02	9.92E+01
Cs-137	Bone - C	2.14E+00	7.01E+00
Ba-140	Bone - C	1.07E-02	1.40E+03
Ce-141	GI Tract - T	2.10E-02	7.15E+02
Ce-144	GI Tract - T	5.02E-01	2.99E+01

TABLE 1.9
BIG ROCK POINT GASEOUS DESIGN OBJECTIVE ANNUAL
QUANTITIES BASED ON TABLE 1.4 CRITICAL RECEPTORS

Nuclide	Organ	Dose Factor mrem/Ci	Design Objective Annual Quantity (Ci)
N-13	Total Body - C	6.81E-08	7.34E+07
Na-24	Total Body - I	8.19E-04	6.11E+03
Mn-56	GI Tract - C	2.16E-04	6.94E+04
Co-57	GI Tract - T	1.47E-02	1.02E+03
Ni-63	Bone - C	2.54E+00	8.45E+00
Ni-65	GI Tract - C	1.35E-04	1.11E+05
Br-82	Total Body - I	4.73E-03	1.06E+03
Rb-88	Total Body - C	1.29E-06	3.88E+06
Sr-91	Bone - I	6.23E-02	2.41E+02
Sr-92	GI Tract - C	3.88E-04	3.87E+04
Nb-95	GI Tract - A	1.79E-01	8.38E+01
Mo-99	Kidney - I	6.81E-03	2.20E+03
Tc-99	GI Tract - A	5.47E-01	2.74E+01
Tc-99m	GI Tract - T	1.67E-05	8.98E+05
Ru-103	GI Tract - A	2.66E-01	5.64E+01
Ru-105	GI Tract - C	1.74E-04	8.62E+04
Sb-125	GI Tract - T	7.05E-02	2.13E+02
Te-127	GI Tract - T	1.31E-04	1.15E+05
I-129	Thyroid - A	7.41E+01	2.02E-01
I-132	Thyroid - C	3.09E-04	4.85E+04
I-134	Thyroid - C	7.69E-05	1.95E+05
I-135	Thyroid - C	1.40E-03	1.07E+04
La-140	GI Tract - A	2.42E-03	6.20E+03
Tc-101	GI Tract - I	8.94E-06	1.68E+06
Ag-110m	GI Tract - T	9.17E-01	1.64E+01
Cs-138	Total Body - C	1.16E-02	4.31E+02
Ba-139	GI Tract - C	8.59E-05	1.75E+05
Np-239	GI Tract - A	6.27E-04	2.39E+04
Pu-238	Bone - T	3.75E+01	4.00E-01
Pu-239	Bone - T	4.34E+01	3.46E-01
Pu-241	Bone - T	9.17E-01	1.64E+01
Am-241	Bone - T	1.51E+01	9.93E-01
Cm-242	Lung - T	8.32E-01	1.80E+01
Cm-244	Bone - T	9.70E+00	1.54E+00

2.0 LIQUID EFFLUENTS

2.1 ALLOWABLE CONCENTRATION

2.1.1 ODCM Requirement

Requirement 2.1.1 of ODCM Section I specifies 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 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 2×10^{-4} μCi/ml total activity. To ensure compliance, the following approach will be used for each release.

2.1.2 Pre-release 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.

$$C_j = \sum_{i=1}^{n} C_{ij} \qquad \text{(II.1)}$$

where:

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

C_{ij} = Concentration of a single radionuclide i, μCi/ml, at release point j.

2.1.3 Total Release-Fraction

The total release-fraction (R_j) for each release point will be calculated by the relationship defined as:

$$R_j = \sum_{i=1}^{n} \frac{C_{ij}}{10 \times EC_i} \qquad \text{(II.2)}$$

where:

C_{ij} = Undiluted effluent concentration of radionuclide i, as determined in Section II, part 2.1.2, μCi/ml, at release point j.

EC_i = The 10CFR20 effluent concentration limit (EC) of radionuclide i, as specified in Section II, part 2.1.1, μCi/ml. (Big Rock Point still uses MPC terminology in some Liquid Analyses Programs, although EC values are utilized.)

R_j = The total release-fraction for the release point.

The sum of the ratios at the discharge to the lake must be ≤1 due to the releases from any or all concurrent releases. The following relationship will assure this criterion is met:

$$f_1(R_1 - N) + f_2(R_2 - N) + f_3(R_3 - N) \leq F \qquad \text{(II.3)}$$

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 release-fractions for the respective releases as determined by Equation II.2.

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

N = 1.0 when $R_i = 1$. when R_i is not 1.0, N = 0.

2.2 INSTRUMENT ALARM SET POINTS

2.2.1 Set Point Determination

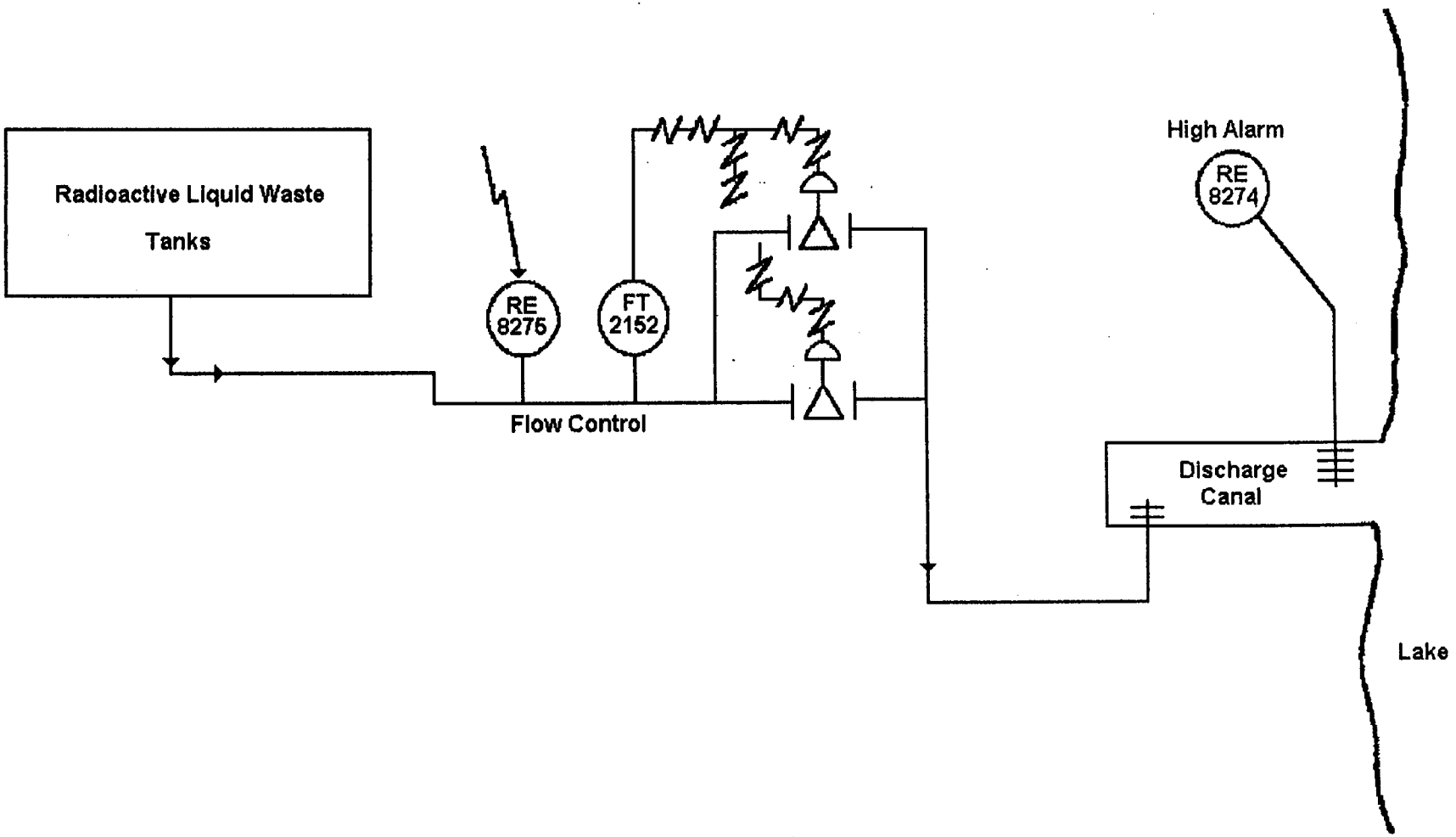
The set point for each liquid effluent monitor will be established using plant instructions. Concentration, flow rate, dilution, principal gamma emitter, geometry and detector efficiency are combined to give an equivalent set point in counts per minute (cpm) or other instrument output as may be appropriate to instrumentation modifications which may occur over the decommissioning interval. The physical and technical description, location and identification number for each liquid effluent radiation detector installed for decommissioning use is contained in Figure 2-1. Modifications or replacements of indicated instrumentation shall be performed only with instrumentation or sampling methods of equivalent or greater sensitivity.

The respective alarm/trip set points at each release point will be set such that the sum of the ratios at each point, as calculated by Equation II.2, will not exceed 1. The value of R is directly related to the total concentration calculated by Equation II.1. An increase in the concentration would indicate an increase in the value of R. A large increase would cause the limits of specification 2.2.1 of ODCM Section I to be exceeded. The minimum alarm/trip set point value is equal to the release concentration, but for ease of operation it may be desired that the set point (S) be set above the effluent concentration (C) by the same factor (b) utilized in setting dilution flow. That is:

$$S = b \times C \qquad \text{(II.4)}$$

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

FIGURE 2-1
LIQUID RELEASE DIAGRAM



2.3 LIQUID EFFLUENT DOSE

2.3.1 Section I ODCM Requirement

Requirement 2.3.1, ODCM, Section I requires that the quantity of radionuclides released be limited such that the dose or dose commitment to an individual from radioactive materials in liquid effluents released to unrestricted areas from each reactor (see Figure 2.2) 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.

2.3.2 Release Analysis (Design Basis Quantity Fraction)

Per ODCM Surveillance Requirement 2.3 of ODCM Section I, the cumulative DBQ fraction for nuclides released is summed at least every 31 days to assure that the sum of nuclide fractions released does not exceed 1.0, year to date 0.5 in any calendar quarter or 0.02 in the next 31 days.

Calculations shall be performed according to the formula:

$$\sum_i \frac{A_i}{(DBQ)_i} = \text{Fraction of DBQ} \qquad \text{(II.5)}$$

where:

A_i = Cumulative or projected 31 day, quarterly or annual activity of nuclide i identified or expected in liquid release (C_i).

$(DBQ)_i$ = Design objective annual quantity of radionuclide i from Table 2.2 (Ci).

2.3.3 Exceeding DBQ Limits

The design basis quantities are derived in such a conservative manner that doses may be greatly overestimated by this technique. Surveillance Requirement 2.3.3 of ODCM Section I specifies ~~a~~ cumulative and projected dose contributions to be determined for the next 31 days, current quarter and year at least once per 31 days. If at any time this calculation, by Equation II.5, results in values greater than 0.02 for a projected 31 day interval, 0.5 for a given quarter or 1.0 for year to date, the NRC LADTAP code may be run to confirm that ODCM Requirement 2.3.1 of ODCM Section I has been met, and whether the actions specified by 1.3.1 (ODCM, Section I) are required to be implemented. If LADTAP is not run, Actions shall be entered in accordance with the conservative DBQ results.

2.3.4 Dose Calculation

Values for the design basis quantities (Ci), and the dose per curie $(D_C/C_C)_i$ for each nuclide i shown in Table 2.2, were calculated as follows.

a. Water Ingestion

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

$$D_j = \sum_{i=1}^{n} (DCF)_{ij} \times I_i \qquad \text{(II.6)}$$

where:

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

j = The organ of interest.

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

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

I_i is described by:

$$I_i = \frac{(A_i)(V)(365)(10^6)}{(800)(d)} \qquad \text{(II.7)}$$

where:

365 = Days per year.

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

V = Average rate of water consumption; adult - 2,000 ml/d, teen and child - 1,400 ml/d, infant - 900 ml/d (Reg Guide 1.109).

d = Dilution water flow for year (ml).

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

10^6 = Converts μCi to pCi.

The dose equation then becomes:

$$D_j = \frac{(4.56E5)(V)}{d} \sum_{i=1}^{i} (DCF)_{ij} \times A_i \qquad \text{(II.8)}$$

b. Fish Ingestion

The dose to an individual from the consumption of fish is described by Equation II.10. In this case the activity ingested of the i^{th} radionuclide (I_i) is described by:

$$I_i = \frac{A_i B_i F}{15d} (10^9) \qquad \text{(II.9)}$$

where:

I_i = Activity of radionuclide i ingested, pCi.

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

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

F = Amount of fish eaten per year; adult - 21 kg, teen - 16 kg, child - 6.9 kg and infant - none.

15 = Dispersion factor from discharge to fish exposure point.

d = Dilution water flow for year (ml).

10^9 = Converts μCi to pCi and gram to kg.

Substitution of Equation II.9 into Equation II.6 gives:

$$D_j = \frac{(6.7E07)(F)}{d} \sum_{i=1}^{i} (A_i)(B_i)(DCF_{ij}) \qquad (II.10)$$

c. Releasing Radionuclides Not Listed in Table 2.2

Table 2.2 contains all nuclides identified to date as routine constituents of liquid releases at Big Rock Point Plant, plus those common to boiling water reactors in general, even if not previously detected at Big Rock Point. 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 2.2 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.

2.3.5 Annual Analysis

A complete analysis utilizing the NRC computer code LADTAP (either by running the code, or by normalization of data to results of a previous year's run) for the total release source 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 in LADTAP. The dose to the j^{th} organ from m radionuclides, D_j, is described by:

$$D_{j(rem)} = \sum_{i=1}^{m} D_{ij} \qquad \text{(II.11)}$$

$$D_{j(rem)} = \sum_{i=1} (DCF)_{ij} \times I_i \qquad \text{(II.12)}$$

where:

D_{ij} = Dose to the j^{th} organ from the i^{th} radionuclide, rem.

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

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

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

I_i for water ingestion is described by:

$$I_i = \frac{A_i\ V r}{v\ d} \qquad \text{(II.13)}$$

and for fish ingestion I_i is described by:

$$I_i = \frac{A_i B_i F r}{v\ d} \qquad \text{(II.14)}$$

where:

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

V = Average rate of water consumption (Table 2.2).

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

ν = Dispersion factor from point of discharge to point of exposure (Table 2.2).

d = Dilution water volume (ml).

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

F = Amount of fish eaten per day (Table 2.2).

2.4 OPERABILITY OF LIQUID RADWASTE EQUIPMENT

The Big Rock Point liquid radwaste system is designed to maintain the release of liquid effluents within the numerical guidance of Appendix I to 10CFR50 and not exceed Requirement 2.3.1 of ODCM Section I. Maintaining the cumulative DBQ release fraction at a value less than 1.0 for the year, 0.5 for the quarter and 0.02 for the next 31 days assures compliance with this requirement.

Action 2.3.2 of ODCM Section I requires that appropriate portions of the liquid radwaste system are operable and used to reduce release levels if projections for the next 31 days exceed 2% of Requirement 2.3.1. annual dose guidelines. In lieu of using installed plant systems, it is permissible to use other equipment or techniques for effluent reduction during the decommissioning process, provided that the equipment or technique is able to maintain doses at least as low as achieved by the installed equipment during the plant operational period (also see ODCM Section III, Requirements 4 through 4.2).

2.5 OFFSITE RELEASE RATE

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 (800 x nearest lake water drinking water intake concentration). The source term used is given in Table 1.1. The most limiting dose due to a hypothetical individual drinking this water is 4.89E-01 mrem, whole body. The release rate which would result in a dose rate equivalent to 500 mrem/y (upon which the 10 times concentration limit of Requirement 2.2.1 of ODCM Section I is based) is the Curies/Year given in Table 1.1 (8.94) times 500/.489 or 9141 Ci/Yr = 2.9E-04 Ci/sec (=290 uCi/sec) if continued for a full year.

The above calculation is informational, supplied at NRC request for inclusion in the ODCM. The release rate value is not used in any plant calculations or related to any ODCM Requirements. The calculation is based upon exposure using the drinking water pathway and an average historical release from Big Rock Point.

Annual analyses are run for the report specified part 1.5 of ODCM Section III. LADTAP is used to calculate estimates of dose to the total body and limiting organs.

Radionuclides of highest dose consequence will remain predominately Cs-137 and Co-60 throughout the decommissioning interval. Iodine-131, which has been an important dose contributor during power operations, will not be present in effluents in detectable concentrations due to decay prior to implementation of this ODCM revision (minimum of 11.6 halflives of decay will have occurred. Cs-134 (also important during plant operation) will decay to significantly lower levels as decommissioning progresses.

TABLE 2.0

BIOACCUMULATION FACTORS

(μCi/g per μCi/ml)

Element	Freshwater Fish
H	9.0E-01
C	4.6E+03
Na	1.0E+02
P	1.0E+03
Cr	2.0E+02
Mn	4.0E+02
Fe	1.0E+02
Co	5.0E+01
Ni	1.0E+02
Cu	5.0E+01
Zn	2.0E+03
Br	4.2E+02
Rb	2.0E+03
Sr	3.0E+01
Y	2.5E+01
Zr	3.3E+00
Nb	3.0E+04
Mo	1.0E+01
Tc	1.5E+01
Ru	1.0E+01
Rh	1.0E+01
Te	4.0E+02
I	1.5E+01
Cs	2.0E+03
Ba	4.0E+00
La	2.5E+01
Ce	1.0E+00
Pr	2.5E+01
Nd	2.5E+01
W	1.2E+03
Np	1.0E+01

ADULT INGESTION DOSE FACTORS
(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
C 14	2.84E-06	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07
NA 24	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06
P 32	1.93E-04	1.20E-05	7.46E-06	NO DATA	NO DATA	NO DATA	2.17E-05
CR 51	NO DATA	NO DATA	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
MN 54	NO DATA	4.57E-06	8.72E-07	NO DATA	1.36E-06	NO DATA	1.40E-05
MN 56	NO DATA	1.15E-07	2.04E-08	NO DATA	1.46E-07	NO DATA	3.67E-06
FE 55	2.75E-06	1.90E-06	4.43E-07	NO DATA	NO DATA	1.06E-06	1.09E-06
FE 59	4.34E-06	1.02E-05	3.91E-06	NO DATA	NO DATA	2.85E-06	3.40E-05
CO 58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05
CO 60	NO DATA	2.14E-06	4.72E-06	NO DATA	NO DATA	NO DATA	4.02E-05
NI 63	1.30E-04	9.01E-06	4.36E-06	NO DATA	NO DATA	NO DATA	1.88E-06
NI 65	5.28E-07	6.86E-08	3.13E-08	NO DATA	NO DATA	NO DATA	1.74E-06
CU 64	NO DATA	8.33E-08	3.91E-08	NO DATA	2.10E-07	NO DATA	7.10E-06
ZN 65	4.84E-06	1.54E-05	6.96E-06	NO DATA	1.03E-05	NO DATA	9.70E-06
ZN 69	1.03E-08	1.97E-08	1.37E-09	NO DATA	1.28E-08	NO DATA	2.96E-09
BR 83	NO DATA	NO DATA	4.02E-08	NO DATA	NO DATA	NO DATA	5.79E-08
BR 84	NO DATA	NO DATA	5.21E-08	NO DATA	NO DATA	NO DATA	4.09E-13
BR 85	NO DATA	NO DATA	2.14E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	2.11E-05	9.83E-06	NO DATA	NO DATA	NO DATA	4.16E-06
RB 88	NO DATA	6.05E-08	3.21E-08	NO DATA	NO DATA	NO DATA	8.36E-19
RB 89	NO DATA	4.01E-08	2.82E-08	NO DATA	NO DATA	NO DATA	2.33E-21
SR 89	3.08E-04	NO DATA	8.84E-06	NO DATA	NO DATA	NO DATA	4.94E-05
SR 90	7.58E-03	NO DATA	1.86E-03	NO DATA	NO DATA	NO DATA	2.19E-04
SR 91	5.67E-06	NO DATA	2.29E-07	NO DATA	NO DATA	NO DATA	2.70E-05
SR 92	2.15E-06	NO DATA	9.30E-08	NO DATA	NO DATA	NO DATA	4.26E-05
Y 90	9.62E-09	NO DATA	2.58E-10	NO DATA	NO DATA	NO DATA	1.02E-04
Y 91m	9.09E-11	NO DATA	3.52E-12	NO DATA	NO DATA	NO DATA	2.67E-10
Y 91	1.41E-07	NO DATA	3.77E-09	NO DATA	NO DATA	NO DATA	7.76E-05
Y 92	8.45E-10	NO DATA	2.47E-11	NO DATA	NO DATA	NO DATA	1.48E-05
Y 93	2.68E-09	NO DATA	7.40E-11	NO DATA	NO DATA	NO DATA	8.50E-05
ZR 95	3.04E-08	9.75E-09	6.60E-09	NO DATA	1.53E-08	NO DATA	3.09E-05
ZR 97	1.68E-09	3.39E-10	1.55E-10	NO DATA	5.12E-10	NO DATA	1.05E-04
NB 95	6.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-05
MO 99	NO DATA	4.31E-06	8.20E-07	NO DATA	9.76E-06	NO DATA	9.99E-06
TC 99m	2.47E-10	6.98E-10	8.89E-09	NO DATA	1.06E-08	3.42E-10	4.13E-07

ADULT INGESTION DOSE FACTORS
(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC101	2.54E-10	3.66E-10	3.59E-09	NO DATA	6.59E-09	1.87E-10	1.10E-21
RU103	1.85E-07	NO DATA	7.97E-08	NO DATA	7.06E-07	NO DATA	2.16E-05
RU105	1.54E-08	NO DATA	6.08E-09	NO DATA	1.99E-07	NO DATA	9.42E-06
RU106	2.75E-06	NO DATA	3.48E-07	NO DATA	5.31E-06	NO DATA	1.78E-04
AG110m	1.60E-07	1.48E-07	8.79E-08	NO DATA	2.91E-07	NO DATA	6.04E-05
TE125m	2.68E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	NO DATA	1.07E-05
TE127m	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	NO DATA	2.27E-05
TE127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	NO DATA	8.68E-06
TE129m	1.15E-05	4.29E-06	1.82E-06	3.95E-06	4.80E-05	NO DATA	5.79E-05
TE129	3.14E-08	1.18E-08	7.65E-09	2.41E-08	1.32E-07	NO DATA	2.37E-08
TE131m	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	NO DATA	8.40E-05
TE131	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	NO DATA	2.79E-09
TE132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	NO DATA	7.71E-05
I 130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	NO DATA	1.92E-06
I 131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	NO DATA	1.57E-06
I 132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	NO DATA	1.02E-07
I 133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	NO DATA	2.22E-06
I 134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	NO DATA	2.51E-10
I 135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	NO DATA	1.31E-06
CS134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06
CS136	6.51E-06	2.57E-05	1.85E-05	NO DATA	1.43E-05	1.96E-06	2.92E-06
CS137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06
CS138	5.52E-08	1.09E-07	5.40E-08	NO DATA	8.01E-08	7.91E-09	4.65E-13
BA139	9.70E-08	6.91E-11	2.84E-09	NO DATA	6.46E-11	3.92E-11	1.72E-07
BA140	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.46E-08	4.18E-05
BA141	4.71E-08	3.56E-11	1.59E-09	NO DATA	3.31E-11	2.02E-11	2.22E-17
BA142	2.13E-08	2.19E-11	1.34E-09	NO DATA	1.85E-11	1.24E-11	3.00E-26
LA140	2.50E-09	1.26E-09	3.33E-10	NO DATA	NO DATA	NO DATA	9.25E-05
LA142	1.28E-10	5.82E-11	1.45E-11	NO DATA	NO DATA	NO DATA	4.25E-07
CE141	9.36E-09	6.33E-09	7.18E-10	NO DATA	2.94E-09	NO DATA	2.42E-05
CE143	1.65E-09	1.22E-06	1.35E-10	NO DATA	5.37E-10	NO DATA	4.56E-05
CE144	4.88E-07	2.04E-07	2.62E-08	NO DATA	1.21E-07	NO DATA	1.65E-04
PR143	9.20E-09	3.69E-09	4.56E-10	NO DATA	2.13E-09	NO DATA	4.03E-05
PR144	3.01E-11	1.25E-11	1.53E-12	NO DATA	7.05E-12	NO DATA	4.33E-18
ND147	6.29E-09	7.27E-09	4.35E-10	NO DATA	4.25E-09	NO DATA	3.49E-05
W 187	1.03E-07	8.61E-08	3.01E-08	NO DATA	NO DATA	NO DATA	2.82E-05
NP239	1.19E-09	1.17E-10	6.45E-11	NO DATA	3.65E-10	NO DATA	2.40E-05

INGESTION DOSE FACTORS FOR TEENAGER
(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07
C 14	4.06E-06	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07
NA 24	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06
P 32	2.76E-04	1.71E-05	1.07E-05	NO DATA	NO DATA	NO DATA	2.32E-05
CR 51	NO DATA	NO DATA	3.60E-09	2.00E-09	7.89E-10	5.14E-09	6.05E-07
MN 54	NO DATA	5.90E-06	1.17E-06	NO DATA	1.76E-06	NO DATA	1.21E-05
MN 56	NO DATA	1.58E-07	2.81E-08	NO DATA	2.00E-07	NO DATA	1.04E-05
FE 55	3.78E-06	2.68E-06	6.25E-07	NO DATA	NO DATA	1.70E-06	1.16E-06
FE 59	5.87E-06	1.37E-05	5.29E-06	NO DATA	NO DATA	4.32E-06	3.24E-05
CO 58	NO DATA	9.72E-07	2.24E-06	NO DATA	NO DATA	NO DATA	1.34E-05
CO 60	NO DATA	2.81E-06	6.33E-06	NO DATA	NO DATA	NO DATA	3.66E-05
NI 63	1.77E-04	1.25E-05	6.00E-06	NO DATA	NO DATA	NO DATA	1.99E-06
NI 65	7.49E-07	9.57E-08	4.36E-08	NO DATA	NO DATA	NO DATA	5.19E-06
CU 64	NO DATA	1.15E-07	5.41E-08	NO DATA	2.91E-07	NO DATA	8.92E-06
ZN 65	5.76E-06	2.00E-05	9.33E-06	NO DATA	1.28E-05	NO DATA	8.47E-06
ZN 69	1.47E-08	2.80E-08	1.96E-09	NO DATA	1.83E-08	NO DATA	5.16E-08
BR 83	NO DATA	NO DATA	5.74E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	7.22E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	3.05E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	2.98E-05	1.40E-05	NO DATA	NO DATA	NO DATA	4.41E-06
RB 88	NO DATA	8.52E-08	4.54E-08	NO DATA	NO DATA	NO DATA	7.30E-15
RB 89	NO DATA	5.50E-08	3.89E-08	NO DATA	NO DATA	NO DATA	8.43E-17
SR 89	4.40E-04	NO DATA	1.26E-05	NO DATA	NO DATA	NO DATA	5.24E-05
SR 90	8.30E-03	NO DATA	2.05E-03	NO DATA	NO DATA	NO DATA	2.33E-04
SR 91	8.07E-06	NO DATA	3.21E-07	NO DATA	NO DATA	NO DATA	3.66E-05
SR 92	3.05E-06	NO DATA	1.30E-07	NO DATA	NO DATA	NO DATA	7.77E-05
Y 90	1.37E-08	NO DATA	3.69E-10	NO DATA	NO DATA	NO DATA	1.13E-04
Y 91m	1.29E-10	NO DATA	4.93E-12	NO DATA	NO DATA	NO DATA	6.09E-09
Y 91	2.01E-07	NO DATA	5.39E-09	NO DATA	NO DATA	NO DATA	8.24E-05
Y 92	1.21E-09	NO DATA	3.50E-11	NO DATA	NO DATA	NO DATA	3.32E-05
Y 93	3.83E-09	NO DATA	1.05E-10	NO DATA	NO DATA	NO DATA	1.17E-04
ZR 95	4.12E-08	1.30E-08	8.94E-09	NO DATA	1.91E-08	NO DATA	3.00E-05
ZR 97	2.37E-09	4.69E-10	2.16E-10	NO DATA	7.11E-10	NO DATA	1.27E-04
NB 95	8.22E-09	4.56E-09	2.51E-09	NO DATA	4.42E-09	NO DATA	1.95E-05
MO 99	NO DATA	6.03E-06	1.15E-06	NO DATA	1.38E-05	NO DATA	1.08E-05
TC 99m	3.32E-10	9.26E-10	1.20E-08	NO DATA	1.38E-08	5.14E-10	6.08E-07

INGESTION DOSE FACTORS FOR TEENAGER
(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC101	3.60E-10	5.12E-10	5.03E-09	NO DATA	9.26E-09	3.12E-10	8.75E-17
RU103	2.55E-07	NO DATA	1.09E-07	NO DATA	8.99E-07	NO DATA	2.13E-05
RU105	2.18E-08	NO DATA	8.46E-09	NO DATA	2.75E-07	NO DATA	1.76E-05
RU106	3.92E-06	NO DATA	4.94E-07	NO DATA	7.56E-06	NO DATA	1.88E-04
AG110m	2.05E-07	1.94E-07	1.18E-07	NO DATA	3.70E-07	NO DATA	5.45E-05
TE125m	3.83E-06	1.38E-06	5.12E-07	1.07E-06	NO DATA	NO DATA	1.13E-05
TE127m	9.67E-06	3.43E-06	1.15E-06	2.30E-06	3.92E-05	NO DATA	2.41E-05
TE127	1.58E-07	5.60E-08	3.40E-08	1.09E-07	6.40E-07	NO DATA	1.22E-05
TE129m	1.63E-05	6.05E-06	2.58E-06	5.26E-06	6.82E-05	NO DATA	6.12E-05
TE129	4.48E-08	1.67E-08	1.09E-08	3.20E-08	1.88E-07	NO DATA	2.45E-07
TE131m	2.44E-06	1.17E-06	9.76E-07	1.76E-06	1.22E-05	NO DATA	9.39E-05
TE131	2.79E-08	1.15E-08	8.72E-09	2.15E-08	1.22E-07	NO DATA	2.29E-09
TE132	3.49E-06	2.21E-06	2.08E-06	2.33E-06	2.12E-05	NO DATA	7.00E-05
I 130	1.03E-06	2.98E-06	1.19E-06	2.43E-04	4.59E-06	NO DATA	2.29E-06
I 131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	NO DATA	1.62E-06
I 132	2.79E-07	7.30E-07	2.62E-07	2.46E-05	1.15E-06	NO DATA	3.18E-07
I 133	2.01E-06	3.41E-06	1.04E-06	4.76E-04	5.98E-06	NO DATA	2.58E-06
I 134	1.46E-07	3.87E-07	1.39E-07	6.45E-06	6.10E-07	NO DATA	5.10E-09
I 135	6.10E-07	1.57E-06	5.82E-07	1.01E-04	2.48E-06	NO DATA	1.74E-06
CS134	8.37E-05	1.97E-04	9.14E-05	NO DATA	6.26E-05	2.39E-05	2.45E-06
CS136	8.49E-06	3.38E-05	2.27E-05	NO DATA	1.84E-05	2.90E-06	2.72E-06
CS137	1.12E-04	1.49E-04	5.19E-05	NO DATA	5.07E-05	1.97E-05	2.12E-06
CS138	7.76E-08	1.49E-07	7.45E-08	NO DATA	1.10E-07	1.28E-08	6.76E-11
BA139	1.39E-07	9.78E-11	4.05E-09	NO DATA	9.22E-11	6.74E-11	1.24E-06
BA140	2.84E-05	3.48E-08	1.83E-06	NO DATA	1.18E-08	2.34E-08	4.38E-05
BA141	6.71E-08	5.01E-11	2.24E-09	NO DATA	4.65E-11	3.43E-11	1.43E-13
BA142	2.99E-08	2.99E-11	1.84E-09	NO DATA	2.53E-11	1.99E-11	9.18E-20
LA140	3.48E-09	1.71E-09	4.55E-10	NO DATA	NO DATA	NO DATA	9.82E-05
LA142	1.79E-10	7.95E-11	1.98E-11	NO DATA	NO DATA	NO DATA	2.42E-06
CE141	1.33E-08	8.88E-09	1.02E-09	NO DATA	4.18E-09	NO DATA	2.54E-05
CE143	2.35E-09	1.71E-06	1.91E-10	NO DATA	7.67E-10	NO DATA	5.14E-05
CE144	6.96E-07	2.88E-07	3.74E-08	NO DATA	1.72E-07	NO DATA	1.75E-04
PR143	1.31E-08	5.23E-09	6.52E-10	NO DATA	3.04E-09	NO DATA	4.31E-05
PR144	4.30E-11	1.76E-11	2.18E-12	NO DATA	1.01E-11	NO DATA	4.74E-14
ND147	9.38E-09	1.02E-08	6.11E-10	NO DATA	5.99E-09	NO DATA	3.68E-05
W 187	1.46E-07	1.19E-07	4.17E-08	NO DATA	NO DATA	NO DATA	3.22E-05
NP239	1.76E-09	1.66E-10	9.22E-11	NO DATA	5.21E-10	NO DATA	2.67E-05

INGESTION DOSE FACTORS FOR CHILD
(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07
C 14	1.21E-05	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06
NA 24	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06
P 32	8.25E-04	3.86E-05	3.18E-05	NO DATA	NO DATA	NO DATA	2.28E-05
CR 51	NO DATA	NO DATA	8.90E-09	4.94E-09	1.35E-09	9.02E-09	4.72E-07
MN 54	NO DATA	1.07E-05	2.85E-06	NO DATA	3.00E-06	NO DATA	8.98E-06
MN 56	NO DATA	3.34E-07	7.54E-08	NO DATA	4.04E-07	NO DATA	4.84E-05
FE 55	1.15E-05	6.10E-06	1.89E-06	NO DATA	NO DATA	3.45E-06	1.13E-06
FE 59	1.65E-05	2.67E-05	1.33E-05	NO DATA	NO DATA	7.74E-06	2.78E-05
CO 58	NO DATA	1.80E-06	5.51E-06	NO DATA	NO DATA	NO DATA	1.05E-05
CO 60	NO DATA	5.29E-06	1.56E-05	NO DATA	NO DATA	NO DATA	2.93E-05
NI 63	5.38E-04	2.88E-05	1.83E-05	NO DATA	NO DATA	NO DATA	1.94E-06
NI 65	2.22E-06	2.09E-07	1.22E-07	NO DATA	NO DATA	NO DATA	2.56E-05
CU 64	NO DATA	2.45E-07	1.48E-07	NO DATA	5.92E-07	NO DATA	1.15E-05
ZN 65	1.37E-05	3.65E-05	2.27E-05	NO DATA	2.30E-05	NO DATA	6.41E-06
ZN 69	4.38E-08	6.33E-08	5.85E-09	NO DATA	3.84E-08	NO DATA	3.99E-06
BR 83	NO DATA	NO DATA	1.71E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	1.98E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	9.12E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	6.70E-05	4.12E-05	NO DATA	NO DATA	NO DATA	4.31E-06
RB 88	NO DATA	1.90E-07	1.32E-07	NO DATA	NO DATA	NO DATA	9.32E-09
RB 89	NO DATA	1.17E-07	1.04E-07	NO DATA	NO DATA	NO DATA	1.02E-09
SR 89	1.32E-03	NO DATA	3.77E-05	NO DATA	NO DATA	NO DATA	5.11E-05
SR 90	1.70E-02	NO DATA	4.31E-03	NO DATA	NO DATA	NO DATA	2.29E-04
SR 91	2.40E-05	NO DATA	9.06E-07	NO DATA	NO DATA	NO DATA	5.30E-05
SR 92	9.03E-06	NO DATA	3.62E-07	NO DATA	NO DATA	NO DATA	1.71E-04
Y 90	4.11E-08	NO DATA	1.10E-09	NO DATA	NO DATA	NO DATA	1.17E-04
Y 91m	3.82E-10	NO DATA	1.39E-11	NO DATA	NO DATA	NO DATA	7.48E-07
Y 91	6.02E-07	NO DATA	1.61E-08	NO DATA	NO DATA	NO DATA	8.02E-05
Y 92	3.60E-09	NO DATA	1.03E-10	NO DATA	NO DATA	NO DATA	1.04E-04
Y 93	1.14E-08	NO DATA	3.13E-10	NO DATA	NO DATA	NO DATA	1.70E-04
ZR 95	1.16E-07	2.55E-08	2.27E-08	NO DATA	3.65E-08	NO DATA	2.66E-05
ZR 97	6.99E-09	1.01E-09	5.96E-10	NO DATA	1.45E-09	NO DATA	1.53E-04
NB 95	2.25E-08	8.76E-09	6.26E-09	NO DATA	8.23E-09	NO DATA	1.62E-05
MO 99	NO DATA	1.33E-05	3.29E-06	NO DATA	2.84E-05	NO DATA	1.10E-05
TC 99m	9.23E-10	1.81E-09	3.00E-08	NO DATA	2.63E-08	9.19E-10	1.03E-06

INGESTION DOSE FACTORS FOR CHILD
(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC101	1.07E-09	1.12E-09	1.42E-08	NO DATA	1.01E-08	5.92E-10	3.56E-09
RU103	7.31E-07	NO DATA	2.81E-07	NO DATA	1.84E-06	NO DATA	1.89E-05
RU105	6.45E-08	NO DATA	2.34E-08	NO DATA	5.67E-07	NO DATA	4.21E-05
RU106	1.17E-05	NO DATA	1.46E-06	NO DATA	1.58E-05	NO DATA	1.82E-04
AG110m	5.39E-07	3.64E-07	2.91E-07	NO DATA	6.78E-07	NO DATA	4.33E-05
TE125m	1.14E-05	3.09E-06	1.52E-06	3.20E-06	NO DATA	NO DATA	1.10E-05
TE127m	2.89E-05	7.78E-06	3.43E-06	6.91E-06	8.24E-05	NO DATA	2.34E-05
TE127	4.71E-07	1.27E-07	1.01E-07	3.26E-07	1.34E-06	NO DATA	1.84E-05
TE129m	4.87E-05	1.36E-05	7.56E-06	1.57E-05	1.43E-04	NO DATA	5.94E-05
TE129	1.34E-07	3.74E-08	3.18E-08	9.56E-08	3.92E-07	NO DATA	8.34E-06
TE131m	7.20E-06	2.49E-06	2.65E-06	5.12E-06	2.41E-05	NO DATA	1.01E-04
TE131	8.30E-08	2.53E-08	2.47E-08	6.35E-08	2.51E-07	NO DATA	4.36E-07
TE132	1.01E-05	4.47E-06	5.40E-06	6.51E-06	4.15E-05	NO DATA	4.50E-05
I 130	2.92E-06	5.90E-06	3.04E-06	6.50E-04	8.82E-06	NO DATA	2.76E-06
I 131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	NO DATA	1.54E-06
I 132	8.00E-07	1.47E-06	6.76E-07	6.82E-05	2.25E-06	NO DATA	1.73E-06
I 133	5.92E-06	7.32E-06	2.77E-06	1.36E-03	1.22E-05	NO DATA	2.95E-06
I 134	4.19E-07	7.78E-07	3.58E-07	1.79E-05	1.19E-06	NO DATA	5.16E-07
I 135	1.75E-06	3.15E-06	1.49E-06	2.79E-04	4.83E-06	NO DATA	2.40E-06
CS134	2.34E-04	3.84E-04	8.10E-05	NO DATA	1.19E-04	4.27E-05	2.07E-06
CS136	2.35E-05	6.46E-05	4.18E-05	NO DATA	3.44E-05	5.13E-06	2.27E-06
CS137	3.27E-04	3.13E-04	4.62E-05	NO DATA	1.02E-04	3.67E-05	1.96E-06
CS138	2.28E-07	3.17E-07	2.01E-07	NO DATA	2.23E-07	2.40E-08	1.46E-07
BA139	4.14E-07	2.21E-10	1.20E-08	NO DATA	1.93E-10	1.30E-10	2.39E-05
BA140	8.31E-05	7.28E-08	4.85E-06	NO DATA	2.37E-08	4.34E-08	4.21E-05
BA141	2.00E-07	1.12E-10	6.51E-09	NO DATA	9.69E-11	6.58E-10	1.14E-07
BA142	8.74E-08	6.29E-11	4.88E-09	NO DATA	5.09E-11	3.70E-11	1.14E-09
LA140	1.01E-08	3.53E-09	1.10E-09	NO DATA	NO DATA	NO DATA	9.84E-05
LA142	5.24E-10	1.67E-10	5.23E-11	NO DATA	NO DATA	NO DATA	3.31E-05
CE141	3.97E-08	1.98E-08	2.94E-09	NO DATA	8.68E-09	NO DATA	2.47E-05
CE143	6.99E-09	3.79E-06	5.49E-10	NO DATA	1.59E-09	NO DATA	5.55E-05
CE144	2.08E-06	6.52E-07	1.11E-07	NO DATA	3.61E-07	NO DATA	1.70E-04
PR143	3.93E-08	1.18E-08	1.95E-09	NO DATA	6.39E-09	NO DATA	4.24E-05
PR144	1.29E-10	3.99E-11	6.49E-12	NO DATA	2.11E-11	NO DATA	8.59E-08
ND147	2.79E-08	2.26E-08	1.75E-09	NO DATA	1.24E-08	NO DATA	3.58E-05
W 187	4.29E-07	2.54E-07	1.14E-07	NO DATA	NO DATA	NO DATA	3.57E-05
NP239	5.25E-09	3.77E-10	2.65E-10	NO DATA	1.09E-09	NO DATA	2.79E-05

INGESTION DOSE FACTORS FOR INFANT
(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07
C 14	2.37E-05	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06
NA 24	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05
P 32	1.70E-03	1.00E-04	6.59E-05	NO DATA	NO DATA	NO DATA	2.30E-05
CR 51	NO DATA	NO DATA	1.41E-08	9.20E-09	2.01E-09	1.79E-08	4.11E-07
MN 54	NO DATA	1.99E-05	4.51E-06	NO DATA	4.41E-06	NO DATA	7.31E-06
MN 56	NO DATA	8.18E-07	1.41E-07	NO DATA	7.03E-07	NO DATA	7.43E-05
FE 55	1.39E-05	8.98E-06	2.40E-06	NO DATA	NO DATA	4.39E-06	1.14E-06
FE 59	3.08E-05	5.38E-05	2.12E-05	NO DATA	NO DATA	1.59E-05	2.57E-05
CO 58	NO DATA	3.60E-06	8.93E-06	NO DATA	NO DATA	NO DATA	8.97E-06
CO 60	NO DATA	1.08E-05	2.55E-05	NO DATA	NO DATA	NO DATA	2.57E-05
NI 63	6.34E-04	3.92E-05	2.20E-05	NO DATA	NO DATA	NO DATA	1.95E-06
NI 65	4.70E-06	5.32E-07	2.42E-07	NO DATA	NO DATA	NO DATA	4.05E-05
CU 64	NO DATA	6.09E-07	2.82E-07	NO DATA	1.03E-06	NO DATA	1.25E-05
ZN 65	1.84E-05	6.31E-05	2.91E-05	NO DATA	3.06E-05	NO DATA	5.33E-05
ZN 69	9.33E-08	1.68E-07	1.25E-08	NO DATA	6.98E-08	NO DATA	1.37E-05
BR 83	NO DATA	NO DATA	3.63E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	3.82E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	1.94E-08	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	1.70E-04	8.40E-05	NO DATA	NO DATA	NO DATA	4.35E-06
RB 88	NO DATA	4.98E-07	2.73E-07	NO DATA	NO DATA	NO DATA	4.85E-07
RB 89	NO DATA	2.86E-07	1.97E-07	NO DATA	NO DATA	NO DATA	9.74E-08
SR 89	2.51E-03	NO DATA	7.20E-05	NO DATA	NO DATA	NO DATA	5.16E-05
SR 90	1.85E-02	NO DATA	4.71E-03	NO DATA	NO DATA	NO DATA	2.31E-04
SR 91	5.00E-05	NO DATA	1.81E-06	NO DATA	NO DATA	NO DATA	5.92E-05
SR 92	1.92E-05	NO DATA	7.13E-07	NO DATA	NO DATA	NO DATA	2.07E-04
Y 90	8.69E-08	NO DATA	2.33E-09	NO DATA	NO DATA	NO DATA	1.20E-04
Y 91m	8.10E-10	NO DATA	2.76E-11	NO DATA	NO DATA	NO DATA	2.70E-06
Y 91	1.13E-06	NO DATA	3.01E-08	NO DATA	NO DATA	NO DATA	8.10E-05
Y 92	7.65E-09	NO DATA	2.15E-10	NO DATA	NO DATA	NO DATA	1.46E-04
Y 93	2.43E-08	NO DATA	6.62E-10	NO DATA	NO DATA	NO DATA	1.92E-04
ZR 95	2.06E-07	5.02E-08	3.56E-08	NO DATA	5.41E-08	NO DATA	2.50E-05
ZR 97	1.48E-08	2.54E-09	1.16E-09	NO DATA	2.56E-09	NO DATA	1.62E-04
NB 95	4.20E-08	1.73E-08	1.00E-08	NO DATA	1.24E-08	NO DATA	1.46E-05
MO 99	NO DATA	3.40E-05	6.63E-06	NO DATA	5.08E-05	NO DATA	1.12E-05
TC 99m	1.92E-09	3.96E-09	5.10E-08	NO DATA	4.26E-08	2.07E-09	1.15E-06

INGESTION DOSE FACTORS FOR INFANT (MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC101	2.27E-09	2.86E-09	2.83E-08	NO DATA	3.40E-08	1.56E-09	4.86E-07
RU103	1.48E-06	NO DATA	4.95E-07	NO DATA	3.08E-06	NO DATA	1.80E-05
RU105	1.36E-07	NO DATA	4.58E-08	NO DATA	1.00E-06	NO DATA	5.41E-05
RU106	2.41E-05	NO DATA	3.01E-06	NO DATA	2.85E-05	NO DATA	1.83E-04
AG110m	9.96E-07	7.27E-07	4.81E-07	NO DATA	1.04E-06	NO DATA	3.77E-05
TE125m	2.33E-05	7.79E-06	3.15E-06	7.84E-06	NO DATA	NO DATA	1.11E-05
TE127m	5.58E-05	1.94E-05	7.08E-06	1.69E-05	1.44E-04	NO DATA	2.36E-05
TE127	1.00E-06	3.35E-07	2.15E-07	8.14E-07	2.44E-06	NO DATA	2.10E-05
TE129m	1.00E-04	3.43E-05	1.54E-05	3.84E-05	2.50E-04	NO DATA	5.97E-05
TE129	2.84E-07	9.79E-08	6.63E-08	2.38E-07	7.07E-07	NO DATA	2.27E-05
TE131m	1.52E-05	6.12E-06	5.05E-06	1.24E-05	4.21E-05	NO DATA	1.03E-04
TE131	1.76E-07	6.50E-08	4.94E-08	1.57E-07	4.50E-07	NO DATA	7.11E-06
TE132	2.08E-05	1.03E-05	9.61E-06	1.52E-05	6.44E-05	NO DATA	3.81E-05
I 130	6.00E-06	1.32E-05	5.30E-06	1.48E-03	1.45E-05	NO DATA	2.83E-06
I 131	3.59E-05	4.23E-05	1.86E-05	1.39E-02	4.94E-05	NO DATA	1.51E-06
I 132	1.66E-06	3.37E-06	1.20E-06	1.58E-04	3.76E-06	NO DATA	2.73E-06
I 133	1.25E-05	1.82E-05	5.33E-06	3.31E-03	2.14E-05	NO DATA	3.08E-06
I 134	8.69E-07	1.78E-06	6.33E-07	4.15E-05	1.99E-06	NO DATA	1.84E-06
I 135	3.64E-06	7.24E-06	2.64E-06	6.49E-04	8.07E-06	NO DATA	2.62E-06
CS134	3.77E-04	7.03E-04	7.10E-05	NO DATA	1.81E-04	7.42E-05	1.91E-06
CS136	4.59E-05	1.35E-04	5.04E-05	NO DATA	5.38E-05	1.10E-05	2.05E-06
CS137	5.22E-04	6.11E-04	4.33E-05	NO DATA	1.64E-04	6.64E-05	1.91E-06
CS138	4.81E-07	7.82E-07	3.79E-07	NO DATA	3.90E-07	6.09E-08	1.25E-06
BA139	8.81E-07	5.84E-10	2.55E-08	NO DATA	3.51E-10	3.54E-10	5.58E-05
BA140	1.71E-04	1.71E-07	8.81E-06	NO DATA	4.06E-08	1.05E-07	4.20E-05
BA141	4.25E-07	2.91E-10	1.34E-08	NO DATA	1.75E-10	1.77E-10	5.19E-06
BA142	1.84E-07	1.53E-10	9.06E-09	NO DATA	8.81E-11	9.26E-11	7.59E-07
LA140	2.11E-08	8.32E-09	2.14E-09	NO DATA	NO DATA	NO DATA	9.77E-05
LA142	1.10E-09	4.04E-10	9.67E-11	NO DATA	NO DATA	NO DATA	6.86E-05
CE141	7.87E-08	4.80E-08	5.65E-09	NO DATA	1.48E-08	NO DATA	2.48E-05
CE143	1.48E-08	9.82E-06	1.12E-09	NO DATA	2.86E-09	NO DATA	5.73E-05
CE144	2.98E-06	1.22E-06	1.67E-07	NO DATA	4.93E-07	NO DATA	1.71E-04
PR143	8.13E-08	3.04E-08	4.03E-09	NO DATA	1.13E-08	NO DATA	4.29E-05
PR144	2.74E-10	1.06E-10	1.38E-11	NO DATA	3.84E-11	NO DATA	4.93E-06
ND147	5.53E-08	5.68E-08	3.48E-09	NO DATA	2.19E-08	NO DATA	3.60E-05
W 187	9.03E-07	6.28E-07	2.17E-07	NO DATA	NO DATA	NO DATA	3.69E-05
NP239	1.11E-08	9.93E-10	5.61E-10	NO DATA	1.98E-09	NO DATA	2.87E-05

TABLE 2.2

BIG ROCK POINT DESIGN OBJECTIVE ANNUAL QUANTITIES FOR LIQUID EFFLUENTS AS DETERMINED BY LADTAP

Design objective annual quantities for liquid effluents were calculated utilizing the computer code LADTAP, a program for calculating radiation exposure to man from routine releases of nuclear reactor liquid effluents (reference NUREG/CR-1276).

Input parameters used are as follows:

Pathway	Age Group	Usage	Dilution	Process Times (Hr)
Fish	Adult	21.0 kg/yr	15.0	24.0
	Teen	16.0	15.0	24.0
	Child	6.9	15.0	24.0
	Infant	0.0	15.0	24.0
Drinking	Adult	730.0 L/yr	800.0	4.6
	Teen	510.0	800.0	4.6
	Child	510.0	800.0	4.6
	Infant	330.0	800.0	4.6
Shoreline	Adult	12.0 hr/yr	2.0	0.0
	Teen	67.0	2.0	0.0
	Child	14.0	2.0	0.0
	Infant	0.0	2.0	0.0
Swimming	Adult	12.0 hr/yr	2.0	0.0
	Teen	67.0	2.0	0.0
	Child	14.0	2.0	0.0
	Infant	0.0	2.0	0.0
Boating	Adult	100.0 hr/yr	15.0	0.0
	Teen	100.0	15.0	0.0
	Child	50.0	15.0	0.0
	Infant	0.0	15.0	0.0

The usage figures are obtained from Regulatory Guide 1.109 and are default values. Dilutions and the process time for drinking water were taken from the NUS study dated June 4, 1976. The minimum process times that can be utilized for fish and drinking are 24.0 hours and 12.0 hours respectively. (LADTAP adds 12.0 hours to the process time listed above for the Drinking Pathway.)

TABLE 2.2

BIG ROCK POINT DESIGN OBJECTIVE ANNUAL QUANTITIES FOR LIQUID EFFLUENTS AS DETERMINED BY LADTAP

The following input parameters are used when running LADTAP for BRP:

1. 50-mile population - 1.54E05
2. Shore width factor - 0.3
3. Total discharge (ft^3/sec) - 45*
4. Transit time for all pathways - 4.6
5. Sport fish harvest (kg/yr) - 3.29E05
6. Commercial fish harvest (kg/yr) - 1.70E05
7. Invertebrate and algae consumption - 0
8. Drinking water population - 7.07E03
9. Shoreline population usage (man-hours) - 3.8E07
10. Swimming population usage (man-hours) - 1.2E07
11. Boating population usage (man-hours) - 3.7E07

*Based upon a nominal flow of 20,000 gpm from the Circulating Water Pump. Actual water discharge is calculated for each LADTAP analysis based on plant data for the analysis period.

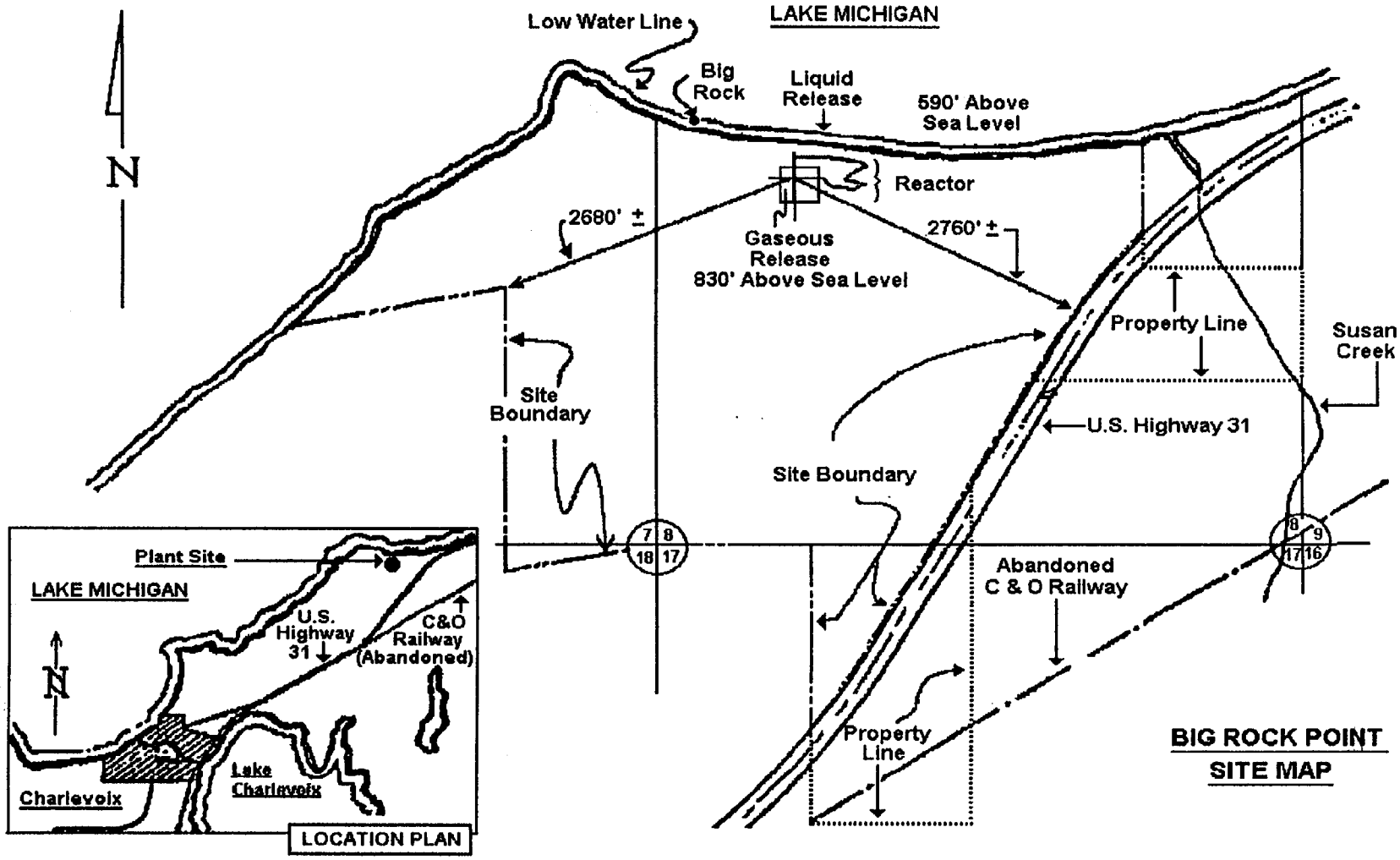
TABLE 2.2

BIG ROCK POINT DESIGN OBJECTIVE ANNUAL QUANTITIES FOR LIQUID EFFLUENTS AS DETERMINED BY *LADTAP

Nuclide	Dose Conversion Factors (mrem/Ci)	Individual/Organ	Design Objective Annual Quantity (Curies)
H-3	5.72E-06	Adult/TB	5.24E+05
Sc-46	3.04E-02	Teen/TB	9.87E+02
Mn-54	2.05E-01	Adult/GI(LLI)	4.88E+01
Fe-55	1.34E-02	Child/Bone	7.46E+02
Co-57	6.85E-03	Teen/TB	4.38E+02
Co-58	1.70E-02	Teen/TB	1.76E+02
Co-60	7.09E-01	Teen/TB	4.23E+00
Zn-65	5.23E-01	Child/TB	5.74E+00
Sr-89	4.72E-01	Child/Bone	2.12E+01
Sr-90	8.16E+00	Adult/Bone	1.23E+00
Zr-95	9.34E-03	Teen/TB	3.21E+02
Ag-110m	1.16E-01	Teen/TB	2.59E+01
Cd-113m	1.80E-01	Adult/GI(LLI)	5.56E+01
Sb-124	2.28E-02	Teen/TB	1.32E+02
Sb-125	7.66E-02	Teen/TB	3.92E+01
Te-127m	4.18E-01	Teen/Kidney	2.39E+01
Cs-134	8.54E+00	Adult/TB	3.51E-01
Cs-137	5.08E+00	Adult/TB	5.91E-01
Ce-144	9.98E-03	Adult/GI(LLI)	1.00E+03
Eu-152	4.86E-01	Teen/TB	6.17E+00

* Based on a constant dilution flow rate of 20,000 gpm for isotopes with > 50 day half-life.

FIGURE 2.2


LAKE MICHIGAN
Low Water Line
Big Rock
Liquid Release
590' Above Sea Level
N
Reactor
2680' ±
2760' ±
Gaseous Release
830' Above Sea Level
Property Line
Susan Creek
Site Boundary
U.S. Highway 31
Site Boundary
7 8
18 17
8 9
17 16
Abandoned C & O Railway
Property Line
BIG ROCK POINT
SITE MAP
Plant Site
LAKE MICHIGAN
U.S. Highway 31
C&O Railway (Abandoned)
N
Lake Charlevoix
Charlevoix
LOCATION PLAN

3.0 URANIUM FUEL CYCLE DOSE

3.1 SPECIFICATION

In accordance with Action 3.2 of ODCM Section I, if either liquid or gaseous quarterly releases exceed the quantity which would cause offsite doses more than twice either of their specified limits, then the cumulative dose contributions from combined release plus direct radiation sources (from the reactor unit and radwaste storage tanks) shall be calculated. This calculation is performed to ensure that the annual (calendar year) dose or dose commitment to any member of the public is ≤25 mrem to the total body or any organ, except the thyroid, which shall be ≤75 mrem. The dose is to be determined for the member of the public projected to be the most highly exposed to these combined sources. If the results of this calculation show the dose to exceed either the 25 or 75 mrem limit, a special report shall be prepared and submitted to the Commission within 30 days, as described by Action 3.2. of ODCM Section I.

3.2 ASSUMPTIONS

3.2.1 The full time resident determined to be the 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 ODCM Section II, parts 2.3.4.a. and 2.3.4.b. (input parameters are summarized in Table 2.2).

3.2.2 Amount of shoreline 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 18 hours for the first quarter.

3.2.3 The dose contribution due to uranium fuel cycle sources other than the plant is ignored in the calculation. This is based on the lack of any operations that fall in the "cycles" definition within a 5 mile radius of Big Rock Point.

3.3 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 or optionally, by conservatively multiplying the mrem/Ci factors of Tables 1.9 and 2.2 by quantity released. Doses to like organs and total body shall be summed (organs are conservatively summed with total body when Tables 1.9 and 2.2 are utilized). Added to this sum will be a mean dose rate, calculated or measured for the shoreline due to the plant during the quarter in question, times the assumed fishing time:

$$D_{40_i} = D_G + D_L + (R_T)(T) \qquad \text{(III.1)}$$

Where:

D_{40_i} = 40 CFR 190 dose to organ (i) (mrem).

D_G = Cumulative dose to an individual organ from gaseous releases (mrem).

D_L = Cumulative dose to an individual organ from liquid releases (mrem).

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

T = Assumed shoreline fishing time for the quarter in question (hours) (see 3.2.2 above).

NOTE: For this calculation, the total body is conservatively assumed to be an additional organ.

ODCM SECTION III

REPORTING AND MAJOR MODIFICATION REQUIREMENTS

1.0 RADIOLOGICAL EFFLUENT RELEASE REPORT

The Radioactive Effluent Release Report shall be submitted in accordance with 10CFR50.36a by May 1 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 10CFR50.36a and Section IV.B.1 of Appendix I to 10CFR50.

1.1 ESTIMATE OF UNCERTAINTY

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.

Estimates for liquid releases 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 liquid radwaste tank or other liquid effluent source. The error term for particulates released to the atmosphere will be based on the counting statistics for one stack or other release point effluent sample taken during the year.

The report shall include an estimate of the lower level of detection (in uCi/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 gamma emitting isotopes listed in Appendix B of Regulatory Guide 1.21 (June 1974) and will be provided based on a typical background spectrum.

1.2 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 periods of the releases.

b. Abnormal Releases

The number of abnormal releases and number of curies of radioactive material released to the environment during abnormal releases should be reported.

1.3 GASEOUS EFFLUENTS

a. Gases

1) Total curies of fission and activation gases released.

2) Average release rates (uCi/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 (all plant contributions will be zero in 1998 and beyond)

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

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

3) Percent of limit for I-131/133.

c. Particulates

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

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

3) Percent of limit for radioactive material in particulate form with half-lives greater than eight 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 of plant origin determined to be released.

d. Tritium

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

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

3) Percentage of applicable limits for tritium.

1.4 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 (uCi/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 (uCi/ml) of tritium 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.

c. Dissolved and/or Entrained Gases

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

2) Average concentrations (uCi/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) Quarterly sums of total curies for each of the gaseous radionuclides determined to be released in liquid effluents based on analyses performed.

d. Alpha Radioactivity

Total curies of gross alpha-emitting materials of plant origin 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.

1.5 SOLID WASTE

The Radioactive Effluent Release Reports shall include the following information for each class of solid waste (as defined by 10 CFR Part 61) shipped offsite during the report period:

a. Container burial volume,

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

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

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

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

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

1.6 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 of ODCM Section II.

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

b. 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.

1.7 ODCM CHANGES

The Radiological Effluent Release Report shall include any changes made during the reporting period to the Offsite Dose Calculation Manual (ODCM), including identification of new locations for dose calculations and/or environmental sampling (ODCM Section II, Table 1.4 and ODCM Section I, Table I.H-1, respectively).

2.0 RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

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

The Radiological Environmental Operating Report shall include summaries, interpretation and statistical evaluation of the results of the radiological environmental surveillance activities for the report period, including a comparison with previous environmental surveillance report data of similar type and an assessment of the observed impacts of the Plant operation on the environment. During the first year following permanent shutdown, the report also shall include the results of any land use census taken during the previous year.

The Annual Radiological Environmental Operating Report shall include summarized and tabulated results in the format of Table III-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 report also shall provide a summary description of the environmental monitoring program and a map depicting sample locations.

3.0 NONROUTINE REPORTS

A report shall be submitted to the NRC in the event that:

a. The Radiological Environmental Monitoring Program is not substantially conducted as described in ODCM Section I.4.

b. Dose to an offsite individual is estimated to have exceeded the requirements of 40 CFR Part 190, per ODCM Section I.3.

c. An unusual or important event occurs due to plant operations that causes a significant radiological environmental impact or affects a potential environmental impact.

d. Nonroutine reports shall be submitted within 30 days of determining that an event has occurred to require such report.

4.0 MAJOR MODIFICATION OF RADIOACTIVE WASTE SYSTEMS

4.1 LICENSEE MODIFICATIONS:

4.1.1 Major modifications of the radwaste system, as defined in 4.2.2 below, shall be reported to the NRC pursuant to 10 CFR 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 10 CFR 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 NRC.

4.1.2 Shall become effective upon review and acceptance by the Site General Manager.

4.2 DEFINITION OF MAJOR RADWASTE SYSTEM MODIFICATION

4.2.1 Purpose

The purpose of this definition is to assure that modifications (including removal) of radwaste systems during decommissioning do not increase the potential for dose due to effluents to exceed the quarterly or semiannual limits of Specifications 1.3 or 2.3, ODCM Section 1 or to reduce capabilities of radwaste treatment to below 2% of the annual limit on a monthly basis, if the installed equipment were capable of meeting this level of release. Note that the 2% per month specification has not been in effect prior to decommissioning, so current system capabilities to meet this 2% per month level are not yet documented.

4.2.2 Definition

A major radwaste system modification is a modification which would cause reduction in effluent treatment such that the system would be unable to meet the quarterly or semiannual offsite dose limits of Specifications 1.3 (airborne release) or 2.3 (liquid release), ODCM Section I. In addition, a major modification would be determined by inability of new equipment or techniques to maintain effluents below 2% of the annual limits in a month, provided that the original equipment would have been capable of meeting that goal. A major modification is not deemed to have occurred for removal of a system no longer utilized for waste treatment, such as, but not limited to:

a. Offgas system (including offgas decay line) following final plant shutdown.

b. Fuel pool cleanup system following fuel removal, with pool cleaned and placed in layup condition.

c. Any other systems whose normal feed or effluent path is taken out of service or reduced by the decommissioning process to the extent that plant effluents do not exceed 2% of the Appendix I limits in any 31 day interval.

Improvements or additions to improve efficiency shall not be considered major modifications.

APPENDIX A

DISCHARGE CANAL DREDGING COMMITMENTS AND REPORTING REQUIREMENTS

NOTE: This appendix provides a currently licensed, albeit very cumbersome, method of "disposing" of canal dredging spoils. At decommissioning, disposal sites such as one generated by this activity, are required to be decommissioned along with the remainder of the site. Subpart E criteria for unrestricted site release provides less restrictive release criteria than this commitment (25 mrem/yr for the site vs 1 mrem/yr for the spoils), but whether the requirement for decommissioning of the spoils disposal site overrides the plant site decommissioning rules is not known. It would appear that direct shipment of dredging spoils for disposal at a licensed facility would be more practical than going through the process defined this appendix if the ultimate destination were required to be the same. However, any approach other than this specific one will require discussions with, and possibly approval by, NRC (and probably revision of the Corps of Engineers dredging permit).

APPENDIX A
DISCHARGE CANAL DREDGING COMMITMENTS AND REPORTING REQUIREMENTS

I. COMMITMENTS AND REPORTING REQUIREMENTS

Commitments related to Discharge Canal Dredging are given in the CPCo December 29, 1989 Application for Disposal of Dredged Discharge Canal Sediment and in the NRC Safety Evaluation dated August 31, 1990.

I.A COMMITMENTS

I.A.1 Prior to dredging the canal, radionuclide concentrations and environmental exposure pathway doses must be evaluated in a manner equivalent to that described in the CPCo December 29, 1989 application.

This evaluation must include a comparison of resultant doses with the following NRC staff guidelines for onsite disposal:

1. The radioactive material should be disposed in a manner such that it is unlikely that material would be recycled.

2. Doses to the total body and any body organ of the maximally exposed individual (a member of the general public or a non-occupationally exposed worker) from the probable pathways of exposure to the disposed material should be less than 1 mrem/yr.

3. Doses to the total body and any body organ of an inadvertent intruder from the probable pathways of exposure should be less than 5 mrem/yr.

4. Doses to the total body and any body organ of an individual from assumed recycling of the disposed material at the time the disposal site is released from regulatory control from all likely pathways of exposure should be less than 1 mrem.

I.A.2 The dredging spoils will be thoroughly surveyed using a gamma-sensitive instrument prior to release for public use.

Release for public access will be contingent upon confirmation that post-disposal area dose rate has not increased above pre-disposal area background, as defined by criterion that pre- and post-disposal levels vary by not more than 25%. The value of 25% allows for temporal variations observed in monthly environmental TLD background data.

APPENDIX A
DISCHARGE CANAL DREDGING COMMITMENTS
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I.A.3 Quality Control surveillance will be performed to ensure the dredge material is deposited in the location specified in the Dredging Permit and is graded accordingly.

I.A.4 Confirmatory measurements of the dredged materials will be recorded after the dredgings are land-spread.

I.B REPORTING REQUIREMENTS

I.B.1 If the NRC staff guidelines in I.A.1 cannot be met, a new application per 10 CFR 20.2002 must be submitted for the disposal.

I.B.2 Should the measurement of I.A.2 and I.A.4 indicate that the levels of radioactivity measured in the pre-operational (pre-dredging) sediment samples were significant underestimates (greater than 25%) of the actual radioactivity of the dredging spoils, CPCo will notify the NRC. The NRC will then reassess possible radiation doses and require appropriate remedial actions as appropriate.

II. PRE-DREDGING REQUIREMENTS

Mechanical dredging of Big Rock Point's Discharge Canal introduces a potential of re-releasing radionuclides absorbed on sediment to the environment in a manner not already accounted for in release records.

II.A Disposal of dredging spoils by relocation from the plant discharge canal to an unrestricted area onshore as specified by Corps of Engineers Permits Numbers 88-56-143 and 87-56-185 has been reviewed in the approved NRC Safety Evaluation dated August 31, 1990. If a new permit is to be used for dredging, review the permit requirements to ensure no unreviewed exposure pathway has been created.

II.B Prior to dredging the canal, a minimum of 10 sediment samples should be collected. The distribution of the sample points should be representative of the area to be dredged. Sediment sample collection should be coordinated with plant operations to ensure there are no radioactive liquid batch releases during or within the 24 hours previous to sediment sampling.

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DISCHARGE CANAL DREDGING COMMITMENTS
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II.B.1 The concentration and total activity of the material to be dredged will be determine for each isotope identified in the sediment samples. Results of semi-annual sediment samples taken from the canal discharge since the time of the previous canal dredging may be used to aid in evaluation of the sediment activity below the immediate surface.

II.B.2 These expected activity concentrations will be compared to the activities given in Table A-1 and will be used as the basis for comparison to the total exposures given in Table A-2.

II.C If any isotopes not listed above are present in the sediment samples, the dose contribution from these isotopes must be determined for all exposure pathways in a manner equivalent to the calculations used in the December 29, 1989 application which are outlined in Section V.

II.D The calculated doses will be compared to the NRC staff guidelines given in Section I.A.1. If any of these guidelines cannot be met, the disposal of the particular dredging will be deemed to be outside the scope of the 10 CFR 20.302 review already approved by the NRC in the Safety Evaluation dated August 31, 1990. In this event, a new application for disposal will be submitted to the NRC for this particular dredging or an alternative disposal method will be pursued.

II.E A pre-dredging survey of the disposal area should be provided no more than ten days prior to dredging to provide a baseline for comparison to post-dredging survey.

II.F Dredging operations should be coordinated with plant operations to ensure no liquid batch releases within 24 hours prior to dredging and no liquid batch releases during the time period of the dredging.

III. POST-DREDGING REQUIREMENTS

III.A A post-dredging survey of the area should be provided no more than 10 days after the spoils are land-spread. Should these measurements indicate the activity in the disposal area has increased greater than 25% of the pre-dredging activity, the NRC will be notified.

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III.B Sediment samples will be analyzed and recorded as confirmatory measurements of the dredged materials after the dredgings are land-spread. Should these measurements indicate that the levels of radioactivity measured in the pre-operational (pre-dredging) sediment samples were significant underestimates (greater than 25%) of the actual radioactivity of the dredging spoils, the NRC will be notified. The NRC will reassess possible radiation doses and require remedial actions as appropriate.

IV. DOCUMENTATION REQUIREMENTS

Records of survey and sampling results shall be maintained until the NRC authorizes disposition.

V. EVALUATION OF THE RADIOLOGICAL IMPACTS OF SEDIMENT DISPOSAL

Potential dose pathways due to dredging and disposing of sediment from the BRP Discharge Canal include:

1. External dose from the sediment during dredging,
2. Groundshine in the disposal area,
3. Inhalation of re-suspended isotopes from dried sediment blown by the wind,
4. Dose from assumed infiltration and contamination of groundwater, and
5. Internal dose from ingestion of food grown on the disposal site.

The maximum dose to workers will be to those workers involved in grading the sediment in the disposal area during the dredging operations. The dose to these workers is determined as groundshine in the disposal area (exposure pathway 2).

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Dose from assumed infiltration and contamination of groundwater is of minimal concern in this case on the basis of location adjacent to Lake Michigan. There are no wells in either potential disposal area or between the disposal area and Lake Michigan (direction of groundwater flow). Exposure to the general public from activity released to Lake Michigan via this pathway is accounted for in Big Rock Point Semiannual Radioactive Effluent Release Reports based on data at the time of the original liquid radioactive releases from which the dredged activity is derived. The activity absorbed on the sediment removed from the canal and re-released to Lake Michigan via this pathway will not increase those original exposure estimates. Even though these doses have been accounted for previously, estimates due to potential radionuclide release from the spoils is included in radiological impact calculations.

Internal exposure from ingestion of food grown on the disposal site is not of concern due to lack of nutrient content within this washed stone/gravel/sand mixture. The disposal sites also are unprotected from harsh offshore winds. Cultivatable vegetation is not supported in either area.

Conservative calculations of external exposure during dredging, liquid pathways, groundshine in the disposal area, and inhalation of dried windblown sediment are detailed below.

V.A External Dose from the Sediment during Dredging and Groundshine in the Disposal Area

1. Assume the worker is exposed a total of 24 hours.

2. The disposal area may be part of a nature trail open to the public.

3. Assume time spent on the nature trial is half the average time spent for shoreline recreation (per Regulatory Guide 1.109).

   Child 7 hr/yr
   Teen 34 hr/yr (this is taken as maximum public exposure time)
   Adult 6 hr/yr

4. It is reasonable to assume plant personnel using the trail for walks during work breaks also will frequent the area often.

   t = 2 walks/day x .25 hr/walk x 5 days/week x 50 week/yr
   t = 125 hr/yr

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However; due to weather conditions, the trails will be accessible only three months per year.

t = 31 hr/yr (since this is not as long as the teen usage time calculated above, the 34 hours for teen exposure is used for dose to public.)

Using methods and parameters described in Regulatory Guide 1.109, the dose D_J^G (r, 0) to the worker is given as:

$$D_J^G (r, 0) = 24 \text{ hours SF} \sum_i C_i^G (r, 0) DFG_{ij}$$

Where C_i is in [pCi/m²]

DFG = open field groundplane dose conversion factor [mrem-m²/pCi hr].

Valves of DFG are given in ODCM Table 1.8.

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SF = Shielding Factors

The thickness of sediment graded out in the disposal area will range from 2 to 4 inches. Assuming the minimal shielding (ie. 2 inch thickness), there will be approximately 1 inch of sediment as shielding.

From American Institute of Steel Construction (AISC) Manual of Steel Construction 7th Edition

ρ dry sediment = 90 to 105 lb/ft^3 for excavated sand and gravel

dry and loose

taking ρ dry sediment as 98 lb/ft^3 => ρ = 1.57 g/cc

$(\mu/\rho)^{Co60}$ = 0.0578 cm^2/g $\quad$ dry sediment

μ dry sediment = 1.57 g/cc x 0.578 cm^2/g

μ dry sediment = 9.07E-02 cm^{-1}

$SF = e^{-\mu x} = e^{-9.07E-02/cm\ (2.54\ cm)}$

SF = 0.79

C_i = ground activity [pC_i/m^2]

= activity [pC_i/g] x ρ dry sediment [g/cc] x 10^6 cc/m^3 x thickness of layer (2" or 5.08E-02 m)

C_i [pC_i/m^2] = 7.98E+04 x activity [pC_i/g]

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Assuming dredging is performed annually and each year the new sediment is deposited and spread to two inches over the previous sediment, the groundshine exposure each year will increase as

total D_J^G year two = D_J^G year one $Be^{-\lambda(1\ yr)}e^{-\mu(2")}$ + D_J^G year two

total D_J^G year three = D_J^G year one $Be^{-\lambda(2\ yr)}e^{-\mu(4")}$

+ D_J^G year two $Be^{-\lambda(1\ yr)}e^{-\mu(2")}$ + D_J^G year three

etc

But D_J^G year n = D_J^G year one

Therefore

$$\text{total } D_J^G \text{ year ten} = D_J^G \text{ year one} \sum_{n=1}^{10} e^{-\lambda(n-1)}\ e^{-\mu(2")(n-1)}\ B[2(n-1)\mu]$$

The accumulative dose each year will increase as

$$D_J^G \text{ year } x = \sum_{n=1}^{X} D_J^G \text{ year } n$$

$$B = \text{Buildup} = 1 + a\ (\mu X) + b\ (\mu X)^2 + c\ (\mu X)^3$$

Where for	Mn54	a = 1.04	b = 0.21	c = 0
	Co60	a = 0.78	b = 0.08	c = 0
	Cs134	a = 1.07	b = 0.28	c = 0
	Cs137	a = 1.07	b = 0.14	c = 0

Doses to the most exposed member of the public (teen exposed 34hrs/yr) are 34/24 = 1.42 times the worker doses.

Buildup factors for gamma emitters not listed above can be obtained using the Table A-3.

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V.B Inhalation of Re-Suspended Isotopes from Dried Sediment Blown by Wind

Using methodology of Regulatory Guide 1.109, the annual organ dose from inhalation of radionuclides in air is:

$$D^{A}_{ja}(r,0) = R_a \sum_{1} x_i (r,0)\, DFA_{ija}$$

Where DFA_{ija} = inhalation dose factor [mrem/pC_i]

Values of DFA given in ODCM Table 1.7.

Ra = annual intake for individual [m^3/yr]

Ra infant = 1400 m^3/yr
Ra child = 3700 m^3/yr
Ra teen, Ra adult = 8000 m^3/yr

X_i = annual average concentration of radionuclide in air [pC_i/m^3]

From Mark's Standard Handbook for Mechanical Engineers (page 18-12). The amount of suspended matter in normal city air = 1.37 mg/m^3 and the amount of suspended matter in manufacturing plant = 4.58 mg/m^3

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Using the value for suspended matter in normal city air would be conservative considering that fresh clean air blows off Lake Michigan across the disposal site to re-suspend isotopes from the dried sediment. Assuming a gentle breeze throughout the year since individuals would not remain in the area if higher winds blowing the sand were present. For added conservatism the value for suspended matter in a manufacturing plant is used.

The maximum time an individual would be in the area is 260 hours/yr as determined for fisherman by the discharge canal (RAE 81-53). Therefore the annual intake for each individual is reduced by the factor f.

$$f = \frac{260 hr/yr}{8760 hr/yr}$$

$$f = 0.03$$

Then,

$$X_i\ [pC_i/m^3] = 4.58\ mg/m^3 \times .001\ g/mg \times activity_i\ [pC_i/gm] \times .03$$

V.C Dose from Infiltration and Contamination of Groundwater

There are no wells in or near the disposal sites.

Ground water flow is toward Lake Michigan at a rate of 0.05 ft/day (per FHSR).

The distance from the nearest edge of the west side disposal site (Permit Number 87-56-185) to Lake Michigan is ~14 ft.

The distance from the nearest edge of the east side disposal site (Permit Number 88-56-143) to Lake Michigan is 25 ft.

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The retention time for radionuclides deposited at the west side disposal site is:

14 ft ÷ 0.05 ft/day = 280 days minimum

and for the east side disposal site is:

25 ft ÷ 0.05 ft/day = 500 days minimum

In the interest of conservatism, we assume all the radionuclides from a single dredging will be released from the disposal area into Lake Michigan, 280 days after dredging.

Dose calculational methods from the Big Rock Point Radiological Effluents Technical Specifications ODCM for liquid effluents are used to determine the annual dose to individuals exposed via this pathway.

The total dose from this pathway is calculated in the 1989 10 CFR 20.302 Submittal, using the ratio of annual DBQ fraction representing activity of dredging to annual DBQ fraction representing total annual liquid release activity. This fraction is used to determine total exposure based on the annual liquid effluent exposure determined using the LADTAP code.

$$\text{Dose from dredging}^2 \quad \frac{\text{DBQ dredging}}{\text{DBA annual release}} \quad \text{annual liquid dose from LADTAP}$$

This method is conservative. A more accurate method to estimate dose from infiltration and contamination of ground water is provided in ODCM Section II C for all liquid exposure pathways.

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TABLE A-1: RADIOLOGICAL PROPERTIES OF SEDIMENT (pC_i/gm)

NUCLIDE	VARIATION (MIN) TO (MAX)	AVERAGE	VARIANCE(S)	TOTAL † ACTIVITY (mC_i)
Sr 90	0-0.108	0.015	0.032	0.001
Mn 65	0-1.996	0.202	0.312	0.147
Co 60	0-4.904	0.431	0.785	0.314
Cs 134	0-0.070	0.001	0.002	0.001
Cs 137	0.170-1.583	0.605	0.309	0.441
Gross Beta*	5.90-17.50	9.696	3.225	7.07

* Average Gross Beta at control sampling location (Ludington) = 8.19 with variance of 3.07 [pC_i/gm wet]. Therefore, no unidentified beta emitters present. Dose due to beta activity is taken into account in dose calculations for specific isotopes.

† Total Activity = Average Concentration (pC_i/gm wet) x max mass excavated (gm) x ($1mC_i/10^9$ pC_i).

Assuming 500 cubic yards excavated with density of 119 lb/ft³ (density of excavated sand, gravel wet = 118 to 120 lb/ft³ per AISC Manual of Steel Construction 7th Edition)

Max mass excavated = 500 cu yard (27 ft³/cu yard) 119 lb/ft³ x

(453.592 g/lb) = 7.29E+08 gm.

These analyses include samples taken annually from 1985 through 1989 as part of Big Rock Point's Radiological Environmental Monitoring Program as well as ten (10) samples taken in June 1989 to ensure samples are representative of activity distributed throughout the canal. The results of these analyses provide a conservative estimate of the activity which may be contained in the sediment at the time of dredging. The total activity of the sediment is based on the average activity concentration encountered in surface samples (see Appendix 1). Sediment samples exclude stones larger than approximately 1/2 inch in diameter. Since the discharge area (and adjacent lake shore) is predominately rock and cobble stone which does not entrain radioactivity of plant origin, these sediment values are much higher than actual average surface concentration.

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TABLE A-2: RADIOLOGICAL IMPACT OF SEDIMENT DISPOSAL - SUMMARY OF VALUES CALCULATED IN APPENDIX 2

Exposure Pathway	Dose Due to Single Dredging (mrem/yr)	Integrated Dose Due to Annual Dredging through 1998 (mrem)
External Dose to Sediment During Dredging (worker)	2.13E-02	5.83E-01
External Dose Due to Groundshine in the Disposal Area (public)	3.02E-02	8.27E-01
Internal Dose Due to Inhalation of Resuspended Isotopes	8.67E-04	8.67E-03
Dose from Assumed Infiltration and Contamination of Groundwater	3.33E-03	3.33E-02
Total Dose	5.57E-02 mrem* first year	1.44 mrem/10 yrs

*NOTE: The total dose is extremely conservative since no individual will receive the total dose from each pathway.

NRC did not include external dose to sediment during dredging (worker) in the totals approved in the Safety Evaluation dated August 31, 1990. Total doses to the general public of 3.57E-02 mrem/year and 8.57E-01 mrem/ten years were accepted.

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TABLE A-3: BUILDUP FACTOR PARAMETERS

Average Gamma Energy (MeV)	PARAMETER		
	A	B	C
0.5	1.10	0.385	0
1.0	1.02	0.122	0
2.0	0.76	0.046	0
4.0	0.55	0.008	0
6.0	0.52	0.007	0
8.0	0.33	0.006	0
10.0	0.28	0.006	0

These valves are based on results from MLTobias, DRVondy, and MPLietzke; Nightmare Program; Oak Ridge National Laboratory, February 26, 1972. Parameter valves have been interpolated for concrete (z of material = 11).

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TABLE III-1

Environmental Radiological Monitoring Program Summary

Name of Facility _____ Docket No _____
Location of Facility _____ Reporting Period _____
(County, State)

Medium or Pathway Sampled (Unit of Measure)	Type/Total No. of Analyses Performed	Lower Limit of Detection [a] (LLD)	All Indicator Locations Mean (f)[b] Range[b]	Location Name Distance and Direction	Mean (f)[b] Range[b]	Control Locations Mean (f)[b] Range[b]	Number of REPORTABLE OCCURRENCES
Air Particulates (pCi/m^3)	Gross Beta 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
	Gamma 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/g) Wet weight	Gamma Spec 8						
	Cs-137	80	<LLD	--	<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 Note a. of Table I.E-1

[b] Mean and range based upon detectable measurements only. Fraction of detectable measurements at specific locations in parens (f).

Note: Example data are provided for illustrative purposes only. Types of data illustrated here are applicable to type of samples required during the first 150 days post shutdown.

ATTACHMENT 7
3 Pages

Consumers Energy
Big Rock Point

RADIOACTIVE EFFLUENT RELEASE REPORT

PROCESS CONTROL PROGRAM (PCP)

Revision 22

1.0 PROGRAM OVERVIEW

The Process Control Program (PCP) is intended to provide a general description of methods for controlling the processing and packaging of radioactive waste for burial. Regardless of the waste class, the resulting waste form when shipped for burial shall meet the following requirements:

1. Waste must be packaged in containers acceptable to the burial site as designated in the waste acceptance criteria.

2. The packaging or waste shall not contain any liquid except as allowed by the disposal site license and waste acceptance criteria.

3. Waste must not contain or be capable of generating, quantities of toxic gases, vapors or fumes harmful to persons transporting, handling or disposing of the waste.

4. Waste must not be pyrophoric. Pyrophoric materials in waste shall be treated, prepared and packaged to be nonflammable.

5. Waste containing hazardous, biological, pathogenic or infectious material must be treated to reduce the potential hazard from the non-radiological materials and be acceptable to the burial site as designated by the waste acceptance criteria.

For Class B and C waste, the waste form should maintain gross physical properties and identity over a 300 year period. To ensure that Class B and C wastes maintain stability, the following minimum conditions should be met:

1. The waste should be a solid form or in a container or structure that provides stability after disposal.

2. The waste or packaging shall not contain any liquid except as authorized by the disposal site license.

3. The waste or container should be resistant to degradation caused by radiation effects.

4. The waste or container should remain stable under the compressive loads inherent in the disposal environment.

5. The waste or container should remain stable if exposed to moisture or water after disposal.

6. The as generated waste should be compatible with the stabilization medium or container.

2.0 WASTE STABILIZATION

Radioactive waste may be inherently stable, or may be stabilized by solidification, encapsulation or use of a High Integrity Container (HIC).

2.1 Inherently stable waste is generally associated with activated or irradiated steel or concrete. The waste shall be packaged as required by the disposal site waste acceptance criteria. Additionally, contact will be made with the disposal site to ensure acceptance of the inherently stable waste classification.

2.2 If solidification or encapsulation of waste is required, the processing of the waste and tests for acceptable solidification/encapsulation shall be documented in procedures specific to the intended method.

2.3 HIC's are generally used for providing stability of waste streams including resin, filter media and non inherently stable waste, such as highly contaminated metals. General criteria for selection and use of a HIC for stability include:

1. The HIC is acceptable for use at the disposal facility.

2. The HIC is used in accordance with the applicable certificate of compliance issued for the HIC.

3. The HIC is acceptable to the operator of the disposal facility and an engineered barrier is available, if required.

4. For HIC's potentially containing liquids, such as resin and filter HIC's, the HIC shall be dewatered and acceptable dewatering testing shall be documented in an approved procedure. After acceptable dewatering has been completed, absorbent or filler material may be added to HIC's to prevent shifting of waste in the container during transport.

3.0 WASTE CLASSIFICATION

3.1 Waste sampling and classification procedures shall be sufficient to identify the actual activities in the waste form within a factor of 10. If scaling factors are used to establish, the scaling factors will be established at the following frequencies.

3.2 Scaling factors for activated components shall be decay corrected to within 6 months of the expected disposal date. After initial determination, no significant additional neutron irradiation will occur to increase the waste stream specific activity.

3.3 For Dry Active Waste, including demolition debris and system components, the scaling factor will be verified every 2 years or if a significant isotopic ratio shift is suspected to have occurred. Big Rock Point has undergone systems decontamination and all normally radioactive systems are assumed to contain the same isotopic make up.

3.4 For liquid waste system filters, the scaling factors will be verified every two years or if a significant isotopic ratio shift is suspected to occur. The major source of liquids at Big Rock Point is the spent fuel pool. Sampling of the spent fuel pool filters is assumed to be representative of the filter waste streams.

3.5 For liquid waste system resins, the scaling factors will be verified for each resin shipping campaign, which is expected to occur on an infrequent basis due to the limited quantity of resin being produced.

3.6 Documentation of the waste stream analysis, waste form and scaling factor determination will be maintained by the Big Rock Point RP&ES section.

4.0 CONTRACTED VENDOR SERVICES

4.1 Vendors used for processing of waste streams shall be selected from the Consumers Energy Approved Suppliers List.

5.0 RADIOACTIVE LIQUID WASTE SYSTEM DESCRIPTION

5.1 The plant liquid radwaste system consists of pumps, piping or hoses, tanks, temporary filters, and temporary demineralizers. The system is designed to process water to levels to allow discharge to the environment.

5.2 Resins and filter media from system operation may be packaged and shipped off site for processing by an approved vendor or dewatered/dryed and shipped off site for disposal at an approved disposal site.