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May 15, 2006

Re: Indian Point Unit 3
Docket No. 50-286
NL-06-056

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop O-P1-17
Washington, DC 20555-0001

Subject: Indian Point Unit 3 Offsite Dose Calculation Manual (ODCM)

Dear Sir:

Enclosed is the ODCM, Revision 17 for Indian Point Unit 3 as required by Technical Specifications Section 5.5.1.c.3. Indian Point Unit 2 ODCM, Revision 9 was sent to the NRC via the IPEC Documents Group (ML052770533).

There are no new commitments being made in this submittal.

If you have any questions or require additional information, please contact Patric W. Conroy, Manager, Licensing at (914) 734-6668.

Sincerely,

Patric W. Conroy
Manager, Licensing
Indian Point Energy Center

Enclosure #1 – Indian Point 3 ODCM, Rev. 17

cc: see next page

A009

cc: Mr. Samuel J. Collins, Regional Administrator, NRC Region I
Mr. John P. Boska, Senior Project Manager, NRC NRR DORL
NRC Resident Inspectors Office, IPEC

ENCLOSURE 1 TO NL-06-056

Indian Point 3 ODCM

ENTERGY NUCLEAR OPERATIONS, INC.
INDIAN POINT NUCLEAR GENERATING UNIT NO. 3
DOCKET NO. 50-286

Entergy Nuclear Northeast

Indian Point 3

TITLE: OFFSITE DOSE CALCULATION MANUAL

(ODCM)

Rev. 17

WRITTEN BY: Steve Sandato 7-6-5

REVIEWED BY: [signature] 7/7/05

OSRC REVIEW: Mtg No 05-019 [signature] 7-14-05

APPROVED BY: [signature] 9/20/05

EFFECTIVE DATE: 9-21-05

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INDIAN POINT 3

OFFSITE DOSE CALCULATION MANUAL

PART I

RADIOLOGICAL EFFLUENT CONTROLS

(RECS)

Revision 17

1.0 DEFINITIONS

****

NOTE:
Common definitions are found in Technical Specifications Section 1.1.
In addition, the following specific terms are defined below.

****

1.1 GASEOUS RADWASTE TREATMENT SYSTEM

A GASEOUS RADWASTE TREATMENT SYSTEM is any system designed and installed to reduce radioactive gaseous effluents by collecting primary coolant system offgases from the primary system and providing for delay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.

1.2 MAXIMUM PERMISSIBLE CONCENTRATION WATER (MPCW)

MPCW is that concentration of a radionuclide equal to 10 times the liquid EFFLUENT CONCENTRATION(s) specified in column 2, Table 2 of Appendix B to 10CFR20.

1.3 MEMBER(S) OF THE PUBLIC

MEMBER(S) OF THE PUBLIC means any individual who is not occupationally associated with the plant. Excluded from this category are utility employees, its contractors or vendors, and delivery or service personnel. Included in this category are persons using the site for recreation or occupation not associated with the plant.

1.4 OFFSITE DOSE CALCULATION MANUAL (ODCM)

The OFFSITE DOSE CALCULATION MANUAL shall contain the current methodology and parameters used in the calculation of offsite doses resulting from radioactive gaseous and liquid effluents, in the calculation of gaseous and liquid effluent monitoring Alarm/Trip Setpoints, and in the conduct of the Radiological Environmental Monitoring Program. The ODCM shall also contain (1) the Radioactive Effluent Controls (RECS) and Radiological Environmental Monitoring Programs (REMP) required by Technical Specification 5.5.1 and 5.5.4 and (2) descriptions of the information that should be included in the Annual Radiological Environmental Operating and Radioactive Effluent Release Reports required by Technical Specifications 5.6.2 and 5.6.3.

1.6 PRIMARY TO SECONDARY LEAK

A PRIMARY TO SECONDARY LEAK is defined by a quantifiable leak rate equal to or greater than 0.5 gpd, AND

a) The presence of fission or activation products in the secondary fluid, verified as Steam Generator U-tube leaks (and not from other known contamination, such as IVSWS leaks), OR

b) Tritium activity in the secondary fluid indicating an increase above historical baseline (normal diffusion) of 5.00E-6 uCi/ml or greater.

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1.6 PROCESS CONTROL PROGRAM (PCP)

The PROCESS CONTROL PROGRAM shall contain the current formulas, sampling, analyses, tests, and determinations to be made to ensure that the processing and packaging of solid radioactive wastes based on demonstrated processing of actual or simulated wet solid wastes will be accomplished in such a way as to assure compliance with 10 CFR Parts 20, 61 and 71 and Federal and State regulations and other requirements governing the disposal of solid radioactive waste. The PCP is further described in RECS 5.5.

1.7 PURGE - PURGING

PURGE or PURGING is the controlled process of discharging air or gas from a confinement in such a manner that replacement air or gas is required to purify the confinement.

1.8 SITE BOUNDARY

The SITE BOUNDARY (ODCM Part II, Figure 1-1) means that line beyond which the land or property is not owned, leased, or otherwise controlled by either site licensee.

1.9 SOURCE CHECK

A SOURCE CHECK shall be the qualitative assessment of channel response when the channel sensor is exposed to a source of increased radioactivity.

1.10 UNRESTRICTED AREA

An UNRESTRICTED AREA (ODCM Part II, Figure 1-1) means an area at or beyond the SITE BOUNDARY, access to which is neither limited nor controlled by the licensee for purposes of radiation protection, or a similarly uncontrolled area within the SITE BOUNDARY that is used for residential quarters or for industrial, commercial, institutional, and/or recreational purposes.

1.11 VENTILATION EXHAUST TREATMENT SYSTEM

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

2/3.0 RADIOLOGICAL EFFLUENT CONTROLS AND SURVEILLANCE REQUIREMENTS

2.1 Radioactive Liquid Effluent Monitoring Instrumentation

CONTROL:

In accordance with Technical Specification 5.5.4, the radioactive liquid effluent monitoring instrumentation channels shown in Table 2.1-1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Control 2.3.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters in the OFFSITE DOSE CALCULATION MANUAL (ODCM).

APPLICABILITY: As shown in Table 2.1-1.

ACTION:

A. With a radioactive liquid effluent monitoring instrumentation channel alarm/trip setpoint less conservative than required by the above Control, immediately suspend the release of radioactive liquid effluents monitored by the affected channel, or declare the channel inoperable, or change the setpoint so it is acceptably conservative.

B. With less than the minimum number of radioactive liquid effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 2.1-1. Exert best efforts to return the instruments to OPERABLE status within 30 days and if unsuccessful, explain in the next Annual Radioactive Effluent Release Report, pursuant to RECS 5.2, why the inoperability was not corrected within this time frame.

C. Report all deviations in the Annual Radioactive Effluent Release Report.

3.1 SURVEILLANCE REQUIREMENTS:

Each radioactive liquid effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION and CHANNEL OPERATIONAL TEST operations at the frequencies shown in Table 3.1-1.

TABLE 2.1-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION		
INSTRUMENT	**MINIMUM CHANNELS OPERABLE [a]**	**ACTION**
1. GROSS RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE [c]		
a. Liquid Radwaste Processing Effluent Line (R-18)	(1)	1
b. Condensate Polisher Facility (CPF) Waste Line (R-61) [b]	(1)	1
c. Steam Generator Blowdown (R-19) [e]	(1)	2
2. GROSS BETA OR GAMMA RADIOACTIVITY MONITORS PROVIDING ALARM BUT NOT PROVIDING AUTOMATIC TERMINATION OF RELEASE		
a. Service Water System Effluent Line (R-16A, R-16B)	(1)	3
b. Service Water System Effluent Line (R-23)	(1)	3
3. FLOW RATE MEASUREMENT DEVICES		
a. Liquid Radwaste Effluent Line	(1)	4
b. CPF Effluent Line [b]	(1)	4
c. Steam Generator Blowdown Effluent Line	(1)	4
4. TANK LEVEL INDICATING DEVICES [d]		
a. Refueling Water Storage Tank	(1)	5
b. Primary Water Storage Tank	(1)	5
c. Monitor Tank #31	(1)	5
d. Monitor Tank #32	(1)	5
e. CPF High Total Dissolved Solids Tank [b]	(1)	5
f. CPF Low Total Dissolved Solids Tank [b]	(1)	5

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TABLE 2.1-1 *(Continued)*

TABLE NOTATION

a) During releases via this pathway, channels shall be OPERABLE and in service during such release on a continuous, uninterrupted basis, except that outages are permitted, within the time frame and limitations of the specified action, for the purpose of maintenance and performance of required CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION or CHANNEL OPERATIONAL TEST.

b) The Condensate Polisher Facility (CPF) instrumentation requirements apply only when a primary to secondary leak is present (R-61, the effluent flow rate meter, and the TDS level instruments). Primary to Secondary Leak is defined in RECS Section 1. 9/05

c) Recorders are only required if alarm/trip setpoints are based on recorder-controller.

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

e) Applicable for Continuous Steam Generator Blowdown to the environment only. Not applicable for Steam Generator Draindowns in Mode 5 or 6.

TABLE 2.1-1 *(Continued)*

TABLE NOTATION

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

a. At least two independent samples are analyzed in accordance with Radiological Effluent Control Surveillance Requirement 3.3.1.A,

and

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

Otherwise, suspend release of radioactive effluents via this pathway.

ACTION 2 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided grab samples are analyzed either for principal gamma emitters or for gross radioactivity (beta or gamma) at a lower limit of detection of at least 5E-7 microcurie/ml (as Cs-137):

a. At least once per 12 hours when the specific activity of the secondary coolant is greater than 0.01 microcurie/gram Dose Equivalent I-131.

b. At least once per 24 hours when the specific activity of the secondary coolant is less than or equal to 0.01 microcurie/gram Dose Equivalent I-131.

ACTION 3 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided that, at least once per 12 hours, grab samples are collected and analyzed for gross radioactivity (beta or gamma) at a lower limit of detection of at least 5E-7 microcurie/ml (as Cs-137).

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

ACTION 5 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, liquid additions to this tank may continue provided the tank liquid level is estimated during all liquid additions to the tank.

TABLE 3.1-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS					
INSTRUMENT	**CHANNEL CHECK**	**SOURCE CHECK**	**CHANNEL CALIBRATION**	**CHANNEL OPERATIONAL TEST**	
1. GROSS RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE [d]					9/05
a. Liquid Radwaste Effluent Line (R-18)	Daily [a]	Daily [a]	24M [i]	Quarterly [a,g]	
b. CPF Effluent Line (R-61)	Daily [a,e]	Monthly [a,e]	24M [i]	Quarterly [a,g]	9/05
c. Steam Generator Blowdown (R-19) [f]	Daily [a]	Monthly [a]	24M [i]	Quarterly [a,g]	
2. GROSS BETA OR GAMMA RADIOACTIVITY MONITORS PROVIDING ALARM BUT NOT PROVIDING AUTOMATIC TERMINATION OF RELEASE					
a. Service Water System Effluent Line (R-16A and R-16B)	Daily [a]	Monthly [a]	24M [i]	Quarterly [a,h]	
b. Service Water System Effluent Line (R-23)	Daily [a]	Monthly [a]	24M [i]	Quarterly [a,h]	9/05
3. FLOW RATE MEASUREMENT DEVICES					
a. Liquid Radwaste Effluent Line	Daily [j]	N.A.	24M	Quarterly	9/05
b. CPF Effluent Line	Daily [j,e]	N.A.	24M	Quarterly	
c. Steam Generator Blow down Effluent Line	Daily [j]	N.A.	24M	Quarterly	
4. TANK LEVEL INDICATING DEVICES [c]					
a. Refueling Water Storage Tank	Daily [b]	N.A.	24M	24M	9/05
b. Primary Water Storage Tank	Daily [b]	N.A	24M	24M	
c. Monitor Tank #31	Daily [b]	N.A.	24M	24M	
d. Monitor Tank #32	Daily [b]	N.A.	24M	24M	
e. CPF High Total Dissolved Solids Tank [e]	Daily [b]	N.A.	24M	24M	
f. CPF Low Total Dissolved Solids Tank [e]	Daily [b]	N.A.	24M	24M	

TABLE 3.1-1 *(Continued)*

TABLE NOTATION

a) When this pathway is utilized for releases, with frequency no more than indicated.

b) During liquid additions to the tank.

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

d) Recorders are only required if alarm/trip setpoints are based on recorder-controller.

e) CHANNEL and SOURCE CHECKS on the CPF instrumentation are required only when a primary to secondary leak exists, per RECS Section 1. The tank level indicator calibrations are also required by the SPDES permit. | 9/05

f) Applicable for Steam Generator Blowdown to the river only. Not applicable for Steam Generator Draindowns in Mode 5 or 6.

g) The CHANNEL OPERATIONAL TEST shall also demonstrate that automatic isolation of this pathway and control room alarm annunciation occur if the following condition exists:

1. Instrument indicates measured levels above the alarm/trip setpoint.

h) The CHANNEL OPERATIONAL TEST shall also demonstrate that control room alarm annunciation occurs if any of the following conditions exists:

1. Instrument indicates measured levels above the alarm setpoint.

2. Instrument controls not set in operate mode.

i) Radioactive calibration standards used for CHANNEL CALIBRATIONS shall be traceable to the National Institute of Standards and Technology (NIST) or an aliquot of calibration solution shall be analyzed with instrumentation which is calibrated with NIST traceable standards. (Standards from suppliers who participate in measurement assurance activities with NIST are acceptable).

j) 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, periodic, or batch releases are made.

Periodicity Abbreviations

N.A.	Not Applicable	24M	At least once per 24 months

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2.2 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

CONTROL:

In accordance with Technical Specification 5.5.4, the radioactive gaseous effluent monitoring instrumentation channels shown in Table 2.2-1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Control 2.4.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters in the ODCM.

APPLICABILITY: As shown in Table 2.2-1.

ACTION:

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

B. With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 2.2-1. Exert best efforts to return the instruments to OPERABLE status within 30 days and, if unsuccessful, explain in the next Annual Radioactive Effluent Release Report, pursuant to RECS 5.2, why the inoperability was not corrected within this time frame.

C. Report all deviations in the Annual Radioactive Effluent Release Report.

3.2 SURVEILLANCE REQUIREMENTS:

Radioactive gaseous effluent monitoring instrumentation channels shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION and CHANNEL OPERATIONAL TEST operations at the frequencies shown in Table 3.2-1.

TABLE 2.2-1

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION			
INSTRUMENT	**MINIMUM CHANNELS OPERABLE**	**APPLICABILITY**	**ACTION**
1. WASTE GAS HOLDUP SYSTEM			
a. Noble Gas Activity Monitor Providing Alarm (R-20)	(1)	(b)	6
2. CONDENSER AIR EJECTOR			
a. Noble Gas Activity Monitor (R-15)	(1)	(a)	8
3. ENVIRONMENTAL RELEASE POINTS: (PLANT VENT [c], ADMIN BUILDING CONTROLLED AREA, RAD MACHINE SHOP)			
a. Noble Gas Activity Monitors:			
• PV (R-14 or R-27)	(1)	(a)	8, 11
• Admin Bldg (R-46)	(1)	(a)	8
• Rams Bldg (R-59)	(1)	(a)	8
b. Iodine Sampler	(1)	(a)	10
c. Particulate Sampler	(1)	(a)	10
d. Flow Rate Monitor	(1) [d]	(a)	7
e. Sampler Flow Rate Monitor	(1)	(a)	7
4. CONTAINMENT PURGE SYSTEM			
a. Containment Noble Gas Activity Monitor (R-12), Providing Alarm and Automatic Termination of Release	(1)	(a)	9

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TABLE NOTATION

(a) Channels shall be OPERABLE and in service on a continuous basis during release via this pathway, except that outages are permitted, within the time frame of the specified action for the purpose of maintenance and performance of required tests, checks and calibrations.

(b) During waste gas holdup system operation (treatment for primary system offgases).

(c) The Plant Vent will also monitor releases from the Vent Header, Auxiliary Building Vents, Fuel Storage Building Vents, and the Rad Waste Area Vent.

(d) The Admin Bldg Controlled Area ventilation system uses default fan flow rate in lieu of a Process Flow Rate Monitor, per ODCM Part II, Section 3.1.13.

TABLE 2.2-1 *(Continued)*

ACTION 6 - With the number of channels OPERABLE less than that required by the Minimum Channels OPERABLE requirement, the radioactive content of the receiving gas decay tank shall be determined daily to ensure compliance with RECS 2.11.

ACTION 7 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided the flow rate is estimated at least once per 4 hours.

ACTION 8 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided grab samples are taken at least once per 12 hours and these samples are analyzed for gross activity within 24 hours.

ACTION 9 - With the number of channels OPERABLE less than the Minimum Channels OPERABLE requirement, immediately suspend PURGING of radioactive effluents via this pathway.

During containment building ventilation in Modes 5 or 6, continuous monitoring and automatic termination of release is not required. One continuous monitor at the final release point (Plant Vent) is sufficient.

ACTION 10 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via the effected pathway may continue provided samples are continuously collected with auxiliary sampling equipment as required in Table 3.4-1.

ACTION 11 - With the number of channels OPERABLE less than that required by the Minimum Channels OPERABLE requirement for the plant vent, the contents of the radwaste gas decay tanks may be released to the environment provided that prior to initiating the release:

a. At least two independent samples of the tank contents are analyzed, AND,

b. At least two technically qualified members of the facilities staff independently verify the release rate calculations and discharge valve lineup.

9/05

TABLE 3.2-1

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS				
INSTRUMENT [a]	**CHANNEL CHECK**	**SOURCE CHECK**	**CHANNEL CALIBRATION**	**CHANNEL OPERATIONAL TEST**
1. WASTE GAS HOLDUP SYSTEM				
a. Noble Gas Activity Monitor Providing Alarm (R-20)	Daily	Monthly	24M [e]	Quarterly [b,d]
2. CONDENSER AIR EJECTOR				
a. Noble Gas Activity Monitor (R-15)	Daily	Monthly	24M [e]	Quarterly [b,d]
3. ENVIRONMENTAL RELEASE POINTS: (PLANT VENT, ADMIN BUILDING CONTROLLED AREA, RAD MACHINE SHOP VENT)				
a. Noble Gas Activity Monitors:				
• PV (R-14 or R-27)	Daily	Monthly	24M [e]	Quarterly [b,d]
• Admin Bldg (R-46)	Daily	Monthly	24M [e]	Quarterly [b,d]
• Rams Bldg (R-59)	Daily	Monthly	24M [e]	Quarterly [b,d]
b. Iodine Sampler	Weekly	N.A.	N.A.	N.A.
c. Particulate Sampler	Weekly	N.A.	N.A.	N.A.
d. Flow Rate Monitor	Daily	N.A.	24M	Quarterly [c]
e. Sampler Flow Rate Monitor	Daily	N.A.	24M	N.A.
4. CONTAINMENT PURGE SYSTEM				
a. Containment Noble Gas Activity Monitor (R12) providing Alarm and Automatic Termination of Release	Daily	Monthly	24M [e]	Quarterly [b,d]

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TABLE 3.2-1 *(Continued)*

TABLE NOTATION

a) Surveillances are required at all times except when monitor has been removed from service in accordance with Table 2.2-1.

b) Will not include operation of automatic control functions.

c) Environmental Release Point flow rate meters are normally associated with the corresponding noble gas radiation monitor. The Administration Building Controlled Area Vent system does NOT have an installed process flow meter and uses default fan flow rate instead, per ODCM Part II, Section 3.1.13. 9/05

d) The CHANNEL OPERATIONAL TEST shall also demonstrate that control room alarm annunciation occurs if any of the following conditions exists:

- Instrument indicates measured levels above the alarm setpoint.
- Instrument controls not set in operate mode.

e) Radioactive Calibration Standards used for CHANNEL CALIBRATIONS shall be traceable to the National Institute of Standards and Technology (NIST) or an aliquot of calibration gas shall be analyzed with instrumentation which is calibrated with NIST traceable standards (standards from suppliers which participate in measurement assurance activities with NIST are acceptable).

Periodicity Abbreviations

N.A.	Not Applicable
24M	At least once per 24 months.

2.3 RADIOACTIVE LIQUID EFFLUENTS

2.3.1 LIQUID EFFLUENT CONCENTRATION

CONTROL:

In accordance with Technical Specifications 5.5.4, the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS shall be limited to 10 times the EFFLUENT CONCENTRATION values specified in Appendix B, Table 2, Column 2 of 10CFR20 in accordance with 10CFR20.1302(2)(i) for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2E-4 uCi/ml.

APPLICABILITY: At all times.

ACTION:

With the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS exceeding the above limits, immediately restore the concentration to within these limits.

3.3.1 SURVEILLANCE REQUIREMENTS:

A. Radioactive liquid wastes shall be sampled and analyzed according to the sampling and analysis program of Table 3.3.1-1.

B. The results of the radioactivity analyses shall be used in accordance with the methodology and parameters in the ODCM to assure that the concentrations at the point of release are maintained within the limits of Control 2.3.1.

TABLE 3.3.1-1

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM				
Liquid Release Type	**Sampling Frequency**	**Minimum Analysis Frequency**	**Type of Activity Analysis**	**Lower Limit of Detection (LLD)[a] (uCi/ml)**
A. Batch Releases [b] (Waste Tanks, Steam Generator Draindowns to the River, etc)	Each Batch (Prior to Release)	Each Batch (Prior to Release)	Principal Gamma Emitters [c]	5E-7
			Mo-99, Ce-144	5E-6
			I-131	1E-6
	One Batch per Month	Monthly	Dissolved & Entrained Gases (Gamma Emitters)	1E-5
	Each Batch	Monthly Composite[d]	H-3	1E-5
			Gross Alpha	1E-7
	Each Batch	Quarterly Composite[d]	Sr-89, Sr-90	5E-8
			Fe-55	1E-6
B. Continuous Steam Generator Blowdown to River [e]	3 per Week Composite[d]	Weekly Composite[d]	Principal Gamma Emitters	5E-7
			Mo-99, Ce-144	5E-6
			I-131	1E-6
	Monthly Grab Sample	Monthly	Dissolved & Entrained Gases (Gamma Emitters)	1E-5
	Weekly Composite[d]	Monthly Composite[d]	H-3	1E-5
			Gross Alpha	1E-7
			Sr-89, Sr-90	5E-8
			Fe-55	1E-6
C. Service Water (In the Radiologically Controlled Area)	Monthly	Monthly	Gamma and Beta emitters [g]	per Section A, Liquid Batch Releases
D. Turbine Hall Drains, SG Feedwater [f]	3 per Week Composite	Weekly	Gamma and Beta emitters [g]	per Section A, Liquid Batch Releases

TABLE 3.3.1-1 *(Continued)*

TABLE NOTATION

a) The LLD is defined, for purposes of these Controls, 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. Equations used in the calculation of the LLD for a particular measurement system are presented in the ODCM.

> It should be recognized that the LLD is defined as an *a priori* (before the fact) limit representing the capability of a measurement system and not as an *a posteriori* (after the fact) limit for a particular measurement.

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

c) The principal gamma emitters for which the LLD Control applies exclusively are the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Cs-134, Cs-137; and Ce-141. This list does not mean that only these nuclides are to be monitored. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radioactive Effluent Release Report pursuant to Reporting Requirement 5.2.

d) A composite sample is one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged for each pathway. 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) Steam Generator Feedwater and Turbine Hall Drains need only be monitored when a Primary to Secondary leak exists. This leak is defined in RECS Section 1.

g) Beta emitters need only be analyzed if gamma emitters have been positively identified.

2.3.2 DOSE FROM LIQUID EFFLUENTS

CONTROLS:

In accordance with Technical Specifications 5.5.4, the dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released, from each reactor unit, to UNRESTRICTED AREAS shall be limited:

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

   and

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

APPLICABILITY: At all times.

ACTION:

With the calculated dose from the release of radioactive materials in liquid effluents exceeding any of the above limits, in lieu of a Licensee Event Report, prepare and submit to the Commission within 30 days, pursuant to RECS 5.7, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective action(s) that have been taken to reduce the release(s) and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

If drinking water supply is taken from the receiving water body within 3 miles of the plant discharge (3 miles downstream for river sited plants), this Special Report shall also include:

1) the results of radiological analyses of the drinking water source; and

2) the radiological impact on finished drinking water supplies with regard to the requirements of 40 CFR Part 141.

3.3.2 SURVEILLANCE REQUIREMENTS:

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

2.3.3 LIQUID RADWASTE TREATMENT SYSTEM

CONTROL:

In accordance with Technical Specification 5.5.4, the liquid radwaste treatment system shall be used when the projected doses due to the liquid effluent, from each reactor unit, to UNRESTRICTED AREAS would exceed 0.06 mrem to the total body or 0.2 mrem to any organ in a 31 day period.

APPLICABILITY: At all times.

ACTION:

With radioactive liquid waste being discharged without treatment and in excess of the above limits, in lieu of a Licensee Event Report, prepare and submit to the Commission within 30 days, pursuant to RECS 5.7, a Special Report that includes the following information:

A. Explanation of why liquid radwaste was being discharged without treatment, identification of any inoperable equipment or subsystems, and the reason for the inoperability,

B. Action(s) taken to restore the inoperable equipment to OPERABLE status, and

C. Summary description of action(s) taken to prevent a recurrence.

3.3.3 SURVEILLANCE REQUIREMENTS:

Doses due to liquid releases from each reactor unit to UNRESTRICTED AREAS shall be projected at least once per month in accordance with the methodology and parameters in the ODCM when the liquid radwaste treatment systems are not being fully utilized.

2.4 RADIOACTIVE GASEOUS EFFLUENTS

2.4.1 GASEOUS EFFLUENT DOSE RATES

CONTROL:

In accordance with Technical Specification 5.5.4, the dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the SITE BOUNDARY shall be limited to the following:

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

and

B. For iodine-131, for tritium, and for all radionuclides in particulate form with half lives greater than 8 days: Less than or equal to a dose rate of 1500 mrem/yr to any organ.

APPLICABILITY: At all times.

ACTION:

With the dose rate(s) exceeding the above limits, immediately restore the release rate to within the above limit(s).

3.4.1 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 iodine-131, tritium, and all radionuclides in particulate form with half lives greater than 8 days in gaseous effluents shall be determined to be within the above limits in accordance with the methodology and parameters in the ODCM by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Table 3.4.1-1.

TABLE 3.4.1-1

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM					
Gaseous Release Type		**Sampling Frequency**	**Minimum Analysis Frequency**	**Type of Activity Analysis**	**Lower Limit of Detection (LLD)[a], uCi/cc**
A. Waste Gas Storage		Batch Grab Sample Prior to Each Release	Batch Grab Sample Prior to Each Release	Principal Noble Gas (NG)Gamma Emitters [b]	1E-4
B. Vapor Containment	Purge	Batch Grab Sample Prior to Each Purge	Batch Grab Sample Prior to Each Purge	Principal NG Gamma Emitters [b]	1E-4
	Press Relief	Monthly [i]	Monthly [i]		
C. Condenser Air Ejector		Grab Sample	Monthly	Principal NG Gamma Emitters [b,h]	1E-4
D. Environmental Release Points (Plant Vent, Admin Bldg Controlled Area Vent, Radioactive Machine Shop Vent)		Monthly Grab Sample [c]	Monthly [c]	Principal NG Gamma Emitters [b]	1E-4
		Monthly Grab Sample [d,e]	Monthly [d,e]	H-3	1E-6
		Continuous [f]	Weekly [g] Charcoal Sample	I-131	1E-12
		Continuous [f]	Weekly [g] Particulate Sample	Principal [b] Gamma Emitters	1E-11
		Continuous [f]	Monthly Composite Particulate Sample	Gross Alpha	1E-11
		Continuous [f]	Quarterly Composite Particulate Sample	Sr-89, Sr-90	1E-11
		Continuous [f]	Noble Gas Monitor	Noble Gases Gross Beta or Gamma	1E-6

TABLE 3.4.1-1 *(Continued)*

TABLE NOTATION

a) The LLD is defined, for purposes of these Controls, 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. Equations used in the calculation of the LLD for a particular measurement system are presented in the ODCM.

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

b) The principal gamma emitters for which the LLD Control applies exclusively are the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 for gaseous emissions and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141 and Ce-144 for particulate emissions. This list does not mean that only these nuclides are to be monitored. Other identifiable gamma peaks (I-131 in particulate form, for example), together with those of the above nuclides, shall also be analyzed and reported in the Annual Radioactive Effluent Release Report pursua nt to RECS 5.2.

c) IF following a shutdown, startup, or thermal power change (within one hour) exceeding 15% of RATED THERMAL POWER, analyses indicate that the DOSE EQUIVALENT IODINE-131 concentration in the primary coolant AND the plant vent noble gas activity (as indicated on a radiation monitor) have increased by a factor of 3 or more THEN: 9/05

1) Sample the Plant Vent for noble gases within 24 hours, AND

2) Sample the Plant Vent for Iodine and Particulate once per 24 hours for at least 7 days with analyses completed within 48 hours of sample changeout. The LLDs of these samples may be increased by a factor of 10.

d) Plant vent Tritium grab samples shall be taken at least once per 24 hours when the refueling canal is flooded unless continuous sampling equipment is in use.

e) Plant vent tritium grab samples shall be taken at least once per 7 days from the ventilation exhaust from the spent fuel pool area, whenever spent fuel is in the spent fuel pool unless continuous sampling equipment is in use.

TABLE 3.4.1-1 *(Continued)*

TABLE NOTATION

f) The ratio of the sample flow rate to the sampled stream flow rate shall be known for the time period covered by each dose or dose rate calculation made in accordance with Controls 2.4.1, 2.4.2 and 2.4.3.

g) Continuous samples shall be changed at least once per 7 days and analyses shall be completed within 48 hours after changing, or after removal from sampler.

9/05

Additionally, IF routine Iodine sampling indicates I-131 in a continuous ventilation pathway, THEN, collect a 24 hour sample (within 48 hours) for short-lived Iodine isotope quantification, on a periodicity not to exceed once per 31 days. The LLDs of these samples may be increased by a factor of 1 0.

h) The air ejector shall be sampled for Iodine and Tritium when a Primary to Secondary Leak exists. This leak is defined in RECS Section 1.

i) Vapor Containment noble gas shall be sampled at least monthly to ensure Pressure Reliefs are quantified with an accurate isotopic mixture. Containment noble gas radiation monitor readings can be used for quantification of Pressure Reliefs, provided the monitor readings are consistent with those observed during recent (at least monthly) grab samples. Sample data is adjusted by the noble gas radiation monitor reading for purposes of quantification of each release. Should the monitor be inoperable, a containment noble gas grab sample is required within 24 hours prior to the Pressure Relief.

2.4.2 DOSE FROM NOBLE GASES

CONTROLS:

In accordance with Technical Specification 5.5.4, the air dose due to noble gases released in gaseous effluents, from each reactor unit, to areas at and beyond the SITE BOUNDARY 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.

APPLICABILITY: At all times.

ACTION:

With the calculated air dose from radioactive noble gases in gaseous effluents exceeding any of the above limits, in lieu of a Licensee Event Report, prepare and submit to the Commission within 30 days, pursuant to RECS 5.7, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

3.4.2 SURVEILLANCE REQUIREMENTS:

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

2.4.3 DOSE FROM IODINE-131, TRITIUM, AND RADIONUCLIDES IN PARTICULATE FORM

CONTROLS:

In accordance with Technical Specification 5.5.4, the dose to a MEMBER OF THE PUBLIC from Iodine-131, Tritium and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released, from each reactor unit, to areas at and beyond the SITE BOUNDARY shall be limited to the following:

1. During any calendar quarter: Less than or equal to 7.5 mrems to any organ

   and,

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

APPLICABILITY: At all times.

ACTION:

With the calculated dose from the release of iodine-131, tritium, and radionuclides in particulate form with half lives greater than 8 days, in gaseous effluents exceeding any of the above limits, in lieu of a Licensee Event Report, prepare and submit to the Commission within 30 days, pursuant to RECS 5.7, 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.

3.4.3 SURVEILLANCE REQUIREMENTS:

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

2.4.4 GASEOUS RADWASTE TREATMENT SYSTEM

CONTROL:

In accordance with Technical Specification 5.5.4, the appropriate GASEOUS RADWASTE TREATMENT SYSTEM and the appropriate VENTILATION EXHAUST TREATMENT SYSTEM shall be used to reduce radioactive materials in gaseous waste prior to their discharge when the projected gaseous effluent air doses due to gaseous effluent releases, from each reactor unit, to areas at and beyond the SITE BOUNDARY would exceed 0.2 mrad for gamma radiation and 0.4 mrad for beta radiation in a 31 day period. The VENTILATION EXHAUST TREATMENT SYSTEM shall be used to reduce radioactive materials in gaseous waste prior to their discharge when the projected doses due to gaseous effluent releases, from each reactor unit, to areas at and beyond the SITE BOUNDARY would exceed 0.3 mrem to any organ of a MEMBER OF THE PUBLIC in a 31 day period.

APPLICABILITY: At all times.

ACTION:

With gaseous waste being discharged without treatment and in excess of the above limits, in lieu of a Licensee Event Report, prepare and submit to the Commission within 30 days, pursuant to RECS 5.7, a Special Report that includes the following information:

A. Explanation of why gaseous radwaste was being discharged without treatment, identification of any inoperable equipment or subsystems, and the reason for the inoperability,

B. Action(s) taken to restore the inoperable equipment to OPERABLE status,

and

C. Summary description of action(s) taken to prevent a recurrence.

3.4.4 SURVEILLANCE REQUIREMENTS:

Doses due to gaseous releases from each reactor unit to areas at and beyond the SITE BOUNDARY shall be projected at least once per month in accordance with the methodology and parameters in the ODCM when the GASEOUS RADWASTE TREATMENT SYSTEMS are not being fully utilized.

2.5/3.5 SOLID RADIOACTIVE WASTE CONTROLS AND SURVEILLANCE REQUIREMENTS:

These sections are contained in the PCP.

2.6 TOTAL DOSE

CONTROL:

In accordance with Technical Specification 5.5.4, limit the annual (calendar year) dose or dose commitment to any MEMBER OF THE PUBLIC due to releases of radioactivity and to direct radiation from uranium fuel cycle sources to less than or equal to 25 mrems to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrems.

APPLICABILITY: At all times.

ACTION:

A. With calculated doses from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Control 2.3.2.1, 2.4.2.1 or 2.4.3.1, calculations should be made, including direct radiation contributions from the reactor units and from outside storage tanks, etc., to determine whether the above limits have been exceeded.

B. If such is the case, in lieu of a Licensee Event Report, prepare and submit to the Commission within 30 days, pursuant to RECS 5.7, 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. If the estimated dose(s) exceeds the above limits and if the release condition resulting in violation of 40 CFR Part 190 has not already been corrected, the Special Report shall include a request for a variance in accordance with the provisions of 40 CFR Part 190. Submittal of the report within 30 days is considered a timely request, and a variance is granted until staff action on the request is complete.

3.6 SURVEILLANCE REQUIREMENTS:

A. Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with Surveillance Requirements 3.3.2, 3.4.2, 3.4.3 and in accordance with the methodology and parameters in the ODCM.

B. Cumulative dose contributions from direct radiation from the reactor units and from radwaste storage tanks, etc., shall be determined in accordance with the methodology and parameters in the ODCM. This requirement is applicable only under conditions set forth in Control 2.6.

2.7 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

CONTROL:

Pursuant to Technical Specifications 5.5.1.b, a program shall be provided to monitor the radiation and radionuclides in the environs of the plant. The program shall provide (1) representative measurements of radioactivity in the highest potential exposure pathways, and (2) verification of the accuracy of the effluent monitoring program and modeling of the environmental exposure pathways. The program shall (1) be contained in the ODCM, (2) conform to the guidance of 10CFR50, Appendix I, and (3) include the following:

A. Monitoring, sampling, analysis, and reporting of radiation and radionuclides in the environment in accordance with the methodology and parameters in the ODCM.

B. A Land Use Census to ensure that changes in the use of areas at and beyond the SITE BOUNDARY are identified and that modifications to the monitoring program are made if required by the results of this census.

C. Participation in an Interlaboratory Comparison Program to ensure that independent checks on the precision and accuracy of the measurements of radioactive materials in the environmental sample matrices are performed as part of the quality assurance program for environmental monitoring.

The Radiological Environmental Monitoring Program (REMP) shall be conducted as specified in Table 2.7-1.

APPLICABILITY: At all times.

ACTION:

A. With the Radiological Environmental Monitoring Program not being conducted as specified in Table 2.7-1, in lieu of a Licensee Event Report, prepare and submit to the Commission, in the Annual Radiological Environmental Operating Report required by RECS 5.3, 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 2.7-2 when averaged over any calendar quarter, in lieu of a Licensee Event Report, prepare and submit to the Commission within 30 days, pursuant to RECS 5.7, 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 so that the potential annual dose to A MEMBER OF THE PUBLIC is less than the calendar year limits of Controls 2.3.2, 2.4.2, and 2.4.3.

When more than one of the radionuclides in Table 2.7-2 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 2.7-2 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 Controls 2.3.2, 2.4.2, and 2.4.3. 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.

C. With milk or fresh leafy vegetable samples unavailable from one or more of the sample locations required by Table 2.7-1, identify locations for obtaining replacement samples and add them to the Radiological Environmental Monitoring Program within 30 days. The specific locations from which samples were unavailable may then be deleted from the monitoring program. In lieu of a Licensee Event Report and pursuant to RECS 5.2, identify the cause of the unavailability of samples and identify the new location(s) for obtaining replacement samples in the next Annual Radioactive Effluent Release Report and also include in the report a revised figure(s) and table for the ODCM reflecting the new location(s).

3.7 SURVEILLANCE REQUIREMENTS:

The radiological environmental monitoring samples shall be collected pursuant to Table 2.7-1 from the specific locations given in the table and figure(s) in the ODCM and the detection capabilities required by Table 3.7-1.

TABLE 2.7-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM			
Exposure Pathway and/or Sample	**Number of Representative Samples and Sample Locations[a]**	**Sampling and Collection Frequency**	**Type and Frequency of Analysis**
1. Direct Radiation[b]	41 routine monitoring stations (DR1-DR41) with two or more dosimeters for measuring and recording integrated dose continuously placed as follows: an inner ring of stations, one in each meteorological sector in the general area of the site boundary (DR1-DR16) an outer ring of stations, one in each meteorological sector in the 6 to 8 km range from the site (DR17- DR32) the balance of the stations (DR33-DR41) to be placed in special interest areas and in one area to serve as a control station.	Quarterly	Gamma dose quarterly

TABLE 2.7-1 *(Continued)*

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**
2. Airborne Radioiodine and Particulates	Samples from 5 locations (A1-A5): 3 samples (A1-A3) from close to the 3 site boundary locations in different sectors, of the highest calculated annual average ground level D/Q. 1 sample (A4) from the vicinity of a community having the highest calculated annual average ground level D/Q. 1 sample (A5) from a control location approximately 15-30 km distant and in the least prevalent wind direction. [c]	Continuous sampler operation with collection weekly, or more frequently if required by dust loading	Radioiodine Canister: I-131 analysis weekly. Particulate Sampler: Gross beta radioactivity analysis following filter change [d] Gamma isotopic analysis [e] of composite (by location) quarterly
3. Waterborne a. Surface [f]	1 sample upstream (Wa1) 1 sample downstream (Wa2)	Composite sample over 1 month period [g]	Gamma isotopic analysis [e] monthly. Composite for tritium analysis quarterly.

TABLE 2.7-1 *(Continued)*

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**
3. Waterborne			
b. Drinking	1 sample (Wb1) of the nearest surface drinking supply	Grab monthly	Gross beta and gamma isotopic analysis monthly. Composite for tritium analysis quarterly. [e]
c. Sediment from Shoreline	2 samples (Wc1-Wc2) 1 sample (Wc1) from downstream area with existing or potential recreational value. 1 control sample (Wc2) from an upstream area.	2 annually at least 90 days apart	Gamma isotopic analysis [e]
4. Ingestion			
a. Milk [l]	Samples from milking animals in 3 locations (Ia1-Ia3) within 5 km distance (for human consumption) having the highest dose potential. If there are none, then 1 sample from milking animals in each of 3 areas (Ia1-Ia3) between 5 to 8 km distant if available where doses are calculated to be greater than 1 mrem per yr[h]. 1 sample from milking animals at a control location (Ia4), 15-30 km distant and in the least prevalent wind direction.	Semimonthly when animals are on pasture; monthly at other times. Concurrently with indicator locations.	Gamma isotopic[e] and I-131 analysis semimonthly when animals are on pasture; monthly at other times.

TABLE 2.7-1 *(Continued)*

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. Ingestion			
b. Fish and Invertebrates	2 samples (Ib1, Ib2) 1 sample (Ib1) of each of 2 species commercially and/or recreationally important species of fish or invertebrate in the vicinity of the discharge when available. 1 sample (Ib2) of each of 2 commercially and/ or recreationally important species (the same species as in Ib1 if available) from an area not influenced by plant discharge.	Sample in season, or semi-annually if they are not seasonal	Gamma isotopic analysis [e]
c. Food Products	Samples of 3 different kinds of broad leaf vegetation (edible or inedible) grown nearest each of two different offsite locations of highest predicted annual average ground level D/Q if milk sampling is not performed (Ic1-Ic2). [j] 1 sample of each of the similar broad leaf vegetation grown 15-30 km distant in the least prevalent wind direction if milk sampling is not performed (Ic3).	Monthly when available Monthly when available	Gamma isotopic[e] and I-131 analysis Gamma isotopic[e] and I-131 analysis

TABLE 2.7-1 *(Continued)*

TABLE NOTATION

[a] The code letters in parenthesis (e.g., DR1, A1, etc.) refer to sample locations as specified in the ODCM. Specific parameters of distance and direction sector from the centerline of one reactor, and additional description where pertinent, shall be provided for each and every sample location in Table 2.7-1 in a table and figure(s) in the ODCM. Refer to NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plant," October 1978, and to Radiological Assessment Branch Technical Position, Revision 1, November 1979. 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 RECS 5.3. It is recognized that, at times, it may not be possible or practicable to continue to obtain samples of the media of choice at the most desired location or time. In these instances suitable alternative media and locations may be chosen for the particular pathway in question and appropriate substitutions made within 30 days in the Radiological Environmental Monitoring Program. In lieu of a Licensee Event Report and pursuant to RECS 5.2, identify the cause of the unavailability of samples for that pathway and identify the new location(s) for obtaining replacement samples in the next Annual Radioactive Effluent Release Report and also include in the report a revised figure(s) and table for the ODCM reflecting the new location(s).

[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. For the purposes of this table, a thermo luminescent dosimeter (TLD) is considered to be one phosphor; two or more phosphors in a packet are considered as two or more dosimeters. Film badges shall not be used as dosimeters for measuring direct radiation.

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

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

TABLE 2.7-1 *(Continued)*

TABLE NOTATION

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

[f] The "upstream" sample shall be taken near the intake structures as described in the ODCM. The "downstream" sample shall be taken from the mixing zone at the diffuser to the discharge canal.

[g] A composite sample is one in which the quantity (aliquot) of liquid sampled shall be collected at time intervals that are very short (e.g., hourly) relative to the compositing period (e.g., monthly) in order to assure obtaining a representative sample.

[h] The dose shall be calculated for the maximum organ and age group using the methodology and parameters in the ODCM.

[i] The requirement to obtain and analyze samples from milch animals within 8 km of the site is intended to ensure monitoring of the "cow-milk" and vegetation pathways. Thus, only milch animals whose milk is used for human consumption are considered in the pathway and sample evaluation.

[j] Broad lead vegetation sampling of at least three different kinds of vegetation may be performed at the SITE BOUNDARY in each of two different sectors with the highest predicted D/Q in lieu of the garden census.

TABLE 2.7-2

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

TABLE NOTATION

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

** If no drinking water pathway exists, a value of 20 pCi/l may be used.

TABLE 3.7-1

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS [a]						
LOWER LIMIT OF DETECTION (LLD) [b,c]						
Analysis	Water (pCi/l)	Airborne Particulate or Gases (pCi/m^3)	Fish (pCi/kg, wet)	Milk (pCi/l)	Food Products (pCi/kg, wet)	Sediment (pCi/kg,dry)
gross beta	4	0.01				
H-3	2,000*					
Mn-54	15		130			
Fe-59	30		260			
Co-58, 60	15		130			
Zn-65	30		260			
Zr-Nb-95	15					
I-131	1**	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-La-140	15			15		

TABLE NOTATION

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

** If no drinking water pathway exists, a value of 15 pCi/l may be used.

TABLE 3.7-1 (Continued)

[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 RECS 5.3.

[b] Required detection capabilities for thermo luminescent dosimeters used for environmental measurements are given in Regulatory Guide 4.13.

[c] The LLD is defined, for purposes of these Controls 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. Equations used in the calculation of the LLD for a particular measurement system are presented in the ODCM, Part II, Appendix B.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement. Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unavoidable small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors shall be identified and described in the Annual Radiological Environmental Operating Report pursuant to RECS 5.3.

2.8 LAND USE CENSUS

CONTROL:

In accordance with Technical Specification 5.5.1.b and RECS 2.7, conduct a land use census which identifies within a distance of 8 km (5 miles) the location in each of the 16 meteorological sectors of the nearest milk animal, the nearest residence and the nearest garden of greater than $50m^2$ (500 ft^2) producing broad leaf vegetation. Broad leaf vegetation sampling of at least three different kinds of vegetation may be performed at the SITE BOUNDARY in each of two different direction sectors with the highest predicted D/Qs in lieu of the garden census. The Controls for broad leaf vegetation sampling in Table 2.7-1.4c shall be followed, including analysis of control samples.

APPLICABILITY: At all times.

ACTION:

A. With a land use census identifying a location(s) that yields a calculated dose or dose commitment greater than the values currently being calculated in Control 3.4.3, in lieu of a Licensee Event Report, identify the new location(s) in the next Annual Radioactive Effluent Release Report, pursuant to RECS 5.2.

B. With a land use census identifying a location(s) that yields a calculated dose or dose commitment (via the same exposure pathway) two times greater than at a location from which samples are currently being obtained in accordance with Control 2.7, add the new location(s) to the Radiological Environmental Monitoring Program within 30 days. The sampling location(s), excluding the control station location, having the lowest calculated dose or dose commitment(s), via the same exposure pathway, may be deleted from this monitoring program after (October 31) of the year in which this land use census was conducted. In lieu of a Licensee Event Report and pursuant to RECS 5.2, identify the new location(s) in the next Annual Radioactive Effluent Release Report and also include in the report a revised figure(s) and table for the ODCM reflecting the new location(s).

3.8 SURVEILLANCE REQUIREMENTS:

The land use census shall be conducted during the growing season at least once per calendar year using that information that will provide the best results, such as by a door-to-door survey, aerial survey or by consulting local agriculture authorities. The results of the land use census shall be included in the Annual Radiological Environmental Operating Report pursuant to RECS 5.3.

2.9 INTERLABORATORY COMPARISON PROGRAM

CONTROL:

In accordance with Technical Specification 5.5.1.b and RECS 2.7, perform analyses on radioactive materials supplied as part of an Interlaboratory Comparison Program.

APPLICABILITY: At all times.

ACTION:

With analyses not being performed as required above, report the corrective actions taken to prevent a recurrence to the Commission in the Annual Radiological Environmental Operating Report pursuant to RECS 5.3.

3.9 SURVEILLANCE REQUIREMENTS:

A summary of the results obtained as part of the required Interlaboratory Comparison Program shall be included in the Annual Radiological Environmental Operation Report pursuant to RECS 5.3.

2.10 RADIOACTIVE LIQUID EFFLUENT HOLDUP TANKS

CONTROL:

The quantity of radioactive material contained in each of the following unprotected outdoor tanks [a] shall be limited to less than or equal to 10 curies, excluding tritium and dissolved or entrained noble gases.

1. Refueling Water Storage Tank [b]
2. Primary Water Storage Tank
3. 31 Monitor Tank
4. 32 Monitor Tank
5. CPF High Total Dissolved Solids Tank [c]
6. CPF Low Total Dissolved Solids Tank [c]
7. Outside Temporary Tank [d]

APPLICABILITY: At all times [c]

ACTION:

With the quantity of radioactive material in any of the above listed tanks exceeding the above limit, 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 Annual Radioactive Effluent Release Report, per RECS 5.2.

3.10 SURVEILLANCE REQUIREMENTS:

The quantity of radioactive material contained in each of the listed tanks shall be determined to be less than or equal to 10 curies excluding tritium and noble gases, by analyzing a representative sample of the tanks' contents at least once per month when radioactive materials are being added to the tank [c].

NOTES:

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

b) After refueling operations, liquid from the reactor cavity will be sampled for radioactive material content prior to pumping into the tank.

c) The Condensate Polisher Facility (CPF) Total Dissolved Solids Tanks require controls and surveillances **only** when a primary to secondary leak exists.

d) Liquid will be sampled for radioactive content prior to being pumped into the tank.

2.11 GAS STORAGE TANKS

CONTROL:

The quantity of radioactivity contained in each gas storage tank shall be limited to less than or equal to 50,000 curies of noble gas (considered as Xe-133 equivalent).

APPLICABILITY: At all times.

ACTION:

With the quantity of radioactive material in any gas storage tank exceeding the above limit, 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 Annual Radioactive Effluent Release Report, per RECS 5.2.

3.11 SURVEILLANCE REQUIREMENTS:

The quantity of radioactive material contained in each gas storage tank shall be determined to be within the limits at least once per 24 hours when radioactive materials are being added to the tank in accordance with the methodology and parameters in the ODCM.

4.0 BASES

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION (2/3.1)

The radioactive liquid effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in liquid effluents during actual or potential releases of liquid effluents. The alarm/trip setpoints for these instruments shall be calculated and adjusted in accordance with the methodology and parameters in the ODCM to ensure that the alarm/trip will occur prior to exceeding 10 times the EFFLUENT CONCENTRATION values specified in Appendix B, Table 2, Column 2 to 10 CFR 20. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63 and 64 of Appendix A to 10 CFR Part 50. The purpose of tank level indicating devices is to assure the detection and control of leaks that if not controlled could potentially result in the transport of radioactive materials to UNRESTRICTED AREAS.

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION (2/3.2)

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

LIQUID EFFLUENTS CONCENTRATION (2/3.3.1)

This Control is provided to ensure that the concentration of radioactive materials released in liquid waste effluents to UNRESTRICTED AREAS will be less than 10 times the EFFLUENT CONCENTRATION values specified in Appendix B, Table 2, Column 2 to 10 CFR 20. The Control provides operational flexibility for releasing liquid effluents in concentrations to follow the Section II.A and II.C design objectives of Appendix I to 10 CFR Part 50. This limitation provides reasonable 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 restrictions authorized by 10 CFR Part 20.1301(e). The concentration limit for the dissolved or entrained noble gases is based upon the assumption that Xe-135 is the controlling radionuclide and its EFFLUENT CONCENTRATION in air (submersion) was converted to an equivalent concentration in water. This control does not affect the requirement to comply with the annual limitations of 10 CFR Part 20.1301(a).

This Control applies to the release of radioactive materials in liquid effluents from all units at the site.

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 Currie, L.A., "Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements," NUREG/CR-4007 (September 1984), and in the HASL Procedures Manual, HASL-300 (revised annually).

DOSE FROM LIQUID EFFLUENTS (2/3.3.2)

This Control is provided to implement the requirements of Sections II.A, III.A and IV.A of Appendix I, 10 CFR Part 50. The Control statement 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 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 the ODCM implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The equations specified in the ODCM for calculating the doses due to the actual release rates of radioactive materials in liquid effluents are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the purpose of Evaluating Compliance with 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.

This Control applies to the release of liquid effluents from each reactor at the site. For units with shared radwaste treatment systems, the liquid effluents from the shared system are proportioned among the units sharing that system.

LIQUID RADWASTE TREATMENT SYSTEM (2/3.3.3)

The requirement that the appropriate portions of this system be used, when specified, provides assurance that the releases of radioactive materials in liquid effluents will be kept "as low as is reasonably achievable". This Control implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objective given in Section II.D of Appendix I to 10 CFR part 50. The specified limits governing the use of appropriate portions of the liquid radwaste treatment system were specified as a suitable fraction of the dose design objectives set forth in Section II.A of Appendix I, 10 CFR Part 50, for liquid effluents.

This Control applies to the release of liquid effluents from each reactor at the site. For units with

GASEOUS EFFLUENTS DOSE RATE (2/3.4.1)

This Control provides reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of a MEMBER OF THE PUBLIC in an UNRESTRICTED AREA, either at or beyond the SITE BOUNDARY in excess of the design objectives of Appendix I to 10 CFR Part 50. This Control is provided to ensure that gaseous effluents from all units on the site will be appropriately controlled. It provides operational flexibility for releasing gaseous effluents to satisfy the Section II.A and II.C design objectives of Appendix I to 10 CFR Part 50. 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 the reduced atmospheric dispersion of gaseous effluents relative to that for the SITE BOUNDARY. Examples of calculations for such MEMBERS OF THE PUBLIC, with the appropriate occupancy factors, shall be given in the ODCM. The specified release rate limits restrict, at all times, the corresponding dose rates above background to a MEMBER OF THE PUBLIC at or beyond the SITE BOUNDARY to less than or equal to 500 mrem/year to the total body or to less than or equal to 3000 mrem/year 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/year. This Control does not affect the requirement to comply with the annual limitations of 10 CFR 20.1301(a).

This Control applies to the release of gaseous effluents from all units at the site.

DOSE FROM NOBLE GASES (2/3.4.2)

This Control is provided to implement the requirements of Sections II.B, III.A and IV.A of Appendix I, 10 CFR Part 50. The Control statements implement the guides set forth in Section II.B of Appendix I. The Action statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in gaseous effluents will be kept "as low as is reasonably achievable." The Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated.

The dose calculation methodology and parameters established in the ODCM for calculating the doses due to the actual release rates of radioactive noble gases in gaseous effluents are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 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 the air doses at and beyond the SITE BOUNDARY are based upon the historical average atmospheric conditions.

This Control applies to the release of gaseous effluents from each reactor at the site. For units with shared radwaste treatment systems, the gaseous effluents from the shared system are proportioned among the units sharing that system.

DOSE FROM IODINE-131, TRITIUM, AND RADIONUCLIDES IN PARTICULATE FORM (2/3.4.3)

This Control is provided to implement the requirements of Sections II.C, III.A and IV.A of Appendix I, 10 CFR Part 50. The Controls are the guides set forth in Section II.C of Appendix I. The Action statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable." The ODCM calculational methods specified in 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 ODCM calculational methodology and parameters for calculating the doses due to the actual release rates of the subject materials are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 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. These equations also provide for determining the actual doses based upon the historical average atmospheric conditions. The release rate controls for Iodine-131, Tritium, and radionuclides in particulate form with half lives greater than 8 days are dependent upon the existing radionuclide pathways to man, in the areas at and beyond the SITE BOUNDARY. The pathways that were examined in the development of these calculations were: 1) individual inhalation of airborne radionuclides, 2) deposition of radionuclides onto green leafy vegetation with subsequent consumption by man, 3) deposition onto grassy areas where milk animals and meat producing animals graze with consumption of the milk and meat by man (determined to be not applicable at Indian Point), and 4) deposition on the ground with subsequent exposure of man.

This Control applies to the release of gaseous effluents from each reactor at the site. For units with shared radwaste treatment systems, the gaseous effluents from the shared systems are proportioned among the units sharing that system.

GASEOUS RADWASTE TREATMENT SYSTEM (2/3.4.4)

The requirement that the appropriate portions of these systems be used, when specified, provides reasonable assurance that the release of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable." This Control implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50, and the design objectives given in Section II.D of Appendix I to 10 CFR Part 50.

The specified limits governing the use of appropriate portions of the systems were specified as a suitable fraction of the dose design objectives set forth in Sections II.B and II.C of Appendix I, 10 CFR Part 50, for gaseous effluents.

This Control applies to the release of gaseous effluents from each reactor at the site. For units with shared radwaste treatment systems, the gaseous effluents from the shared systems are proportioned among the units sharing that system.

TOTAL DOSE (2/3.6)

This Control is provided to meet the dose limitations of 40 CFR Part 190 that have been incorporated into 10 CFR Part 20.1301(d). The Control requires the preparation and submittal of a Special Report whenever the calculated doses due to releases of radioactivity and to radiation from uranium fuel cycle sources exceed 25 mrems to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrems.

For sites containing up to 4 reactors, it is highly unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40 CFR Part 190 if the individual reactors remain within twice the dose design objectives of Appendix I, and if direct radiation doses from the reactor units and outside storage tanks, etc., are kept small. The Special Report will describe a course of action that should result in the limitation of the annual dose to a MEMBER OF THE PUBLIC to within the 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 8 km must be considered. If the dose to any MEMBER OF THE PUBLIC is estimated to exceed the requirements of 40 CFR Part 190, submittal of the Special Report within 30 days 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 Part 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 variance only relates to the limits of 40 CFR Part 190, and does not apply in any way to the other requirements for dose limitation of 10 CFR Parts 20, as addressed in Controls 2.3.1 and 2.4.1. 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.

Demonstration of compliance with the limits of 40 CFR Part 190 or with the design objectives of Appendix I to 10 CFR Part 50 will be considered to demonstrate compliance with the 0.1 rem limit of 10 CFR Part 20.1301.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (2/3.7)

The Radiological Environmental Monitoring Program required by this Control provides representative measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposures of MEMBERS OF THE PUBLIC resulting from the station operation.

This monitoring program implements Section IV.B.2 of Appendix I to 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 and the modeling of the environmental exposure pathways. Isotopes identified in REMP are compared to those identified in the applicable Annual Effluent Report. Program changes may be initiated based on these operational experiences.

The required detection capabilities for environmental sample analyses are tabulated in terms of the lower limits of detection (LLDs). The LLDs required by Table 3.7-1 are considered optimum for routine environmental measurements in industrial laboratories. It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

LAND USE CENSUS (2/3.8)

This Control is provided to ensure that changes in the use of areas at and beyond the SITE BOUNDARY are identified and that modifications to the Radiological Environmental Monitoring Program are made if required by the results of this census. The best information from the door-to-door survey, from aerial survey or from consulting with local agricultural authorities shall be used. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10 CFR Part 50. Restricting the census to gardens of greater than 50 m^2 provides assurance that significant exposure pathways via leafy vegetables will be identified and monitored since a garden of this size is the minimum required to produce the quantity (26 kg/year) of leafy vegetables assumed in Regulatory Guide 1.109 for consumption by a child. To determine this minimum garden size, the following assumptions were made: 1) 20% of the garden was used for growing broad leaf vegetation (i.e., similar to lettuce and cabbage), and 2) a vegetation yield of 2 kg/m^2.

INTERLABORATORY COMPARISON PROGRAM (2/3.9)

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

LIQUID HOLDUP TANKS (2/3.10)

Pursuant to Technical Specification 5.5.11.c, the tanks listed in this specification include all those outdoor tanks that are not surrounded by liners, dikes, or walls capable of holding the tank contents and that do not have tank overflows and surrounding area drains connected to the liquid radwaste treatment system.

Restricting the quantity of radioactive material contained in the specified tanks provides assurance that in the event of an uncontrolled release of the tanks' contents, the resulting concentrations would be less than the values given in Appendix B, Table 2, Column 2 to 10CFR20, at the nearest potable water supply and the nearest surface water supply in an UNRESTRICED AREA.

GAS STORAGE TANKS (2/3.11)

Pursuant to Technical Specification 5.5.11.b, the tanks included in this specification are those tanks for which the quantity of radioactivity contained is not limited directly or indirectly by another specification to a quantity that is less than the quantity that provides assurance that in the event of an uncontrolled release of the tanks' contents, the resulting total body exposure to a MEMBER OF THE PUBLIC at the nearest SITE BOUNDARY will not exceed 0.5 rem in an event of 2 hours duration.

Restricting the quantity of radioactivity contained in each gas storage tank provides assurance that in the event of an uncontrolled release of the tanks' contents, the resulting total body exposure to a MEMBER OF THE PUBLIC at the nearest SITE BOUNDARY will not exceed 0.5 rem. This is consistent with NUREG-0133.

5.0 ADMINISTRATIVE REQUIREMENTS

5.1 RECORDS RETENTION

In addition to the applicable record retention requirements of Title 10, Code of Federal Regulations, records shall be retained in accordance with the retention schedule of TRM 5.5.

The following specific Effluent and Environmental records shall be retained for the duration of the unit operating license:

- Records of any drawing changes reflecting facility design modifications made to systems and equipment described in the Final Safety Analysis Report.
- Records of gaseous or liquid radioactive material released to the environs.
- Records of reviews performed for changes made to procedures or equipment or reviews of tests and experiments pursuant to 10 CFR 50.59.
- Records of analyses required by the radiological environmental monitoring program that would permit evaluation of the accuracy of the analysis at a later date. This should include procedures effective at specified times and records showing that these procedures were followed.
- Records of reviews performed for changes made to the Offsite Dose Calculation Manual and the Process Control Program.

5.2 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

A Radioactive Effluent Release Report covering the operation of the unit during the previous year shall be submitted prior to May 1 of each year. A single submittal may be made for a multiple unit station. The submittal should combine those sections that are common to all units at the station. However, for units with separate radwaste systems, the submittal shall specify the releases of radioactive material from each unit.

The Annual Radioactive Effluent Release Report shall include the following information:

- A summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit as outlined in Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," Revision 1, June 1974, with data summarized on a quarterly basis following the format of Appendix B thereof or as modified in the RECS.

- For solid wastes, the following information for each class of solid waste (as defined by 10 CFR Part 61) shipped offsite during the report period will be presented in tabular form similar to that of Table 3 of Regulatory Guide 1.21:

  a. Container 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 (e.g., dewatered spent resin, compacted dry waste, evaporator bottoms),

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

  f. Solidification agent or absorbent (e.g., cement, urea formaldehyde).

- An annual summary of hourly meteorological data collected over the previous year. This annual summary may be either in the form of an hour-by-hour listing on electronic media of wind speed, wind direction, atmospheric stability, and precipitation (if measured), or in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability. In lieu of submission with the Radioactive Effluent Release Report, the licensee has the option of retaining this summary of required meteorological data on site in a file that shall be provided to the NRC upon request.

- An assessment of the radiation doses due to the radioactive liquid and gaseous effluents released from the unit or station during the previous calendar year.

- An assessment of the radiation doses from radioactive liquid and gaseous effluents to MEMBERS OF THE PUBLIC due to their activities inside the SITE BOUNDARY during the report period. All assumptions used in making these assessments, i.e., specific activity, exposure time and location, shall be included in the report. Approximate and conservative approximate methods for determining the meteorological conditions shall be used for determining gaseous pathway doses. The assessment of radiation doses shall be performed in accordance with the methodology and parameters in the OFFSITE DOSE CALCULATION MANUAL (ODCM).

- An assessment of radiation doses to the likely most exposed MEMBER OF THE PUBLIC from reactor releases and other nearby uranium fuel cycle sources, when required by Sections 2.6 and 3.6, including doses from primary effluent pathways and direct radiation, for the previous calendar year to show conformance with 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operation." Acceptable methods for calculating the dose contribution from liquid and gaseous effluents are given in Regulatory Guide 1.109 Rev. 1, October, 1977.

- A list and description of unplanned releases from the site to UNRESTRICTED AREAS of radioactive materials in gaseous and liquid effluents made during the reporting period.

- Pursuant to Controls 2.1 and 2.2, an explanation as to why the inoperability of liquid or gaseous effluent monitoring instrumentation was not corrected within the time specified.

- Pursuant to Controls 2.1 and 2.2, a discussion of all deviations from the provisions of these Controls.

- Pursuant to Control 2.7 and Table 2.7-1, Notation (a), identify the causes of the unavailability of samples for pathway analysis and identify the new locations for obtaining replacement samples. Include revised figure(s) and table for the ODCM reflecting the new locations.

- Pursuant to Table 3.3.1-1, Notation (c) and Table 3.4.1-1, Notation (b), a discussion of identifiable gamma peaks, including those of nuclides specified in Tables 3.3.1-1 and 3.4.1-1.

- Pursuant to Control 2.8, a listing of new location(s) for dose calculations and/or environmental monitoring identified by the land use census. Include revised figure(s) and table for the ODCM reflecting the new location(s).

- Pursuant to Controls 2.10 and 2.11, a description of the events leading to liquid holdup tanks or gas storage tanks exceeding the Control limits.

- Pursuant to RECS 5.4, a discussion of the major changes to radioactive liquid, gaseous, and solid waste treatment systems.

- Pursuant to RECS 5.5 and 5.6, any changes made during the reporting period to the PROCESS CONTROL PROGRAM (PCP) and to the OFFSITE DOSE CALCULATION MANUAL (ODCM), respectively.

5.3 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

An annual Radiological Environmental Operating Report covering the operation of the unit during the previous calendar year shall be submitted prior to May 15th of each year, according to Technical Specification 5.6.2. A single submittal may be made for a multiple unit station.

The Annual Radiological Environmental Operating Report shall include:

- Summaries, interpretations, and an analysis of trends of the results of the Radiological Environmental Monitoring Program for the report period, including a comparison, as appropriate, with preoperational studies, with operational controls, and with previous environmental surveillance reports, and an assessment of the observed impacts of the plant operation on the environment.

- At least two legible maps covering all sampling locations keyed to a table giving distances and directions from the centerline of one reactor. One map shall cover stations near the site boundary and the second shall include the more distant stations.

- The results of analysis of all radiological environmental samples and of all environmental radiation measurements taken during the period pursuant to the locations specified in the tables and figures in the ODCM, as well as summarized and tabulated results of these analyses and measurements in the format of the table in the Radiological Assessment Branch Technical Position, Revision 1, November 1979. In the event that some individual 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.

- A summary description of the Radiological Environmental Monitoring Program.

- A discussion of the reasons for not conducting the Radiological Environmental Monitoring Program as specified by Control 2.7 and the plans for preventing recurrence.

- Pursuant to Control 2.7, a discussion of environmental sample measurements that exceed the reporting levels of Table 2.7-2 but are not the result of plant effluents.

- Pursuant to Table 2.7-1, Notation (a), a discussion of all deviations from the sampling schedule of Table 2.7-1.

- Pursuant to Table 3.7-1, Notation (c), a discussion of the contributing factors for cases in which the LLD required by Table 3.7-1 was not achievable.

- Pursuant to Table 3.7-1, Notation (a), a discussion of identifiable nuclide peaks, including those of nuclides specified in Table 3.7-1.

- Pursuant to Control 3.8, the results of the land use census.

- Pursuant to Control 2.9, the corrective actions taken to prevent a recurrence if the Interlaboratory Comparison Program is not being performed as required.

- Pursuant to Control 3.9, the results of licensee participation in the Interlaboratory Comparison Program.

5.4 MAJOR CHANGES TO RADIOACTIVE LIQUID, GASEOUS AND SOLID WASTE TREATMENT SYSTEMS

Licensee initiated major changes to the radioactive waste systems (liquid, gaseous and solid) shall be reported to the Commission in the Annual Radioactive Effluent Release Report for the period in which the evaluation was reviewed by the OSRC. The discussion of each shall contain:

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

- Sufficient detailed information to totally support the reason for the change without benefit of additional or supplemental information

- A detailed description of the equipment, components and processes involved and the interfaces with other plant systems

- An evaluation of the change, which shows the predicted releases of radioactive materials in liquid and gaseous effluents and/or quantity of solid waste that differ from those previously predicted in the license application and amendments thereto

- An evaluation of the change, which shows the expected maximum exposures to an individual in the UNRESTRICTED AREA and to the general population that differ from those previously estimated in the license application and amendments thereto

- A comparison of the predicted releases of radioactive materials, in liquid and gaseous effluents and in solid waste, to the actual releases for the period prior to when the changes are to be made

- An estimate of the exposure to plant operating personnel as a result of the change

- Documentation of the fact that the change was reviewed and found acceptable by the OSRC.

- A single submittal may be made for a multiple unit station

- The information called for in this Specification will be submitted as part of the annual FSAR update

5.5 PROCESS CONTROL PROGRAM (PCP)

5.5.1 The PCP shall be approved by the Commission prior to implementation.

5.5.2 Licensee initiated changes to the PCP:

5.5.2.1 Shall be documented and records of reviews performed shall be retained as required by RECS 5.1. This documentation shall contain:

- Sufficient information to support the change together with the appropriate analyses or evaluations justifying the change(s); and

- A determination that the change will maintain the overall conformance of the solidified waste product to existing requirements of Federal, State, or other applicable regulations.

5.5.2.2 Shall become effective upon review and acceptance by the OSRC and the approval of the Site Executive Officer.

5.5.2.3 Shall be submitted to the Commission as a part of or concurrent with the Annual Radioactive Effluent Release Report for the period of the report in which any change to the PCP was made. Each change shall be identified by marking in the margin of the affected pages, clearly indicating the area of the page that was changed, and shall indicate the date (e.g., month/year) the change was implemented.

5.6 OFFSITE DOSE CALCULATION MANUAL (ODCM)

5.6.1 The ODCM shall be approved by the Commission prior to implementation.

5.6.2 Licensee initiated changes to the ODCM:

5.6.2.1 Shall be documented and records of reviews performed shall be retained as required by RECS 5.1. This documentation shall contain:

- Sufficient information to support the change together with the appropriate analyses or evaluations justifying the changes(s); and
- A determination that the change will maintain the level of radioactive effluent control required pursuant to 10 CFR 20.1302, 40 CFR Part 190, 10 CFR 50.36a, and Appendix I to 10 CFR Part 50 and not adversely impact the accuracy or reliability of effluent dose or setpoint calculations;

5.6.2.2 Shall become effective upon review and acceptance by the OSRC and the approval of the Site Executive Officer.

5.6.2.3 Shall be submitted to the Commission as a part of or concurrent with the Annual Radioactive Effluent Release Report for the period of the report in which any change to the ODCM was made. Each change shall be identified by marking in the margin of the affected pages, clearly indicating the area of the page that was changed, and shall indicate the date (e.g., month/year) the change was implemented.

5.7 SPECIAL REPORTS

In lieu of a Licensee Event Report (LER), the following special reports must be generated within 30 days:

- Pursuant to Control 2.3.2, identify the cause(s) for exceeding the specified limits for dose or dose commitment to a MEMBER OF THE PUBLIC from the release of radioactive materials in liquid effluents to UNRESTRICTED AREAS. Define the corrective action(s) taken to reduce the releases and the proposed corrective action(s) to be taken to assure subsequent releases will be in compliance with limits. Include the results of radiological analyses of the drinking water source and the radiological impact on finished drinking water supplies with regard to the requirements of 40 CFR Part 141.
- Pursuant to Control 2.3.3, explain why liquid radwaste was discharged without treatment and identify any inoperable liquid radwaste treatment system equipment or subsystems and the reason for the inoperability. Include the action(s) taken to restore the inoperable equipment to OPERABLE status and a summary description of the action(s) taken to prevent a recurrence.

- Pursuant to Control 2.4.2, identify the cause(s) for exceeding the specified limit(s) for the air dose due to radioactive noble gases released in gaseous effluents. Define the corrective actions taken to reduce the releases and define the proposed corrective actions to be taken to assure subsequent releases will be in compliance with limits specified in the Control.

- Pursuant to Control 2.4.3, identify the cause(s) for exceeding the specified limits for the dose to a MEMBER OF THE PUBLIC from the release of iodine-131, tritium, and radionuclides in particulate form with half lives greater than 8 days in gaseous effluents. Define the corrective actions taken to reduce the releases and define the proposed corrective actions to be taken to assure subsequent releases will be in compliance with limits specified in the Control.

- Pursuant to Control 2.4.4, explain why gaseous radwaste was discharged without treatment and identify inoperable gaseous radwaste treatment system equipment or subsystems and the reason for the inoperability. Include the action(s) taken to restore the inoperable equipment to OPERABLE status and a summary description of the action(s) taken to prevent a recurrence.

- Pursuant to Control 2.6 and 10 CFR Part 20.2203(a)(4), define the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the specified total dose limits. Include a schedule for achieving conformance with the limits and describe the 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. 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 releases covered by this report. Also describe the levels of radiation and the concentrations of radioactive material involved as well as the cause of the exposure levels or concentrations. Include a request, if required by the provisions of the Control, for a variance in accordance with the provisions of 40 CFR Part 190.

- Pursuant to Control 2.7, identify the cause(s) for exceeding the reporting levels of Table 2.7-2 and define the corrective actions to be taken to reduce radioactive effluents so that the potential annual dose to a MEMBER OF THE PUBLIC is less than the calendar year limits of Controls 2.3.2, 2.4.2, and 2.4.3. Report when more than one radionuclide in Table 2.7-2 is detected and

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

- Report when radionuclides other than those in Table 2.7-2 are detected and are the result of plant effluents and the potential annual dose to a MEMBER OF THE PUBLIC is equal to or greater than the calendar year limits of Controls 2.3.2, 2.4.2, and 2.4.3.

INDIAN POINT 3

OFFSITE DOSE CALCULATION MANUAL

ODCM PART II - CALCULATIONAL METHODOLOGIES

REVISION 17

1.0 INSTRUMENTATION AND SYSTEMS

1.1 Effluent Monitoring System Description

Effluent monitor information is provided in Table 1-1, including an indication of which monitors use effluent setpoints. Figures 2-1 and 3-1 show a schematic of the possible radioactive release points which monitor locations for liquid and gaseous pathways, respectively.

1.2 Setpoints

This section provides equations and methodology used for each alarm and trip setpoint on each effluent release point according to Sections 2.1 and 2.2 of the RECS.

1.2.1 Setpoints for Gaseous Effluent Monitors

Setpoints for gaseous monitors are based on the permissible discharge rate as calculated in Section 3 of the ODCM. These setpoints are inherently conservative due to the assumed mixture (Table 3-8) and the use of the most restrictive setpoints (annual average dose limit), which are used whenever practical. Higher release rates may be authorized with the proper concurrence, as delineated in Section 3.1.8. The methodology identified in Section 3, along with an isotopic mix described in Table 3-8, are used to generate the following noble gas discharge rates (normally utilized for alarm setpoints):

Indian Point Unit 3 Conservative Permissible Discharge Rates (μCi/sec)

Basis of Limit	Iodine/Particulate*	Noble Gases
Annual Average **	4.05E-2	3.57E+3
Quarterly Average **	8.10E-2	7.14E+3
Instantaneous ***	1.38E+1	7.00E+4

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* Half-lives greater than 8 days

** These limits are not part of Section 2.4.1 of the RECS, but are included for information, as these limits are used for operational control of releases.

*** Derived from Section 2.4.1 of the RECS.

1.2.1.1 The Plant Vent Wide Range Gas Monitor (R-27) reads and alarms in μCi/sec, hence, the alarm setpoints are set directly in μCi/sec.

1.2.1.2 If the monitor reads and alarms in μCi/cc, the maximum alarm set point is calculated as follows:

$$S = D / [(F) * (4.72E+2)]$$

where: S = Maximum alarm setpoint in μCi/cc

D = Permissible discharge rate in μCi/sec

F = Vent duct flow in ft^3/min

4.72E+2 = unit conversion factor (28317 cc•min/ft^3•60sec)

1.2.1.3 If the monitor reads and alarms in cpm, then the maximum alarm setpoint is calculated as follows:

$$S = D / [(F) * (4.72E+2) * (CF)]$$

where:

S, D, F, and 4.72E+2 are defined in the previous step

CF = Rad Monitor Conversion Factor (μCi/cc per net cpm)

1.2.1.4 Normally, maximum allowable limits are calculated using a standard nuclide mix. However, setpoints may be determined based on the actual mix, on a case by case basis. This method is usually performed when the instantaneous release rate is applied. Should this method be applied, extra care should be applied to setpoint partitioning (for all release points) to ensure site dose rate limits are not approached.

1.2.1.5 During normal operation, the Unit 3 main plant vent is the only significant release point. Hence, monitors on the plant vent are routinely set at the *annual* limit, which is approximately 10% of the conservative *instantaneous* limit.

Monitor setpoints on other pathways are routinely set to 1% of the *instantaneous* limit. If multiple pathways become significant, each pathway's permissible release rate is apportioned with the Plant Vent's to ensure the total discharge rate for all release points remains less than the maximum permissible discharge rate.

1.2.2 Setpoints for Liquid Effluent Monitors

1.2.2.1 Liquid Effluent Monitors have setpoints based on limiting the concentrations in the discharge canal to ten times the concentration values in Appendix B, Table 2, Column 2 to 10CFR20 in accordance with 10CFR20.1302(2)(i). Monitor setpoints are inherently conservative due to the routine use of Circulating Water Pumps for liquid waste releases, and Service Water for continuous releases. In actuality, both Circulating and Service Water systems contribute to site dilution.

1.2.2.2 For monitors that read and alarm in μCi/ml, such as the liquid waste disposal monitor (R-18), the service water monitors (R-16 A and B and R-23), and the steam generator blowdown monitor (R-19) the alarm setpoint is calculated as follows:

S = [(ADC) (F)]/[f] = Maximum alarm setpoint in μCi/ml

where:

F = Available discharge canal dilution flow for this release in gal/min

f = calculated allowable release rate in gal/min (Section 2.2.6)

ADC = Allowed diluted concentration is the equivalent MPCW for gamma emitting isotopes weighted for total specific activity (beta and gamma emitters). This parameter is further clarified in Section 2.2.

NOTE: The gamma equivalent MPCW or ADC must be used due to the insensitivity of the radiation monitor to beta emitters and the time necessary to analyze liquid releases for these beta emitters.

1.2.2.3 Alert setpoints should be used on batch liquid release monitors to ensure the contents of the batch tank have not changed since sampling. The alert setpoint is calculated as follows:

$$AS = (C) * (M)$$

where:

AS = Alert setpoint in μCi/ml

C = Average monitor reading at time of sample

M = A conservative factor based upon the mixing ratio of two tank volumes and an expected monitor response error term (typically 1.25, coinciding with 25%).

NOTE: Liquid Monitor alert setpoints do not control any auto functions but simply provide indication to the operators.

1.3 MAP DEFINING UNRESTRICTED AREAS FOR RADIOACTIVE GASEOUS AND LIQUID EFFLUENTS

Information regarding radioactive gaseous and liquid effluents, which will allow identification of structures and release points as well as definition of UNRESTRICTED AREAS within the SITE BOUNDARY that are accessible to MEMBERS OF THE PUBLIC, shall be shown in Figure 1-1.

The definition of UNRESTRICED AREA used in implementing the Radiological Effluent Controls (RECS or ODCM Part I) has been expanded over that in 10 CFR 20.1003. For calculations performed pursuant to 10 CFR 50.36a, the concept of UNRESTRICTED AREAS refers to areas at or beyond the SITE BOUNDARY and does not include areas over water bodies. This definition is utilized in the RECS to keep levels of radioactive materials in liquid and gaseous effluents as low as reasonably achievable.

Figure 1-1 MAP DEFINING UNRESTRICTED AREAS FOR RADIOACTIVE GASEOUS AND LIQUID EFFLUENTS

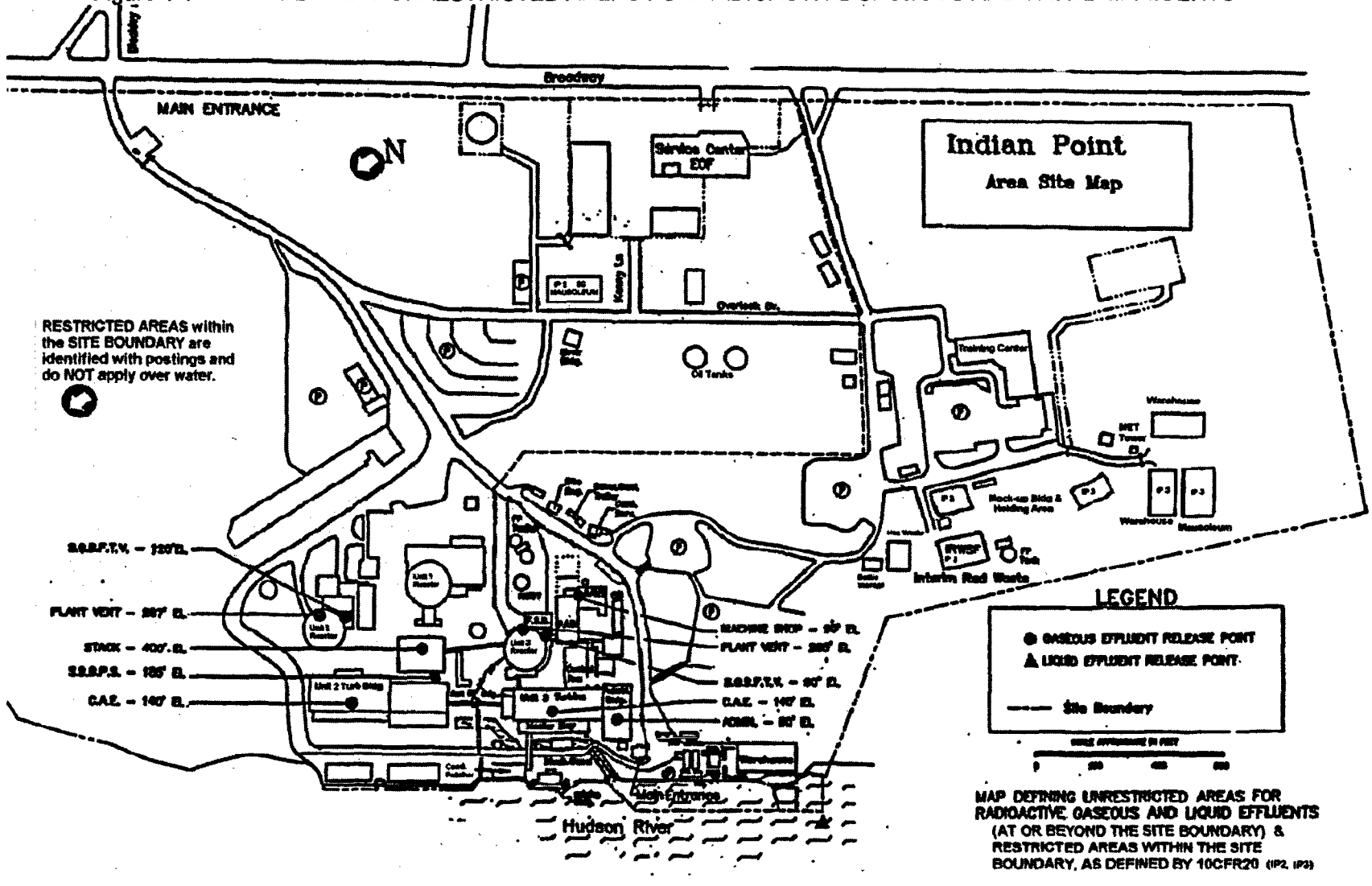

TABLE 1 – 1 (Page 1 of 2)

EFFLUENT MONITORING SYSTEM DATA

CHANNEL	MONITOR DESCRIPTION	SAMPLING LOCATIONS	RANGE	EFFLUENT CONTROL FUNCTIONS	ALARM SETPOINT USED
R-12 G	Containment Gas Monitor	Samples drawn from 32 and 35 Containment Fan Coolers	1E-7 to 1E-1 μCi/cc	Containment Ventilation Isolation	Note 1
R-14 G	Plant Vent Radiogas Monitor	In Plant Vent at approximately 105' elevation	1E-6 to 1E-1 μCi/cc	Secures waste gas tank release and Containment Ventilation Isolation	Note 1
R-15 G	Condenser Air Ejector Monitor	In-line detector on the air ejector exhaust header	1E-6 to 1E+0 μCi/cc	On alarm diverts air ejector flow to VC, steam to condenser priming air ejector stopped and steam to reheater secured	Note 1
R-20 G	Waste Gas Disposal System Monitor	Adjacent to line monitor on suction to waste gas compressors	1E-2 to 1E+3 μCi/cc	None	Note 3
R-27 G	Plant Vent Wide-Range Monitor	Sample drawn from inside Plant Vent	1E-7 to 1E+5 μCi/cc	Secure waste gas tank release and Containment Ventilation Isolation	Note 1
R-46 G	Administration Building Vent Radiogas Monitor	4th Floor Administration Building Monitor Exhaust Plenum for Controlled Areas	1E+1 to 1E+6 cpm (typically 5E-8 to 5E-2μCi/cc)	None	Note 1
R-59 G	RAMS Building Vent Radiogas Monitor	55' RAMS Building Monitor Exhaust Plenum	1E-6 to 1E+2 μCi/cc	None	Note 1

TABLE 1 – 1 (Page 2 of 2)

EFFLUENT MONITORING SYSTEM DATA

CHANNEL	MONITOR DESCRIPTION	SAMPLING LOCATIONS	RANGE	EFFLUENT CONTROL FUNCTIONS	ALARM SETPOINT USED
R-16 A/B L	Fan Cooler and Motor Cooler Service Water Return	Adjacent to service water return line from V.C. fan cooler units and motor coolers	1E-7 to 1E-1 µCi/cc	None	Note 1
R-17 A/B L	Component Cooling System pump outlet	Adjacent to line monitors on each pump outlet	1E-6 to 1E-1 µCi/ml	None	Note 2
R-23 L	Component Cooling Heat Exchanger Service Water Monitor	Adjacent to line monitor mounted on service water return line from Component Cooling Heat Exchanger	1E-7 to 1E-1 µCi/cc	None	Note 1
R-18 L	Waste Disposal Liquid Effluent Monitor	In-line monitor on monitor tank recirc pump discharge	1E-7 to 1E-1 µCi/cc	Terminates monitor tank release on alarm	Note 1
R-19 L	SG Blowdown Monitor	PAB blowdown room monitors steam generator blown	1E-6 to 1E+2 µCi/cc	Closes blowdown isolation valves and SG sample valves	Note 1
R-61 L	CPF Regen Waste Release Monitor	Monitor recirculation of HTDS and LTDS tanks in condensate polisher (used when primary to secondary leakage exists).	1E-7 to 1E-1 µCi/cc	Terminates HTDS or LTDS tank release	Note 4

Note 1 Alarm setpoint used for effluent considerations. G = Gaseous L = Liquid

Note 2 Alarm setpoint NOT used for effluent considerations, used for information only.

Note 3 Ensures 50000 Ci limit in gas decay tanks is not exceeded.

Note 4 Alarm setpoint based on effluent considerations ONLY if a Primary to Secondary Leak exists, per RECS Section 1.

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2.0 LIQUID EFFLUENTS

2.1 Liquid Effluent Releases - General Information

2.1.1 The surveillance and lower limit of detection requirements for liquid radioactive effluents are contained in Section 3.3.1 of the Radiological Effluent Controls (RECS). Lower limit of detection calculations are listed in ODCM Part II, Appendix B.

2.1.2 A completed and properly authorized Liquid Radioactive Waste Permit should be issued prior to the release of any radioactive waste from an isolated tank to the discharge canal. A permit is required for each radioactive tank to be discharged.

2.1.3 All activity determinations for liquid radioactive effluents will be performed in such a manner as to be representative of the activity released to the river.

2.1.4 The radioactivity in liquid waste tanks shall be continuously monitored during release except as allowed by Section 2.1 of the RECS. If the flowmeter is inoperable, the flow shall be estimated every four hours by difference in tank level or by discharge pump curves.

2.1.5 Prior to discharge, the radioactive waste tank contents shall be recirculated for at least two tank volumes. After this recirculation, and prior to discharge, a sample shall be taken and analyzed for activity with a portion of the sample set aside for composite analysis. The measured activity shall be used for calculating allowable discharge rate and the alarm setpoint for the liquid waste discharge monitor.

2.1.6 Radioactive releases of steam generator blowdown during primary to secondary leaks when released to the river should be documented on Liquid Radioactive Waste Release Permits using data supplied by the Chemistry Technician.

2.1.7 Assurance that combined liquid releases from Units 2 and 3 do not exceed the requirement of the RECS, Section 2.3 (10CFR20 requirements) are provided by administrative controls which include routine use of unit-specific dilution flow for each permitted release. In order to facilitate two-unit operation, however, upon agreement between shift managers, one unit can reduce or eliminate radioactive liquid waste discharges for a period of time to allow the other unit to use the full site dilution flow, or a specified portion thereof, for a limited time.

2.1.8 Time average dose calculations (10CFR50) may use total site dilution flow for both units, with the determined dose contributions additive for a site report over any specified period.

2.1.9 Steam Generator Blowdown activity is determined by samples taken at least three times per week. These "grab" samples of the steam generators are collected in a manner to be proportional to the rate of flow of individual steam generator to total steam generator blowdown. These samples are then analyzed for the various radionuclides at frequencies specified in Table 3.3.1-1 of the RECS. Further flow proportional composites are made where appropriate.

2.1.10 The discharge canal flow rate is determined by the use of pump flow characteristics curves. Nominal maximum flow for condenser cooling pumps is 140,000 gpm. During the cold weather months, the condenser cooling pumps are operated at reduced speed, nominally 64,000 gpm.

2.1.11 Radioactivity content in outdoor tanks is to be limited to less than 10 curies, excluding tritium and noble gas, as per Section 2.10 of the RECS. Compliance with this requirement is demonstrated by limiting the radioactive concentration in these tanks to the value which results in 10 curies when the tank is at full liquid capacity, except as modified below. The radioactive concentration limits for these tanks are:

RWST:
$$\frac{10\,curies \times 10^{6}\,\mu Ci/curie}{358{,}500\,gal \times 3785\,ml/gal} = 7.3\times10^{-3}\,\mu Ci/ml$$

PWST:
$$\frac{10\,curies \times 10^{6}\,\mu Ci/curie}{165{,}000\,gals \times 3785\,ml/gal} = 1.6\times10^{-2}\,\mu Ci/ml$$

31 & 32 MT:
$$\frac{10\ curies \times 10^{6}\,\mu Ci/curie}{11{,}750\,gals \times 3785\,ml/gal} = 2.2\times10^{-1}\,\mu Ci/ml$$

Condensate Polisher High and Low Total Dissolved Solids Tanks:
$$\frac{10\ curies \times 10^{6}\,\mu Ci/curie}{60{,}000\,gals \times 3785\,ml/gal} = 4.4\times10^{-2}\,\mu Ci/ml$$

Outside Temporary Tanks:
$$\frac{10\ curies \times 10^{-6}\,\mu Ci/curie}{Volume\ (gal) \times 3785\,ml/\ gal} = \mu Ci/ml$$

The refueling water storage tank has the potential to be filled from the reactor cavity with liquid which exceeds the limits stated. Therefore, prior to filling the RWST from the reactor cavity after refueling operations, the reactor cavity (or residual heat removal system) must be sampled for radioactivity and action taken to ensure that the total activity in the tank does not exceed 10 curies.

Outside temporary tanks should not be filled with liquid which could exceed the concentration limit calculated. Therefore, prior to transfer to outside temporary tanks, the source of liquid shall be sampled for radioactivity. If it exceeds the concentration limit calculated, action shall be taken to ensure that the total activity in the tank does not exceed 10 curies.

2.1.12 Although R-19 continuously monitors steam generator blowdown to the river, there are no continuous composite samples for steam generator blowdown. The method of determining release concentration is as follows:

Individual blowdown flow rate to river (by flowmeter or curves)	X	Sample Blowdown Concentration	=	Composite activity being released

2.1.13 The service water radioactivity monitors listed in Table 2.1-1 of the RECS are defined as the process radiation monitors which monitor components discharging into or are cooled by the service water system. These and other liquid effluent process radiation monitors are:

Service Water:

R-16 A or B: Fan Cooler and Motor Cooler unit service water return monitors

R-23: Component cooling service water return

Liquid Waste (separate release points):

R-18: Liquid waste release monitor

R-19: Steam generator blowdown radioactivity monitor

R-61: Condensate Polisher waste monitor. Applicable only after a Primary to Secondary Leak, as per ODCM Part II, Sec 1, Table 1-1, Note 4.

If all monitors on the effected release path are taken out of service and the removal of that monitor from service is not specifically addressed in the RECS, releases may continue via this pathway provided that samples are taken on the effected stream every 12 hours.

2.1.14 Liquid effluent concentrations must be within the limitations of 2.3.1 of the RECS. The total dose per quarter and per year must be within the limitations of 2.3.2 of the RECS.

2.1.15 There are no drinking water intakes within 3 miles downstream of the site on the Hudson River (see Section 2.4.1 for further details).

2.1.16 A turbine hall drain system which would collect leakage of contaminated secondary plant waters during operation does not exist at IP3. The sumps present in the turbine hall (five foot elevation) receive drains from areas containing secondary plant components at sub-atmospheric pressures. These sumps do not meet the intent of a turbine hall drain system as defined in NUREG 0472.

Quantification of effluents is performed on this pathway during a Primary to Secondary leak, as defined by ODCM Part II, Section 1, Table 1-1, Note 4. In these cases, releases from this pathway would be quantified by periodic sampling and determination of the release rate to the river.

At elevated Steam Generator activity levels (approximately 1.0E-4 or above), turbine hall drains may require temporary processing, should effluents via this pathway approach the 31-day dose projection limits per RECS 2.3.2. In this case, water is directed to the Condensate Polishing Facility or otherwise processed prior to release.

Activity released via this pathway is determined as follows:

$$\begin{pmatrix} \textit{Turbine Hall} \\ \textit{Drain} \\ \textit{Effluent Activity} \end{pmatrix} = \begin{pmatrix} \textit{Feedwater} \\ \textit{Specific} \\ \textit{Activity} \end{pmatrix} * \begin{pmatrix} \textit{Steam Plant} \\ \textit{Makeup} \\ \textit{Rate} \end{pmatrix} - \begin{pmatrix} \textit{SG Blowdown} \\ \textit{Rate to the} \\ \textit{River} \end{pmatrix}$$

2.1.17 Carbon 14 is released at a rate of .07 curies per GW(e)/yr with an average make up rate of 0.5 gal/min based upon studies performed by the New York State Department of Health. The estimate of Carbon 14 releases are included in the Radiological Impact on Man section of the Annual Radioactive Effluent Release Report. These estimates are not included in dose calculations for routine releases.

2.1.18 Several normally non-radioactive systems are periodically analyzed for radioactivity. These include condensate polisher regenerant waste and the Spent Fuel Pool Backup Heat Exchanger secondary cooling system (when in use). The monitoring program for these release points is consistent with the direction set forth in NRC IE Bulletin 80-10 "Contamination of Non-radioactive Systems and Resulting Potential for Unmonitored, Uncontrolled Release of Radioactivity to Environment". Should a system become contaminated, releases will be evaluated and quantified (as either batch or continuous) in accordance with the requirements listed in the RECS.

2.1.19 The liquid waste monitor tanks have an airborne release pathway. The original plant design limited the gases through this pathway by reducing the entrained gases to less than 2E-3 μCi/ml. When the entrained gas concentration in the monitor tank inlet exceeds 2E-3 μCi/ml, the noble gas release will be quantified by calculating the difference (in μCi's) between the gaseous activity added to the tank and the gaseous activity present in the effluent release sample. This difference will be the activity released through the tank vents and is quantified as an airborne release.

2.1.20 Due to the addition of Hafnium control rods in fuel cycle 11, an offsite dose may need to be calculated for Hafnium isotopes in waste pathways. In the absence of site-specific bioaccumulation and dose factors for Hafnium, factors for Zirconium will be used, as suggested in ICRP 30. Should these calculations become necessary, they will be performed per Section 2.5 and manually added to other totals.

2.2 Liquid Effluent Concentrations

2.2.1 This section provides a description of the means that will be used to demonstrate compliance with the RECS, Section 2.3.1.

2.2.2 Compliance with the instantaneous limits of 10CFR20 is achieved by allocating dilution per Section 2.1.7, on a per unit basis. Compliance with 10CFR50 (quarterly and annual limitations) is assured by completing a monthly report which summarizes the time-average releases from the site.

2.2.3 Each isolated liquid waste tank must be recirculated for at least two tank volumes prior to sampling in order to ensure a representative sample is obtained. A default minimum recirculation time may be used for 31 and 32 monitor tank in lieu of the actual calculation. This value is 4 hours, based upon the following calculation:

$$\frac{11750\ gals * 2\ Tank\ Volumes}{100\ gal/\min} = 3.9\ Hours \approx 4\ Hours$$

Note: Nominal monitor tank pump flow rate is approximately 135 gpm. For conservativism however, 100 gpm is used for the recirculation flow rate, while 150 gpm is used for the discharge flow rate in all release calculations.

2.2.4 The concentration in liquid effluents prior to dilution in the discharge canal is determined by sampling prior to release for batch releases. For continuous release the concentration can be determined by either grab sampling as in the batch release method or by direct reading radiation monitor. If the process radiation monitor is utilized care should be taken to ensure the calibration factor used is appropriate for the mixture being released.

For non-direct reading monitors, the following calculation is used:

$$C = CF * CR$$

C = Concentration of liquid effluent (μCi/ml) prior to dilution

CF = Conversion factor of monitor $\frac{\mu Ci/ml}{ncpm}$

CR = Count rate of monitor (ncpm)

2.2.5 The final diluted concentration in the discharge canal is determined by the following:

$$CD = (C) * (f)/(F)$$

Where: CD = Diluted concentration in the discharge canal in μCi/ml

C = Concentration in the liquid to be released prior to dilution in uCi/ml

F = Dilution flow in the discharge canal in gal/min

f = Release rate of liquid effluent in gal/min

NOTE: This equation is not used for calculating allowable release rates.

2.2.6 Calculation of Maximum Permissible Concentration in Liquid Effluents

a. This section describes the methodology used to ensure the requirements of section 2.3.1 of the RECS are satisfied. The total discharge canal concentration of radionuclides must be maintained less than those identified by section 2.3.1 of the RECS. The noble gases will be included using the limit 2E-4 μCi/ml as specified in section 2.3.1 of the RECS. This will normally be ensured by using an Allowed Dilution Concentration on each discrete release. This differs from the ADC calculated in 10CFR20 appendix B in that for radioisotopes that do not have gammas greater than 60 kev emitted during decay, default values are included to estimate their contribution. The Allowed Diluted Concentration is derived and calculated as follows:

$$ADC = \frac{MPCWt * CG}{Total\ activity} \quad or \quad ADC = \frac{MPCWt * CG}{CG+CB} \quad or \quad ADC = \frac{MPCWt}{1+CB/CG}$$

where:

ADC = Allowed diluted concentration in μCi/ml

MPCWt = Maximum permissible concentration in water for all isotopes (beta & gamma), in μCi/ml, as defined in RECS, Section 1.8, as follows:

$$MPCWt = \frac{\sum_i Ci}{\sum_i \left(Ci / MPCWi \right)}$$

Ci and MPCWi = Concentration and MPCW for each isotope

CB = The concentration of the non gamma emitters, in μCi/cc

CG = The concentration of the gamma emitters in uCi/ml

b. A representative sample must be obtained. In the case of a batch release this is ensured by having the contents of the tank recirculated for at least two tank volumes after the tank has been isolated. The minimum recirculation time is determined as follows:

T = 2 (V) / (G) where;

T = Minimum recirculation time in min

V = Volumes in the tank to be discharged, in gal

G = Recirculation rate in gal/min

NOTE: As stated in Section 2.2.3, a default recirculation time for 31 and 32 Monitor tanks of 4 hours may be used to simplify routine calculations.

c. After the tank has been sampled, determine the Allowed Diluted Concentration as per step 2.2.6a.

d. Determine if other liquid radioactive discharges are being made from this unit and obtain the radioactive concentration and discharge rate. If another release is occurring, the available dilution flow must be adjusted. This may be performed by allocation or by calculation. The required dilution flow is calculated as follows:

$$E = \frac{Dr * CG}{ADC}$$ where;

Dr = Current release discharge rate, gpm

E = Required dilution for current existing release(s), gpm

CG and ADC are defined in Section 2.2.6.a

e. Calculate the permissible discharge rate as follows:

$$D = \frac{ADC * B}{CG}$$ Where:

D = Permissible discharge rate in gal/min

ADC = Calculated and described in Step 2.2.6.a

CG = Gamma emitter concentration in μCi/ml

B = Adjusted dilution flow from the unit, in gpm, from Step 2.2.6.d, above, as follows:

$$B = [\ Available Dilution\ Flow] - [\ Required Dilution\ Flow for other releases\ (E)]$$

(With no "other" releases, *B* simply becomes the *Available Dilution Flow.*)

2.3 Liquid Effluent Dose Calculation Requirements

2.3.1 Section 2.3.2 of the RECS requires that the dose or dose commitment above background to an individual in an unrestricted area from radioactive materials in liquid effluents released from each reactor unit shall be limited:

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

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

NOTE: If either of the above limits is exceeded by a factor of two or more, then cumulative dose contributions from direct radiation would be determined by evaluation of existing perimeter and environmental TLDs per Section 2.6.A of the RECS.

2.3.2 Section 2.3.3 of the RECS requires that appropriate portions of the radwaste treatment system be used to reduce the radioactive material in liquid waste prior to their discharge when the projected dose due to liquid effluent from each reactor unit when averaged over 31 days, would exceed 0.06 mrem to the total body or 0.2 mrem to any organ. Doses due to liquid release shall be projected at least once per 31 days. These doses are projected based on the dose methodology in Section 2.4. or 2.5. The average of previous months' doses is used to project future dose:

$$\begin{bmatrix}\text{Dose}\\ \text{Projection}\end{bmatrix} = \frac{\text{Current Month Dose} + \text{Previous months' Dose}}{\text{number of months used}} \pm \begin{bmatrix}major\\ planned\\ evolutions\end{bmatrix}$$

The term for planned evolutions is routinely determined from previous similar evolutions, such as releases associated with plant shutdown.

2.3.3 Section 2.3.1 of the RECS requires that the concentration of radioactive material released from the site shall be limited to 10 times the concentration values specified in 10 CFR Part 20, Appendix B, Table 2, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases the concentration shall be limited to 2E-4 μCi/ml total activity.

2.4 Dose Methodology (Computer Calculation)

2.4.1 NUREG 0133 (Ref. 1, Section 4.3, Pg. 14) states that cumulative dose contributions should consider the dose contribution from the maximum exposed individual's consumption of fish, invertebrates, and potable water as appropriate. The river at IP3NPP is considered to be fresh water when in reality it is a tidal estuary and never completely fresh. Observed average chlorosity at IP3NPP has ranged as high as 2.5 gm/liter or about 13% sea water and 87% fresh water.

Hence, use of the Hudson River for water supply purposes is precluded south of Chelsea (mile point 65) which is the nearest point of potable water supply (approximately 15 miles upstream of IP3NPP). Radionuclide concentrations in the nearest water supply have been calculated (Ref. 2) to be a factor of at least 500 lower than the river water in the Ind ian Point area.

Due to the absence of a potable water pathway downstream of IP3NPP, RECS 2.3.2 reporting regulations for a 3 mile downstream limit do not apply. Exposures from ingestion of drinking water is therefore negligible.

Based on these factors, potable water consumption is not considered to be a pathway at IP3NPP. Thus, at IP3NPP, the cumulative dose considers only the dose contributions from the maximum exposed individuals consumption of fish and invertebrates. Tables of dose factors for three age groups were developed as per Section 2.4.3 and are included as Tables 2-1, 2-2, and 2-3. (Infant dose factors are 0 and are not included).

2.4.2 The relationships and methods that form the calculational base for dose accounting for the liquid effluent pathway are described in this section. These relationships can be used to meet the calculational requirements of Section 2.3.1. The cumulative dose factors (AiT) are calculated in Section 2.4.3. The following equation is generally applicable and can be used for any number of isotopes released over any time period.

$$D(T) = \sum_{i=1}^{m} [A_{iT} * \sum_{k=1}^{n} (dt_k)(C_{ik})(F_k)]$$

Where:

m = The total number of isotopes released. 9/05

$D(T)$ = The liquid effluent cumulative dose commitment from nuclides to the total body or any organ, T, for the time period k, in mrem. 9/05

dt_k = The length of the time period, k over which C_{ik} and F_k are averaged for all liquid releases, in hours. (This can be individual release durations summed, or an entire period duration, defined with each application of this equation.) 9/05

C_{ik} = The undiluted liquid effluent average concentration of nuclide, i, in μCi/ml, during time period dt_k from any liquid release.

n = The total number of releases considered.

A_{iT} = The site related ingestion dose commitment factor to the total body or any organ for each IP3NPP identified principal gamma and beta emitter listed in Table 2-1, 2-2, and 2-3, in mrem-ml per hr-μCi.

F_k = The total dilution factor for C_{ik} during any liquid effluent releases. Defined as the ratio of the maximum undiluted liquid waste flow during release to the average flow from the site discharge structure to unrestricted receiving waters, times an applicable factor.

The term C_{ik} represents the total undiluted concentration of radioactive material in liquid waste at the release point as determined by the radioactive liquid waste sampling and analysis program as contained in the RECS. All dilution factors beyond the sample point are included in the F_k and A_{iT} terms. 9/05

The term F_k is a total dilution factor and is determined as follows:

$$F_k = \frac{\text{Liquid Radioactive Waste Flow}}{[\text{Discharge Structure Exit Flow} * \text{Applicable Factor}]}$$

The liquid radioactive waste flow is the flow from all continuous and batch radioactive effluent releases specified in the RECS from all liquid radioactive waste management systems. The discharge structure exit flow is the average flow during disposal from the discharge structure release point into the receiving body of water. Based on studies by New York University Medical Center (ref. 14 page 7), the appropriate "Applicable Factor" (also known as the "near field dilution factor") is 5.

F_k is first determined with dilution flow concurrent with applicable releases, for permitting requirements (see Section 2.2). Doses are later recalculated (for the entire site) on a quarterly basis to determine actual doses from quarterly total site dilution volume. This method allows both an immediate and accurate long-term assessment of radiation dose resulting from liquid effluent releases at Indian Point. 9/05

2.4.3 Dose Factor for Liquid Effluent Calculations

2.4.3.1 The equation for dose from liquid effluents requires the use of a dose factor A_{iT} for each nuclide, i, which embodies the dose factors, pathway transfer factor, pathway usage factors, and dilution factors for the points of pathway origin. IPEC follows the guidance of NUREG 0133 and has calculated A_{iT} for the total body and critical organ of the maximum exposed individual (e.g. the adult). All the factors needed in the equation were obtained from Regulatory Guide 1.109 with the exception of the fish and invertebrate bioaccumulation factors (BF_i and BI_i) for Cesium, Niobium, Silver, and Antimony, which were determined locally (References 2, 12, 13, and 25). 9/05

For Cesium a site specific factor of 224 was used instead of the 2,000 presented in Table A-1 of the Regulatory Guide for fish. Similarly, a factor of 224 was used for invertebrates instead of the Regulatory Guide value of 1000. For Silver, the fish and invertebrate factors are 2.3 and 3300, respectively. For Niobium, the fish and invertebrate factors are 300 and 100 respectively. For Antimony, the fish and invertebrate factors are 1 and 300 respectively. The justification for these substitutions is discussed in Section 2.6. The summary dose factor is as follows:

$$A_{iT} = K[(UF)BF_i + (UI)BI_i]Df$$

Where:

A_{iT} = Composite dose parameter for the total body or critical organ for nuclide, i, for all appropriate pathways, mrem/hr per µCi/ml.

K = Units conversion factor, 114155 = $\frac{(1E6pCi/\mu Ci) * (1E3ml/kg)}{8760\ hr/yr}$

UF = kg/yr fish consumption from Table E-5 of Regulatory Guide 1.109:

21 Adult	6.9 Child
16 Teen	0 Infant

BFi = Fresh Water Fish Bioaccumulation factor for nuclide, i, in pCi/kg per pCi/l from Table A-1 of Regulatory Guide 1.109.

UI = kg/yr invertebrate consumption from Table E-5 of Regulatory Guide 1.109:

5.0 Adult	1.7 Child
3.8 Teen	0 Infant

BIi = Salt Water Invertebrates Bioaccumulation factor for nuclide, i, in pCi/kg per pCi/l from Table A-1 of Regulatory Guide 1.109.

DF_i = Dose conversion factor for nuclide i, for age groups in pre-selected organs, T, in mrem/pCi, from Tables E-11, 12 & 13 of Regulatory Guide 1.109.

IP3NPP has compiled A_{iT} factors for 3 age groups and various organs for the maximum exposed individual. These are included as Table 2-1, 2-2, and 2-3. For completeness, this table includes all isotopes found in Reg Guide 1.109, however, several isotopes listed are not routinely identified at IP-3. In addition, the values for Antimony, Silver, Cesium, and Niobium are site specific as previously discussed.

2.5 Backup Calculation Methodology

Note: These methods provide backup calculations identical to those in Section 2.4.

2.5.1 An alternate computer method which completely complies with Section 2.4 should be used when the primary computer system is inoperable.

2.5.2 Hand Calculations which completely comply with Section 2.4 can be employed if the primary and secondary computer codes are inoperable. Because they are time consuming and subject to calculational errors, procedural guidance in the actual flow of calculations should be used to maintain a standard format. These procedures are also used for periodic benchmark tests of the computer codes.

2.6 Site Specific Bio-Accumulation & Dose Factors

2.6.1 As stated in Section 2.4.3 the bioaccumulation factor (BF_i) for Cesium in fish is assumed to be 224 instead of the 2000 listed in Regulatory Guide 1.109 (Ref. 3). Similarly, the bioaccumulation factor for invertebrates is 224. This is based on the fact that the Hudson River at IP3NPP is not completely fresh, the Bioaccumulation Factor for salt water is 40 (Ref. 2), and that the behavior of Cesium in the Hudson is a complex phenomenon.

The NYU Study (Ref. 2) shows that Cesium concentrations in fish are regulated at a relatively constant value independent of the concentration of Cesium in water, and the bioaccumulation factors are thus inversely proportional to the water concentration of Cesium. This explains the lower bioaccumulation factor for Cesium reported by numerous investigators for salt water fish as opposed to fresh water fish because of the higher stable Cesium content of sea water. The NYU Report states that water at Indian Point has a dissolved Cesium concentration which is much higher than would be expected from simple mixing between sea water and fresh water and postulates that these higher concentrations result from leaching of Cesium from bottom sediment by saline water.

Use of the bioaccumulation factors of Regulatory Guide 1.109 for a fresh water site will thus substantially overestimate fish ingestion doses because no account is taken of the phenomena just discussed. However, radio-cesium concentrations in fish may still be estimated through the use of a bioaccumulation factor, provided that this factor is determined from the body of water of interest. This factor has been estimated (Ref. 12, page 33) to be about 224 for the flesh of indigenous fish caught in the Indian Point area. In contrast, the Cesium fresh water bioaccumulation factor presented by Regulatory Guide 1.109 for fish is 2000.

Fish ingestion doses would therefore be overestimated by a factor of 13 if the Regulatory Guide values were used.

Similarly for invertebrates, the site specific bioaccumulation factor of 224 is used. This is larger than the value of 25 given in Reg Guide 1.109 for salt water invertebrates.

A second conservatism in the NRC model concerns the location at which the concentrations in the river of the discharged Cesium are evaluated. Use of this model implies that these fish have grown directly in such a location prior to being caught, which is unrealistic and adds about a factor of five in conservation. This conservatism remains in the calculation, thus the use of the NYU (Ref. 12) bioaccumulation factor is justifiable since this remains as a conservative calculation.

2.6.2 No bioaccumulation factor for Silver is listed in Rev. 1 of Regulatory Guide 1.109, Table A-1. The values of 2.3 and 5000 for fish and invertebrates were obtained from ORNL-4992 (sponsored by ERDA 660, Ref. 25) and are included in the ODCM in the interests of increased accuracy since Ag-110m is a potential component of IP3NPP liquid releases.

2.6.3 International Atomic Energy Agency Report No. 57 provides data more recent than that presented in Regulatory Guide 1.109 for niobium bioaccumulation factors. The factor in the Regulatory Guide appears to be substantially over-conservative and, therefore, the more recent IAEA information is incorporated into the dose calculation methodology for liquid releases of radio-niobium. The values from Table XVII of IAEA No. 57 are 300 and 100 for freshwater fish and marine invertebrates respectively and are incorporated into this ODCM.

2.6.4 Antimony isotopes are not listed in Reg. Guide 1.109. As for Niobium above, IAEA Report No. 57 was used to provide bioaccumulation factors for the Antimony isotopes in Table 2-1. Dose factors were calculated for Antimony as per Reference #13.

2.6.5 In summary, with the exception of the bioaccumulation factors discussed above, all remaining factors are as follows: fish factors are for fresh water and invertebrate factors are for salt water.

Table 2 - 1

Site Related Adult Ingestion Dose Commitment Factors
(Freshwater Fish and Saltwater Invertebrate Consumption)

(AiT)
mR/hr per uCi/ml

ISOTOPE	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.82E-01	2.82E-01	2.82E-01	2.82E-01	2.82E-01	2.82E-01
BE-7	3.29E-01	7.45E-01	3.69E-01	0.00E+00	7.83E-01	0.00E+00	1.28E+02
NA-24	4.08E+02	4.08E+02	4.08E+02	4.08E+02	4.08E+02	4.08E+02	4.08E+02
P-32	4.96E+07	3.08E+06	1.92E+06	0.00E+00	0.00E+00	0.00E+00	5.57E+06
CR-51	0.00E+00	0.00E+00	4.31E+00	2.58E+00	9.50E-01	5.72E+00	1.08E+03
MN-54	0.00E+00	5.43E+03	1.04E+03	0.00E+00	1.61E+03	0.00E+00	1.66E+04
MN-56	0.00E+00	1.37E+02	2.42E+01	0.00E+00	1.73E+02	0.00E+00	4.36E+03
FE-55	3.21E+04	2.21E+04	5.16E+03	0.00E+00	0.00E+00	1.24E+04	1.27E+04
FE-59	5.06E+04	1.19E+05	4.56E+04	0.00E+00	0.00E+00	3.32E+04	3.96E+05
CO-58	0.00E+00	5.15E+02	1.15E+03	0.00E+00	0.00E+00	0.00E+00	1.04E+04
CO-60	0.00E+00	1.48E+03	3.26E+03	0.00E+00	0.00E+00	0.00E+00	2.78E+04
NI-63	4.97E+04	3.45E+03	1.67E+03	0.00E+00	0.00E+00	0.00E+00	7.19E+02
NI-65	2.02E+02	2.62E+01	1.20E+01	0.00E+00	0.00E+00	0.00E+00	6.65E+02
CU-64	0.00E+00	9.08E+01	4.26E+01	0.00E+00	2.29E+02	0.00E+00	7.74E+03
ZN-65	1.61E+05	5.13E+05	2.32E+05	0.00E+00	3.43E+05	0.00E+00	3.23E+05
ZN-69	3.43E+02	6.57E+02	4.57E+01	0.00E+00	4.27E+02	0.00E+00	9.87E+01
BR-83	0.00E+00	0.00E+00	4.05E+01	0.00E+00	0.00E+00	0.00E+00	5.84E+01
BR-84	0.00E+00	0.00E+00	5.25E+01	0.00E+00	0.00E+00	0.00E+00	4.13E-04
BR-85	0.00E+00	0.00E+00	2.16E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	1.01E+05	4.72E+04	0.00E+00	0.00E+00	0.00E+00	2.00E+04
RB-88	0.00E+00	2.91E+02	1.54E+02	0.00E+00	0.00E+00	0.00E+00	4.02E-09
RB-89	0.00E+00	1.93E+02	1.35E+02	0.00E+00	0.00E+00	0.00E+00	1.12E-11
SR-89	2.57E+04	0.00E+00	7.37E+02	0.00E+00	0.00E+00	0.00E+00	4.12E+03
SR-90	6.32E+05	0.00E+00	1.55E+05	0.00E+00	0.00E+00	0.00E+00	1.82E+04
SR-91	4.72E+02	0.00E+00	1.91E+01	0.00E+00	0.00E+00	0.00E+00	2.25E+03
SR-92	1.79E+02	0.00E+00	7.75E+00	0.00E+00	0.00E+00	0.00E+00	3.55E+03
Y-90	6.07E+00	0.00E+00	1.63E-01	0.00E+00	0.00E+00	0.00E+00	6.43E+04
Y-91M	5.73E-02	0.00E+00	2.22E-03	0.00E+00	0.00E+00	0.00E+00	1.68E-01
Y-91	8.89E+01	0.00E+00	2.38E+00	0.00E+00	0.00E+00	0.00E+00	4.89E+04
Y-92	5.33E-01	0.00E+00	1.56E-02	0.00E+00	0.00E+00	0.00E+00	9.33E+03
Y-93	1.69E+00	0.00E+00	4.67E-02	0.00E+00	0.00E+00	0.00E+00	5.36E+04
ZR-95	1.63E+00	5.22E-01	3.54E-01	0.00E+00	8.20E-01	0.00E+00	1.66E+03
ZR-97	9.00E-02	1.82E-02	8.30E-03	0.00E+00	2.74E-02	0.00E+00	5.63E+03
NB-95	4.83E+00	2.69E+00	1.44E+00	0.00E+00	2.65E+00	0.00E+00	1.63E+04
MO-99	0.00E+00	1.28E+02	2.43E+01	0.00E+00	2.90E+02	0.00E+00	2.97E+02
TC-99M	1.59E-02	4.50E-02	5.73E-01	0.00E+00	6.84E-01	2.21E-02	2.66E+01
TC-101	1.64E-02	2.36E-02	2.32E-01	0.00E+00	4.25E-01	1.21E-02	7.09E-14
RU-103	1.10E+02	0.00E+00	4.74E+01	0.00E+00	4.20E+02	0.00E+00	1.28E+04
RU-105	9.16E+00	0.00E+00	3.62E+00	0.00E+00	1.18E+02	0.00E+00	5.60E+03
RU-106	1.64E+03	0.00E+00	2.07E+02	0.00E+00	3.16E+03	0.00E+00	1.06E+05
AG-110M	4.58E+02	4.23E+02	2.51E+02	0.00E+00	8.32E+02	0.00E+00	1.73E+05
SB-122	3.47E+01	7.99E-01	1.20E+01	5.38E-01	0.00E+00	2.08E+01	1.32E+04
SB-124	4.86E+02	9.20E+00	1.91E+02	1.18E+00	0.00E+00	3.79E+02	1.38E+04
SB-125	3.11E+02	3.47E+00	7.40E+01	3.16E-01	0.00E+00	2.40E+02	3.42E+03

Table 2 - 1

Site Related Adult Ingestion Dose Commitment Factors
(Freshwater Fish and Saltwater Invertebrate Consumption)

(AiT)
mR/hr per uCi/ml

ISOTOPE	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-125M	2.72E+03	9.87E+02	3.65E+02	8.19E+02	1.11E+04	0.00E+00	1.09E+04
TE-127M	6.88E+03	2.46E+03	8.38E+02	1.76E+03	2.79E+04	0.00E+00	2.31E+04
TE-127	1.12E+02	4.01E+01	2.42E+01	8.28E+01	4.55E+02	0.00E+00	8.82E+03
TE-129M	1.17E+04	4.36E+03	1.85E+03	4.01E+03	4.88E+04	0.00E+00	5.88E+04
TE-129	3.19E+01	1.20E+01	7.77E+00	2.45E+01	1.34E+02	0.00E+00	2.41E+01
TE-131M	1.76E+03	8.60E+02	7.16E+02	1.36E+03	8.71E+03	0.00E+00	8.53E+04
TE-131	2.00E+01	8.36E+00	6.32E+00	1.65E+01	8.77E+01	0.00E+00	2.83E+00
TE-132	2.56E+03	1.66E+03	1.55E+03	1.83E+03	1.60E+04	0.00E+00	7.83E+04
I-130	4.88E+01	1.44E+02	5.68E+01	1.22E+04	2.24E+02	0.00E+00	1.24E+02
I-131	2.68E+02	3.84E+02	2.20E+02	1.26E+05	6.58E+02	0.00E+00	1.01E+02
I-132	1.31E+01	3.50E+01	1.23E+01	1.23E+03	5.58E+01	0.00E+00	6.58E+00
I-133	9.16E+01	1.59E+02	4.86E+01	2.34E+04	2.78E+02	0.00E+00	1.43E+02
I-134	6.84E+00	1.86E+01	6.64E+00	3.22E+02	2.95E+01	0.00E+00	1.62E-02
I-135	2.86E+01	7.48E+01	2.76E+01	4.93E+03	1.20E+02	0.00E+00	8.45E+01
CS-134	4.14E+04	9.84E+04	8.04E+04	0.00E+00	3.18E+04	1.06E+04	1.72E+03
CS-136	4.33E+03	1.71E+04	1.23E+04	0.00E+00	9.51E+03	1.30E+03	1.94E+03
CS-137	5.30E+04	7.25E+04	4.75E+04	0.00E+00	2.46E+04	8.18E+03	1.40E+03
CS-138	3.67E+01	7.25E+01	3.59E+01	0.00E+00	5.33E+01	5.26E+00	3.09E-04
BA-139	6.47E+00	4.61E-03	1.89E-01	0.00E+00	4.31E-03	2.61E-03	1.15E+01
BA-140	1.35E+03	1.70E+00	8.87E+01	0.00E+00	5.78E-01	9.73E-01	2.79E+03
BA-141	3.14E+00	2.37E-03	1.06E-01	0.00E+00	2.21E-03	1.35E-03	1.48E-09
BA-142	1.42E+00	1.46E-03	8.93E-02	0.00E+00	1.23E-03	8.27E-04	2.00E-18
LA-140	1.58E+00	7.95E-01	2.10E-01	0.00E+00	0.00E+00	0.00E+00	5.83E+04
LA-142	8.07E-02	3.67E-02	9.15E-03	0.00E+00	0.00E+00	0.00E+00	2.68E+02
CE-141	3.23E+00	2.18E+00	2.48E-01	0.00E+00	1.01E+00	0.00E+00	8.35E+03
CE-143	5.69E-01	4.21E+02	4.66E-02	0.00E+00	1.85E-01	0.00E+00	1.57E+04
CE-144	1.68E+02	7.04E+01	9.04E+00	0.00E+00	4.17E+01	0.00E+00	5.69E+04
PR-143	5.80E+00	2.33E+00	2.88E-01	0.00E+00	1.34E+00	0.00E+00	2.54E+04
PR-144	1.90E-02	7.88E-03	9.65E-04	0.00E+00	4.45E-03	0.00E+00	2.73E-09
ND-147	3.97E+00	4.59E+00	2.74E-01	0.00E+00	2.68E+00	0.00E+00	2.20E+04
W-187	2.98E+02	2.49E+02	8.71E+01	0.00E+00	0.00E+00	0.00E+00	8.16E+04
NP-239	3.53E-02	3.47E-03	1.91E-03	0.00E+00	1.08E-02	0.00E+00	7.12E+02
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-57	0.00E+00	1.21E+02	2.01E+02	0.00E+00	0.00E+00	0.00E+00	3.07E+03
SR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB-94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB-97	4.05E-02	1.02E-02	3.74E-03	0.00E+00	1.20E-02	0.00E+00	3.78E+01
CD-109	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SN-113	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-133	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-134	3.29E+01	2.15E+01	1.32E+01	2.88E+01	2.08E+02	0.00E+00	3.65E-02
CE-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HG-203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 2 - 2

Site Related Teen Ingestion Dose Commitment Factors
(Freshwater Fish and Saltwater Invertebrate Consumption)

(AiT)
mR/hr per uCi/ml

ISOTOPE	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.17E-01	2.17E-01	2.17E-01	2.17E-01	2.17E-01	2.17E-01
BE-7	3.58E-01	8.02E-01	4.01E-01	0.00E+00	8.50E-01	0.00E+00	9.76E+01
NA-24	4.20E+02	4.20E+02	4.20E+02	4.20E+02	4.20E+02	4.20E+02	4.20E+02
P-32	5.40E+07	3.35E+06	2.09E+06	0.00E+00	0.00E+00	0.00E+00	4.54E+06
CR-51	0.00E+00	0.00E+00	4.44E+00	2.47E+00	9.73E-01	6.34E+00	7.46E+02
MN-54	0.00E+00	5.33E+03	1.06E+03	0.00E+00	1.59E+03	0.00E+00	1.09E+04
MN-56	0.00E+00	1.43E+02	2.54E+01	0.00E+00	1.81E+02	0.00E+00	9.40E+03
FE-55	3.35E+04	2.37E+04	5.54E+03	0.00E+00	0.00E+00	1.51E+04	1.03E+04
FE-59	5.20E+04	1.21E+05	4.69E+04	0.00E+00	0.00E+00	3.83E+04	2.87E+05
CO-58	0.00E+00	5.10E+02	1.18E+03	0.00E+00	0.00E+00	0.00E+00	7.04E+03
CO-60	0.00E+00	1.48E+03	3.32E+03	0.00E+00	0.00E+00	0.00E+00	1.92E+04
NI-63	5.15E+04	3.64E+03	1.75E+03	0.00E+00	0.00E+00	0.00E+00	5.79E+02
NI-65	2.18E+02	2.79E+01	1.27E+01	0.00E+00	0.00E+00	0.00E+00	1.51E+03
CU-64	0.00E+00	9.53E+01	4.48E+01	0.00E+00	2.41E+02	0.00E+00	7.39E+03
ZN-65	1.46E+05	5.07E+05	2.36E+05	0.00E+00	3.24E+05	0.00E+00	2.15E+05
ZN-69	3.73E+02	7.10E+02	4.97E+01	0.00E+00	4.64E+02	0.00E+00	1.31E+03
BR-83	0.00E+00	0.00E+00	4.41E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	5.55E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	2.34E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	1.09E+05	5.12E+04	0.00E+00	0.00E+00	0.00E+00	1.61E+04
RB-88	0.00E+00	3.12E+02	1.66E+02	0.00E+00	0.00E+00	0.00E+00	2.67E-05
RB-89	0.00E+00	2.01E+02	1.42E+02	0.00E+00	0.00E+00	0.00E+00	3.09E-07
SR-89	2.79E+04	0.00E+00	8.00E+02	0.00E+00	0.00E+00	0.00E+00	3.33E+03
SR-90	5.27E+05	0.00E+00	1.30E+05	0.00E+00	0.00E+00	0.00E+00	1.48E+04
SR-91	5.12E+02	0.00E+00	2.04E+01	0.00E+00	0.00E+00	0.00E+00	2.32E+03
SR-92	1.94E+02	0.00E+00	8.25E+00	0.00E+00	0.00E+00	0.00E+00	4.93E+03
Y-90	6.57E+00	0.00E+00	1.77E-01	0.00E+00	0.00E+00	0.00E+00	5.42E+04
Y-91M	6.18E-02	0.00E+00	2.36E-03	0.00E+00	0.00E+00	0.00E+00	2.92E+00
Y-91	9.64E+01	0.00E+00	2.58E+00	0.00E+00	0.00E+00	0.00E+00	3.95E+04
Y-92	5.80E-01	0.00E+00	1.68E-02	0.00E+00	0.00E+00	0.00E+00	1.59E+04
Y-93	1.84E+00	0.00E+00	5.03E-02	0.00E+00	0.00E+00	0.00E+00	5.61E+04
ZR-95	1.68E+00	5.29E-01	3.64E-01	0.00E+00	7.78E-01	0.00E+00	1.22E+03
ZR-97	9.65E-02	1.91E-02	8.80E-03	0.00E+00	2.90E-02	0.00E+00	5.17E+03
NB-95	4.86E+00	2.70E+00	1.48E+00	0.00E+00	2.61E+00	0.00E+00	1.15E+04
MO-99	0.00E+00	1.36E+02	2.60E+01	0.00E+00	3.12E+02	0.00E+00	2.44E+02
TC-99M	1.63E-02	4.55E-02	5.89E-01	0.00E+00	6.77E-01	2.52E-02	2.98E+01
TC-101	1.77E-02	2.51E-02	2.47E-01	0.00E+00	4.55E-01	1.53E-02	4.30E-09
RU-103	1.15E+02	0.00E+00	4.93E+01	0.00E+00	4.06E+02	0.00E+00	9.63E+03
RU-105	9.85E+00	0.00E+00	3.82E+00	0.00E+00	1.24E+02	0.00E+00	7.96E+03
RU-106	1.77E+03	0.00E+00	2.23E+02	0.00E+00	3.42E+03	0.00E+00	8.50E+04
AG-110M	4.45E+02	4.22E+02	2.56E+02	0.00E+00	8.04E+02	0.00E+00	1.18E+05
SB-122	4.35E+01	8.47E-01	1.27E+01	5.53E-01	0.00E+00	2.72E+01	9.13E+03
SB-124	5.09E+02	9.40E+00	1.99E+02	1.16E+00	0.00E+00	4.45E+02	1.03E+04
SB-125	3.27E+02	3.58E+00	7.64E+01	3.11E-01	0.00E+00	2.85E+02	2.53E+03

Table 2 - 2

Site Related Teen Ingestion Dose Commitment Factors
(Freshwater Fish and Saltwater Invertebrate Consumption)

(AiT)
mR/hr per uCi/ml

ISOTOPE	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-125M	2.96E+03	1.07E+03	3.96E+02	8.28E+02	0.00E+00	0.00E+00	8.75E+03
TE-127M	7.48E+03	2.65E+03	8.90E+02	1.78E+03	3.03E+04	0.00E+00	1.87E+04
TE-127	1.22E+02	4.33E+01	2.63E+01	8.44E+01	4.95E+02	0.00E+00	9.44E+03
TE-129M	1.26E+04	4.68E+03	2.00E+03	4.07E+03	5.28E+04	0.00E+00	4.74E+04
TE-129	3.47E+01	1.29E+01	8.44E+00	2.48E+01	1.46E+02	0.00E+00	1.90E+02
TE-131M	1.89E+03	9.06E+02	7.55E+02	1.36E+03	9.44E+03	0.00E+00	7.27E+04
TE-131	2.16E+01	8.90E+00	6.75E+00	1.66E+01	9.44E+01	0.00E+00	1.77E+00
TE-132	2.70E+03	1.71E+03	1.61E+03	1.80E+03	1.64E+04	0.00E+00	5.42E+04
I-130	5.06E+01	1.46E+02	5.84E+01	1.19E+04	2.25E+02	0.00E+00	1.12E+02
I-131	2.87E+02	4.02E+02	2.16E+02	1.17E+05	6.92E+02	0.00E+00	7.95E+01
I-132	1.37E+01	3.58E+01	1.29E+01	1.21E+03	5.64E+01	0.00E+00	1.56E+01
I-133	9.87E+01	1.67E+02	5.11E+01	2.34E+04	2.94E+02	0.00E+00	1.27E+02
I-134	7.17E+00	1.90E+01	6.82E+00	3.17E+02	2.99E+01	0.00E+00	2.50E-01
I-135	2.99E+01	7.71E+01	2.86E+01	4.96E+03	1.22E+02	0.00E+00	8.54E+01
CS-134	4.24E+04	9.97E+04	4.63E+04	0.00E+00	3.17E+04	1.21E+04	1.24E+03
CS-136	4.35E+03	1.71E+04	1.15E+04	0.00E+00	9.32E+03	1.47E+03	1.38E+03
CS-137	5.67E+04	7.54E+04	2.63E+04	0.00E+00	2.57E+04	9.97E+03	1.07E+03
CS-138	3.93E+01	7.54E+01	3.77E+01	0.00E+00	5.57E+01	6.48E+00	3.42E-02
BA-139	7.05E+00	4.96E-03	2.05E-01	0.00E+00	4.67E-03	3.42E-03	6.28E+01
BA-140	1.44E+03	1.76E+00	9.28E+01	0.00E+00	5.98E-01	1.19E+00	2.22E+03
BA-141	3.40E+00	2.54E-03	1.14E-01	0.00E+00	2.36E-03	1.74E-03	7.25E-06
BA-142	1.52E+00	1.52E-03	9.33E-02	0.00E+00	1.28E-03	1.01E-03	4.65E-12
LA-140	1.67E+00	8.20E-01	2.18E-01	0.00E+00	0.00E+00	0.00E+00	4.71E+04
LA-142	8.58E-02	3.81E-02	9.49E-03	0.00E+00	0.00E+00	0.00E+00	1.16E+03
CE-141	3.49E+00	2.33E+00	2.67E-01	0.00E+00	1.10E+00	0.00E+00	6.66E+03
CE-143	6.16E-01	4.48E+02	5.01E-02	0.00E+00	2.01E-01	0.00E+00	1.35E+04
CE-144	1.82E+02	7.55E+01	9.80E+00	0.00E+00	4.51E+01	0.00E+00	4.59E+04
PR-143	6.28E+00	2.51E+00	3.13E-01	0.00E+00	1.46E+00	0.00E+00	2.07E+04
PR-144	2.06E-02	8.44E-03	1.05E-03	0.00E+00	4.84E-03	0.00E+00	2.27E-05
ND-147	4.50E+00	4.89E+00	2.93E-01	0.00E+00	2.87E+00	0.00E+00	1.76E+04
W-187	3.22E+02	2.62E+02	9.19E+01	0.00E+00	0.00E+00	0.00E+00	7.10E+04
NP-239	3.98E-02	3.75E-03	2.08E-03	0.00E+00	1.18E-02	0.00E+00	6.03E+02
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-57	0.00E+00	1.25E+02	2.10E+02	0.00E+00	0.00E+00	0.00E+00	2.33E+03
SR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB-94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB-97	4.36E-02	1.08E-02	3.95E-03	0.00E+00	1.27E-02	0.00E+00	2.58E+02
CD-109	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SN-113	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-133	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-134	3.46E+01	2.22E+01	2.32E+01	2.84E+01	2.12E+02	0.00E+00	1.28E+00
CE-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HG-203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 2 - 3

Site Related Child Ingestion Dose Commitment Factors
(Freshwater Fish and Saltwater Invertebrate Consumption)

(AiT)
mR/hr per uCi/ml

ISOTOPE	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.81E-01	1.81E-01	1.81E-01	1.81E-01	1.81E-01	1.81E-01
BE-7	4.77E-01	8.08E-01	5.33E-01	0.00E+00	7.96E-01	0.00E+00	4.52E+01
NA-24	4.57E+02	4.57E+02	4.57E+02	4.57E+02	4.57E+02	4.57E+02	4.57E+02
P-32	6.98E+07	3.27E+06	2.69E+06	0.00E+00	0.00E+00	0.00E+00	1.93E+06
CR-51	0.00E+00	0.00E+00	4.86E+00	2.70E+00	7.37E-01	4.92E+00	2.58E+02
MN-54	0.00E+00	4.20E+03	1.12E+03	0.00E+00	1.18E+03	0.00E+00	3.53E+03
MN-56	0.00E+00	1.31E+02	2.96E+01	0.00E+00	1.59E+02	0.00E+00	1.90E+04
FE-55	4.55E+04	2.42E+04	7.48E+03	0.00E+00	0.00E+00	1.37E+04	4.47E+03
FE-59	6.53E+04	1.06E+05	5.27E+04	0.00E+00	0.00E+00	3.07E+04	1.10E+05
CO-58	0.00E+00	4.20E+02	1.29E+03	0.00E+00	0.00E+00	0.00E+00	2.45E+03
CO-60	0.00E+00	1.23E+03	3.64E+03	0.00E+00	0.00E+00	0.00E+00	6.84E+03
NI-63	6.85E+04	3.67E+03	2.33E+03	0.00E+00	0.00E+00	0.00E+00	2.47E+02
NI-65	2.83E+02	2.66E+01	1.55E+01	0.00E+00	0.00E+00	0.00E+00	3.26E+03
CU-64	0.00E+00	9.05E+01	5.47E+01	0.00E+00	2.19E+02	0.00E+00	4.25E+03
ZN-65	1.55E+05	4.12E+05	2.56E+05	0.00E+00	2.59E+05	0.00E+00	7.23E+04
ZN-69	4.94E+02	7.14E+02	6.60E+01	0.00E+00	4.33E+02	0.00E+00	4.50E+04
BR-83	0.00E+00	0.00E+00	5.67E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-84	0.00E+00	0.00E+00	6.56E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR-85	0.00E+00	0.00E+00	3.02E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	1.06E+05	6.50E+04	0.00E+00	0.00E+00	0.00E+00	6.80E+03
RB-88	0.00E+00	3.00E+02	2.08E+02	0.00E+00	0.00E+00	0.00E+00	1.47E+01
RB-89	0.00E+00	1.85E+02	1.64E+02	0.00E+00	0.00E+00	0.00E+00	1.61E+00
SR-89	3.63E+04	0.00E+00	1.04E+03	0.00E+00	0.00E+00	0.00E+00	1.41E+03
SR-90	4.68E+05	0.00E+00	1.19E+05	0.00E+00	0.00E+00	0.00E+00	6.30E+03
SR-91	6.60E+02	0.00E+00	2.49E+01	0.00E+00	0.00E+00	0.00E+00	1.46E+03
SR-92	2.48E+02	0.00E+00	9.96E+00	0.00E+00	0.00E+00	0.00E+00	4.70E+03
Y-90	8.79E+00	0.00E+00	2.35E-01	0.00E+00	0.00E+00	0.00E+00	2.50E+04
Y-91M	8.17E-02	0.00E+00	2.97E-03	0.00E+00	0.00E+00	0.00E+00	1.60E+02
Y-91	1.29E+02	0.00E+00	3.44E+00	0.00E+00	0.00E+00	0.00E+00	1.71E+04
Y-92	7.70E-01	0.00E+00	2.20E-02	0.00E+00	0.00E+00	0.00E+00	2.22E+04
Y-93	2.44E+00	0.00E+00	6.69E-02	0.00E+00	0.00E+00	0.00E+00	3.63E+04
ZR-95	2.10E+00	4.62E-01	4.11E-01	0.00E+00	6.62E-01	0.00E+00	4.82E+02
ZR-97	1.27E-01	1.83E-02	1.08E-02	0.00E+00	2.63E-02	0.00E+00	2.77E+03
NB-95	5.75E+00	2.24E+00	1.60E+00	0.00E+00	2.10E+00	0.00E+00	4.14E+03
MO-99	0.00E+00	1.31E+02	3.23E+01	0.00E+00	2.79E+02	0.00E+00	1.08E+02
TC-99M	1.99E-02	3.89E-02	6.46E-01	0.00E+00	5.66E-01	1.98E-02	2.22E+01
TC-101	2.30E-02	2.41E-02	3.06E-01	0.00E+00	4.11E-01	1.27E-02	7.66E-02
RU-103	1.48E+02	0.00E+00	5.67E+01	0.00E+00	3.72E+02	0.00E+00	3.82E+03
RU-105	1.30E+01	0.00E+00	4.73E+00	0.00E+00	1.15E+02	0.00E+00	8.50E+03
RU-106	2.36E+03	0.00E+00	2.95E+02	0.00E+00	3.19E+03	0.00E+00	3.68E+04
AG-110M	5.24E+02	3.54E+02	2.83E+02	0.00E+00	6.59E+02	0.00E+00	4.21E+04
SB-122	5.80E+01	8.56E-01	1.70E+01	7.43E-01	0.00E+00	2.36E+01	4.46E+03
SB-124	6.55E+02	8.50E+00	2.29E+02	1.44E+00	0.00E+00	3.63E+02	4.09E+03
SB-125	4.22E+02	3.25E+00	8.85E+01	3.91E-01	0.00E+00	2.35E+02	1.01E+03

Table 2 - 3

Site Related Child Ingestion Dose Commitment Factors
(Freshwater Fish and Saltwater Invertebrate Consumption)

(AiT)
mR/hr per uCi/ml

ISOTOPE	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE-125M	3.81E+03	1.03E+03	5.08E+02	1.07E+03	0.00E+00	0.00E+00	3.68E+03
TE-127M	9.67E+03	2.60E+03	1.15E+03	2.31E+03	2.76E+04	0.00E+00	7.83E+03
TE-127	1.58E+02	4.25E+01	3.38E+01	1.09E+02	4.48E+02	0.00E+00	6.15E+03
TE-129M	1.63E+04	4.55E+03	2.53E+03	5.25E+03	4.78E+04	0.00E+00	1.99E+04
TE-129	4.48E+01	1.25E+01	1.06E+01	3.20E+01	1.31E+02	0.00E+00	2.79E+03
TE-131M	2.41E+03	8.33E+02	8.86E+02	1.71E+03	8.06E+03	0.00E+00	3.38E+04
TE-131	2.78E+01	8.46E+00	8.26E+00	2.12E+01	8.40E+01	0.00E+00	1.46E+02
TE-132	3.38E+03	1.50E+03	1.81E+03	2.18E+03	1.39E+04	0.00E+00	1.51E+04
I-130	6.28E+01	1.27E+02	6.54E+01	1.40E+04	1.90E+02	0.00E+00	5.94E+01
I-131	3.70E+02	3.72E+02	2.12E+02	1.23E+05	6.11E+02	0.00E+00	3.31E+01
I-132	1.72E+01	3.16E+01	1.45E+01	1.47E+03	4.84E+01	0.00E+00	3.72E+01
I-133	1.27E+02	1.58E+02	5.96E+01	2.93E+04	2.63E+02	0.00E+00	6.35E+01
I-134	9.02E+00	1.67E+01	7.70E+00	3.85E+02	2.56E+01	0.00E+00	1.11E+01
I-135	3.77E+01	6.78E+01	3.21E+01	6.00E+03	1.04E+02	0.00E+00	5.16E+01
CS-134	5.15E+04	8.44E+04	1.78E+04	0.00E+00	2.62E+04	9.39E+03	4.55E+02
CS-136	5.17E+03	1.42E+04	9.19E+03	0.00E+00	7.56E+03	1.13E+03	4.99E+02
CS-137	7.19E+04	6.88E+04	1.02E+04	0.00E+00	2.24E+04	8.07E+03	4.31E+02
CS-138	5.01E+01	6.97E+01	4.42E+01	0.00E+00	4.90E+01	5.28E+00	3.21E+01
BA-139	9.34E+00	4.99E-03	2.71E-01	0.00E+00	4.35E-03	2.93E-03	5.39E+02
BA-140	1.87E+03	1.64E+00	1.09E+02	0.00E+00	5.35E-01	9.79E-01	9.50E+02
BA-141	4.51E+00	2.53E-03	1.47E-01	0.00E+00	2.19E-03	1.48E-02	2.57E+00
BA-142	1.97E+00	1.42E-03	1.10E-01	0.00E+00	1.15E-03	8.35E-04	2.57E-02
LA-140	2.16E+00	7.55E-01	2.54E-01	0.00E+00	0.00E+00	0.00E+00	2.10E+04
LA-142	1.12E-01	3.57E-02	1.12E-02	0.00E+00	0.00E+00	0.00E+00	7.08E+03
CE-141	4.65E+00	2.32E+00	3.45E-01	0.00E+00	1.02E+00	0.00E+00	2.90E+03
CE-143	8.19E-01	4.44E+02	6.44E-02	0.00E+00	1.86E-01	0.00E+00	6.51E+03
CE-144	2.44E+02	7.64E+01	1.30E+01	0.00E+00	4.23E+01	0.00E+00	1.99E+04
PR-143	8.40E+00	2.52E+00	4.17E-01	0.00E+00	1.37E+00	0.00E+00	9.06E+03
PR-144	2.76E-02	8.53E-03	1.39E-03	0.00E+00	4.51E-03	0.00E+00	1.84E+01
ND-147	5.96E+00	4.83E+00	3.74E-01	0.00E+00	2.65E+00	0.00E+00	7.65E+03
W-187	4.08E+02	2.42E+02	1.08E+02	0.00E+00	0.00E+00	0.00E+00	3.40E+04
NP-239	5.15E-02	3.70E-03	2.60E-03	0.00E+00	1.07E-02	0.00E+00	2.74E+02
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-57	0.00E+00	1.15E+02	2.33E+02	0.00E+00	0.00E+00	0.00E+00	9.43E+02
SR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB-94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB-97	5.55E-02	1.00E-02	4.68E-03	0.00E+00	1.11E-02	0.00E+00	3.09E+03
CD-109	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SN-113	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BA-133	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TE-134	4.31E+01	1.94E+01	2.59E+01	3.41E+01	1.80E+02	0.00E+00	1.97E+02
CE-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HG-203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 2-4

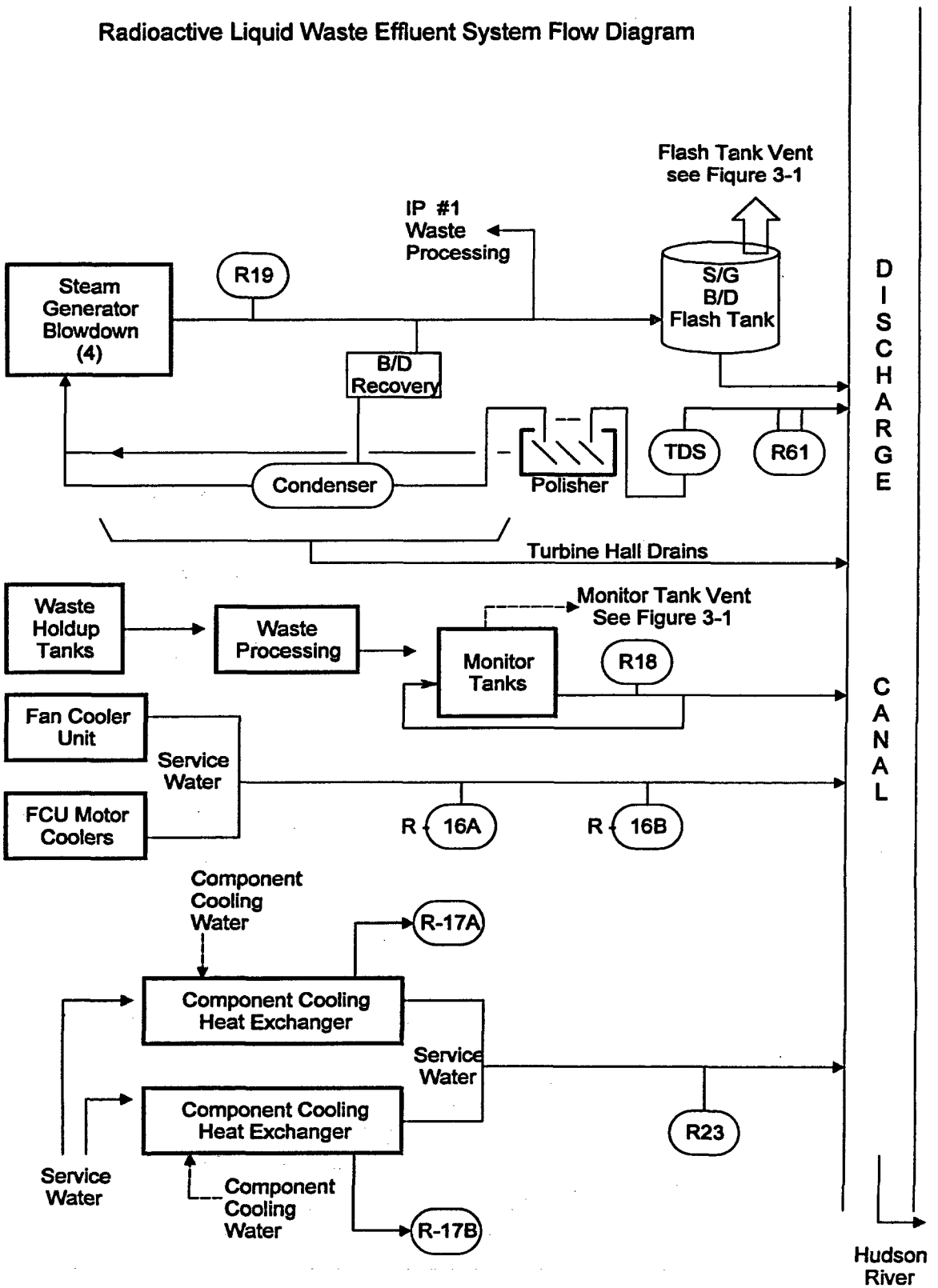
Bio-Accumulation Factors for Liquid Effluent Isotopes
(pCi/kg per pCi/liter)

ISOTOPE	Freshwater Fish BFi	Saltwater Invertebrates BIi	ISOTOPE	Freshwater Fish BFi	Saltwater Invertebrates BIi
H-3	9.000E-01	9.300E-01	TE-125M	4.000E+02	1.000E+02
BE-7	2.000E+00	2.000E+02	TE-127M	4.000E+02	1.000E+02
NA-24	1.000E+02	1.900E-01	TE-127	4.000E+02	1.000E+02
P-32	1.000E+05	3.000E+04	TE-129M	4.000E+02	1.000E+02
CR-51	2.000E+02	2.000E+03	TE-129	4.000E+02	1.000E+02
MN-54	4.000E+02	4.000E+02	TE-131M	4.000E+02	1.000E+02
MN-56	4.000E+02	4.000E+02	TE-131	4.000E+02	1.000E+02
FE-55	1.000E+02	2.000E+04	TE-132	4.000E+02	1.000E+02
FE-59	1.000E+02	2.000E+04	I-130	1.500E+01	5.000E+01
CO-58	5.000E+01	1.000E+03	I-131	1.500E+01	5.000E+01
CO-60	5.000E+01	1.000E+03	I-132	1.500E+01	5.000E+01
NI-63	1.000E+02	2.500E+02	I-133	1.500E+01	5.000E+01
NI-65	1.000E+02	2.500E+02	I-134	1.500E+01	5.000E+01
CU-64	5.000E+01	1.700E+03	I-135	1.500E+01	5.000E+01
ZN-65	2.000E+03	5.000E+04	CS-134	2.240E+02	2.240E+02
ZN-69	2.000E+03	5.000E+04	CS-136	2.240E+02	2.240E+02
BR-83	4.200E+02	3.100E+00	CS-137	2.240E+02	2.240E+02
BR-84	4.200E+02	3.100E+00	CS-138	2.240E+02	2.240E+02
BR-85	4.200E+02	3.100E+00	BA-139	4.000E+00	1.000E+02
RB-86	2.000E+03	1.700E+01	BA-140	4.000E+00	1.000E+02
RB-88	2.000E+03	1.700E+01	BA-141	4.000E+00	1.000E+02
RB-89	2.000E+03	1.700E+01	BA-142	4.000E+00	1.000E+02
SR-89	3.000E+01	2.000E+01	LA-140	2.500E+01	1.000E+03
SR-90	3.000E+01	2.000E+01	LA-142	2.500E+01	1.000E+03
SR-91	3.000E+01	2.000E+01	CE-141	1.000E+00	6.000E+02
SR-92	3.000E+01	2.000E+01	CE-143	1.000E+00	6.000E+02
Y-90	2.500E+01	1.000E+03	CE-144	1.000E+00	6.000E+02
Y-91M	2.500E+01	1.000E+03	PR-143	2.500E+01	1.000E+03
Y-91	2.500E+01	1.000E+03	PR-144	2.500E+01	1.000E+03
Y-92	2.500E+01	1.000E+03	ND-147	2.500E+01	1.000E+03
Y-93	2.500E+01	1.000E+03	W-187	1.200E+03	3.000E+01
ZR-95	3.300E+00	8.000E+01	NP-239	1.000E+01	1.000E+01
ZR-97	3.300E+00	8.000E+01	K-40	0.000E+00	0.000E+00
NB-95	3.000E+02	1.000E+02	CO-57	5.000E+01	1.000E+03
MO-99	1.000E+01	1.000E+01	SR-85	0.000E+00	0.000E+00
TC-99M	1.500E+01	5.000E+01	Y-88	0.000E+00	0.000E+00
TC-101	1.500E+01	5.000E+01	NB-94	3.000E+02	1.000E+02
RU-103	1.000E+01	1.000E+03	NB-97	3.000E+02	1.000E+02
RU-105	1.000E+01	1.000E+03	CD-109	0.000E+00	0.000E+00
RU-106	1.000E+01	1.000E+03	SN-113	0.000E+00	0.000E+00
AG-110M	2.300E+00	5.000E+03	BA-133	0.000E+00	0.000E+00
SB-122	1.000E+00	3.000E+02	TE-134	4.000E+02	1.000E+02
SB-124	1.000E+00	3.000E+02	CE-139	0.000E+00	0.000E+00
SB-125	1.000E+00	3.000E+02	HG-203	0.000E+00	0.000E+00

Bio-Accumulation Factors and DFi's for Noble Gases = 0

Figure 2-1

Radioactive Liquid Waste Effluent System Flow Diagram



3.0 GASEOUS EFFLUENTS

3.1 Gaseous Effluent Releases - General Information

3.1.1 The surveillance and lower limit of detection requirements for gaseous radioactive effluents are contained in the RECS. Lower limits of detection calculations are addressed in ODCM Part II, Appendix B.

3.1.2 A completed and properly authorized Airborne Radioactive Waste Release Permit shall be issued prior to the release of airborne activity from the waste gas holding system and containment purge. If a containment purge exceeds 150 hours in duration then the purge will be considered a continuous, long term release for reporting purposes (See Section 3.1.16).

3.1.3 Since Indian Point is a two unit site, the derived instantaneous µCi/sec limits delineated in Section 3.2.1 are apportioned to each site. The time-average limits in 3.2.2, 3.2.3, and 3.2.4 are "per reactor" limits and the full dose limits are applicable to IP3.

3.1.4 During Modes 5 and 6, there is no flowpath for a release from the Condenser Air Ejector, and the monthly grab sample described in Radiological Effluent Controls Table 3.4.1-1 is not required. During normal plant operation without a primary to secondary leak, almost all gaseous releases are through the main Plant Vent. A negligible amount may be identified in the Administration Building and Radioactive Machine Shop vents. In the event of extended operation with a primary to secondary leak, low level releases are expected from both the blowdown flash tank vent and condenser air ejector. However, the limits on steam generator leakage are much more restrictive than those for effluent releases. Allocation of portions of the allowable release rate to these various release points is not warranted. If the instantaneous release rate is used (taking advantage of the one hour averaging allowed by 3.3.1 or 3.4.1), then all release points will be considered when establishing the Plant Vent alarm setpoint per ODCM Part II, Section 1.

3.1.5 For releases that are expected to continue for periods over two days, a new release permit will normally be issued each day. Containment purge release permits may be closed, with the release reclassified as continuous building ventilation when activity in containment is sufficiently reduced, at the discretion of the Chemistry Superintendent. However, when plant conditions change that will cause the activity in containment or any other permitted release of extended duration to significantly change, a new permit shall be issued. 9/05

3.1.6 Assurance that the combined gaseous releases from Units 2 and 3 do not exceed Section 3.2.1 limits for the site is provided by administrative controls for both units. These controls include apportionment of the 10CFR20 limitations and back-calculating radiation monitor setpoints accordingly. These calculations are discussed in Appendix A.

3.1.7 By mutual agreement with units 2 and 3 Shift Supervisors, one unit can reduce or eliminate discharges for a period of time to allow the other unit to use the full site permissible discharge rate, or a specific portion thereof, for discharge when necessary.

3.1.8 Conservative release rate limitations have been established to aid in controlling time average dose limits. The annual average limit shall normally be used for calculating limitations on discharge. If this limitation unduly restricts an individual release, the quarterly average release rate limit (μCi/sec) may be used for the release provided the quarterly time average dose limit will not be exceeded and the Site Operations Manager or his assistant is in agreement.

The instantaneous limit may be used if the General Manager, Plant Operations or his designee is in agreement. If determined to be required, Chemistry may provide a true instantaneous limit based on the actual or suspected mixture. Along with the permissions above, the Chemistry Superintendent or his designee should review the calculations for application of this true (ODCM) instantaneous limit. An hour is generally used as the default interval in which to determine the proximity to this limit in uCi/sec or mrem/yr.

9/05

3.1.9 Containment Pressure Reliefs

Containment pressure reliefs occur frequently enough to be considered continuous releases. Grab samples of containment atmosphere are obtained periodically to ensure the use of accurate mixtures in effluent calculations. To ensure that the release rate will not be exceeded, the containment noble gas monitor (R-12) and the expected flowrate are used to calculate release rates from containment and at the stack effluent. The effluent noble gas monitor in the plant vent is used to verify these calculations.

3.1.10 Composite Particulate Samples

One of the following methods will be used to obtain a composite sample:

- Samples will be taken weekly and integrated monthly; or
- Samples will be taken weekly and counted together once per month.

3.1.11 Gas Storage Tank Activity Limit

The quantity of radioactivity in each gas storage tank is limited to 50,000 Ci of noble gas, per RECS 2.11. This limit was calculated using the equations from Section 5.6.1 of NUREG 0133 and the following parameters:

Ki = 294 mrem-m^3/μCi-yr, Xe-133 equivalent Table B-1 (RG 1.109)

X/Q = 1.03 x 10^{-3} sec/m^3, Indian Point 3 FSAR

Qit must be calculated so that the dose is less than 500 mrem in a year:

$$Qit = \frac{(500mrem) * 3.15E+7 \text{ sec}/yr}{(1E6\mu Ci/Ci)(294mrem - m^3/\mu Ci - yr)(1.03E-3 \text{ sec}/m^3)} = 52{,}011 Ci;\ \underline{50{,}000\ Ci}$$

This limit assumes 100% Xe-133 as per NUREG 0133. Utilizing the Ki from an expected mixture during RCS degasification

$$Ki = 787\frac{mrem - m^3}{\mu Ci - yr},$$

the gas tank conservative administrative limit should be 19,400 curies.

The basis for assuring that accidental gas releases from liquid holdup tanks do not exceed Section 3.2.1 limits, is Technical Specifications 3.4.16 (≤ 1 μCi/cc Dose Equivalent Iodine-131 in Reactor Coolant). Using the assumptions discussed in FSAR section 14.2.3, the potential total curies in the liquid holdup tanks is limited to less than the conservative limit for the Gas Storage Tanks (19,400 curies).

3.1.12 Gas Storage Tank Surveillance Requirements

There are two methods available to ensure that the activity in the gas storage tank is within the conservative administrative limit (19400 Ci).

$$\frac{1.94E+4*1E6\mu Ci/Ci}{525ft^3*\left(\frac{164.7psia}{14.7psia}\right)*2.83E4cc/ft^3} = 1.17E+2\mu Ci/cc$$

1. The total gaseous activity will normally be limited to less than 117 μCi/cc. If this concentration limit is exceeded, then the contents of the tank will be monitored and actions taken to ensure the 19,400 curie per tank limit is not exceeded.
2. The waste gas line monitor (R-20) reads in μCi/cc. It allows for control of waste gas tank curie content by limiting the input concentration to 117 μCi/cc, thereby limiting the curies to 19,400.

Large gas decay tanks on fill and CVCS tanks (which are indicative of the gas mixture in or from the reuse system) are continuously monitored for H_2 and O_2 through in-line instrumentation. With either in-line instrument out of service, a grab sample of the tank on receipt shall be taken daily, unless in degassing operation, when the periodicity is every four hours.

Other primary system tank cover gases can be manually directed through these instruments for individual samples.

3.1.13 The normal flow rate measurement for the Radioactive Machine Shop (RAMS) and the Plant Vent (PV) is obtained from the installed process monitor. When the instrument is out of service, the estimated flow from the RAMS is obtained by summing each operable exhaust fan's design flow rate. Estimated flow from the PV is obtained similarly, or from an alternate flow instrument (still considered an estimate). The design system flow rate of 12500 CFM is used for Administration Building ventilation. The process flow rate monitor surveillance requirements specified in RECS Table 3.2-1 are not applicable for the Administration Building, nor are they applicable when the RAMS or PV installed instruments are out of service and rated fan flow is used.

3.1.14 The activity released via the blowdown flash tank vent is determined by obtaining the steam generator blowdown Tritium, Noble Gas, and Iodine activity, partitioned per Regulatory Guide 1.42 "Interim Licensing Policy On As Low As Practicable for Gaseous Radioiodine Releases from Light Water Cooled Nuclear Power Reactors" (from NUREG 0472, Rev3, DRAFT 6, TABLE 3.3-13), or Reference 4, "An Evaluation to Demonstrate the Compliance of the Indian Point Reactors with the Design Objectives of 10CFR50, Appendix I".

3.1.15 Carbon 14 is released at a rate of 9.6 curies per GW(e)/yr based upon studies performed by the New York State Department of Health at Indian Point 3. This is released in a gaseous form, the primary dose from which is in the CO_2 form. Therefore, these are exempt from the dose limits specified in Sections 2.4.1, 2.4.3 and 2.4.4 of the RECS. The Carbon 14 doses resulting from these releases are calculated in accordance with the methodology in Reg. Guide 1.109 and listed in the Radiological Impact on Man section of the Annual Radioactive Effluent Release Report. This calculation is performed using the fraction of carbon 14 released in the CO_2 form (26%).

3.1.16 Evaluations of previous gas decay tank and containment purge releases have been performed. These evaluations indicate that these "Short Term Releases" (less than 500 hours per year and less than 150 hours per quarter) are sufficiently random to utilize the long term meteorological dispersion factor (NUREG 0133, Section 3.3, Page 8). The short-term correction factor, will only be used when non-random releases are to be made an a routine basis.

3.1.17 The liquid waste Monitor Tanks have an airborne release pathway. The original plant design limited the gases through this pathway by reducing the entrained gases to less than 2E-3 μCi/ml. The removal of the CVCS gas stripper under modification 86-3-122 CVCS requires the quantification of these gases when the entrained gaseous activity in the Monitor Tank inlet exceeds 2E-3 μCi/ml. No action is required if the inlet noble gas concentration is less than 2E-3 μCi/ml. This gas release will be quantified by calculating the difference (in μCi's) between the gaseous activity added to the tank and the gaseous activity present in the effluent release sample. This difference will be quantified as an airborne ground level batch release, using a specifically determined ground level dispersion constant (Section 3.5.3). | 9/05

A separate release permit evaluating this release is not required prior to release. Calculation of this rate of release is not required, however the time average dose contribution shall be calculated and controlled per Sections 3.3 and 3.4 of the ODCM. Section 3.6 provides additional detail relative to the finite cloud correction assumptions for this pathway.

3.1.18 Airborne releases from the Steam Generator Safety or Atmospheric Dump Valves can occur during a Primary to Secondary leak. Tritium, Noble Gas, and Iodine effluent doses are determined using a source term activity (Main Steam or Steam Generator Blowdown), an Iodine partition factor (per Section 3.1.14), and a release rate, determined from Engineering Design Calculation 187 (Steam Generator Atmospherics), or design flowrate (from Steam Generator Safeties) at specific pressures in the Steam Generator.

3.1.19 Other release pathways resulti ng from Primary to Secondary leakage include the steam driven auxiliary feed pump vent, the gland seal exhaust vent, the air ejector vent, and the Feed Water heater flash tank vent. Offsite doses from these or other abnormal airborne release points are calculated by obtaining the release rate (from system descriptions and/or steam tables corrected for system pressure, as applicable) and source term activity (eg. Main Steam , Reactor Coolant, or best esti mate) for Tritium, Noble Gas, and Iodine, partitioned as per Section 3.1.14.

3.1.20 The Monitor Tank vent, the Condenser Air Ejector, and the Gland Seal Exhaust points are ground level releases. Unless otherwise designated, other release points are considered mixed mode, per Section 3.6. | 9/05

3.2 Gaseous Effluent Dose Calculation Requirements

3.2.1 Section 2.4.1 of the RECS requires that the dose rate due to radioactive materials released in gaseous effluents from the site at or beyond the site boundary shall be limited to:

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, Tritium, and for all radioactive materials in particulate form with half lives greater than 8 days: Less than or equal to 1500 mrem/yr to any organ.

The methodologies for performing these calculations are discussed in Sections 3.3.1 and 3.3.2, respectively.

3.2.2 Section 2.4.2 of the RECS requires that the air dose due to noble gases released in gaseous effluents from each reactor unit at or beyond the site boundary shall be limited to:

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

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

The methodology for calculating these doses is discussed in Section 3.3.3.

NOTE: If either of the above limits is exceeded by a factor of two or more, then cumulative dose contributions from direct radiation would be determined by evaluation of existing perimeter and environmental TLDs per Section 2.6. of the RECS.

3.2.3 Section 2.4.3 of the RECS requires that the dose to a member of the general public from Iodine 131, Tritium, and radionuclides in particulate form (half-lives > 8 days) in gaseous effluents released from each reactor unit shall be limited to:

a) Less than or equal to 7.5 mrem to any organ during a calendar quarter

b) Less than or equal to 15 mrem to any organ during a calendar year.

Cumulative dose contributions for the current calendar quarter and current calendar year shall be determined at least once every 31 days. The methodology for calculating these doses is discussed in Section 3.3.4.

NOTE: If either of the previous limits is exceeded by a factor of two or more, then cumulative dose contributions from direct radiation would be determined by evaluation of existing perimeter and environmental TLDs per Section 2.6 of the RECS.

3.2.4 Section 2.4.4 of the RECS requires that for each reactor unit, the appropriate portions of the gaseous radwaste treatment system shall be used to reduce radioactive effluents in gaseous waste prior to their discharge when projected gaseous effluent air dose at the site boundary when averaged over 31 days, would exceed 0.2 mrad for gamma radiation or 0.4 mrad for beta radiation. These doses are projected based on the dose methodology discussed in Section 3.3.3 (noble gas) and 3.3.4 (iodine). The average of previous months' doses is used to project future dose as follows:

$$\begin{bmatrix}\text{Dose}\\ \text{Projection}\end{bmatrix} = \frac{\text{Current Month Dose} + \text{Previous months' Dose}}{\text{number of months used}} \pm \begin{bmatrix}\textit{major}\\ \textit{planned}\\ \textit{evolutions}\end{bmatrix}$$

The term for planned evolutions is routinely determined from previous similar evolutions, such as releases associated with plant shutdown.

The appropriate portions of the ventilation exhaust treatment system shall be used to reduce radioactive materials in gaseous releases when the projected doses averaged over 31 days, would exceed 0.3 mrem to any organ (at nearest residence). Dose due to gaseous releases from the site shall be calculated at least once every 31 days.

3.3 Dose Methodology (Computer Calculation)

3.3.1 Instantaneous Dose Rates - Noble Gas Releases

When the instantaneous limit applies, the process radiation monitor response or release rate can be averaged over a one-hour time interval.

3.3.1.1 The equations developed in this section are used to meet the calculational requirements of paragraph 3.2.1. The magnitude of this pathway is the same for all age groups so there is no critical group.

Based on an agreement with Unit 2, Indian Point Unit 3 utilizes 50% of the site release limit as measured in Ci/sec which translates to 55.4% of the applicable dose rate limit for noble gas releases.

Each unit has different dispersion factors due to their relative positions to the critical sector of the unrestricted area boundary. The conversion from dose rate to Ci/sec was determined with the use of a model which incorporates a finite cloud exposure correction. The methodology is discussed in Section 3.6.

A calculation showing the relationship between Ci/sec and dose rates from Units 2 and 3 is shown in Appendix A. The equations for calculating the dose rate limitations are obtained from NUREG 0133 (Ref. 1, Section 5.2.1). Utilizing the above assumptions, these equations reduce to the following which are to be summed for each nuclide, i. (Note Section 3.1.6 allows use of higher release rates up to the maximum of the allowable maximum permissible discharge rate.)

$$\sum_i \left[(Ki) * \left(\overline{X/Q} \right) * (\dot{Q}i) \right] \leq 275 \text{ mrem/yr whole body}$$

$$\sum_i \left[(Li + 1.1Mi) * \left(\overline{X/Q} \right) * (\dot{Q}i) \right] \leq 1{,}766 \text{ mrem/yr to the skin;}$$

Where:

Ki = The total body dose factor due to gamma emissions for each identified noble gas radionuclide, in mrem/yr per $\mu Ci/m^3$ (finite cloud correction included, per Table 3-4).

Li = The skin dose factor due to beta emissions for each identified noble gas radionuclide, in mrem/yr per $\mu Ci/m^3$, per Table 3-5.

Mi = The air dose factor due to gamma emissions for each identified noble gas radionuclide, in mrad/yr per $\mu Ci/m^3$ (finite cloud correction included, per Table 3-6).

Ni = The air dose factor due to beta emissions for each identified noble gas radionuclide, in mrad/yr per $\mu Ci/m^3$, per Table 3-7.

$\dot{Q}i$ = The release rate of radionuclides, i, in gaseous effluent for all release points in $\mu Ci/sec$.

(X/Q) = For all vent releases, the highest calculated annual averaged relative concentration at the critical receptor (SW at 350 meters), 4.47E-6 sec/m^3, as shown on Page 1 of Appendix A.

The Ki, Li, Mi, and Ni factors were obtained from Table B-1 of Regulatory Guide 1.109 and are included in this document as Tables 3-4, 3-5, 3-6, and 3-7 respectively. The Ki and Mi factors have a finite cloud correction factor included.

3.3.1.2 These equations can also be expressed in the following manner:

$(\overline{K})(\dot{Q}t)(\overline{X/Q})$ = mrem/yr dose to whole body

$(\overline{L}+1.1\overline{M})(\overline{X/Q})(\dot{Q}t)$ = mrem/yr dose to skin

Where:

$\dot{Q}$ t = The release rate of all noble gases summed together in μCi/sec, i.e., the sum of all $\dot{Q}$ i.

$$\overline{K} = (1/\dot{Q}t)\sum_{i=1}^{n}(\dot{Q}i)(Ki)$$

$$\overline{L} = (1/\dot{Q}t)\sum_{i=1}^{n}(\dot{Q}i)(Li)$$

$$\overline{M} = (1/\dot{Q}t)\sum_{i=1}^{n}(\dot{Q}i)(Mi)$$

$$\overline{N} = (1/\dot{Q}t)\sum_{i=1}^{n}(\dot{Q}i)Ni)$$

The values of $\overline{K}$, $\overline{L}$, $\overline{M}$, and $\overline{N}$ are listed in Table 3-8 for the unrestricted area boundary.

3.3.2 Instantaneous Dose Rates - I-131, Part w/>8 day t½, and H-3

The equation developed in this section is used to meet the calculational requirements of RECS 2.4.1. The critical organ is considered to be the child thyroid as stated in Section 4.0 of the RECS. Based on different dispersion to the critical sector of the unrestricted area boundary for units 2 and 3, 50% of the site release limit (in Ci/sec) translates to 67.2% of the applicable dose rate limit for unit 3 (see Appendix A). The equation for calculating the dose rate limitation is abbreviated from that shown in NUREG 0133 (Ref. 1, Section 5.2.1, Pg. 25) in that ground plane and milk pathways are not considered due to insignificant contribution compared to the inhalation pathway . Utilizing the above assumptions, this equation reduces to the following:

$$\sum_{i}(Pi*(X/Q)*\dot{Q}i) \text{ must be less than } 1008 \text{ mrem/yr}$$

Where:

Pi = The dose parameter for radionuclides other than noble gases for the inhalation pathway in mrem/yr per μCi/m^3. These parameters (calculated in Section 3.3.2.1) are calculated separately for each isotope, age group, and organ.

$\dot{Q}i$ = The release rate of radionuclide 131 and particulates, i, in gaseous effluents for all release points in μCi/sec.

X/Q = 4.47E-6 sec/m^3. The annual average dispersion parameter for the inhalation pathway at the controlling location (350 meters SW) due to all vent releases (see Page 1 of Appendix A and Section 3.5).

3.3.2.1 Calculation of Pi(in): Inhalation Dose Factor

Pi (inhalation) = K' (BR) DFAi (mrem/yr per μCi/m^3)

Where:

K' = A constant of conversion, 10^6 pCi/μCi

BR = The breathing rate of each age group as per 3.3.4.5.a (Table E-5 of Reg. Guide 1.109).

DFAi = The inhalation dose factor for each age group, organ, and nuclide, in mrem/pCi. These values are taken from Reg Guide 1.109, Table E-7 through E-9 and are reproduced in Tables 3-1a through 3-1d.

3.3.3 Time Average Dose - Noble Gas Release

3.3.3.1 The equations in this section are used to meet the calculational requirements of Paragraphs 3.2.2 and 3.2.4. All releases at IP3NPP are assumed to be mixed mode unless indicated otherwise. The magnitude for this pathway is the same for all age groups so there is no critical group. Dispersion parameters are discussed in Section 3.5.

3.3.3.2 The equation for calculating the dose limitations are obtained from NUREG 0133 (Ref. 1, Section 5.3). The doses are evaluated at the unrestricted area boundary in the worst meteorological section (SSW sector at 380 meters). These equations reduce to the following:

$$gamma\ air\ mrad = 3.17E-8 * \sum_i Mi\,[(X/Q)(\tilde{Q}i) + (x/q)(\tilde{q}i) + (x/q_{mt})(\tilde{q}i_{mt})]$$

$$beta\ air\ mrad = 3.17E-8 * \sum_i Ni\,[(X/Q)(\tilde{Q}i) + (x/q)(\tilde{q}i) + (x/q_{mt})(\tilde{q}i_{mt})]$$

Where:

Air dose limits are as follows:

	Any Calendar Quarter	Any Calendar Year
Gamma Air	*5 mrad*	*10 mrad*
Beta Air	*10 mrad*	*20 mrad*

(X/Q) =The highest calculated annual average relative concentration for the unrestricted area boundary in the SW sector at 350 meters for long term releases (greater than 500 hrs/yr or 150 hr s/qtr or as noted in 3.1.16), 4.47E-6 sec/m^3.

(x/q) = The relative concentration for the unrestricted area boundary for short term releases (equal to or less than 500 hrs/yr or 150 hrs/qtr and not random as defined in NUREG 0133, Section 3.3). This value is calculated as per Section 3.5.

(x/q_{mt})=The relative concentration for the unrestricted area boundary for ground level releases from the monitor tank vents in the SW sector at 350 meters, per Section 3.5.3, in sec/m^3.

Mi = The air dose factor due to gamma emission for each identified noble gas radionuclide in mrad/yr per µCi/m^3.

Ni = The air dose factor due to beta emissions for each identified noble gas radionuclide in mrad/yr per µCi/m^3.

$\tilde{q}i_{mt}$ = The total releases of noble gas radionuclides in monitor tank vents in µCi. Releases shall be cumulative over the calendar quarter or years as appropriate.

$\tilde{q}i$ = The total release of noble gas radionuclides in gaseous effluents, i, for short term releases (equal to or less than 500 hrs/yr or 150 hrs/qtr and not random as defined in NUREG 0133, Section 3.3) from all vents, in µCi. Releases shall be cumulative over the calendar quarter or year as appropriate.

$\tilde{Q}i$ = The total release of noble gas radionuclides in gaseous effluents, i, for long term releases (greater than 500 hrs/yr or 150 hrs/qtr or as noted in 3.1.16) from all vents in µCi. Releases shall be cumulative over the calendar quarter or year as appropriate.

3.17 E-8 = The inverse of the number of seconds in a year.

The air dose factors Mi and Ni were obtained from Table B-1 of Regulatory Guide 1.109 and are listed in Table 3-6 and 3-7 respectively. The M air dose factors are finite cloud corrected.

3.3.4 Time Averaged Dose - Radioiodine 131, Part w/t½ >8 days, and Tritium

3.3.4.1 The equations in this section are used to meet the calculational requirements of Paragraphs 3.2.3 and 3.2.4.

3.3.4.2 The pathways considered in this analysis are inhalation, ground plane, and vegetable ingestion at the nearest resident. The meat and milk ingestion pathways are not considered because of the lack of milk-producing cows within ten miles of the plant, and because of the high degree of commercial, industrial, and residential land usage in the area, as defined by the land use census. Doses are calculated at the nearest resident using meteorological data from the worst sector (SSW sector at 1525 meters) for conservativism.

3.3.4.3 The equations for calculating the dose limitations are obtained from NUREG 0133 (Ref. 1, Section 5.3). These equations reduce to the following :

During any calendar quarter:

$$(3.17\,E-08)*\sum_i (Ri(W\,\tilde{Q}i + w\,\tilde{q}i) \text{ must be less than } 7.5 \text{ mrem}$$

During any calendar year:

$$(3.17\,E-08)*\sum_i (Ri(W\,\tilde{Q}i + w\,\tilde{q}i) \text{ must be less than } 15 \text{ mrem}$$

Where:

$\tilde{Q}i$ = The plant releases of radioiodine 131 and radioactive materials in particulate form with half-lives greater than 8 days for long term releases as defined in Section 3.1.16, in µCi. Releases shall be cumulative over the calendar quarter or year, as appropriate.

$\tilde{q}i$ = The plant releases of radioiodine 131 and radioactive materials in particulate form with half-lives greater than 8 days for short term releases as defined in Section 3.1.16, in µCi. Releases shall be cumulative over the calendar quarter or year, as appropriate.

W = The dispersion or deposition parameter (based on meteorological data defined in Section 3.5) for estimating the dose to an individual at the nearest resident for long term releases as defined in Section 3.1.16.

w = The vent dispersion or deposition parameter for estimating the dose to an individual at the nearest resident for short term releases (as defined in Section 3.1.16) and calculated as in Section 3.5.

3.17 E-08 = The inverse number of seconds in a year.

Ri = The dose factor for each identified pathway, organ, and radionuclide, i, in m^2 ·mrem/yr per μCi/sec or mrem/yr per $\mu Ci/m^3$. These dose factors are determined as described in Sections 3.3.4.5a-d.

3.3.4.4 Utilizing the assumptions contained in Section 3.3.4.3, these equations for the nearest resident reduce to the following:

$$DN = (3.17E\text{-}8)\sum_{i}[Ri(I)*[Wn(in)\tilde{Q}i + wn(in)\tilde{q}i] + (Ri(G) + Ri(V))*[Wn(dep)\tilde{Q}i + wn(dep)\tilde{q}i]]$$

Where:

DN = total dose at the nearest residence, and must be less than or equal to 7.5 mrem per quarter, and less than or equal to 15 mrem Annually.

Wn(in) = The highest calculated annual average dispersion parameter for the inhalation pathway for the nearest residence in the unrestricted area located in the SSW sector at 1574 meters, 1.02E-6 sec/m^3.

wn(in) = The dispersion parameter for the inhalation pathway for the nearest residence in the unrestricted area located in the SSW sector at 1574 meters, 1.02E-6 sec/m^3, corrected for short term releases.

Wn(dep)= The highest calculated annual average deposition parameter for the nearest residence in the unrestricted area located in the South sector at 1133 meters, 7.45E-9 m^{-2} for all isotopes except Tritium, which uses the X/Q value instead (1.02E-6 sec/m^3).

wn(dep)= The deposition parameter for the nearest residence in the unrestricted area located in the South sector at 1133 meters, 7.45E-9 m^{-2} for all isotopes except Tritium, which uses the X/Q value instead (1.02E-6 sec/m^3), corrected for short term releases.

$\tilde{Q}i$ = The plant releases of radioiodine 131 and radioactive materials in particulate form with half-lives greater than 8 days for long term releases as defined earlier, (uCi).

$\tilde{q}i$ = The plant releases of radioiodine 131 and radioactive materials in particulate form with half-lives greater than 8 days for short term releases as defined earlier (uCi).

Ri (I): Inhalation pathway factor for each radionuclide, i.

Ri (G): Ground plane pathway factor for each radionuclide, i.

Ri (V): Vegetation pathway factor for each radionuclide, i.

3.3.4.5 Calculation of Dose Factors

3.3.4.5.a Calculation of Ri (I) (X/Q) Inhalation Pathway Factor

$$Ri\ (I)_{(X/Q)} = K'[(BR)\ a]\ [(DFAi)\ a](mrem/yr\ per\ \mu Ci/m^3)$$

Where:

K' = Constant of unit conversion, 10^6 pCi/uCi

(BR) a = Breathing rate of the receptor of age group (a) in m^3/yr.

(from Regulatory Guide 1.109, Table E-5)

Infant = 1400 (m^3/yr)

Child = 3700 (m^3/yr)

Adult/Teen = 8000 (m^3/yr)

(DFAi) a = The maximum organ inhalation dose factor for the receptor of age group (a) for the ith radionuclide in mrem/pCi. The total body is considered as an organ in the selection of (DFAi)a.

Child and infant inhalation dose factors are generally more restrictive, however, doses from each age group are calculated separately. The (DFAi)a values are listed in Tables 3-1a through 3-1d. The Ri values for the inhalation pathway are listed in Table 3-10a through 3-10d.

3.3.4.5.b Calculation of Ri(G)(D/Q) Ground Plane Pathway Factor

$$Ri(G)_{(D/Q)} = \frac{K'K''(SF)(DFGi)(1-e^{(-kit)})}{Ki} = \frac{m^2 \cdot mrem/yr}{uCi/\sec}$$

Where:

K' = A constant of conversion, 10^6 pCi/μCi.

K" = A constant of conversion, 8760 hr/yr.

ki = Decay constant for the ith radionuclide sec^{-1}.

t = The exposure time, 4.73 x 10^8 sec (15 years).

DFGi = The ground plane dose conversion factor for ith radionuclide (mrem/hr per pCi/m^2).

SF = Shielding factor (dimensionless) = 0.7 (from Table E-15 of Regulatory Guide 1.109).

The values of DFGi were obtained from Table E-6 of Regulatory Guide 1.109 and are listed in Table 3-2. These values were used to calculate Ri(G), which is the same for all age groups and organs and is listed in Table 3-12.

3.3.4.5.c Calculation of Ri(V)(D/Q) - Vegetation Pathway Factor

$$Ri(V)_{(D/Q)} = \frac{K'(r)}{Yv(ki+kw)} * (DFLi)a * [(UaL)fL * e^{(-kitL)} + (UaS)fg * e^{(-kith)}]$$

Where:

K' = Constant of conversion, 10^6 pCi/μCi

r = Dimensionless correction factor for Iodine and Particulate from Table E-15 of Reg Guide 1.109, as follows:

0.2 for particulates 1.0 for radioiodine

$DFLi_a$ = Reg Guide 1.109 dose factor for each nuclide, in mrem/pCi, for each age group.

UaL = Consumption rate of fresh leafy vegetation by the receptor in age group (a) in kg/yr.

ki = Decay constant for the radionuclide, in sec^{-1}

UaS = Consumption rate of non-leafy vegetables by the receptor in age group (a) in kg/yr.

fL = The fraction of the annual intake of leafy vegetation grown locally.

fg = The fraction of the annual intake of non-leafy vegetation grown locally.

kw = Decay constant for removal of activity on leaf and plant surfaces by weathering, 5.73E-7 sec^{-1} (corresponding to a 14 day half-life).

tL = The average time between harvest of leafy vegetation and its consumption in seconds.

th = The average time between harvest of stored vegetation and its consumption in seconds.

Yv = The vegetation area density in kg/m^2.

The concentration of Tritium in vegetation is based on the airborne concentration rather than the deposition. Therefore, the Ri(V) is based on X/Q:

$$(RiV)_{(X/Q)} = K'K''[(UaL)fL+(UaS)fg](DFLi)a\ (0.75)(0.5/H)\ (mrem/yr\ per\ \mu Ci/m^3)$$

Where:

K" = A constant of unit conversion, 1000 gm/kg

H = Absolute humidity of the atmosphere in gm/m^3. This value may be considered as 8 gm/m^3 (NUREG 0133, pg 27) in lieu of site specific information.

0.75 = The fraction of total feed that is water

0.5 = The ratio of the specific activity of the feed grass water to the atmospheric water

DFLia for each age group is given in Tables 3-3a through 3-3d.

Ri(V) values are listed in Table 3-11a through 3-11c.

Ri(V) Parameters Are From The Following Sources:

PARAMETER	VALUE	Reg Guide 1.109 Table
r (dimensionless)	1.0 for radioiodines	E-15
	0.2 for particulates	
(DFLi) a (mrem/pCi)	Each radionuclide	E-11 to E-14
UaL (kg/yr) - infant	0	E-5
- child	26	E-5
- teen	42	E-5
- adult	64	E-5
UaS (kg/yr) - infant	0	E-5
- child	520	E-5
- teen	630	E-5
- adult	520	E-5
fL (dimensionless)	1.0	E-15
fg (dimensionless)	0.76	E-15
tL (seconds)	8.6E4 (1 day)	E-15
th (seconds)	5.18E6 (60 days)	E-15
Yv (kg/m^2)	2.0	E-15

3.4 Backup Simplified Dose Methodology

The dose calculation procedures described in this section are provided for use as a backup whenever the primary computer methodology cannot be followed.

3.4.1 Instantaneous Dose Rates - Noble Gas Releases

Note: When the instantaneous limit applies, the process radiation monitor response or release rate can be averaged over a one-hour time interval.

3.4.1.1 This section describes the alternative calculational methods to meet the requirements of Paragraph 3.2.1. These methods provide calculational results as per section 3.3.1.

3.4.1.2 To determine an acceptable noble gas instantaneous release rate in µCi/sec, a standard isotopic mixture of noble gases may be assumed. This isotopic mixture was measured for a mixture of isotopes typical of reactor coolant with exposed fuel. This requirement is evaluated at the worst sector of the unrestricted area boundary. Based on this isotopic mixture, standard Ks, Ls, Ms, and Ns (lower case s denotes a weighted sum, see Table 3-8) can be determined using the technique presented in paragraph 3.3.1.2 and Ki, Li, Mi, and Ni values from Tables 3.4-7. The data and results of this calculation are shown in Table 3-8.

3.4.1.3 The isotopic mixture chosen was obtained from a reactor coolant sample during an operating period with exposed fuel. Table 3-8 contains the mixture data and the fractional relative abundance of each isotope. These standard factors can be used with the equations and limits presented in Section 3.3.1.

3.4.1.4 Utilizing the equations from Paragraph 3.3.1.2 and the values from Table 3-8, conservative unit 3 maximum release limits for all noble gases in µCi/sec are calculated in Appendix A and summarized below:

Maximum instantaneous release rates:

$$\dot{Q}t \le \frac{266}{Ks(X/Q)} \le \frac{266}{(8.49E+2)(4.47E-6)} \le 7.00E+4 \frac{\mu Ci}{\sec}(Whole\ Body)$$

$$\dot{Q}t \le \frac{1806}{(Ls+1.1Ms)(X/Q)} \le \frac{1806}{(2306)(4.47E-6)} \le 1.75E+5 \frac{\mu Ci}{\sec}(Skin)$$

3.4.1.5 For individual release rate determinations, alternate computer codes and/or a Hand Calculation Template serve as back up methodologies should the primary computer method be inoperable. These methods comply with calculations in Section 3.3.1.

3.4.2 Instantaneous Dose Rates-I-131, Particulates w/t½ >8 days, & H-3

3.4.2.1 This section describes the alternative calculational method to meet the requirements of Paragraph 3.2.1. The purposes of this method is to provide backup calculational techniques, both computer aided and hand calculated, which approximate section 3.3.2.

3.4.2.2 To determine an acceptable iodine and particulate release rate, it is assumed that the limit on these releases shall be met if the total noble gas concentration in the VC is at least a factor of 20,000 more than the concentration of radioiodine and long lived particulates or VC iodines and long lived particulates are less than 1E-7 µCi/cc. This has historically been the case and this assures that the noble gas activity will be limiting.

3.4.2.3 Backup instantaneous dose rate calculations can be performed with an alternate computer code or by formatted hand calculations. These methods are identical to section 3.3.2.

3.4.3 Time Averaged Dose - Noble Gas Releases

3.4.3.1 This section describes alternative methods of meeting the requirements of Paragraphs 3.2.2 and 3.2.4, and the alternative methods of implementing the calculation techniques presented in Section 3.3.3.

3.4.3.2 The values of $\overline{Ki}$, $\overline{Li}$, $\overline{Mi}$, and $\overline{Ni}$ for the Plant Vent (PV) mixed mode releases and the Monitor Tank (MT) ground plane releases are determined for each release using the dispersion parameter for the site boundary in the worst sector. The calculations are as follows:

$$PV\overline{Ki} = (Ki)*(X/Q)PV \quad \text{and} \quad MTKi = (\overline{Ki})*(X/Q)MT$$

$$PV\overline{Li} = (Li)*(X/Q)PV \quad \text{and} \quad MTLi = (\overline{Li})*(X/Q)MT$$

$$PV\overline{Mi} = (Mi)*(X/Q)PV \quad \text{and} \quad MTMi = (\overline{Mi})*(X/Q)MT$$

$$PV\overline{Ni} = (Ni)*(X/Q)MT \quad \text{and} \quad MTNi = (\overline{Ni})*(X/Q)MT$$

Where:

Ki = The total body dose factor due to gamma emissions for each identified noble gas radionuclide in mrem/yr per µCi/m^3 (finite cloud correction used).

Li = The skin dose factor due to beta emissions for each identified noble gas radionuclide in mrem/yr per $\mu Ci/m^3$.

Mi = The air dose factor due to gamma emissions for each identified noble gas radionuclide in mrem/yr per $\mu Ci/m^3$ (finite cloud correction used).

Ni = The air dose factor due to beta emissions for each identified noble gas radionuclide in mrad/yr per $\mu Ci/m^3$.

(X/Q)PV = The highest calculated annual average dispersion parameter for the noble gas pathway at the unrestricted area boundary, 4.47E-6 sec/m^3 and applicable to plant vent mixed mode releases.

(X/Q)MT = The highest calculated annual average X/Q for ground level monitor tank noble gas release pathway, 5.00E-5 sec/m^3.

3.4.3.3 Determine weighted average dose factors as follows:

All values of Ki, Li, Mi, and Ni are shown in Table 3-4 through 3-7 for the unrestricted area boundary.

Each of the following expressions is summed over all the nuclides:

PV Kt = $\sum[Ki*(Ci/Ct)]$

PV Lt = $\sum[Li*(Ci/Ct)]$

PV Mt = $\sum[Mi*(Ci/Ct)]$

PV Nt = $\sum[Ni*(Ci/Ct)]$

For the monitor tank pathway, MTKt, MTLt, MTMt, and MTNt are calculated in the same way as for plant vent (PV) releases above, except that Ci and Ct apply to gaseous activity for the monitor tank vent pathway.

Where:

Ci = Concentration of isotope i ($\mu Ci/cc$) in analysis, t (for either PV or MT pathway)

Ct = Concentration of all noble gas isotopes ($\mu Ci/cc$) for a specific analysis, *t*, (for either the PV or MT pathway)

These calculations can be performed by hand (via formatted procedure) or by using alternate computer codes to compute all or part of the dose calculation.

3.4.3.4 Calculate resultant doses and compare with limits as per 3.3.3. The sum of all releases in a calendar quarter or calendar year should be compared to the limits of Section 3.2.2 and 3.2.4 as appropriate for gamma air dose and beta air dose.

3.4.4 Time Averaged Dose-Iodine 131 and Particulates w/t½ days& H-3

3.4.4.1 This section describes the alternate methods of meeting the requirements of Paragraphs 3.2.3 and 3.2.4 and of implementing the calculational techniques presented in Section 3.3.4.

3.4.4.2 If the primary computer method is inoperable, dose calculations can be performed by:

a) an alternate computer code which complies with Section 3.3.4, using all identified Iodine and Particulate isotopes;

- or -

b) hand calculations (via a formalized departmental procedure) which comply with Section 3.3.4.

3.4.4.3 Sum the Iodine, Particulate, and Tritium dose contributions and compare quarterly and annual totals to the limits described in Section 3.2.3.

3.5 Calculation of Meteorological Dispersion Factors

3.5.1 For the purpose of these calculations, the site boundary was taken to be the unrestricted area boundary. The distances to the site boundary and nearest residents are shown in Table 3-9 for each of the 16 major compass sectors. Site boundary distances at IPEC are measured from the applicable unit's Plant Vent, while distances to the nearest resident in each of these sectors is measured from a common point, the unit 1 superheater stack. 9/05

In the sectors where the Hudson River forms the site or exclusion area boundary, the near shore is assumed as the boundary of the "unrestricted area", because, in general, IPEC does not attempt to control population on the river. Potential confusion regarding the near or far shore for this application is effectively removed per the definition of "unrestricted area" in NUREG 0133 (Ref. 1, Section 2.2, Page 6). This section states that these criteria do "not include areas over water bodies" and the river is therefore not applicable for evaluating the maximum unrestricted area boundary concentrations.

3.5.2 The atmospheric transport and diffusion model used in the evaluation of dispersion and deposition factors is the sector-average straight-line model in Regulatory Guide 1.111 (Ref. 15) for mixed-mode releases with plume-rise effects, downwash, and building-wake correction.

The analyses were carried out using the AEOLUS-3 computer code (Ref. 16) and are documented in detail in Ref. 17. Hourly meteorological data was collected from 1981 through 1990, and updated with data from 1992 to 2002, in accordance with the accuracy requirements of Regulatory Guide 1.23 (Ref. 18). The data recovery index for these periods was in excess of 99%.

Comparison of the new meteorological data with previous data continues to show little difference in the overall dispersion conditions at the site. In the analyses, wind-speed coefficients in Regulatory Guide 1.111 were used to extrapolate the measured wind speeds to the height of the main vent (on top of the primary containment). Also, the regulatory plume entrainment model was used to determine plume partitioning between ground-level and elevated releases, and no credit was taken for decay and depletion in transit. 9/05

Recirculation effects were accounted for by confining in-valley flows within the valley out to a distance of 10 miles (up or down the valley) and allowing a portion of them to return to the site without additional dilution.

3.5.3 To meet the calculational requirements of Paragraphs 3.2.1, 3.2.2, and 3.2.4 the annual average dispersion factors are calculated approximately once every ten years, for each compass sector at the site unrestricted area boundary. The most restrictive meteorological dispersion and deposition factors determined from this accumulation of data is currently presented in Attachment A.

The distances to the site boundary and nearest resident in each sector were determined from the land use census and global positioning technology, and are listed in Table 3-9.

For the monitor tank release pathway, ground level dispersion values (X/Q) were assessed using the methodology discussed in Section 3.5.2. The most restrictive X/Q was determined to be in the SW sector at 350m with a value of 5.00E-5 sec/m^3 (concentration X/Q per Ref. 21). This value is specific only to the Monitor Tank pathway for noble gas dose at the site boundary.

3.5.4 To meet the calculational requirements of Paragraph 3.2.3 (Iodines and Particulates), the annual average deposition and dispersion parameters were calculated for the nearest residents in each of the compass sectors.

Because no real dairy exists within 5 miles of the power plant, the grass-cow-milk pathway and its dispersion factor are not included.

Dispersion and deposition parameters for the nearest resident were calculated using the models and data described in Sec. 3.5.2 above and are as follows:

Wn(in) = The highest calculated annual average dispersion parameters for the inhalation pathway for the nearest residence in the unrestricted area, per Attachment A. | 9/05

Wn(dep)= The highest calculated annual average deposition parameters for the ground plane and vegetation pathways for the nearest residence in the unrestricted area, per Attachment A. | 9/05

For Tritium in the vegetation pathway, Wn(in) is used.

NOTE: For the monitor tank pathway, iodines and particulates are effectively removed by demineralization, therefore dispersion parameters are not needed for this pathway.

3.5.5 To meet the calculational requirements of Paragraphs 3.2.2, 3.2.3 and 3.2.4 and the calculation methodologies described in Sections 3.3.4 and 3.3.3, short term release dispersion and deposition factors may need to be calculated.

For this document, short term release dispersion and deposition factors are determined from the long term annual average parameters and a method presented by Sagendorf in NUREG 0324 (Ref. 5) as recommended by NUREG 0133 (Ref. 1, Section 3.3, Page 8). This method makes use of a factor (F), developed for a particular compass sector and distance, which is simply multiplied by the annual average dispersion or deposition parameter for the same sector and distance to develop the corresponding short-term parameter.

This factor is defined as:

$$F = [NTOTAL/8760]^m$$

Where:

F = The non-dimensional correction factor used to convert annual average dispersion or deposition factors to short term dispersion or deposition factors.

NTOTAL = The total duration of a short-term release (or releases) in hours, during a chosen reporting period.

$$m = \frac{\log(ANMX / F15MX)}{\log(8760)}$$

8760 = The total number of hours in a year.

ANMX = The calculated historical average dispersion (sec/m^3) or deposition (m^{-2}) factor for the compass sector and distance of interest.

F15MX = The short term dispersion (sec/m^3) or deposition (m^{-2}) factor for the compass sector and distance of interest. This is the 15th percentile value such that worse weather conditions can only exist 15% of the time and better weather conditions 85% of the time.

The atmospheric transport and diffusion model used in the evaluation of short-term dispersion and deposition parameters (F15MX) is the Gaussian plume-centerline model in Regulatory Guide 1.145 (Ref. 19), adapted for mixed-mode releases with plume-rise effects, downwash, building-wake correction and plume meander considerations.

As was the case with the annual average parameters, the analyses were carried out using the AEOLUS-3 computer code (Ref. 16) and the most recent 10-year hourly meteorological data. They are documented in detail in Reference 17.

Note that, in line with the guidance in NUREG-0133 (Ref. 1, Sec. 5.3.1, page 29), short-term releases (equal to or less than 500 hours per year) are considered to be cumulative over the calendar quarter or year, as appropriate. However, from Sec. 3.1.16 of the ODCM Part II, and in line with Sec. 3.3, page 8 of NUREG-0133, gas-decay tank releases and containment purges have been determined to be sufficiently random so as to permit use of the long-term dispersion and deposition parameters for assessment of their radiological impact.

3.5.6 The short term 15th percentile dispersion or deposition factor for use in the equation of the preceding paragraphs and the simplified F factor equation for mixed-mode releases to critical locations of each IPEC unit are as follows:

a) Site Boundary Noble Gas:

		Unit 2	Unit 3
F15MX	=	7.724E-5 sec/m^3	1.590E-4 sec/m^3
ANMX	=	2.219E-6 sec/m^3	4.470E-6 sec/m^3
$m = \frac{\log(ANMX / F15MX)}{\log(8760)}$	=	−0.391	−0.393
F =		[NTOTAL/8760]$^{-0.391}$	[NTOTAL/8760]$^{-0.393}$

b) Nearest Residence Inhalation:

		Unit 2	Unit 3
F15MX	=	4.992E-5 sec/m^3	4.888E-5 sec/m^3
ANMX	=	1.030E-6 sec/m^3	1.016E-6 sec/m^3
$m = \frac{\log(ANMX / F15MX)}{\log(8760)}$	=	−0.428	−0.427
F =		[NTOTAL/8760]$^{-0.428}$	[NTOTAL/8760]$^{-0.427}$

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c) Nearest Residence Deposition:

		Unit 2	Unit 3
F15MX	=	3.995E-7 m^{-2}	4.019E-7 m^{-2}
ANMX	=	7.517E-9 m^{-2}	7.451E-9 m^{-2}
$m = \frac{\log(ANMX / F15MX)}{\log(8760)}$	=	−0.438	−0.439
F =		[NTOTAL/8760]$^{-0.438}$	[NTOTAL/8760]$^{-0.439}$

d) The slopes ("m") for ground level short term correction factors are calculated in a similar fashion, from ground level data found in Reference 17:

	Unit 2	Unit 3
Site Boundary Noble Gas:	-0.390	-0.397
Nearest Resident Inhalation:	-0.427	-0.427
Nearest Resident Deposition:	-0.455	-0.455

3.6 Justification for and Use of Finite Cloud Assumption for Assessing Site Boundary Dose

Two models are available for the computation of doses from external gamma radiation:

a) The semi-infinite cloud model, which is conservatively applicable only for ground-level releases assumes ground level airborne concentrations are the same throughout a cloud that is large in extent relative to the photon path lengths in air.

b) The finite-cloud model, which takes into consideration the actual plume dimensions and the elevation above the receptor.

The semi-infinite cloud model (which is normally used in a variety of applications because of its simplicity) has two drawbacks:

1. It could be overly conservative for receptors close to the release point (particularly for ground-level releases under stable conditions with limited plume dispersion) due to the basis that the high concentration at the receptor is assumed to exist everywhere, and;

2. It is not suitable for elevated releases since gamma radiation emanating from the radioactive cloud could still reach a receptor on the ground even though the plume is still aloft (the concentration at ground level is equal to zero).

For practical applications, it is possible to define isotope-dependent finite-cloud correction factors to express the difference in external radiation exposures between a finite cloud (which may be either at ground level or elevated) and a semi-finite cloud. Physically, when such a correction factor is applied to the calculated ground-level concentration resulting from a given plume, it will define the equivalent concentration in a semi-infinite cloud which would yield the same external exposure as the finite cloud. Such a correction factor is a function of both the airborne radionuclide energy and of plume dispersion under the prevailing conditions. At distant receptors, where the plume dimensions reach limiting conditions, such correction factors reduce to unity.

The AEOLUS-3 code (which was used for the determination of the annual average dispersion and deposition parameters listed in Section 3.5), also has the capability of providing a basis for computation of isotope-specific finite-cloud correction factors based on the models in "Meteorology and Atomic Energy" (Ref. 20, Sec. 7.5.2). The code was used (along with the mixed-mode release option and the 10-year hourly meteorological data base) for the determination of the correction factors as would be applicable at the IPEC site boundary. Note that the correction factors can be viewed as adjustment factors to the dose conversion factors in Regulatory Guide 1.109 (Ref. 3) for immersion in semi-infinite clouds. The nuclide specific correction factors and adjusted dose factors are presented in Tables 3-4 and 3-6 for the IP3 site boundary.

For the monitor tank pathway (ground release concentration X/Q), use of the finite cloud corrected data presented in tables 3-4 and 3-6 will provide a conservative result. The conservativism is due to the indicated correction factors for the mixed mode case yielding larger correction factors per nuclide. However, in the event that a ground level specific finite cloud correction factor is desired (which will yield lower calculated doses) the Xe-133 gamma X/Q value may be used as described in Reference 21.

3.7 Direct Radiation Measurements and Total Dose Calculations (40CFR190)

Per RECS 3.6, the direct radiation component for potential off site dose is determined by Radiological Engineering (using References 26 through 29) as follows:

Direct Radiation Dose = VC + IRWSF + SGM + $RMHA_i$ + etc ...

where;

VC	=	The Vapor Containment structure
IRWSF	=	The Interim Radioactive Waste Storage Facility
SGM	=	The Steam Generator Mausoleum
RMHA	=	A Radioactive Material Handling Area, as posted
i	=	The ith RMHA

Other structures or tanks are included as determined by Radiological Engineering.

The calculations in References 26 through 29 were performed in order to meet the requirements of NRC Generic Letter 81-38, 11/10/1981, Storage of Low-Level Radioactive Wastes at Power Reactor Sites.

> "Offsite doses from onsite storage must be sufficiently low to account for other uranium fuel cycle sources (e.g., an additional dose of <1 mrem/year is not likely to cause the limits of 40 CFR 190 to be exceeded). On site dose limits will be controlled per 10 CFR 20..."

The IRWSF, SGM, and RMHAs fence line dose rates are limited by department procedures to keep dose rates at the SITE BOUNDARY fence < 1 mrem/yr based on calculations performed in References 26 through 29. These calculations contain realistic occupancy factors for the SITE BOUNDARY fence (including the IP2 shared fence) and the nearest neighbor.

3.8 Gaseous Effluent Dose to MEMBERS OF THE PUBLIC Visiting the Site

Per RECS Section 4 (bases) and the discussion regarding gaseous effluent dose rate, visiting MEMBERS OF THE PUBLIC will receive negligible dose, as calculated per ODCM Part II, Sections 3.3.3 and 3.3.4, due the application of multiplicative occupancy factors. These factors are determined by comparing the expected hours on site to 8760 hours (the number of hours in a year, which is used in the calculations demonstrated in Sections 3.3.3 and 3.3.4). Examples of these calculations are as follows:

example 1: Several students visit the site for an 8-hour guided tour. Their occupancy factor is: 8 / 8760 or .0009.

example 2: A man drives his wife to work and drops her off at the security gate each morning, with a total stay-time on site for 2 minutes per day. His occupancy factor is calculated as follows:

2 min/60 min per hour =.0333 hr ; 0.0333 / 8760 = **3.8E-6**

These factors, when multiplied by doses calculated per Sections 3.3.3 and 3.3.4, demonstrate that dose to these MEMBERS OF THE PUBLIC is negligible, despite any potential reduction in the atmospheric dispersion.

Table 3-1a

ADULT INHALATION DOSE FACTORS

(mrem per pCi inhaled)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07
Be-7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na-24	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06
P-32	1.65E-04	9.64E-06	6.26E-06	0.00E+00	0.00E+00	0.00E+00	1.08E-05
Cr-51	0.00E+00	0.00E+00	1.25E-08	7.44E-09	2.85E-09	1.80E-06	4.15E-07
Mn-54	0.00E+00	4.95E-06	7.87E-07	0.00E+00	1.23E-06	1.75E-04	9.67E-06
Mn-56	0.00E+00	1.55E-10	2.29E-11	0.00E+00	1.63E-10	1.18E-06	2.53E-06
Fe-55	3.07E-06	2.12E-06	4.93E-07	0.00E+00	0.00E+00	9.01E-06	7.54E-07
Fe-59	1.47E-06	3.47E-06	1.32E-06	0.00E+00	0.00E+00	1.27E-04	2.35E-05
Co-58	0.00E+00	1.98E-07	2.59E-07	0.00E+00	0.00E+00	1.16E-04	1.33E-05
Co-60	0.00E+00	1.44E-06	1.85E-06	0.00E+00	0.00E+00	7.46E-04	3.56E-05
Ni-63	5.40E-05	3.93E-06	1.81E-06	0.00E+00	0.00E+00	2.23E-05	1.67E-06
Ni-65	1.92E-10	2.62E-11	1.14E-11	0.00E+00	0.00E+00	7.00E-07	1.54E-06
Cu-64	0.00E+00	1.83E-10	7.69E-11	0.00E+00	5.78E-10	8.48E-07	6.12E-06
Zn-65	4.05E-06	1.29E-05	5.82E-06	0.00E+00	8.62E-06	1.08E-04	6.68E-06
Zn-69	4.23E-12	8.14E-12	5.65E-13	0.00E+00	5.27E-12	1.15E-07	2.04E-09
Br-83	0.00E+00	0.00E+00	3.01E-08	0.00E+00	0.00E+00	0.00E+00	2.90E-08
Br-84	0.00E+00	0.00E+00	3.91E-08	0.00E+00	0.00E+00	0.00E+00	2.05E-13
Br-85	0.00E+00	0.00E+00	1.60E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.69E-05	7.37E-06	0.00E+00	0.00E+00	0.00E+00	2.08E-06
Rb-88	0.00E+00	4.84E-08	2.41E-08	0.00E+00	0.00E+00	0.00E+00	4.18E-19
Rb-89	0.00E+00	3.20E-08	2.12E-08	0.00E+00	0.00E+00	0.00E+00	1.16E-21
Sr-89	3.80E-05	0.00E+00	1.09E-06	0.00E+00	0.00E+00	1.75E-04	4.37E-05
Sr-90	1.24E-02	0.00E+00	7.62E-04	0.00E+00	0.00E+00	1.20E-03	9.02E-05
Sr-91	7.74E-09	0.00E+00	3.13E-10	0.00E+00	0.00E+00	4.56E-06	2.39E-05
Sr-92	8.43E-10	0.00E+00	3.64E-11	0.00E+00	0.00E+00	2.06E-06	5.38E-06
Y-90	2.61E-07	0.00E+00	7.01E-09	0.00E+00	0.00E+00	2.12E-05	6.32E-05
Y-91m	3.26E-11	0.00E+00	1.27E-12	0.00E+00	0.00E+00	2.40E-07	1.66E-10
Y-91	5.78E-05	0.00E+00	1.55E-06	0.00E+00	0.00E+00	2.13E-04	4.81E-05
Y-92	1.29E-09	0.00E+00	3.77E-11	0.00E+00	0.00E+00	1.96E-06	9.19E-06
Y-93	1.18E-08	0.00E+00	3.26E-10	0.00E+00	0.00E+00	6.06E-06	5.27E-05
Zr-95	1.34E-05	4.30E-06	2.91E-06	0.00E+00	6.77E-06	2.21E-04	1.88E-05
Zr-97	1.21E-08	2.45E-09	1.13E-09	0.00E+00	3.71E-09	9.84E-06	6.54E-05
Nb-95	1.76E-06	9.77E-07	5.26E-07	0.00E+00	9.67E-07	6.31E-05	1.30E-05
Mo-99	0.00E+00	1.51E-08	2.87E-09	0.00E+00	3.64E-08	1.14E-05	3.10E-05
Tc-99m	1.29E-13	3.64E-13	4.63E-12	0.00E+00	5.52E-12	9.55E-08	5.20E-07
Tc-101	5.22E-15	7.52E-15	7.38E-14	0.00E+00	1.35E-13	4.99E-08	1.36E-21
Ru-103	1.91E-07	0.00E+00	8.23E-08	0.00E+00	7.29E-07	6.31E-05	1.38E-05
Ru-105	9.88E-11	0.00E+00	3.89E-11	0.00E+00	1.27E-10	1.37E-06	6.02E-06
Ru-106	8.64E-06	0.00E+00	1.09E-06	0.00E+00	1.67E-05	1.17E-03	1.14E-04
Ag-110m	1.35E-06	1.25E-06	7.43E-07	0.00E+00	2.46E-06	5.79E-04	3.78E-05
Sb-122	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-124	3.90E-06	7.36E-08	1.55E-06	9.44E-09	0.00E+00	3.10E-04	5.08E-05
Sb-125	6.67E-06	7.44E-08	1.58E-06	6.75E-09	0.00E+00	2.18E-04	1.26E-05

Table 3-1a

ADULT INHALATION DOSE FACTORS

(mrem per pCi inhaled)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
Te-125m	4.27E-07	1.98E-07	5.84E-08	1.31E-07	1.55E-06	3.92E-05	8.83E-06
Te-127m	1.58E-06	7.21E-07	1.96E-07	4.11E-07	5.72E-06	1.20E-04	1.87E-05
Te-127	1.75E-10	8.03E-11	3.87E-11	1.32E-10	6.37E-10	8.14E-07	7.17E-06
Te-129m	1.22E-06	5.84E-07	1.98E-07	4.30E-07	4.57E-06	1.45E-04	4.79E-05
Te-129	6.22E-12	2.99E-12	1.55E-12	4.87E-12	2.34E-11	2.42E-07	1.96E-08
Te-131m	8.74E-09	5.45E-09	3.63E-09	6.88E-09	3.86E-08	1.82E-05	6.95E-05
Te-131	1.39E-12	7.44E-13	4.49E-13	1.17E-12	5.46E-12	1.74E-07	2.30E-09
Te-132	3.25E-08	2.69E-08	2.02E-08	2.37E-08	1.82E-07	3.60E-05	6.37E-05
I-130	5.72E-07	1.68E-06	6.60E-07	1.42E-04	2.61E-06	0.00E+00	9.61E-07
I-131	3.15E-06	4.47E-06	2.56E-06	1.49E-03	7.66E-06	0.00E+00	7.85E-07
I-132	1.45E-07	4.07E-07	1.45E-07	1.43E-05	6.48E-07	0.00E+00	5.08E-08
I-133	1.08E-06	1.85E-06	5.65E-07	2.69E-04	3.23E-06	0.00E+00	1.11E-06
I-134	8.05E-08	2.16E-07	7.69E-08	3.73E-06	3.44E-07	0.00E+00	1.26E-10
I-135	3.35E-07	8.73E-07	3.21E-07	5.60E-05	1.39E-06	0.00E+00	6.56E-07
Cs-134	4.66E-05	1.06E-04	9.10E-05	0.00E+00	3.59E-05	1.22E-05	1.30E-06
Cs-136	4.88E-06	1.83E-05	1.38E-05	0.00E+00	1.07E-05	1.50E-06	1.46E-06
Cs-137	5.98E-05	7.76E-05	5.35E-05	0.00E+00	2.78E-05	9.40E-06	1.05E-06
Cs-138	4.14E-08	7.76E-08	4.05E-08	0.00E+00	6.00E-08	6.07E-09	2.33E-13
Ba-139	1.17E-10	8.32E-14	3.42E-12	0.00E+00	7.78E-14	4.70E-07	1.12E-07
Ba-140	4.88E-06	6.13E-09	3.21E-07	0.00E+00	2.09E-09	1.59E-04	2.73E-05
Ba-141	1.25E-11	9.41E-15	4.20E-13	0.00E+00	8.75E-15	2.42E-07	1.45E-17
Ba-142	3.29E-12	3.38E-15	2.07E-13	0.00E+00	2.86E-15	1.49E-07	1.96E-26
La-140	4.30E-08	2.17E-08	5.73E-09	0.00E+00	0.00E+00	1.70E-05	5.73E-05
La-142	8.54E-11	3.88E-11	9.65E-12	0.00E+00	0.00E+00	7.91E-07	2.64E-07
Ce-141	2.49E-06	1.69E-06	1.91E-07	0.00E+00	7.83E-07	4.52E-05	1.50E-05
Ce-143	2.33E-08	1.72E-08	1.91E-09	0.00E+00	7.60E-09	9.97E-06	2.83E-05
Ce-144	4.29E-04	1.79E-04	2.30E-05	0.00E+00	1.06E-04	9.72E-04	1.02E-04
Pr-143	1.17E-06	4.69E-07	5.80E-08	0.00E+00	2.70E-07	3.51E-05	2.50E-05
Pr-144	3.76E-12	1.56E-12	1.91E-13	0.00E+00	8.81E-13	1.27E-07	2.69E-18
Nd-147	6.59E-07	7.62E-07	4.56E-08	0.00E+00	4.45E-07	2.76E-05	2.16E-05
W-187	1.06E-09	8.85E-10	3.10E-10	0.00E+00	0.00E+00	3.63E-06	1.94E-05
Np-239	2.87E-08	2.82E-09	1.55E-09	0.00E+00	8.75E-09	4.70E-06	1.49E-05
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-57	0.00E+00	8.65E-08	8.39E-08	0.00E+00	0.00E+00	4.62E-05	3.93E-06
Sr-85	4.00E-06	0.00E+00	9.70E-05	0.00E+00	0.00E+00	6.00E-05	7.60E-06
Y-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-97	2.78E-11	7.03E-12	2.56E-12	0.00E+00	8.18E-12	3.00E-07	3.02E-08
Cd-109	0.00E+00	4.90E-05	1.60E-06	0.00E+00	4.70E-05	9.10E-05	8.20E-06
Sn-113	8.20E-06	2.70E-07	5.60E-07	1.70E-07	0.00E+00	1.20E-04	1.50E-06
Ba-133	9.50E-06	4.20E-07	2.50E-06	0.00E+00	2.10E-09	1.90E-04	1.00E-05
Te-134	3.84E-12	3.22E-12	1.57E-12	3.44E-12	2.18E-11	4.34E-07	2.97E-11
Ce-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg-203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 3-1b

TEEN INHALATION DOSE FACTORS

(mrem per pCi inhaled)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07
Be-7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na-24	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06
P-32	2.36E-04	1.37E-05	8.95E-06	0.00E+00	0.00E+00	0.00E+00	1.16E-05
Cr-51	0.00E+00	0.00E+00	1.69E-08	9.37E-09	3.84E-09	2.62E-06	3.75E-07
Mn-54	0.00E+00	6.39E-06	1.05E-06	0.00E+00	1.59E-06	2.48E-04	8.35E-06
Mn-56	0.00E+00	2.12E-10	3.15E-11	0.00E+00	2.24E-10	1.90E-06	7.18E-06
Fe-55	4.18E-06	2.98E-06	6.93E-07	0.00E+00	0.00E+00	1.55E-05	7.99E-07
Fe-59	1.99E-06	4.62E-06	1.79E-06	0.00E+00	0.00E+00	1.91E-04	2.23E-05
Co-58	0.00E+00	2.59E-07	3.47E-07	0.00E+00	0.00E+00	1.68E-04	1.19E-05
Co-60	0.00E+00	1.89E-06	2.48E-06	0.00E+00	0.00E+00	1.09E-03	3.24E-05
Ni-63	7.25E-05	5.43E-06	2.47E-06	0.00E+00	0.00E+00	3.84E-05	1.77E-06
Ni-65	2.73E-10	3.66E-11	1.59E-11	0.00E+00	0.00E+00	1.17E-06	4.59E-06
Cu-64	0.00E+00	2.54E-10	1.06E-10	0.00E+00	8.01E-10	1.39E-06	7.68E-06
Zn-65	4.82E-06	1.67E-05	7.80E-06	0.00E+00	1.08E-05	1.55E-04	5.83E-06
Zn-69	6.04E-12	1.15E-11	8.07E-13	0.00E+00	7.53E-12	1.98E-07	3.56E-08
Br-83	0.00E+00	0.00E+00	4.30E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	5.41E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	2.29E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	2.38E-05	1.05E-05	0.00E+00	0.00E+00	0.00E+00	2.21E-06
Rb-88	0.00E+00	6.82E-08	3.40E-08	0.00E+00	0.00E+00	0.00E+00	3.65E-15
Rb-89	0.00E+00	4.40E-08	2.91E-08	0.00E+00	0.00E+00	0.00E+00	4.22E-17
Sr-89	5.43E-05	0.00E+00	1.56E-06	0.00E+00	0.00E+00	3.02E-04	4.64E-05
Sr-90	1.35E-02	0.00E+00	8.35E-04	0.00E+00	0.00E+00	2.06E-03	9.56E-05
Sr-91	1.10E-08	0.00E+00	4.39E-10	0.00E+00	0.00E+00	7.59E-06	3.24E-05
Sr-92	1.19E-09	0.00E+00	5.08E-11	0.00E+00	0.00E+00	3.43E-06	1.49E-05
Y-90	3.73E-07	0.00E+00	1.00E-08	0.00E+00	0.00E+00	3.66E-05	6.99E-05
Y-91m	4.63E-11	0.00E+00	1.77E-12	0.00E+00	0.00E+00	4.00E-07	3.77E-09
Y-91	8.26E-05	0.00E+00	2.21E-06	0.00E+00	0.00E+00	3.67E-04	5.11E-05
Y-92	1.84E-09	0.00E+00	5.36E-11	0.00E+00	0.00E+00	3.35E-06	2.06E-05
Y-93	1.69E-08	0.00E+00	4.65E-10	0.00E+00	0.00E+00	1.04E-05	7.24E-05
Zr-95	1.82E-05	5.73E-06	3.94E-06	0.00E+00	8.42E-06	3.36E-04	1.86E-05
Zr-97	1.72E-08	3.40E-09	1.57E-09	0.00E+00	5.15E-09	1.62E-05	7.88E-05
Nb-95	2.32E-06	1.29E-06	7.08E-07	0.00E+00	1.25E-06	9.39E-05	1.21E-05
Mo-99	0.00E+00	2.11E-08	4.03E-09	0.00E+00	5.14E-08	1.92E-05	3.36E-05
Tc-99m	1.73E-13	4.83E-13	6.24E-12	0.00E+00	7.20E-12	1.44E-07	7.66E-07
Tc-101	7.40E-15	1.05E-14	1.03E-13	0.00E+00	1.90E-13	8.34E-08	1.09E-16
Ru-103	2.63E-07	0.00E+00	1.12E-07	0.00E+00	9.29E-07	9.79E-05	1.36E-05
Ru-105	1.40E-10	0.00E+00	5.42E-11	0.00E+00	1.76E-10	2.27E-06	1.13E-05
Ru-106	1.23E-05	0.00E+00	1.55E-06	0.00E+00	2.38E-05	2.01E-03	1.20E-04
Ag-110m	1.73E-06	1.64E-06	9.99E-07	0.00E+00	3.13E-06	8.44E-04	3.41E-05
Sb-122	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-124	5.38E-06	9.92E-08	2.10E-06	1.22E-08	0.00E+00	4.81E-04	4.98E-05
Sb-125	9.23E-06	1.01E-07	2.15E-06	8.80E-09	0.00E+00	3.42E-04	1.24E-05

Table 3-1b

TEEN INHALATION DOSE FACTORS

(mrem per pCi inhaled)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
Te-125m	6.10E-07	2.80E-07	8.34E-08	1.75E-07	0.00E+00	6.70E-05	9.38E-06
Te-127m	2.25E-06	1.02E-06	2.73E-07	5.48E-07	8.17E-06	2.07E-04	1.99E-05
Te-127	2.51E-10	1.14E-10	5.52E-11	1.77E-10	9.10E-10	1.40E-06	1.01E-05
Te-129m	1.74E-06	8.23E-07	2.81E-07	5.72E-07	6.49E-06	2.47E-04	5.06E-05
Te-129	8.87E-12	4.22E-12	2.20E-12	6.48E-12	3.32E-11	4.12E-07	2.02E-07
Te-131m	1.23E-08	7.51E-09	5.03E-09	9.06E-09	5.49E-08	2.97E-05	7.76E-05
Te-131	1.97E-12	1.04E-12	6.30E-13	1.55E-12	7.72E-12	2.92E-07	1.89E-09
Te-132	4.50E-08	3.63E-08	2.74E-08	3.07E-08	2.44E-07	5.61E-05	5.79E-05
I-130	7.80E-07	2.24E-06	8.96E-07	1.86E-04	3.44E-06	0.00E+00	1.14E-06
I-131	4.43E-06	6.14E-06	3.30E-06	1.83E-03	1.05E-05	0.00E+00	8.11E-07
I-132	1.99E-07	5.47E-07	1.97E-07	1.89E-05	8.65E-07	0.00E+00	1.59E-07
I-133	1.52E-06	2.56E-06	7.78E-07	3.65E-04	4.49E-06	0.00E+00	1.29E-06
I-134	1.11E-07	2.90E-07	1.05E-07	4.94E-06	4.58E-07	0.00E+00	2.55E-09
I-135	4.62E-07	1.18E-06	4.36E-07	7.76E-05	1.86E-06	0.00E+00	8.69E-07
Cs-134	6.28E-05	1.41E-04	6.86E-05	0.00E+00	4.69E-05	1.83E-05	1.22E-06
Cs-136	6.44E-06	2.42E-05	1.71E-05	0.00E+00	1.38E-05	2.22E-06	1.36E-06
Cs-137	8.38E-05	1.06E-04	3.89E-05	0.00E+00	3.80E-05	1.51E-05	1.06E-06
Cs-138	5.82E-08	1.07E-07	5.58E-08	0.00E+00	8.28E-08	9.84E-09	3.38E-11
Ba-139	1.67E-10	1.18E-13	4.87E-12	0.00E+00	1.11E-13	8.08E-07	8.06E-07
Ba-140	6.84E-06	8.38E-09	4.40E-07	0.00E+00	2.85E-09	2.54E-04	2.86E-05
Ba-141	1.78E-11	1.32E-14	5.93E-13	0.00E+00	1.23E-14	4.11E-07	9.33E-14
Ba-142	4.62E-12	4.63E-15	2.84E-13	0.00E+00	3.92E-15	2.39E-07	5.99E-20
La-140	5.99E-08	2.95E-08	7.82E-09	0.00E+00	0.00E+00	2.68E-05	6.09E-05
La-142	1.20E-10	5.31E-11	1.32E-11	0.00E+00	0.00E+00	1.27E-06	1.50E-06
Ce-141	3.55E-06	2.37E-06	2.71E-07	0.00E+00	1.11E-06	7.67E-05	1.58E-05
Ce-143	3.32E-08	2.42E-08	2.70E-09	0.00E+00	1.08E-08	1.63E-05	3.19E-05
Ce-144	6.11E-04	2.53E-04	3.28E-05	0.00E+00	1.51E-04	1.67E-03	1.08E-04
Pr-143	1.67E-06	6.64E-07	8.28E-08	0.00E+00	3.86E-07	6.04E-05	2.67E-05
Pr-144	5.37E-12	2.20E-12	2.72E-13	0.00E+00	1.26E-12	2.19E-07	2.94E-14
Nd-147	9.83E-07	1.07E-06	6.41E-08	0.00E+00	6.28E-07	4.65E-05	2.28E-05
W-187	1.50E-09	1.22E-09	4.29E-10	0.00E+00	0.00E+00	5.92E-06	2.21E-05
Np-239	4.23E-08	3.99E-09	2.21E-09	0.00E+00	1.25E-08	8.11E-06	1.65E-05
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-57	0.00E+00	1.18E-07	1.15E-07	0.00E+00	0.00E+00	7.33E-05	3.93E-06
Sr-85	5.00E-06	0.00E+00	1.30E-06	0.00E+00	0.00E+00	8.80E-05	6.90E-06
Y-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-97	3.93E-11	9.72E-12	3.55E-12	0.00E+00	1.14E-11	4.91E-07	2.71E-07
Cd-109	0.00E+00	1.00E-04	3.40E-06	0.00E+00	6.70E-05	1.60E-04	8.60E-06
Sn-113	1.50E-05	4.70E-07	9.70E-07	2.90E-07	0.00E+00	2.00E-04	1.50E-06
Ba-133	4.70E-05	8.00E-07	3.30E-06	0.00E+00	2.80E-09	2.90E-04	9.70E-06
Te-134	5.31E-12	4.35E-12	3.64E-12	4.46E-12	2.91E-11	6.75E-07	1.37E-09
Ce-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg-203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 3-1c

CHILD INHALATION DOSE FACTORS

(mrem per pCi inhaled)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07
Be-7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na-24	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06
P-32	7.04E-04	3.09E-05	2.67E-05	0.00E+00	0.00E+00	0.00E+00	1.14E-05
Cr-51	0.00E+00	0.00E+00	4.17E-08	2.31E-08	6.57E-09	4.59E-06	2.93E-07
Mn-54	0.00E+00	1.16E-05	2.57E-06	0.00E+00	2.71E-06	4.26E-04	6.19E-06
Mn-56	0.00E+00	4.48E-10	8.43E-11	0.00E+00	4.52E-10	3.55E-06	3.33E-05
Fe-55	1.28E-05	6.80E-06	2.10E-06	0.00E+00	0.00E+00	3.00E-05	7.75E-07
Fe-59	5.59E-06	9.04E-06	4.51E-06	0.00E+00	0.00E+00	3.43E-04	1.91E-05
Co-58	0.00E+00	4.79E-07	8.55E-07	0.00E+00	0.00E+00	2.99E-04	9.29E-06
Co-60	0.00E+00	3.55E-06	6.12E-06	0.00E+00	0.00E+00	1.91E-03	2.60E-05
Ni-63	2.22E-04	1.25E-05	7.56E-06	0.00E+00	0.00E+00	7.43E-05	1.71E-06
Ni-65	8.08E-10	7.99E-11	4.44E-11	0.00E+00	0.00E+00	2.21E-06	2.27E-05
Cu-64	0.00E+00	5.39E-10	2.90E-10	0.00E+00	1.63E-09	2.59E-06	9.92E-06
Zn-65	1.15E-05	3.06E-05	1.90E-05	0.00E+00	1.93E-05	2.69E-04	4.41E-06
Zn-69	1.81E-11	2.61E-11	2.41E-12	0.00E+00	1.58E-11	3.84E-07	2.75E-06
Br-83	0.00E+00	0.00E+00	1.28E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	1.48E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	6.84E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	5.36E-05	3.09E-05	0.00E+00	0.00E+00	0.00E+00	2.16E-06
Rb-88	0.00E+00	1.52E-07	9.90E-08	0.00E+00	0.00E+00	0.00E+00	4.66E-09
Rb-89	0.00E+00	9.33E-08	7.83E-08	0.00E+00	0.00E+00	0.00E+00	5.11E-10
Sr-89	1.62E-04	0.00E+00	4.66E-06	0.00E+00	0.00E+00	5.83E-04	4.52E-05
Sr-90	2.73E-02	0.00E+00	1.74E-03	0.00E+00	0.00E+00	3.99E-03	9.28E-05
Sr-91	3.28E-08	0.00E+00	1.24E-09	0.00E+00	0.00E+00	1.44E-05	4.70E-05
Sr-92	3.54E-09	0.00E+00	1.42E-10	0.00E+00	0.00E+00	6.49E-06	6.55E-05
Y-90	1.11E-06	0.00E+00	2.99E-08	0.00E+00	0.00E+00	7.07E-05	7.24E-05
Y-91m	1.37E-10	0.00E+00	4.98E-12	0.00E+00	0.00E+00	7.60E-07	4.64E-07
Y-91	2.47E-04	0.00E+00	6.59E-06	0.00E+00	0.00E+00	7.10E-04	4.97E-05
Y-92	5.50E-09	0.00E+00	1.57E-10	0.00E+00	0.00E+00	6.46E-06	6.46E-05
Y-93	5.04E-08	0.00E+00	1.38E-09	0.00E+00	0.00E+00	2.01E-05	1.05E-04
Zr-95	5.13E-05	1.13E-05	1.00E-05	0.00E+00	1.61E-05	6.03E-04	1.65E-05
Zr-97	5.07E-08	7.34E-09	4.32E-09	0.00E+00	1.05E-08	3.06E-05	9.49E-05
Nb-95	6.35E-06	2.48E-06	1.77E-06	0.00E+00	2.33E-06	1.66E-04	1.00E-05
Mo-99	0.00E+00	4.66E-08	1.15E-08	0.00E+00	1.06E-07	3.66E-05	3.42E-05
Tc-99m	4.81E-13	9.41E-13	1.56E-11	0.00E+00	1.37E-11	2.57E-07	1.30E-06
Tc-101	2.19E-14	2.30E-14	2.91E-13	0.00E+00	3.92E-13	1.58E-07	4.41E-09
Ru-103	7.55E-07	0.00E+00	2.90E-07	0.00E+00	1.90E-06	1.79E-04	1.21E-05
Ru-105	4.13E-10	0.00E+00	1.50E-10	0.00E+00	3.63E-10	4.30E-06	2.69E-05
Ru-106	3.68E-05	0.00E+00	4.57E-06	0.00E+00	4.97E-05	3.87E-03	1.16E-04
Ag-110m	4.56E-06	3.08E-06	2.47E-06	0.00E+00	5.74E-06	1.48E-03	2.71E-05
Sb-122	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-124	1.55E-05	2.00E-07	5.41E-06	3.41E-08	0.00E+00	8.76E-04	4.43E-05
Sb-125	2.66E-05	2.05E-07	5.59E-06	2.46E-08	0.00E+00	6.27E-04	1.09E-05

Table 3-1c

CHILD INHALATION DOSE FACTORS

(mrem per pCi inhaled)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
Te-125m	1.82E-06	6.29E-07	2.47E-07	5.20E-07	0.00E+00	1.29E-04	9.13E-06
Te-127m	6.72E-06	2.31E-06	8.16E-07	1.64E-06	1.72E-05	4.00E-04	1.93E-05
Te-127	7.49E-10	2.57E-10	1.65E-10	5.30E-10	1.91E-09	2.71E-06	1.52E-05
Te-129m	5.19E-06	1.85E-06	8.22E-07	1.71E-06	1.36E-05	4.76E-04	4.91E-05
Te-129	2.64E-11	9.45E-12	6.44E-12	1.93E-11	6.94E-11	7.93E-07	6.89E-06
Te-131m	3.63E-08	1.60E-08	1.37E-08	2.64E-08	1.08E-07	5.56E-05	8.32E-05
Te-131	5.87E-12	2.28E-12	1.78E-12	4.59E-12	1.59E-11	5.55E-07	3.60E-07
Te-132	1.30E-07	7.36E-08	7.12E-08	8.58E-08	4.79E-07	1.02E-04	3.72E-05
I-130	2.21E-06	4.43E-06	2.28E-06	4.99E-04	6.61E-06	0.00E+00	1.38E-06
I-131	1.30E-05	1.30E-05	7.37E-06	4.39E-03	2.13E-05	0.00E+00	7.68E-07
I-132	5.72E-07	1.10E-06	5.07E-07	5.23E-05	1.69E-06	0.00E+00	8.65E-07
I-133	4.48E-06	5.49E-06	2.08E-06	1.04E-03	9.13E-06	0.00E+00	1.48E-06
I-134	3.17E-07	5.84E-07	2.69E-07	1.37E-05	8.92E-07	0.00E+00	2.58E-07
I-135	1.33E-06	2.36E-06	1.12E-06	2.14E-04	3.62E-06	0.00E+00	1.20E-06
Cs-134	1.76E-04	2.74E-04	6.07E-05	0.00E+00	8.93E-05	3.27E-05	1.04E-06
Cs-136	1.76E-05	4.62E-05	3.14E-05	0.00E+00	2.58E-05	3.93E-06	1.13E-06
Cs-137	2.45E-04	2.23E-04	3.47E-05	0.00E+00	7.63E-05	2.81E-05	9.78E-07
Cs-138	1.71E-07	2.27E-07	1.50E-07	0.00E+00	1.68E-07	1.84E-08	7.29E-08
Ba-139	4.98E-10	2.66E-13	1.45E-11	0.00E+00	2.33E-13	1.56E-06	1.56E-05
Ba-140	2.00E-05	1.75E-08	1.17E-06	0.00E+00	5.71E-09	4.71E-04	2.75E-05
Ba-141	5.29E-11	2.95E-14	1.72E-12	0.00E+00	2.56E-14	7.89E-07	7.44E-08
Ba-142	1.35E-11	9.73E-15	7.54E-13	0.00E+00	7.87E-15	4.44E-07	7.41E-10
La-140	1.74E-07	6.08E-08	2.04E-08	0.00E+00	0.00E+00	4.94E-05	6.10E-05
La-142	3.50E-10	1.11E-10	3.49E-11	0.00E+00	0.00E+00	2.35E-06	2.05E-05
Ce-141	1.06E-05	5.28E-06	7.83E-07	0.00E+00	2.31E-06	1.47E-04	1.53E-05
Ce-143	9.89E-08	5.37E-08	7.77E-09	0.00E+00	2.26E-08	3.12E-05	3.44E-05
Ce-144	1.83E-03	5.72E-04	9.77E-05	0.00E+00	3.17E-04	3.23E-03	1.05E-04
Pr-143	4.99E-06	1.50E-06	2.47E-07	0.00E+00	8.11E-07	1.17E-04	2.63E-05
Pr-144	1.61E-11	4.99E-12	8.10E-13	0.00E+00	2.64E-12	4.23E-07	5.32E-08
Nd-147	2.92E-06	2.36E-06	1.84E-07	0.00E+00	1.30E-06	8.87E-05	2.22E-05
W-187	4.41E-09	2.61E-09	1.17E-09	0.00E+00	0.00E+00	1.11E-05	2.46E-05
Np-239	1.26E-07	9.04E-09	6.35E-09	0.00E+00	2.63E-08	1.57E-05	1.73E-05
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-57	0.00E+00	2.44E-07	2.88E-07	0.00E+00	0.00E+00	1.37E-04	3.58E-06
Sr-85	1.20E-05	0.00E+00	3.20E-06	0.00E+00	0.00E+00	1.50E-04	5.50E-06
Y-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-97	1.16E-10	2.08E-11	9.73E-12	0.00E+00	2.31E-11	9.24E-07	7.51E-06
Cd-109	0.00E+00	1.90E-04	8.00E-06	0.00E+00	1.70E-04	3.00E-04	8.10E-06
Sn-113	3.80E-05	8.90E-07	2.30E-06	7.10E-07	0.00E+00	3.60E-04	1.30E-06
Ba-133	1.10E-04	1.10E-06	1.00E-05	0.00E+00	5.40E-09	5.20E-04	8.30E-06
Te-134	1.53E-11	8.81E-12	9.40E-12	1.24E-11	5.71E-11	1.23E-06	4.87E-07
Ce-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg-203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 3-1d

INFANT INHALATION DOSE FACTORS

(mrem per pCi inhaled)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07
Be-7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na-24	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06
P-32	1.45E-03	8.03E-05	5.53E-05	0.00E+00	0.00E+00	0.00E+00	1.15E-05
Cr-51	0.00E+00	0.00E+00	6.39E-08	4.11E-08	9.45E-09	9.17E-06	2.55E-07
Mn-54	0.00E+00	1.81E-05	3.56E-06	0.00E+00	3.56E-06	7.14E-04	5.04E-06
Mn-56	0.00E+00	1.10E-09	1.58E-10	0.00E+00	7.86E-10	8.95E-06	5.12E-05
Fe-55	1.41E-05	8.39E-06	2.38E-06	0.00E+00	0.00E+00	6.21E-05	7.82E-07
Fe-59	9.69E-06	1.68E-05	6.77E-06	0.00E+00	0.00E+00	7.25E-04	1.77E-05
Co-58	0.00E+00	8.71E-07	1.30E-06	0.00E+00	0.00E+00	5.55E-04	7.95E-06
Co-60	0.00E+00	5.73E-06	8.41E-06	0.00E+00	0.00E+00	3.22E-03	2.28E-05
Ni-63	2.42E-04	1.46E-05	8.29E-06	0.00E+00	0.00E+00	1.49E-04	1.73E-06
Ni-65	1.71E-09	2.03E-10	8.79E-11	0.00E+00	0.00E+00	5.80E-06	3.58E-05
Cu-64	0.00E+00	1.34E-09	5.53E-10	0.00E+00	2.84E-09	6.64E-06	1.07E-05
Zn-65	1.38E-05	4.47E-05	2.22E-05	0.00E+00	2.32E-05	4.62E-04	3.67E-05
Zn-69	3.85E-11	6.91E-11	5.13E-12	0.00E+00	2.87E-11	1.05E-06	9.44E-06
Br-83	0.00E+00	0.00E+00	2.72E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	2.86E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	1.46E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.36E-04	6.30E-05	0.00E+00	0.00E+00	0.00E+00	2.17E-06
Rb-88	0.00E+00	3.98E-07	2.05E-07	0.00E+00	0.00E+00	0.00E+00	2.42E-07
Rb-89	0.00E+00	2.29E-07	1.47E-07	0.00E+00	0.00E+00	0.00E+00	4.87E-08
Sr-89	2.84E-04	0.00E+00	8.15E-06	0.00E+00	0.00E+00	1.45E-03	4.57E-05
Sr-90	2.92E-02	0.00E+00	1.85E-03	0.00E+00	0.00E+00	8.03E-03	9.36E-05
Sr-91	6.83E-08	0.00E+00	2.47E-09	0.00E+00	0.00E+00	3.76E-05	5.24E-05
Sr-92	7.50E-09	0.00E+00	2.79E-10	0.00E+00	0.00E+00	1.70E-05	1.00E-04
Y-90	2.35E-06	0.00E+00	6.30E-08	0.00E+00	0.00E+00	1.92E-04	7.43E-05
Y-91m	2.91E-10	0.00E+00	9.90E-12	0.00E+00	0.00E+00	1.99E-06	1.68E-06
Y-91	4.20E-04	0.00E+00	1.12E-05	0.00E+00	0.00E+00	1.75E-03	5.02E-05
Y-92	1.17E-08	0.00E+00	3.29E-10	0.00E+00	0.00E+00	1.75E-05	9.04E-05
Y-93	1.07E-07	0.00E+00	2.91E-09	0.00E+00	0.00E+00	5.46E-05	1.19E-04
Zr-95	8.24E-05	1.99E-05	1.45E-05	0.00E+00	2.22E-05	1.25E-03	1.55E-05
Zr-97	1.07E-07	1.83E-08	8.36E-09	0.00E+00	1.85E-08	7.88E-05	1.00E-04
Nb-95	1.12E-05	4.59E-06	2.70E-06	0.00E+00	3.37E-06	3.42E-04	9.05E-06
Mo-99	0.00E+00	1.18E-07	2.31E-08	0.00E+00	1.89E-07	9.63E-05	3.48E-05
Tc-99m	9.98E-13	2.06E-12	2.66E-11	0.00E+00	2.22E-11	5.79E-07	1.45E-06
Tc-101	4.65E-14	5.88E-14	5.80E-13	0.00E+00	6.99E-13	4.17E-07	6.03E-07
Ru-103	1.44E-06	0.00E+00	4.85E-07	0.00E+00	3.03E-06	3.94E-04	1.15E-05
Ru-105	8.74E-10	0.00E+00	2.93E-10	0.00E+00	6.42E-10	1.12E-05	3.46E-05
Ru-106	6.20E-05	0.00E+00	7.77E-06	0.00E+00	7.61E-05	8.26E-03	1.17E-04
Ag-110m	7.13E-06	5.16E-06	3.57E-06	0.00E+00	7.80E-06	2.62E-03	2.36E-05
Sb-122	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-124	2.71E-05	3.97E-07	8.56E-06	7.18E-08	0.00E+00	1.89E-03	4.22E-05
Sb-125	3.69E-05	3.41E-07	7.78E-06	4.45E-08	0.00E+00	1.17E-03	1.05E-05

Table 3-1d

INFANT INHALATION DOSE FACTORS

(mrem per pCi inhaled)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
Te-125m	3.40E-06	1.42E-06	4.70E-07	1.16E-06	0.00E+00	3.19E-04	9.22E-06
Te-127m	1.19E-05	4.93E-06	1.48E-06	3.48E-06	2.68E-05	9.37E-04	1.95E-05
Te-127	1.59E-05	6.81E-10	3.49E-10	1.32E-09	3.47E-09	7.39E-06	1.74E-05
Te-129m	1.01E-05	4.35E-06	1.59E-06	3.91E-06	2.27E-05	1.20E-03	4.93E-05
Te-129	5.63E-11	2.48E-11	1.34E-11	4.82E-11	1.25E-10	2.14E-06	1.88E-05
Te-131m	7.62E-08	3.93E-08	2.59E-08	6.38E-08	1.89E-07	1.42E-04	8.51E-05
Te-131	1.24E-11	5.87E-12	3.57E-12	1.13E-11	2.85E-11	1.47E-06	5.87E-06
Te-132	2.66E-07	1.69E-07	1.26E-07	1.99E-07	7.39E-07	2.43E-04	3.15E-05
I-130	4.54E-06	9.91E-06	3.98E-06	1.14E-03	1.09E-05	0.00E+00	1.42E-06
I-131	2.71E-05	3.17E-05	1.40E-05	1.06E-02	3.70E-05	0.00E+00	7.56E-07
I-132	1.21E-06	2.53E-06	8.99E-07	1.21E-04	2.82E-06	0.00E+00	1.36E-06
I-133	9.46E-06	1.37E-05	4.00E-06	2.54E-03	1.60E-05	0.00E+00	1.54E-06
I-134	6.58E-07	1.34E-06	4.75E-07	3.18E-05	1.49E-06	0.00E+00	9.21E-07
I-135	2.76E-06	5.43E-06	1.98E-06	4.97E-04	6.05E-06	0.00E+00	1.31E-06
Cs-134	2.83E-04	5.02E-04	5.32E-05	0.00E+00	1.36E-04	5.69E-05	9.53E-07
Cs-136	3.45E-05	9.61E-05	3.78E-05	0.00E+00	4.03E-05	8.40E-06	1.02E-06
Cs-137	3.92E-04	4.37E-04	3.25E-05	0.00E+00	1.23E-04	5.09E-05	9.53E-07
Cs-138	3.61E-07	5.58E-07	2.84E-07	0.00E+00	2.93E-07	4.67E-08	6.26E-07
Ba-139	1.06E-09	7.03E-13	3.07E-11	0.00E+00	4.23E-13	4.25E-06	3.64E-05
Ba-140	4.00E-05	4.00E-08	2.07E-06	0.00E+00	9.59E-09	1.14E-03	2.74E-05
Ba-141	1.12E-10	7.70E-14	3.55E-12	0.00E+00	4.64E-14	2.12E-06	3.39E-06
Ba-142	2.84E-11	2.36E-14	1.40E-12	0.00E+00	1.36E-14	1.11E-06	4.95E-07
La-140	3.61E-07	1.43E-07	3.68E-08	0.00E+00	0.00E+00	1.20E-04	6.06E-05
La-142	7.36E-10	2.69E-10	6.46E-11	0.00E+00	0.00E+00	5.87E-06	4.25E-05
Ce-141	1.98E-05	1.19E-05	1.42E-06	0.00E+00	3.75E-06	3.69E-04	1.54E-05
Ce-143	2.09E-07	1.38E-07	1.58E-08	0.00E+00	4.03E-08	8.30E-05	3.55E-05
Ce-144	2.28E-03	8.65E-04	1.26E-04	0.00E+00	3.84E-04	7.03E-03	1.06E-04
Pr-143	1.00E-05	3.74E-06	4.99E-07	0.00E+00	1.41E-06	3.09E-04	2.66E-05
Pr-144	3.42E-11	1.32E-11	1.72E-12	0.00E+00	4.80E-12	1.15E-06	3.06E-06
Nd-147	5.67E-06	5.81E-06	3.57E-07	0.00E+00	2.25E-06	2.30E-04	2.23E-05
W-187	9.26E-09	6.44E-09	2.23E-09	0.00E+00	0.00E+00	2.83E-05	2.54E-05
Np-239	2.65E-07	2.37E-08	1.34E-08	0.00E+00	4.73E-08	4.25E-05	1.78E-05
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-57	0.00E+00	4.65E-07	4.58E-07	0.00E+00	0.00E+00	2.71E-04	3.47E-06
Sr-85	2.70E-05	0.00E+00	5.40E-06	0.00E+00	0.00E+00	3.00E-04	4.80E-06
Y-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-97	2.44E-10	5.21E-11	1.88E-11	0.00E+00	4.07E-11	2.37E-06	1.92E-05
Cd-109	0.00E+00	2.60E-04	1.00E-05	0.00E+00	2.00E-04	6.20E-04	8.00E-06
Sn-113	6.00E-05	1.60E-06	3.60E-06	1.30E-06	0.00E+00	7.80E-04	1.20E-06
Ba-133	1.90E-04	1.70E-06	1.30E-05	0.00E+00	8.90E-09	9.10E-04	7.70E-06
Te-134	3.18E-11	2.04E-11	1.68E-11	2.91E-11	9.59E-11	2.93E-06	2.53E-06
Ce-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg-203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 3-2

Total Body & Skin Ground Plane Dose Factors (mrem/hr per pCi/m^2) with Isotope half-life and Stable Element Tranfer Data (Fm, cow)

				Ground Plane Dose Factors	
Isotope	Halflife	unit	Fm	TotBody(DFg)	Skin(DFs)
H-3	12.350	Y	1.00E-02	0.00E+00	0.00E+00
Be-7	53.300	D	1.00E-04	0.00E+00	0.00E+00
Na-24	15.000	H	4.00E-02	2.50E-08	2.90E-08
P-32	14.290	D	2.50E-02	0.00E+00	0.00E+00
Cr-51	27.704	D	2.20E-03	2.20E-10	2.60E-10
Mn-54	312.500	D	2.50E-04	5.80E-09	6.80E-09
Mn-56	2.578	H	2.50E-04	1.10E-08	1.30E-08
Fe-55	2.700	Y	1.20E-03	0.00E+00	0.00E+00
Fe-59	44.529	D	1.20E-03	8.00E-09	9.40E-09
Co-58	70.800	D	1.00E-03	7.00E-09	8.20E-09
Co-60	5.271	Y	1.00E-03	1.70E-08	2.00E-08
Ni-63	96.000	Y	6.70E-03	0.00E+00	0.00E+00
Ni-65	2.520	H	6.70E-03	3.70E-09	4.30E-09
Cu-64	12.701	H	1.40E-02	1.50E-09	1.70E-09
Zn-65	243.900	D	3.90E-02	4.00E-09	4.60E-09
Zn-69	0.950	H	3.90E-02	0.00E+00	0.00E+00
Br-83	2.390	H	5.00E-02	6.40E-11	9.30E-11
Br-84	0.530	H	5.00E-02	1.20E-08	1.40E-08
Br-85	0.050	H	5.00E-02	0.00E+00	0.00E+00
Rb-86	18.660	D	3.00E-02	6.30E-10	7.20E-10
Rb-88	0.297	H	3.00E-02	3.50E-09	4.00E-09
Rb-89	0.253	H	3.00E-02	1.50E-08	1.80E-08
Sr-89	50.500	D	8.00E-04	5.60E-13	6.50E-13
Sr-90	29.120	Y	8.00E-04	0.00E+00	0.00E+00
Sr-91	9.500	H	8.00E-04	7.10E-09	8.30E-09
Sr-92	2.710	H	8.00E-04	9.00E-09	1.00E-08
Y-90	2.667	D	1.00E-05	2.20E-12	2.60E-12
Y-91m	0.829	H	1.00E-05	3.80E-09	4.40E-09
Y-91	58.510	D	1.00E-05	2.40E-11	2.70E-11
Y-92	3.540	H	1.00E-05	1.60E-09	1.90E-09
Y-93	10.100	H	1.00E-05	5.70E-10	7.80E-10
Zr-95	63.980	D	5.00E-06	5.00E-09	5.80E-09
Zr-97	16.900	H	5.00E-06	5.50E-09	6.40E-09
Nb-95	35.150	D	2.50E-03	5.10E-09	6.00E-09
Mo-99	2.750	D	7.50E-03	1.90E-09	2.20E-09
Tc-99m	6.020	H	2.50E-02	9.60E-10	1.10E-09
Tc-101	0.237	H	2.50E-02	2.70E-09	3.00E-09
Ru-103	39.280	D	1.00E-06	3.60E-09	4.20E-09
Ru-105	4.440	H	1.00E-06	4.50E-09	5.10E-09
Ru-106	368.200	D	1.00E-06	1.50E-09	1.80E-09
Ag-110m	249.900	D	5.00E-02	1.80E-08	2.10E-08
Sb-122	2.700	D	1.50E-03	0.00E+00	0.00E+00
Sb-124	60.200	D	1.50E-03	1.30E-08	1.50E-08
Sb-125	2.770	Y	1.50E-03	3.10E-09	3.50E-09

Table 3-2

Total Body & Skin Ground Plane Dose Factors (mrem/hr per pCi/m^2) with Isotope half-life and Stable Element Tranfer Data (Fm, cow)

				Ground Plane Dose Factors	
Isotope	Halflife	unit	Fm	TotBody(DFg)	Skin(DFs)
Te-125m	58.000	D	1.00E-03	3.50E-11	4.80E-11
Te-127m	109.000	D	1.00E-03	1.10E-12	1.30E-12
Te-127	9.350	H	1.00E-03	1.00E-11	1.10E-11
Te-129m	33.600	D	1.00E-03	7.70E-10	9.00E-10
Te-129	1.160	H	1.00E-03	7.10E-10	8.40E-10
Te-131m	30.000	H	1.00E-03	8.40E-09	9.90E-09
Te-131	0.417	H	1.00E-03	2.20E-09	2.60E-06
Te-132	3.258	D	1.00E-03	1.70E-09	2.00E-09
I-130	12.360	H	6.00E-03	1.40E-08	1.70E-08
I-131	8.040	D	6.00E-03	2.80E-09	3.40E-09
I-132	2.300	H	6.00E-03	1.70E-08	2.00E-08
I-133	20.800	H	6.00E-03	3.70E-09	4.50E-09
I-134	0.877	H	6.00E-03	1.60E-08	1.90E-08
I-135	6.610	H	6.00E-03	1.20E-08	1.40E-08
Cs-134	2.062	Y	1.20E-02	1.20E-08	1.40E-08
Cs-136	13.100	D	1.20E-02	1.50E-08	1.70E-08
Cs-137	30.000	Y	1.20E-02	4.20E-09	4.90E-09
Cs-138	0.537	H	1.20E-02	2.10E-08	2.40E-08
Ba-139	1.378	H	4.00E-04	2.40E-09	2.70E-09
Ba-140	12.740	D	4.00E-04	2.10E-09	2.40E-09
Ba-141	0.304	H	4.00E-04	4.30E-09	4.90E-09
Ba-142	0.177	H	4.00E-04	7.90E-09	9.00E-09
La-140	1.678	D	5.00E-06	1.50E-08	1.70E-08
La-142	1.542	H	5.00E-06	1.50E-08	1.80E-08
Ce-141	32.501	D	1.00E-04	5.50E-10	6.20E-10
Ce-143	33.000	H	1.00E-04	2.20E-09	2.50E-09
Ce-144	284.300	D	1.00E-04	3.20E-10	3.70E-10
Pr-143	13.560	D	5.00E-06	0.00E+00	0.00E+00
Pr-144	0.288	H	5.00E-06	2.00E-10	2.30E-10
Nd-147	10.980	D	5.00E-06	1.00E-09	1.20E-09
W-187	23.900	H	5.00E-04	3.10E-09	3.60E-09
Np-239	2.360	D	5.00E-06	9.50E-10	1.10E-09
K-40	1.28E+09	Y	1.00E-02	0.00E+00	0.00E+00
Co-57	270.900	D	1.00E-03	9.10E-10	1.00E-09
Sr-85	64.840	D	8.00E-04	0.00E+00	0.00E+00
Y-88	106.640	D	1.00E-05	0.00E+00	0.00E+00
Nb-94	2.03E+04	Y	2.50E-03	0.00E+00	0.00E+00
Nb-97	1.202	H	2.50E-03	4.60E-09	5.40E-09
Cd-109	1.271	Y	1.20E-04	0.00E+00	0.00E+00
Sn-113	115.100	D	2.50E-03	0.00E+00	0.00E+00
Ba-133	10.740	Y	4.00E-04	0.00E+00	0.00E+00
Te-134	0.697	H	1.00E-03	1.00E-09	1.20E-09
Ce-139	137.660	D	1.00E-04	0.00E+00	0.00E+00
Hg-203	46.600	D	3.80E-02	0.00E+00	0.00E+00

Table 3-3a

ADULT INGESTION DOSE FACTORS

(mrem per pCi ingested)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
Be-7	2.77E-09	6.26E-09	3.10E-09	0.00E+00	6.58E-09	0.00E+00	1.08E-06
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	0.00E+00	0.00E+00	0.00E+00	2.17E-05
Cr-51	0.00E+00	0.00E+00	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
Mn-54	0.00E+00	4.57E-06	8.72E-07	0.00E+00	1.36E-06	0.00E+00	1.40E-05
Mn-56	0.00E+00	1.15E-07	2.04E-08	0.00E+00	1.46E-07	0.00E+00	3.67E-06
Fe-55	2.75E-06	1.90E-06	4.43E-07	0.00E+00	0.00E+00	1.06E-06	1.09E-06
Fe-59	4.34E-06	1.02E-05	3.91E-06	0.00E+00	0.00E+00	2.85E-06	3.40E-05
Co-58	0.00E+00	7.45E-07	1.67E-06	0.00E+00	0.00E+00	0.00E+00	1.51E-05
Co-60	0.00E+00	2.14E-06	4.72E-06	0.00E+00	0.00E+00	0.00E+00	4.02E-05
Ni-63	1.30E-04	9.01E-06	4.36E-06	0.00E+00	0.00E+00	0.00E+00	1.88E-06
Ni-65	5.28E-07	6.86E-08	3.13E-08	0.00E+00	0.00E+00	0.00E+00	1.74E-06
Cu-64	0.00E+00	8.33E-08	3.91E-08	0.00E+00	2.10E-07	0.00E+00	7.10E-06
Zn-65	4.84E-06	1.54E-05	6.96E-06	0.00E+00	1.03E-05	0.00E+00	9.70E-06
Zn-69	1.03E-08	1.97E-08	1.37E-09	0.00E+00	1.28E-08	0.00E+00	2.96E-09
Br-83	0.00E+00	0.00E+00	4.02E-08	0.00E+00	0.00E+00	0.00E+00	5.79E-08
Br-84	0.00E+00	0.00E+00	5.21E-08	0.00E+00	0.00E+00	0.00E+00	4.09E-13
Br-85	0.00E+00	0.00E+00	2.14E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	2.11E-05	9.83E-06	0.00E+00	0.00E+00	0.00E+00	4.16E-06
Rb-88	0.00E+00	6.05E-08	3.21E-08	0.00E+00	0.00E+00	0.00E+00	8.36E-19
Rb-89	0.00E+00	4.01E-08	2.82E-08	0.00E+00	0.00E+00	0.00E+00	2.33E-21
Sr-89	3.08E-04	0.00E+00	8.84E-06	0.00E+00	0.00E+00	0.00E+00	4.94E-05
Sr-90	7.58E-03	0.00E+00	1.86E-03	0.00E+00	0.00E+00	0.00E+00	2.19E-04
Sr-91	5.67E-06	0.00E+00	2.29E-07	0.00E+00	0.00E+00	0.00E+00	2.70E-05
Sr-92	2.15E-06	0.00E+00	9.30E-08	0.00E+00	0.00E+00	0.00E+00	4.26E-05
Y-90	9.62E-09	0.00E+00	2.58E-10	0.00E+00	0.00E+00	0.00E+00	1.02E-04
Y-91m	9.09E-11	0.00E+00	3.52E-12	0.00E+00	0.00E+00	0.00E+00	2.67E-10
Y-91	1.41E-07	0.00E+00	3.77E-09	0.00E+00	0.00E+00	0.00E+00	7.76E-05
Y-92	8.45E-10	0.00E+00	2.47E-11	0.00E+00	0.00E+00	0.00E+00	1.48E-05
Y-93	2.68E-09	0.00E+00	7.40E-11	0.00E+00	0.00E+00	0.00E+00	8.50E-05
Zr-95	3.04E-08	9.75E-09	6.60E-09	0.00E+00	1.53E-08	0.00E+00	3.09E-05
Zr-97	1.68E-09	3.39E-10	1.55E-10	0.00E+00	5.12E-10	0.00E+00	1.05E-04
Nb-95	6.22E-09	3.46E-09	1.86E-09	0.00E+00	3.42E-09	0.00E+00	2.10E-05
Mo-99	0.00E+00	4.31E-06	8.20E-07	0.00E+00	9.76E-06	0.00E+00	9.99E-06
Tc-99m	2.47E-10	6.98E-10	8.89E-09	0.00E+00	1.06E-08	3.42E-10	4.13E-07
Tc-101	2.54E-10	3.66E-10	3.59E-09	0.00E+00	6.59E-09	1.87E-10	1.10E-21
Ru-103	1.85E-07	0.00E+00	7.97E-08	0.00E+00	7.06E-07	0.00E+00	2.16E-05
Ru-105	1.54E-08	0.00E+00	6.08E-09	0.00E+00	1.99E-07	0.00E+00	9.42E-06
Ru-106	2.75E-06	0.00E+00	3.48E-07	0.00E+00	5.31E-06	0.00E+00	1.78E-04
Ag-110m	1.60E-07	1.48E-07	8.79E-08	0.00E+00	2.91E-07	0.00E+00	6.04E-05
Sb-122	2.00E-07	4.60E-09	6.90E-08	3.10E-09	0.00E+00	1.20E-07	7.60E-05
Sb-124	2.80E-06	5.30E-08	1.10E-06	6.80E-09	0.00E+00	2.18E-06	7.95E-05
Sb-125	1.79E-06	2.00E-08	4.26E-07	1.82E-09	0.00E+00	1.38E-06	1.97E-05

Table 3-3a

ADULT INGESTION DOSE FACTORS

(mrem per pCi ingested)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
Te-125m	2.68E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	0.00E+00	1.07E-05
Te-127m	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	0.00E+00	2.27E-05
Te-127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	0.00E+00	8.68E-06
Te-129m	1.15E-05	4.29E-06	1.82E-06	3.95E-06	4.80E-05	0.00E+00	5.79E-05
Te-129	3.14E-08	1.18E-08	7.65E-09	2.41E-08	1.32E-07	0.00E+00	2.37E-08
Te-131m	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	0.00E+00	8.40E-05
Te-131	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	0.00E+00	2.79E-09
Te-132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	0.00E+00	7.71E-05
I-130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	0.00E+00	1.92E-06
I-131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	0.00E+00	1.57E-06
I-132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	0.00E+00	1.02E-07
I-133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	0.00E+00	2.22E-06
I-134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	0.00E+00	2.51E-10
I-135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	0.00E+00	1.31E-06
Cs-134	6.22E-05	1.48E-04	1.21E-04	0.00E+00	4.79E-05	1.59E-05	2.59E-06
Cs-136	6.51E-06	2.57E-05	1.85E-05	0.00E+00	1.43E-05	1.96E-06	2.92E-06
Cs-137	7.97E-05	1.09E-04	7.14E-05	0.00E+00	3.70E-05	1.23E-05	2.11E-06
Cs-138	5.52E-08	1.09E-07	5.40E-08	0.00E+00	8.01E-08	7.91E-09	4.65E-13
Ba-139	9.70E-08	6.91E-11	2.84E-09	0.00E+00	6.46E-11	3.92E-11	1.72E-07
Ba-140	2.03E-05	2.55E-08	1.33E-06	0.00E+00	8.67E-09	1.46E-08	4.18E-05
Ba-141	4.71E-08	3.56E-11	1.59E-09	0.00E+00	3.31E-11	2.02E-11	2.22E-17
Ba-142	2.13E-08	2.19E-11	1.34E-09	0.00E+00	1.85E-11	1.24E-11	3.00E-26
La-140	2.50E-09	1.26E-09	3.33E-10	0.00E+00	0.00E+00	0.00E+00	9.25E-05
La-142	1.28E-10	5.82E-11	1.45E-11	0.00E+00	0.00E+00	0.00E+00	4.25E-07
Ce-141	9.36E-09	6.33E-09	7.18E-10	0.00E+00	2.94E-09	0.00E+00	2.42E-05
Ce-143	1.65E-09	1.22E-06	1.35E-10	0.00E+00	5.37E-10	0.00E+00	4.56E-05
Ce-144	4.88E-07	2.04E-07	2.62E-08	0.00E+00	1.21E-07	0.00E+00	1.65E-04
Pr-143	9.20E-09	3.69E-09	4.56E-10	0.00E+00	2.13E-09	0.00E+00	4.03E-05
Pr-144	3.01E-11	1.25E-11	1.53E-12	0.00E+00	7.05E-12	0.00E+00	4.33E-18
Nd-147	6.29E-09	7.27E-09	4.35E-10	0.00E+00	4.25E-09	0.00E+00	3.49E-05
W-187	1.03E-07	8.61E-08	3.01E-08	0.00E+00	0.00E+00	0.00E+00	2.82E-05
Np-239	1.19E-09	1.17E-10	6.45E-11	0.00E+00	3.65E-10	0.00E+00	2.40E-05
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-57	0.00E+00	1.75E-07	2.91E-07	0.00E+00	0.00E+00	0.00E+00	4.44E-06
Sr-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-97	5.22E-11	1.32E-11	4.82E-12	0.00E+00	1.54E-11	0.00E+00	4.87E-08
Cd-109	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-113	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba-133	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-134	3.24E-08	2.12E-08	1.30E-08	2.83E-08	2.05E-07	0.00E+00	3.59E-11
Ce-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg-203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 3-3b

TEEN INGESTION DOSE FACTORS

(mrem per pCi ingested)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07
Be-7	3.96E-09	8.87E-09	4.43E-09	0.00E+00	9.40E-09	0.00E+00	1.08E-06
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	0.00E+00	0.00E+00	0.00E+00	2.32E-05
Cr-51	0.00E+00	0.00E+00	3.60E-09	2.00E-09	7.89E-10	5.14E-09	6.05E-07
Mn-54	0.00E+00	5.90E-06	1.17E-06	0.00E+00	1.76E-06	0.00E+00	1.21E-05
Mn-56	0.00E+00	1.58E-07	2.81E-08	0.00E+00	2.00E-07	0.00E+00	1.04E-05
Fe-55	3.78E-06	2.68E-06	6.25E-07	0.00E+00	0.00E+00	1.70E-06	1.16E-06
Fe-59	5.87E-06	1.37E-05	5.29E-06	0.00E+00	0.00E+00	4.32E-06	3.24E-05
Co-58	0.00E+00	9.72E-07	2.24E-06	0.00E+00	0.00E+00	0.00E+00	1.34E-05
Co-60	0.00E+00	2.81E-06	6.33E-06	0.00E+00	0.00E+00	0.00E+00	3.66E-05
Ni-63	1.77E-04	1.25E-05	6.00E-06	0.00E+00	0.00E+00	0.00E+00	1.99E-06
Ni-65	7.49E-07	9.57E-08	4.36E-08	0.00E+00	0.00E+00	0.00E+00	5.19E-06
Cu-64	0.00E+00	1.15E-07	5.41E-08	0.00E+00	2.91E-07	0.00E+00	8.92E-06
Zn-65	5.76E-06	2.00E-05	9.33E-06	0.00E+00	1.28E-05	0.00E+00	8.47E-06
Zn-69	1.47E-08	2.80E-08	1.96E-09	0.00E+00	1.83E-08	0.00E+00	5.16E-08
Br-83	0.00E+00	0.00E+00	5.74E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	7.22E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	3.05E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	2.98E-05	1.40E-05	0.00E+00	0.00E+00	0.00E+00	4.41E-06
Rb-88	0.00E+00	8.52E-08	4.54E-08	0.00E+00	0.00E+00	0.00E+00	7.30E-15
Rb-89	0.00E+00	5.50E-08	3.89E-08	0.00E+00	0.00E+00	0.00E+00	8.43E-17
Sr-89	4.40E-04	0.00E+00	1.26E-05	0.00E+00	0.00E+00	0.00E+00	5.24E-05
Sr-90	8.30E-03	0.00E+00	2.05E-03	0.00E+00	0.00E+00	0.00E+00	2.33E-04
Sr-91	8.07E-06	0.00E+00	3.21E-07	0.00E+00	0.00E+00	0.00E+00	3.66E-05
Sr-92	3.05E-06	0.00E+00	1.30E-07	0.00E+00	0.00E+00	0.00E+00	7.77E-05
Y-90	1.37E-08	0.00E+00	3.69E-10	0.00E+00	0.00E+00	0.00E+00	1.13E-04
Y-91m	1.29E-10	0.00E+00	4.93E-12	0.00E+00	0.00E+00	0.00E+00	6.09E-09
Y-91	2.01E-07	0.00E+00	5.39E-09	0.00E+00	0.00E+00	0.00E+00	8.24E-05
Y-92	1.21E-09	0.00E+00	3.50E-11	0.00E+00	0.00E+00	0.00E+00	3.32E-05
Y-93	3.83E-09	0.00E+00	1.05E-10	0.00E+00	0.00E+00	0.00E+00	1.17E-04
Zr-95	4.12E-08	1.30E-08	8.94E-09	0.00E+00	1.91E-08	0.00E+00	3.00E-05
Zr-97	2.37E-09	4.69E-10	2.16E-10	0.00E+00	7.11E-10	0.00E+00	1.27E-04
Nb-95	8.22E-09	4.56E-09	2.51E-09	0.00E+00	4.42E-09	0.00E+00	1.95E-05
Mo-99	0.00E+00	6.03E-06	1.15E-06	0.00E+00	1.38E-05	0.00E+00	1.08E-05
Tc-99m	3.32E-10	9.26E-10	1.20E-08	0.00E+00	1.38E-08	5.14E-10	6.08E-07
Tc-101	3.60E-10	5.12E-10	5.03E-09	0.00E+00	9.26E-09	3.12E-10	8.75E-17
Ru-103	2.55E-07	0.00E+00	1.09E-07	0.00E+00	8.99E-07	0.00E+00	2.13E-05
Ru-105	2.18E-08	0.00E+00	8.46E-09	0.00E+00	2.75E-07	0.00E+00	1.76E-05
Ru-106	3.92E-06	0.00E+00	4.94E-07	0.00E+00	7.56E-06	0.00E+00	1.88E-04
Ag-110m	2.05E-07	1.94E-07	1.18E-07	0.00E+00	3.70E-07	0.00E+00	5.45E-05
Sb-122	3.30E-07	6.42E-09	9.64E-08	4.19E-09	0.00E+00	2.06E-07	6.92E-05
Sb-124	3.86E-06	7.12E-08	1.51E-06	8.79E-09	0.00E+00	3.37E-06	7.81E-05
Sb-125	2.48E-06	2.71E-08	5.79E-07	2.36E-09	0.00E+00	2.16E-06	1.92E-05

Table 3-3b

TEEN INGESTION DOSE FACTORS

(mrem per pCi ingested)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
Te-125m	3.83E-06	1.38E-06	5.12E-07	1.07E-06	0.00E+00	0.00E+00	1.13E-05
Te-127m	9.67E-06	3.43E-06	1.15E-06	2.30E-06	3.92E-05	0.00E+00	2.41E-05
Te-127	1.58E-07	5.60E-08	3.40E-08	1.09E-07	6.40E-07	0.00E+00	1.22E-05
Te-129m	1.63E-05	6.05E-06	2.58E-06	5.26E-06	6.82E-05	0.00E+00	6.12E-05
Te-129	4.48E-08	1.67E-08	1.09E-08	3.20E-08	1.88E-07	0.00E+00	2.45E-07
Te-131m	2.44E-06	1.17E-06	9.76E-07	1.76E-06	1.22E-05	0.00E+00	9.39E-05
Te-131	2.79E-08	1.15E-08	8.72E-09	2.15E-08	1.22E-07	0.00E+00	2.29E-09
Te-132	3.49E-06	2.21E-06	2.08E-06	2.33E-06	2.12E-05	0.00E+00	7.00E-05
I-130	1.03E-06	2.98E-06	1.19E-06	2.43E-04	4.59E-06	0.00E+00	2.29E-06
I-131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	0.00E+00	1.62E-06
I-132	2.79E-07	7.30E-07	2.62E-07	2.46E-05	1.15E-06	0.00E+00	3.18E-07
I-133	2.01E-06	3.41E-06	1.04E-06	4.76E-04	5.98E-06	0.00E+00	2.58E-06
I-134	1.46E-07	3.87E-07	1.39E-07	6.45E-06	6.10E-07	0.00E+00	5.10E-09
I-135	6.10E-07	1.57E-06	5.82E-07	1.01E-04	2.48E-06	0.00E+00	1.74E-06
Cs-134	8.37E-05	1.97E-04	9.14E-05	0.00E+00	6.26E-05	2.39E-05	2.45E-06
Cs-136	8.59E-06	3.38E-05	2.27E-05	0.00E+00	1.84E-05	2.90E-06	2.72E-06
Cs-137	1.12E-04	1.49E-04	5.19E-05	0.00E+00	5.07E-05	1.97E-05	2.12E-06
Cs-138	7.76E-08	1.49E-07	7.45E-08	0.00E+00	1.10E-07	1.28E-08	6.76E-11
Ba-139	1.39E-07	9.78E-11	4.05E-09	0.00E+00	9.22E-11	6.74E-11	1.24E-06
Ba-140	2.84E-05	3.48E-08	1.83E-06	0.00E+00	1.18E-08	2.34E-08	4.38E-05
Ba-141	6.71E-08	5.01E-11	2.24E-09	0.00E+00	4.65E-11	3.43E-11	1.43E-13
Ba-142	2.99E-08	2.99E-11	1.84E-09	0.00E+00	2.53E-11	1.99E-11	9.18E-20
La-140	3.48E-09	1.71E-09	4.55E-10	0.00E+00	0.00E+00	0.00E+00	9.82E-05
La-142	1.79E-10	7.95E-11	1.98E-11	0.00E+00	0.00E+00	0.00E+00	2.42E-06
Ce-141	1.33E-08	8.88E-09	1.02E-09	0.00E+00	4.18E-09	0.00E+00	2.54E-05
Ce-143	2.35E-09	1.71E-06	1.91E-10	0.00E+00	7.67E-10	0.00E+00	5.14E-05
Ce-144	6.96E-07	2.88E-07	3.74E-08	0.00E+00	1.72E-07	0.00E+00	1.75E-04
Pr-143	1.31E-08	5.23E-09	6.52E-10	0.00E+00	3.04E-09	0.00E+00	4.31E-05
Pr-144	4.30E-11	1.76E-11	2.18E-12	0.00E+00	1.01E-11	0.00E+00	4.74E-14
Nd-147	9.38E-09	1.02E-08	6.11E-10	0.00E+00	5.99E-09	0.00E+00	3.68E-05
W-187	1.46E-07	1.19E-07	4.17E-08	0.00E+00	0.00E+00	0.00E+00	3.22E-05
Np-239	1.76E-09	1.66E-10	9.22E-11	0.00E+00	5.21E-10	0.00E+00	2.67E-05
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-57	0.00E+00	2.38E-07	3.99E-07	0.00E+00	0.00E+00	0.00E+00	4.44E-06
Sr-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-97	7.37E-11	1.83E-11	6.68E-12	0.00E+00	2.14E-11	0.00E+00	4.37E-07
Cd-109	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-113	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba-133	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-134	4.47E-08	2.87E-08	3.00E-08	3.67E-08	2.74E-07	0.00E+00	1.66E-09
Ce-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg-203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 3-3c

CHILD INGESTION DOSE FACTORS

(mrem per pCi ingested)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07
Be-7	1.18E-08	2.00E-08	1.32E-08	0.00E+00	1.97E-08	0.00E+00	1.12E-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	0.00E+00	0.00E+00	0.00E+00	2.28E-05
Cr-51	0.00E+00	0.00E+00	8.90E-09	4.94E-09	1.35E-09	9.02E-09	4.72E-07
Mn-54	0.00E+00	1.07E-05	2.85E-06	0.00E+00	3.00E-06	0.00E+00	8.98E-06
Mn-56	0.00E+00	3.34E-07	7.54E-08	0.00E+00	4.04E-07	0.00E+00	4.84E-05
Fe-55	1.15E-05	6.10E-06	1.89E-06	0.00E+00	0.00E+00	3.45E-06	1.13E-06
Fe-59	1.65E-05	2.67E-05	1.33E-05	0.00E+00	0.00E+00	7.74E-06	2.78E-05
Co-58	0.00E+00	1.80E-06	5.51E-06	0.00E+00	0.00E+00	0.00E+00	1.05E-05
Co-60	0.00E+00	5.29E-06	1.56E-05	0.00E+00	0.00E+00	0.00E+00	2.93E-05
Ni-63	5.38E-04	2.88E-05	1.83E-05	0.00E+00	0.00E+00	0.00E+00	1.94E-06
Ni-65	2.22E-06	2.09E-07	1.22E-07	0.00E+00	0.00E+00	0.00E+00	2.56E-05
Cu-64	0.00E+00	2.45E-07	1.48E-07	0.00E+00	5.92E-07	0.00E+00	1.15E-05
Zn-65	1.37E-05	3.65E-05	2.27E-05	0.00E+00	2.30E-05	0.00E+00	6.41E-06
Zn-69	4.38E-08	6.33E-08	5.85E-09	0.00E+00	3.84E-08	0.00E+00	3.99E-06
Br-83	0.00E+00	0.00E+00	1.71E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	1.98E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	9.12E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	6.70E-05	4.12E-05	0.00E+00	0.00E+00	0.00E+00	4.31E-06
Rb-88	0.00E+00	1.90E-07	1.32E-07	0.00E+00	0.00E+00	0.00E+00	9.32E-09
Rb-89	0.00E+00	1.17E-07	1.04E-07	0.00E+00	0.00E+00	0.00E+00	1.02E-09
Sr-89	1.32E-03	0.00E+00	3.77E-05	0.00E+00	0.00E+00	0.00E+00	5.11E-05
Sr-90	1.70E-02	0.00E+00	4.31E-03	0.00E+00	0.00E+00	0.00E+00	2.29E-04
Sr-91	2.40E-05	0.00E+00	9.06E-07	0.00E+00	0.00E+00	0.00E+00	5.30E-05
Sr-92	9.03E-06	0.00E+00	3.62E-07	0.00E+00	0.00E+00	0.00E+00	1.71E-04
Y-90	4.11E-08	0.00E+00	1.10E-09	0.00E+00	0.00E+00	0.00E+00	1.17E-04
Y-91m	3.82E-10	0.00E+00	1.39E-11	0.00E+00	0.00E+00	0.00E+00	7.48E-07
Y-91	6.02E-07	0.00E+00	1.61E-08	0.00E+00	0.00E+00	0.00E+00	8.02E-05
Y-92	3.60E-09	0.00E+00	1.03E-10	0.00E+00	0.00E+00	0.00E+00	1.04E-04
Y-93	1.14E-08	0.00E+00	3.13E-10	0.00E+00	0.00E+00	0.00E+00	1.70E-04
Zr-95	1.16E-07	2.55E-08	2.27E-08	0.00E+00	3.65E-08	0.00E+00	2.66E-05
Zr-97	6.99E-09	1.01E-09	5.96E-10	0.00E+00	1.45E-09	0.00E+00	1.53E-04
Nb-95	2.25E-08	8.76E-09	6.26E-09	0.00E+00	8.23E-09	0.00E+00	1.62E-05
Mo-99	0.00E+00	1.33E-05	3.29E-06	0.00E+00	2.84E-05	0.00E+00	1.10E-05
Tc-99m	9.23E-10	1.81E-09	3.00E-08	0.00E+00	2.63E-08	9.19E-10	1.03E-06
Tc-101	1.07E-09	1.12E-09	1.42E-08	0.00E+00	1.91E-08	5.92E-10	3.56E-09
Ru-103	7.31E-07	0.00E+00	2.81E-07	0.00E+00	1.84E-06	0.00E+00	1.89E-05
Ru-105	6.45E-08	0.00E+00	2.34E-08	0.00E+00	5.67E-07	0.00E+00	4.21E-05
Ru-106	1.17E-05	0.00E+00	1.46E-06	0.00E+00	1.58E-05	0.00E+00	1.82E-04
Ag-110m	5.39E-07	3.64E-07	2.91E-07	0.00E+00	6.78E-07	0.00E+00	4.33E-05
Sb-122	9.83E-07	1.45E-08	2.88E-07	1.26E-08	0.00E+00	4.00E-07	7.56E-05
Sb-124	1.11E-05	1.44E-07	3.88E-06	2.44E-08	0.00E+00	6.15E-06	6.93E-05
Sb-125	7.15E-06	5.51E-08	1.50E-06	6.63E-09	0.00E+00	3.98E-06	1.71E-05

Table 3-3c

CHILD INGESTION DOSE FACTORS

(mrem per pCi ingested)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
Te-125m	1.14E-05	3.09E-06	1.52E-06	3.20E-06	0.00E+00	0.00E+00	1.10E-05
Te-127m	2.89E-05	7.78E-06	3.43E-06	6.91E-06	8.24E-05	0.00E+00	2.34E-05
Te-127	4.71E-07	1.27E-07	1.01E-07	3.26E-07	1.34E-06	0.00E+00	1.84E-05
Te-129m	4.87E-05	1.36E-05	7.56E-06	1.57E-05	1.43E-04	0.00E+00	5.94E-05
Te-129	1.34E-07	3.74E-08	3.18E-08	9.56E-08	3.92E-07	0.00E+00	8.34E-06
Te-131m	7.20E-06	2.49E-06	2.65E-06	5.12E-06	2.41E-05	0.00E+00	1.01E-04
Te-131	8.30E-08	2.53E-08	2.47E-08	6.35E-08	2.51E-07	0.00E+00	4.36E-07
Te-132	1.01E-05	4.47E-06	5.40E-06	6.51E-06	4.15E-05	0.00E+00	4.50E-05
I-130	2.92E-06	5.90E-06	3.04E-06	6.50E-04	8.82E-06	0.00E+00	2.76E-06
I-131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	0.00E+00	1.54E-06
I-132	8.00E-07	1.47E-06	6.76E-07	6.82E-05	2.25E-06	0.00E+00	1.73E-06
I-133	5.92E-06	7.32E-06	2.77E-06	1.36E-03	1.22E-05	0.00E+00	2.95E-06
I-134	4.19E-07	7.78E-07	3.58E-07	1.79E-05	1.19E-06	0.00E+00	5.16E-07
I-135	1.75E-06	3.15E-06	1.49E-06	2.79E-04	4.83E-06	0.00E+00	2.40E-06
Cs-134	2.34E-04	3.84E-04	8.10E-05	0.00E+00	1.19E-04	4.27E-05	2.07E-06
Cs-136	2.35E-05	6.46E-05	4.18E-05	0.00E+00	3.44E-05	5.13E-06	2.27E-06
Cs-137	3.27E-04	3.13E-04	4.62E-05	0.00E+00	1.02E-04	3.67E-05	1.96E-06
Cs-138	2.28E-07	3.17E-07	2.01E-07	0.00E+00	2.23E-07	2.40E-08	1.46E-07
Ba-139	4.14E-07	2.21E-10	1.20E-08	0.00E+00	1.93E-10	1.30E-10	2.39E-05
Ba-140	8.31E-05	7.28E-08	4.85E-06	0.00E+00	2.37E-08	4.34E-08	4.21E-05
Ba-141	2.00E-07	1.12E-10	6.51E-09	0.00E+00	9.69E-11	6.58E-10	1.14E-07
Ba-142	8.74E-08	6.29E-11	4.88E-09	0.00E+00	5.09E-11	3.70E-11	1.14E-09
La-140	1.01E-08	3.53E-09	1.19E-09	0.00E+00	0.00E+00	0.00E+00	9.84E-05
La-142	5.24E-10	1.67E-10	5.23E-11	0.00E+00	0.00E+00	0.00E+00	3.31E-05
Ce-141	3.97E-08	1.98E-08	2.94E-09	0.00E+00	8.68E-09	0.00E+00	2.47E-05
Ce-143	6.99E-09	3.79E-06	5.49E-10	0.00E+00	1.59E-09	0.00E+00	5.55E-05
Ce-144	2.08E-06	6.52E-07	1.11E-07	0.00E+00	3.61E-07	0.00E+00	1.70E-04
Pr-143	3.93E-08	1.18E-08	1.95E-09	0.00E+00	6.39E-09	0.00E+00	4.24E-05
Pr-144	1.29E-10	3.99E-11	6.49E-12	0.00E+00	2.11E-11	0.00E+00	8.59E-08
Nd-147	2.79E-08	2.26E-08	1.75E-09	0.00E+00	1.24E-08	0.00E+00	3.58E-05
W-187	4.29E-07	2.54E-07	1.14E-07	0.00E+00	0.00E+00	0.00E+00	3.57E-05
Np-239	5.25E-09	3.77E-10	2.65E-10	0.00E+00	1.09E-09	0.00E+00	2.79E-05
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-57	0.00E+00	4.93E-07	9.98E-07	0.00E+00	0.00E+00	0.00E+00	4.04E-06
Sr-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-97	2.17E-10	3.92E-11	1.83E-11	0.00E+00	4.35E-11	0.00E+00	1.21E-05
Cd-109	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-113	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba-133	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-134	1.29E-07	5.80E-08	7.74E-08	1.02E-07	5.37E-07	0.00E+00	5.89E-07
Ce-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg-203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 3-3d

INFANT INGESTION DOSE FACTORS

(mrem per pCi ingested)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07
Be-7	2.26E-08	4.72E-08	2.51E-08	0.00E+00	3.34E-08	0.00E+00	1.11E-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	0.00E+00	0.00E+00	0.00E+00	2.30E-05
Cr-51	0.00E+00	0.00E+00	1.41E-08	9.20E-09	2.01E-09	1.79E-08	4.11E-07
Mn-54	0.00E+00	1.99E-05	4,51E-06	0.00E+00	4.41E-06	0.00E+00	7.31E-06
Mn-56	0.00E+00	8.18E-07	1.41E-07	0.00E+00	7.03E-07	0.00E+00	7.43E-05
Fe-55	1.39E-05	8.98E-06	2.40E-06	0.00E+00	0.00E+00	4.39E-06	1.14E-06
Fe-59	3.08E-05	5.38E-05	2.12E-05	0.00E+00	0.00E+00	1.59E-05	2.57E-05
Co-58	0.00E+00	3.60E-06	8.98E-06	0.00E+00	0.00E+00	0.00E+00	8.97E-06
Co-60	0.00E+00	1.08E-05	2.55E-05	0.00E+00	0.00E+00	0.00E+00	2.57E-05
Ni-63	6.34E-04	3.92E-05	2.20E-05	0.00E+00	0.00E+00	0.00E+00	1.95E-06
Ni-65	4.70E-06	5.32E-07	2.42E-07	0.00E+00	0.00E+00	0.00E+00	4.05E-05
Cu-64	0.00E+00	6.09E-07	2.82E-07	0.00E+00	1.03E-06	0.00E+00	1.25E-05
Zn-65	1.84E-05	6.31E-05	2.91E-05	0.00E+00	3.06E-05	0.00E+00	5.33E-05
Zn-69	9.33E-08	1.68E-07	1.25E-08	0.00E+00	6.98E-08	0.00E+00	1.37E-05
Br-83	0.00E+00	0.00E+00	3.63E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	3.82E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	1.94E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.70E-04	8.40E-05	0.00E+00	0.00E+00	0.00E+00	4.35E-06
Rb-88	0.00E+00	4.98E-07	2.73E-07	0.00E+00	0.00E+00	0.00E+00	4.85E-07
Rb-89	0.00E+00	2.86E-07	1.97E-07	0.00E+00	0.00E+00	0.00E+00	9.74E-08
Sr-89	2.51E-03	0.00E+00	7.20E-05	0.00E+00	0.00E+00	0.00E+00	5.16E-05
Sr-90	1.85E-02	0.00E+00	4.71E-03	0.00E+00	0.00E+00	0.00E+00	2.31E-04
Sr-91	5.00E-05	0.00E+00	1.81E-06	0.00E+00	0.00E+00	0.00E+00	5.92E-05
Sr-92	1.92E-05	0.00E+00	7.13E-07	0.00E+00	0.00E+00	0.00E+00	2.07E-04
Y-90	8.69E-08	0.00E+00	2.33E-09	0.00E+00	0.00E+00	0.00E+00	1.20E-04
Y-91m	8.10E-10	0.00E+00	2.76E-11	0.00E+00	0.00E+00	0.00E+00	2.70E-06
Y-91	1.13E-06	0.00E+00	3.01E-08	0.00E+00	0.00E+00	0.00E+00	8.10E-05
Y-92	7.65E-09	0.00E+00	2.15E-10	0.00E+00	0.00E+00	0.00E+00	1.46E-04
Y-93	2.43E-08	0.00E+00	6.62E-10	0.00E+00	0.00E+00	0.00E+00	1.92E-04
Zr-95	2.06E-07	5.02E-08	3.56E-08	0.00E+00	5.41E-08	0.00E+00	2.50E-05
Zr-97	1.48E-08	2.54E-09	1.16E-09	0.00E+00	2.56E-09	0.00E+00	1.62E-04
Nb-95	4.20E-08	1.73E-08	1.00E-08	0.00E+00	1.24E-08	0.00E+00	1.46E-05
Mo-99	0.00E+00	3.40E-05	6.63E-06	0.00E+00	5.08E-05	0.00E+00	1.12E-05
Tc-99m	1.92E-09	3.96E-09	5.10E-08	0.00E+00	4.26E-08	2.07E-09	1.15E-06
Tc-101	2.27E-09	2.86E-09	2.83E-08	0.00E+00	3.40E-08	1.56E-09	4.86E-07
Ru-103	1.48E-06	0.00E+00	4.95E-07	0.00E+00	3.08E-06	0.00E+00	1.80E-05
Ru-105	1.36E-07	0.00E+00	4.58E-08	0.00E+00	1.00E-06	0.00E+00	5.41E-05
Ru-106	2.41E-05	0.00E+00	3.01E-06	0.00E+00	2.85E-05	0.00E+00	1.83E-04
Ag-110m	9.96E-07	7.27E-07	4.81E-07	0.00E+00	1.04E-06	0.00E+00	3.77E-05
Sb-122	2.10E-06	3.85E-08	6.13E-07	3.14E-08	0.00E+00	1.09E-06	7.65E-05
Sb-124	2.14E-05	3.15E-07	6.63E-06	5.68E-08	0.00E+00	1.34E-05	6.60E-05
Sb-125	1.23E-05	1.19E-07	2.53E-06	1.54E-08	0.00E+00	7.72E-06	1.64E-05

Table 3-3d

INFANT INGESTION DOSE FACTORS

(mrem per pCi ingested)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
Te-125m	2.33E-05	7.79E-06	3.15E-06	7.84E-06	0.00E+00	0.00E+00	1.11E-05
Te-127m	5.85E-05	1.94E-05	7.08E-06	1.69E-05	1.44E-04	0.00E+00	2.36E-05
Te-127	1.00E-06	3.35E-07	2.15E-07	8.14E-07	2.44E-06	0.00E+00	2.10E-05
Te-129m	1.00E-04	3.43E-05	1.54E-05	3.84E-05	2.50E-04	0.00E+00	5.97E-05
Te-129	2.84E-07	9.79E-08	6.63E-08	2.38E-07	7.07E-07	0.00E+00	2.27E-05
Te-131m	1.52E-05	6.12E-06	5.05E-06	1.24E-05	4.21E-05	0.00E+00	1.03E-04
Te-131	1.76E-07	6.50E-08	4.94E-08	1.57E-07	4.50E-07	0.00E+00	7.11E-06
Te-132	2.08E-05	1.03E-05	9.61E-06	1.52E-05	6.44E-05	0.00E+00	3.81E-05
I-130	6.00E-06	1.32E-05	5.30E-06	1.48E-03	1.45E-05	0.00E+00	2.83E-06
I-131	3.59E-05	4.23E-05	1.86E-05	1.39E-02	4.94E-05	0.00E+00	1.51E-06
I-132	1.66E-06	3.37E-06	1.20E-06	1.58E-04	3.76E-06	0.00E+00	2.73E-06
I-133	1.25E-05	1.82E-05	5.33E-06	3.31E-03	2.14E-05	0.00E+00	3.08E-06
I-134	8.69E-07	1.78E-06	6.33E-07	4.15E-05	1.99E-06	0.00E+00	1.84E-06
I-135	3.64E-06	7.24E-06	2.64E-06	6.49E-04	8.07E-06	0.00E+00	2.62E-06
Cs-134	3.77E-04	7.03E-04	7.10E-05	0.00E+00	1.81E-04	7.42E-05	1.91E-06
Cs-136	4.59E-05	1.35E-04	5.04E-05	0.00E+00	5.38E-05	1.10E-05	2.05E-06
Cs-137	5.22E-04	6.11E-04	4.33E-05	0.00E+00	1.64E-04	6.64E-05	1.91E-06
Cs-138	4.81E-07	7.82E-07	3.79E-07	0.00E+00	3.90E-07	6.09E-08	1.25E-06
Ba-139	8.81E-07	5.84E-10	2.55E-08	0.00E+00	3.51E-10	3.54E-10	5.58E-05
Ba-140	1.71E-04	1.71E-07	8.81E-06	0.00E+00	4.06E-08	1.05E-07	4.20E-05
Ba-141	4.25E-07	2.91E-10	1.34E-08	0.00E+00	1.75E-10	1.77E-10	5.19E-06
Ba-142	1.84E-07	1.53E-10	9.06E-09	0.00E+00	8.81E-11	9.26E-11	7.59E-07
La-140	2.11E-08	8.32E-09	2.14E-09	0.00E+00	0.00E+00	0.00E+00	9.77E-05
La-142	1.10E-09	4.04E-10	9.67E-11	0.00E+00	0.00E+00	0.00E+00	6.86E-05
Ce-141	7.87E-08	4.80E-08	5.65E-09	0.00E+00	1.48E-08	0.00E+00	2.48E-05
Ce-143	1.48E-08	9.82E-06	1.12E-09	0.00E+00	2.86E-09	0.00E+00	5.73E-05
Ce-144	2.98E-06	1.22E-06	1.67E-07	0.00E+00	4.93E-07	0.00E+00	1.71E-04
Pr-143	8.13E-08	3.04E-08	4.03E-09	0.00E+00	1.13E-08	0.00E+00	4.29E-05
Pr-144	2.74E-10	1.06E-10	1.38E-11	0.00E+00	3.84E-11	0.00E+00	4.93E-06
Nd-147	5.53E-08	5.68E-08	3.48E-09	0.00E+00	2.19E-08	0.00E+00	3.60E-05
W-187	9.03E-07	6.28E-07	2.17E-07	0.00E+00	0.00E+00	0.00E+00	3.69E-05
Np-239	1.11E-08	9.93E-10	5.61E-10	0.00E+00	1.98E-09	0.00E+00	2.87E-05
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-57	0.00E+00	1.15E-06	1.87E-06	0.00E+00	0.00E+00	0.00E+00	3.92E-06
Sr-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cd-109	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-113	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba-133	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ce-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg-203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 3 - 4

TOTAL BODY DOSE FACTORS

Ki

FROM NOBLE GASES (GAMMA)

NUCLIDE	Gamma TB*	X	(pCi/uCi)	X	FINITE CLOUD ** CORRECTION FACTOR	=	Ki***
Kr-83m	7.56E-08		1.00E+6		5.78E-01		4.37E-02
Kr-85m	1.17E-03		1.00E+6		4.46E-01		5.22E+02
Kr-85	1.61E-05		1.00E+6		3.85E-01		6.19E+00
Kr-87	5.92E-03		1.00E+6		3.09E-01		1.83E+03
Kr-88	1.47E-02		1.00E+6		2.88E-01		4.23E+03
Kr-89	1.66E-02		1.00E+6		3.03E-01		5.03E+03
Kr-90	1.56E-02		1.00E+6		3.29E-01		5.13E+03
Xe-131m	9.15E-05		1.00E+6		5.62E-01		5.14E+01
Xe-133m	2.51E-04		1.00E+6		5.12E-01		1.29E+02
Xe-133	2.94E-04		1.00E+6		5.78E-01		1.70E+02
Xe-135m	3.12E-03		1.00E+6		3.87E-01		1.21E+03
Xe-135	1.81E-03		1.00E+6		4.55E-01		8.24E+02
Xe-137	1.42E-03		1.00E+6		3.65E-01		5.18E+02
Xe-138	8.83E-03		1.00E+6		3.14E-01		2.77E+03
Ar-41	8.84E-03		1.00E+6		3.21E-01		2.84E+03

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* From Regulatory Guide 1.109, Table B-1 (mrem/yr per pCi/cu mtr)

** The finite cloud correction factor is described in Section 3.6.

*** Ki (mrem/yr per uCi/cu mtr)

Table 3 - 5

SKIN DOSE FACTORS

Li

FROM NOBLE GASES (BETA)

NUCLIDE	Beta Skin*	X	(pCi/uCi)	=	Li**
Kr-83m	0.00E+00		1.00E+6		0.00E+00
Kr-85m	1.46E-03		1.00E+6		1.46E+03
Kr-85	1.34E-03		1.00E+6		1.34E+03
Kr-87	9.73E-03		1.00E+6		9.73E+03
Kr-88	2.37E-03		1.00E+6		2.37E+03
Kr-89	1.01E-02		1.00E+6		1.01E+04
Kr-90	7.29E-03		1.00E+6		7.29E+03
Xe-131m	4.76E-04		1.00E+6		4.76E+02
Xe-133m	9.94E-04		1.00E+6		9.94E+02
Xe-133	3.06E-04		1.00E+6		3.06E+02
Xe-135m	7.11E-04		1.00E+6		7.11E+02
Xe-135	1.86E-03		1.00E+6		1.86E+03
Xe-137	1.22E-02		1.00E+6		1.22E+04
Xe-138	4.13E-03		1.00E+6		4.13E+03
Ar-41	2.69E-03		1.00E+6		2.69E+03

* From Regulatory Guide 1.109, Table B-1 (mrem/yr per pCi/cu mtr)

** Li (mrem/yr per uCi/cu mtr)

Table 3 - 6

AIR DOSE FACTORS

Mi

FROM NOBLE GASES (GAMMA)

NUCLIDE	Gamma*	X	(pCi/uCi)	X	FINITE CLOUD ** CORRECTION FACTOR	=	Mi***
Kr-83m	1.93E-05		1.00E+6		5.78E-01		1.12E+01
Kr-85m	1.23E-03		1.00E+6		4.46E-01		5.49E+02
Kr-85	1.72E-05		1.00E+6		3.85E-01		6.62E+00
Kr-87	6.17E-03		1.00E+6		3.09E-01		1.91E+03
Kr-88	1.52E-02		1.00E+6		2.88E-01		4.37E+03
Kr-89	1.73E-02		1.00E+6		3.03E-01		5.24E+03
Kr-90	1.63E-02		1.00E+6		3.29E-01		5.36E+03
Xe-131m	1.56E-04		1.00E+6		5.62E-01		8.77E+01
Xe-133m	3.27E-04		1.00E+6		5.12E-01		1.68E+02
Xe-133	3.53E-04		1.00E+6		5.78E-01		2.04E+02
Xe-135m	3.36E-03		1.00E+6		3.87E-01		1.30E+03
Xe-135	1.92E-03		1.00E+6		4.55E-01		8.74E+02
Xe-137	1.51E-03		1.00E+6		3.65E-01		5.51E+02
Xe-138	9.21E-03		1.00E+6		3.14E-01		2.89E+03
Ar-41	9.30E-03		1.00E+6		3.21E-01		2.99E+03

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* From Regulatory Guide 1.109, Table B-1 (mrad/yr per pCi/cu mtr)

** The finite cloud correction factor is described in Section 3.6.

*** Mi (mrad/yr per uCi/cu mtr)

Table 3 - 7

AIR DOSE FACTORS

Ni

FROM NOBLE GASES (BETA)

NUCLIDE	Beta*	X	(pCi/uCi)	=	Ni**
Kr-83m	2.88E-04		1.00E+6		2.88E+02
Kr-85m	1.97E-03		1.00E+6		1.97E+03
Kr-85	1.95E-03		1.00E+6		1.95E+03
Kr-87	1.03E-02		1.00E+6		1.03E+04
Kr-88	2.93E-03		1.00E+6		2.93E+03
Kr-89	1.06E-02		1.00E+6		1.06E+04
Kr-90	7.83E-03		1.00E+6		7.83E+03
Xe-131m	1.11E-03		1.00E+6		1.11E+03
Xe-133m	1.48E-03		1.00E+6		1.48E+03
Xe-133	1.05E-03		1.00E+6		1.05E+03
Xe-135m	7.39E-04		1.00E+6		7.39E+02
Xe-135	2.46E-03		1.00E+6		2.46E+03
Xe-137	1.27E-02		1.00E+6		1.27E+04
Xe-138	4.75E-03		1.00E+6		4.75E+03
Ar-41	3.28E-03		1.00E+6		3.28E+03

* From Regulatory Guide 1.109, Table B-1 (mrad/yr per pCi/cu mtr)

** Ni (mrad/yr per uCi/cu mtr)

TABLE 3 – 8

NOBLE GAS DOSE FACTORS

For Instantaneous and Time Average Mixtures at the Site Boundary

Radionuclide	Instantaneous Mix (%)	Time Average Mix (%)
Kr-85m	3.09	
Kr-85	0	18.98
Kr-87	2.80	
Kr-88	5.22	
Xe-131m	0	0.162
Xe-133m	1.39	0.485
Xe-133	56.8	78.1
Xe-135m	1.34	
Xe-135	19.2	2.21
Xe-138	2.81	
Ar-41	7.43	
Total	100	100

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Unit 2 effective instantaneous dose factors	Unit 3 effective instantaneous dose factors	units	Unit 2 effective average dose factors	Unit 3 effective average dose factors
$\overline{K}$ = 1507	$\overline{K}$ = 849	mrem/yr per uCi/m^3	$\overline{K}$ = 237	$\overline{K}$ = 153
$\overline{L}$ = 1310	$\overline{L}$ = 1310	mrem/yr per uCi/m^3	$\overline{L}$ = 540	$\overline{L}$ = 540
$\overline{M}$ = 1601	$\overline{M}$ = 905	mrad/yr per uCi/m^3	$\overline{M}$ = 281	$\overline{M}$ = 181
$\overline{N}$ = 1977	$\overline{N}$ = 1977	mrad/yr per uCi/m^3	$\overline{N}$ = 1254	$\overline{N}$ = 1254

Instantaneous Mixture Basis:

This mix defines the shared-site noble gas limits between the two units, and is used for administrative guidelines for instantaneous releases based on an RCS noble gas mix at 1.6 yrs into a 24-month cycle, with two failed fuel rods, per Reference 30. These mixtures provide conservative application for calculating setpoints per 10CFR20, in terms of uCi/sec before an actual sample of the release is available, per Appendix I.

Time Averaged Release Mixture Basis:

This mix defines the routine (time-averaged) releases from either unit. It was derived from average noble-gas releases from year 2000-2003 at IPEC units 2 and 3 per Reference 30. They are used in conjunction with calculations to determine representative quarterly and annual time averaged release rates in curies per second for administrative purposes only, per Appendix A.

TABLE 3 – 9

LOCATIONS OF SITE BOUNDARY AND NEAREST RESIDENCE

Sector by compass point	Distance to Site Boundary from Unit 2 Plant Vent, in meters	Distance to Site Boundary from Unit 3 Plant Vent, in meters	Distance to nearest resident, from Unit 1 superheater, in meters
N	RIVER	RIVER	1788.1
NNE	RIVER	RIVER	3111.3
NE	550	636	1907.3
ENE	600	775	1478.2
E	662	785	1370.9
ESE	569	622	715.2
SE	553	564	1168.2
SSE	569	551	1239.7
S	700	566	1132.5
SSW	755	480	1573.5
SW	544	350	3015.9
WSW	RIVER	RIVER	2169.6
W	RIVER	RIVER	1918.7
WNW	RIVER	RIVER	1752.4
NW	RIVER	RIVER	1692.7
NNW	RIVER	RIVER	1609.3

9/05

Distances are measured from the unit-specific Plant Vent to the Site Boundary. The distance to the Nearest Resident is measured from the Unit 1 Superheater Stack for both units 2 and 3, per Reference 31.

Table 3-10a

ADULT INHALATION Ri(I) (mrem/yr per uCi/m^3)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03
Be-7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na-24	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04	1.02E+04
P-32	1.32E+06	7.71E+04	5.01E+04	0.00E+00	0.00E+00	0.00E+00	8.64E+04
Cr-51	0.00E+00	0.00E+00	1.00E+02	5.95E+01	2.28E+01	1.44E+04	3.32E+03
Mn-54	0.00E+00	3.96E+04	6.30E+03	0.00E+00	9.84E+03	1.40E+06	7.74E+04
Mn-56	0.00E+00	1.24E+00	1.83E-01	0.00E+00	1.30E+00	9.44E+03	2.02E+04
Fe-55	2.46E+04	1.70E+04	3.94E+03	0.00E+00	0.00E+00	7.21E+04	6.03E+03
Fe-59	1.18E+04	2.78E+04	1.06E+04	0.00E+00	0.00E+00	1.02E+06	1.88E+05
Co-58	0.00E+00	1.58E+03	2.07E+03	0.00E+00	0.00E+00	9.28E+05	1.06E+05
Co-60	0.00E+00	1.15E+04	1.48E+04	0.00E+00	0.00E+00	5.97E+06	2.85E+05
Ni-63	4.32E+05	3.14E+04	1.45E+04	0.00E+00	0.00E+00	1.78E+05	1.34E+04
Ni-65	1.54E+00	2.10E-01	9.12E-02	0.00E+00	0.00E+00	5.60E+03	1.23E+04
Cu-64	0.00E+00	1.46E+00	6.15E-01	0.00E+00	4.62E+00	6.78E+03	4.90E+04
Zn-65	3.24E+04	1.03E+05	4.66E+04	0.00E+00	6.90E+04	8.64E+05	5.34E+04
Zn-69	3.38E-02	6.51E-02	4.52E-03	0.00E+00	4.22E-02	9.20E+02	1.63E+01
Br-83	0.00E+00	0.00E+00	2.41E+02	0.00E+00	0.00E+00	0.00E+00	2.32E+02
Br-84	0.00E+00	0.00E+00	3.13E+02	0.00E+00	0.00E+00	0.00E+00	1.64E-03
Br-85	0.00E+00	0.00E+00	1.28E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.35E+05	5.90E+04	0.00E+00	0.00E+00	0.00E+00	1.66E+04
Rb-88	0.00E+00	3.87E+02	1.93E+02	0.00E+00	0.00E+00	0.00E+00	3.34E-09
Rb-89	0.00E+00	2.56E+02	1.70E+02	0.00E+00	0.00E+00	0.00E+00	9.28E-12
Sr-89	3.04E+05	0.00E+00	8.72E+03	0.00E+00	0.00E+00	1.40E+06	3.50E+05
Sr-90	9.92E+07	0.00E+00	6.10E+06	0.00E+00	0.00E+00	9.60E+06	7.22E+05
Sr-91	6.19E+01	0.00E+00	2.50E+00	0.00E+00	0.00E+00	3.65E+04	1.91E+05
Sr-92	6.74E+00	0.00E+00	2.91E-01	0.00E+00	0.00E+00	1.65E+04	4.30E+04
Y-90	2.09E+03	0.00E+00	5.61E+01	0.00E+00	0.00E+00	1.70E+05	5.06E+05
Y-91m	2.61E-01	0.00E+00	1.02E-02	0.00E+00	0.00E+00	1.92E+03	1.33E+00
Y-91	4.62E+05	0.00E+00	1.24E+04	0.00E+00	0.00E+00	1.70E+06	3.85E+05
Y-92	1.03E+01	0.00E+00	3.02E-01	0.00E+00	0.00E+00	1.57E+04	7.35E+04
Y-93	9.44E+01	0.00E+00	2.61E+00	0.00E+00	0.00E+00	4.85E+04	4.22E+05
Zr-95	1.07E+05	3.44E+04	2.33E+04	0.00E+00	5.42E+04	1.77E+06	1.50E+05
Zr-97	9.68E+01	1.96E+01	9.04E+00	0.00E+00	2.97E+01	7.87E+04	5.23E+05
Nb-95	1.41E+04	7.82E+03	4.21E+03	0.00E+00	7.74E+03	5.05E+05	1.04E+05
Mo-99	0.00E+00	1.21E+02	2.30E+01	0.00E+00	2.91E+02	9.12E+04	2.48E+05
Tc-99m	1.03E-03	2.91E-03	3.70E-02	0.00E+00	4.42E-02	7.64E+02	4.16E+03
Tc-101	4.18E-05	6.02E-05	5.90E-04	0.00E+00	1.08E-03	3.99E+02	1.09E-11
Ru-103	1.53E+03	0.00E+00	6.58E+02	0.00E+00	5.83E+03	5.05E+05	1.10E+05
Ru-105	7.90E-01	0.00E+00	3.11E-01	0.00E+00	1.02E+00	1.10E+04	4.82E+04
Ru-106	6.91E+04	0.00E+00	8.72E+03	0.00E+00	1.34E+05	9.36E+06	9.12E+05
Ag-110m	1.08E+04	1.00E+04	5.94E+03	0.00E+00	1.97E+04	4.63E+06	3.02E+05
Sb-122	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-124	3.12E+04	5.89E+02	1.24E+04	7.55E+01	0.00E+00	2.48E+06	4.06E+05
Sb-125	5.34E+04	5.95E+02	1.26E+04	5.40E+01	0.00E+00	1.74E+06	1.01E+05

Table 3-10a

ADULT INHALATION $R_i(I)$ (mrem/yr per uCi/m^3)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
Te-125m	3.42E+03	1.58E+03	4.67E+02	1.05E+03	1.24E+04	3.14E+05	7.06E+04
Te-127m	1.26E+04	5.77E+03	1.57E+03	3.29E+03	4.58E+04	9.60E+05	1.50E+05
Te-127	1.40E+00	6.42E-01	3.10E-01	1.06E+00	5.10E+00	6.51E+03	5.74E+04
Te-129m	9.76E+03	4.67E+03	1.58E+03	3.44E+03	3.66E+04	1.16E+06	3.83E+05
Te-129	4.98E-02	2.39E-02	1.24E-02	3.90E-02	1.87E-01	1.94E+03	1.57E+02
Te-131m	6.99E+01	4.36E+01	2.90E+01	5.50E+01	3.09E+02	1.46E+05	5.56E+05
Te-131	1.11E-02	5.95E-03	3.59E-03	9.36E-03	4.37E-02	1.39E+03	1.84E+01
Te-132	2.60E+02	2.15E+02	1.62E+02	1.90E+02	1.46E+03	2.88E+05	5.10E+05
I-130	4.58E+03	1.34E+04	5.28E+03	1.14E+06	2.09E+04	0.00E+00	7.69E+03
I-131	2.52E+04	3.58E+04	2.05E+04	1.19E+07	6.13E+04	0.00E+00	6.28E+03
I-132	1.16E+03	3.26E+03	1.16E+03	1.14E+05	5.18E+03	0.00E+00	4.06E+02
I-133	8.64E+03	1.48E+04	4.52E+03	2.15E+06	2.58E+04	0.00E+00	8.88E+03
I-134	6.44E+02	1.73E+03	6.15E+02	2.98E+04	2.75E+03	0.00E+00	1.01E+00
I-135	2.68E+03	6.98E+03	2.57E+03	4.48E+05	1.11E+04	0.00E+00	5.25E+03
Cs-134	3.73E+05	8.48E+05	7.28E+05	0.00E+00	2.87E+05	9.76E+04	1.04E+04
Cs-136	3.90E+04	1.46E+05	1.10E+05	0.00E+00	8.56E+04	1.20E+04	1.17E+04
Cs-137	4.78E+05	6.21E+05	4.28E+05	0.00E+00	2.22E+05	7.52E+04	8.40E+03
Cs-138	3.31E+02	6.21E+02	3.24E+02	0.00E+00	4.80E+02	4.86E+01	1.86E-03
Ba-139	9.36E-01	6.66E-04	2.74E-02	0.00E+00	6.22E-04	3.76E+03	8.96E+02
Ba-140	3.90E+04	4.90E+01	2.57E+03	0.00E+00	1.67E+01	1.27E+06	2.18E+05
Ba-141	1.00E-01	7.53E-05	3.36E-03	0.00E+00	7.00E-05	1.94E+03	1.16E-07
Ba-142	2.63E-02	2.70E-05	1.66E-03	0.00E+00	2.29E-05	1.19E+03	1.57E-16
La-140	3.44E+02	1.74E+02	4.58E+01	0.00E+00	0.00E+00	1.36E+05	4.58E+05
La-142	6.83E-01	3.10E-01	7.72E-02	0.00E+00	0.00E+00	6.33E+03	2.11E+03
Ce-141	1.99E+04	1.35E+04	1.53E+03	0.00E+00	6.26E+03	3.62E+05	1.20E+05
Ce-143	1.86E+02	1.38E+02	1.53E+01	0.00E+00	6.08E+01	7.98E+04	2.26E+05
Ce-144	3.43E+06	1.43E+06	1.84E+05	0.00E+00	8.48E+05	7.78E+06	8.16E+05
Pr-143	9.36E+03	3.75E+03	4.64E+02	0.00E+00	2.16E+03	2.81E+05	2.00E+05
Pr-144	3.01E-02	1.25E-02	1.53E-03	0.00E+00	7.05E-03	1.02E+03	2.15E-08
Nd-147	5.27E+03	6.10E+03	3.65E+02	0.00E+00	3.56E+03	2.21E+05	1.73E+05
W-187	8.48E+00	7.08E+00	2.48E+00	0.00E+00	0.00E+00	2.90E+04	1.55E+05
Np-239	2.30E+02	2.26E+01	1.24E+01	0.00E+00	7.00E+01	3.76E+04	1.19E+05
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-57	0.00E+00	6.92E+02	6.71E+02	0.00E+00	0.00E+00	3.70E+05	3.14E+04
Sr-85	3.20E+04	0.00E+00	7.76E+05	0.00E+00	0.00E+00	4.80E+05	6.08E+04
Y-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-97	2.22E-01	5.62E-02	2.05E-02	0.00E+00	6.54E-02	2.40E+03	2.42E+02
Cd-109	0.00E+00	3.92E+05	1.28E+04	0.00E+00	3.76E+05	7.28E+05	6.56E+04
Sn-113	6.56E+04	2.16E+03	4.48E+03	1.36E+03	0.00E+00	9.60E+05	1.20E+04
Ba-133	7.60E+04	3.36E+03	2.00E+04	0.00E+00	1.68E+01	1.52E+06	8.00E+04
Te-134	3.07E-02	2.58E-02	1.26E-02	2.75E-02	1.74E-01	3.47E+03	2.38E-01
Ce-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg-203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 3-10b

TEEN INHALATION Ri(I) (mrem/yr per uCi/m^3)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03
Be-7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na-24	1.38E+04	1.38E+04	1.38E+04	1.38E+04	1.38E+04	1.38E+04	1.38E+04
P-32	1.89E+06	1.10E+05	7.16E+04	0.00E+00	0.00E+00	0.00E+00	9.28E+04
Cr-51	0.00E+00	0.00E+00	1.35E+02	7.50E+01	3.07E+01	2.10E+04	3.00E+03
Mn-54	0.00E+00	5.11E+04	8.40E+03	0.00E+00	1.27E+04	1.98E+06	6.68E+04
Mn-56	0.00E+00	1.70E+00	2.52E-01	0.00E+00	1.79E+00	1.52E+04	5.74E+04
Fe-55	3.34E+04	2.38E+04	5.54E+03	0.00E+00	0.00E+00	1.24E+05	6.39E+03
Fe-59	1.59E+04	3.70E+04	1.43E+04	0.00E+00	0.00E+00	1.53E+06	1.78E+05
Co-58	0.00E+00	2.07E+03	2.78E+03	0.00E+00	0.00E+00	1.34E+06	9.52E+04
Co-60	0.00E+00	1.51E+04	1.98E+04	0.00E+00	0.00E+00	8.72E+06	2.59E+05
Ni-63	5.80E+05	4.34E+04	1.98E+04	0.00E+00	0.00E+00	3.07E+05	1.42E+04
Ni-65	2.18E+00	2.93E-01	1.27E-01	0.00E+00	0.00E+00	9.36E+03	3.67E+04
Cu-64	0.00E+00	2.03E+00	8.48E-01	0.00E+00	6.41E+00	1.11E+04	6.14E+04
Zn-65	3.86E+04	1.34E+05	6.24E+04	0.00E+00	8.64E+04	1.24E+06	4.66E+04
Zn-69	4.83E-02	9.20E-02	6.46E-03	0.00E+00	6.02E-02	1.58E+03	2.85E+02
Br-83	0.00E+00	0.00E+00	3.44E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	4.33E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	1.83E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.90E+05	8.40E+04	0.00E+00	0.00E+00	0.00E+00	1.77E+04
Rb-88	0.00E+00	5.46E+02	2.72E+02	0.00E+00	0.00E+00	0.00E+00	2.92E-05
Rb-89	0.00E+00	3.52E+02	2.33E+02	0.00E+00	0.00E+00	0.00E+00	3.38E-07
Sr-89	4.34E+05	0.00E+00	1.25E+04	0.00E+00	0.00E+00	2.42E+06	3.71E+05
Sr-90	1.08E+08	0.00E+00	6.68E+06	0.00E+00	0.00E+00	1.65E+07	7.65E+05
Sr-91	8.80E+01	0.00E+00	3.51E+00	0.00E+00	0.00E+00	6.07E+04	2.59E+05
Sr-92	9.52E+00	0.00E+00	4.06E-01	0.00E+00	0.00E+00	2.74E+04	1.19E+05
Y-90	2.98E+03	0.00E+00	8.00E+01	0.00E+00	0.00E+00	2.93E+05	5.59E+05
Y-91m	3.70E-01	0.00E+00	1.42E-02	0.00E+00	0.00E+00	3.20E+03	3.02E+01
Y-91	6.61E+05	0.00E+00	1.77E+04	0.00E+00	0.00E+00	2.94E+06	4.09E+05
Y-92	1.47E+01	0.00E+00	4.29E-01	0.00E+00	0.00E+00	2.68E+04	1.65E+05
Y-93	1.35E+02	0.00E+00	3.72E+00	0.00E+00	0.00E+00	8.32E+04	5.79E+05
Zr-95	1.46E+05	4.58E+04	3.15E+04	0.00E+00	6.74E+04	2.69E+06	1.49E+05
Zr-97	1.38E+02	2.72E+01	1.26E+01	0.00E+00	4.12E+01	1.30E+05	6.30E+05
Nb-95	1.86E+04	1.03E+04	5.66E+03	0.00E+00	1.00E+04	7.51E+05	9.68E+04
Mo-99	0.00E+00	1.69E+02	3.22E+01	0.00E+00	4.11E+02	1.54E+05	2.69E+05
Tc-99m	1.38E-03	3.86E-03	4.99E-02	0.00E+00	5.76E-02	1.15E+03	6.13E+03
Tc-101	5.92E-05	8.40E-05	8.24E-04	0.00E+00	1.52E-03	6.67E+02	8.72E-07
Ru-103	2.10E+03	0.00E+00	8.96E+02	0.00E+00	7.43E+03	7.83E+05	1.09E+05
Ru-105	1.12E+00	0.00E+00	4.34E-01	0.00E+00	1.41E+00	1.82E+04	9.04E+04
Ru-106	9.84E+04	0.00E+00	1.24E+04	0.00E+00	1.90E+05	1.61E+07	9.60E+05
Ag-110m	1.38E+04	1.31E+04	7.99E+03	0.00E+00	2.50E+04	6.75E+06	2.73E+05
Sb-122	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-124	4.30E+04	7.94E+02	1.68E+04	9.76E+01	0.00E+00	3.85E+06	3.98E+05
Sb-125	7.38E+04	8.08E+02	1.72E+04	7.04E+01	0.00E+00	2.74E+06	9.92E+04

Table 3-10b

TEEN INHALATION Ri(I) (mrem/yr per uCi/m^3)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
Te-125m	4.88E+03	2.24E+03	6.67E+02	1.40E+03	0.00E+00	5.36E+05	7.50E+04
Te-127m	1.80E+04	8.16E+03	2.18E+03	4.38E+03	6.54E+04	1.66E+06	1.59E+05
Te-127	2.01E+00	9.12E-01	4.42E-01	1.42E+00	7.28E+00	1.12E+04	8.08E+04
Te-129m	1.39E+04	6.58E+03	2.25E+03	4.58E+03	5.19E+04	1.98E+06	4.05E+05
Te-129	7.10E-02	3.38E-02	1.76E-02	5.18E-02	2.66E-01	3.30E+03	1.62E+03
Te-131m	9.84E+01	6.01E+01	4.02E+01	7.25E+01	4.39E+02	2.38E+05	6.21E+05
Te-131	1.58E-02	8.32E-03	5.04E-03	1.24E-02	6.18E-02	2.34E+03	1.51E+01
Te-132	3.60E+02	2.90E+02	2.19E+02	2.46E+02	1.95E+03	4.49E+05	4.63E+05
I-130	6.24E+03	1.79E+04	7.17E+03	1.49E+06	2.75E+04	0.00E+00	9.12E+03
I-131	3.54E+04	4.91E+04	2.64E+04	1.46E+07	8.40E+04	0.00E+00	6.49E+03
I-132	1.59E+03	4.38E+03	1.58E+03	1.51E+05	6.92E+03	0.00E+00	1.27E+03
I-133	1.22E+04	2.05E+04	6.22E+03	2.92E+06	3.59E+04	0.00E+00	1.03E+04
I-134	8.88E+02	2.32E+03	8.40E+02	3.95E+04	3.66E+03	0.00E+00	2.04E+01
I-135	3.70E+03	9.44E+03	3.49E+03	6.21E+05	1.49E+04	0.00E+00	6.95E+03
Cs-134	5.02E+05	1.13E+06	5.49E+05	0.00E+00	3.75E+05	1.46E+05	9.76E+03
Cs-136	5.15E+04	1.94E+05	1.37E+05	0.00E+00	1.10E+05	1.78E+04	1.09E+04
Cs-137	6.70E+05	8.48E+05	3.11E+05	0.00E+00	3.04E+05	1.21E+05	8.48E+03
Cs-138	4.66E+02	8.56E+02	4.46E+02	0.00E+00	6.62E+02	7.87E+01	2.70E-01
Ba-139	1.34E+00	9.44E-04	3.90E-02	0.00E+00	8.88E-04	6.46E+03	6.45E+03
Ba-140	5.47E+04	6.70E+01	3.52E+03	0.00E+00	2.28E+01	2.03E+06	2.29E+05
Ba-141	1.42E-01	1.06E-04	4.74E-03	0.00E+00	9.84E-05	3.29E+03	7.46E-04
Ba-142	3.70E-02	3.70E-05	2.27E-03	0.00E+00	3.14E-05	1.91E+03	4.79E-10
La-140	4.79E+02	2.36E+02	6.26E+01	0.00E+00	0.00E+00	2.14E+05	4.87E+05
La-142	9.60E-01	4.25E-01	1.06E-01	0.00E+00	0.00E+00	1.02E+04	1.20E+04
Ce-141	2.84E+04	1.90E+04	2.17E+03	0.00E+00	8.88E+03	6.14E+05	1.26E+05
Ce-143	2.66E+02	1.94E+02	2.16E+01	0.00E+00	8.64E+01	1.30E+05	2.55E+05
Ce-144	4.89E+06	2.02E+06	2.62E+05	0.00E+00	1.21E+06	1.34E+07	8.64E+05
Pr-143	1.34E+04	5.31E+03	6.62E+02	0.00E+00	3.09E+03	4.83E+05	2.14E+05
Pr-144	4.30E-02	1.76E-02	2.18E-03	0.00E+00	1.01E-02	1.75E+03	2.35E-04
Nd-147	7.86E+03	8.56E+03	5.13E+02	0.00E+00	5.02E+03	3.72E+05	1.82E+05
W-187	1.20E+01	9.76E+00	3.43E+00	0.00E+00	0.00E+00	4.74E+04	1.77E+05
Np-239	3.38E+02	3.19E+01	1.77E+01	0.00E+00	1.00E+02	6.49E+04	1.32E+05
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-57	0.00E+00	9.44E+02	9.20E+02	0.00E+00	0.00E+00	5.86E+05	3.14E+04
Sr-85	4.00E+04	0.00E+00	1.04E+04	0.00E+00	0.00E+00	7.04E+05	5.52E+04
Y-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-97	3.14E-01	7.78E-02	2.84E-02	0.00E+00	9.12E-02	3.93E+03	2.17E+03
Cd-109	0.00E+00	8.00E+05	2.72E+04	0.00E+00	5.36E+05	1.28E+06	6.88E+04
Sn-113	1.20E+05	3.76E+03	7.76E+03	2.32E+03	0.00E+00	1.60E+06	1.20E+04
Ba-133	3.76E+05	6.40E+03	2.64E+04	0.00E+00	2.24E+01	2.32E+06	7.76E+04
Te-134	4.25E-02	3.48E-02	2.91E-02	3.57E-02	2.33E-01	5.40E+03	1.10E+01
Ce-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg-203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 3-10c

CHILD INHALATION Ri(I) (mrem/yr per uCi/m^3)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03
Be-7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na-24	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04
P-32	2.60E+06	1.14E+05	9.88E+04	0.00E+00	0.00E+00	0.00E+00	4.22E+04
Cr-51	0.00E+00	0.00E+00	1.54E+02	8.55E+01	2.43E+01	1.70E+04	1.08E+03
Mn-54	0.00E+00	4.29E+04	9.51E+03	0.00E+00	1.00E+04	1.58E+06	2.29E+04
Mn-56	0.00E+00	1.66E+00	3.12E-01	0.00E+00	1.67E+00	1.31E+04	1.23E+05
Fe-55	4.74E+04	2.52E+04	7.77E+03	0.00E+00	0.00E+00	1.11E+05	2.87E+03
Fe-59	2.07E+04	3.34E+04	1.67E+04	0.00E+00	0.00E+00	1.27E+06	7.07E+04
Co-58	0.00E+00	1.77E+03	3.16E+03	0.00E+00	0.00E+00	1.11E+06	3.44E+04
Co-60	0.00E+00	1.31E+04	2.26E+04	0.00E+00	0.00E+00	7.07E+06	9.62E+04
Ni-63	8.21E+05	4.63E+04	2.80E+04	0.00E+00	0.00E+00	2.75E+05	6.33E+03
Ni-65	2.99E+00	2.96E-01	1.64E-01	0.00E+00	0.00E+00	8.18E+03	8.40E+04
Cu-64	0.00E+00	1.99E+00	1.07E+00	0.00E+00	6.03E+00	9.58E+03	3.67E+04
Zn-65	4.26E+04	1.13E+05	7.03E+04	0.00E+00	7.14E+04	9.95E+05	1.63E+04
Zn-69	6.70E-02	9.66E-02	8.92E-03	0.00E+00	5.85E-02	1.42E+03	1.02E+04
Br-83	0.00E+00	0.00E+00	4.74E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	5.48E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	2.53E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.98E+05	1.14E+05	0.00E+00	0.00E+00	0.00E+00	7.99E+03
Rb-88	0.00E+00	5.62E+02	3.66E+02	0.00E+00	0.00E+00	0.00E+00	1.72E+01
Rb-89	0.00E+00	3.45E+02	2.90E+02	0.00E+00	0.00E+00	0.00E+00	1.89E+00
Sr-89	5.99E+05	0.00E+00	1.72E+04	0.00E+00	0.00E+00	2.16E+06	1.67E+05
Sr-90	1.01E+08	0.00E+00	6.44E+06	0.00E+00	0.00E+00	1.48E+07	3.43E+05
Sr-91	1.21E+02	0.00E+00	4.59E+00	0.00E+00	0.00E+00	5.33E+04	1.74E+05
Sr-92	1.31E+01	0.00E+00	5.25E-01	0.00E+00	0.00E+00	2.40E+04	2.42E+05
Y-90	4.11E+03	0.00E+00	1.11E+02	0.00E+00	0.00E+00	2.62E+05	2.68E+05
Y-91m	5.07E-01	0.00E+00	1.84E-02	0.00E+00	0.00E+00	2.81E+03	1.72E+03
Y-91	9.14E+05	0.00E+00	2.44E+04	0.00E+00	0.00E+00	2.63E+06	1.84E+05
Y-92	2.04E+01	0.00E+00	5.81E-01	0.00E+00	0.00E+00	2.39E+04	2.39E+05
Y-93	1.86E+02	0.00E+00	5.11E+00	0.00E+00	0.00E+00	7.44E+04	3.89E+05
Zr-95	1.90E+05	4.18E+04	3.70E+04	0.00E+00	5.96E+04	2.23E+06	6.11E+04
Zr-97	1.88E+02	2.72E+01	1.60E+01	0.00E+00	3.88E+01	1.13E+05	3.51E+05
Nb-95	2.35E+04	9.18E+03	6.55E+03	0.00E+00	8.62E+03	6.14E+05	3.70E+04
Mo-99	0.00E+00	1.72E+02	4.25E+01	0.00E+00	3.92E+02	1.35E+05	1.27E+05
Tc-99m	1.78E-03	3.48E-03	5.77E-02	0.00E+00	5.07E-02	9.51E+02	4.81E+03
Tc-101	8.10E-05	8.51E-05	1.08E-03	0.00E+00	1.45E-03	5.85E+02	1.63E+01
Ru-103	2.79E+03	0.00E+00	1.07E+03	0.00E+00	7.03E+03	6.62E+05	4.48E+04
Ru-105	1.53E+00	0.00E+00	5.55E-01	0.00E+00	1.34E+00	1.59E+04	9.95E+04
Ru-106	1.36E+05	0.00E+00	1.69E+04	0.00E+00	1.84E+05	1.43E+07	4.29E+05
Ag-110m	1.69E+04	1.14E+04	9.14E+03	0.00E+00	2.12E+04	5.48E+06	1.00E+05
Sb-122	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-124	5.74E+04	7.40E+02	2.00E+04	1.26E+02	0.00E+00	3.24E+06	1.64E+05
Sb-125	9.84E+04	7.59E+02	2.07E+04	9.10E+01	0.00E+00	2.32E+06	4.03E+04

Table 3-10c

CHILD INHALATION Ri(I) (mrem/yr per uCi/m^3)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
Te-125m	6.73E+03	2.33E+03	9.14E+02	1.92E+03	0.00E+00	4.77E+05	3.38E+04
Te-127m	2.49E+04	8.55E+03	3.02E+03	6.07E+03	6.36E+04	1.48E+06	7.14E+04
Te-127	2.77E+00	9.51E-01	6.10E-01	1.96E+00	7.07E+00	1.00E+04	5.62E+04
Te-129m	1.92E+04	6.85E+03	3.04E+03	6.33E+03	5.03E+04	1.76E+06	1.82E+05
Te-129	9.77E-02	3.50E-02	2.38E-02	7.14E-02	2.57E-01	2.93E+03	2.55E+04
Te-131m	1.34E+02	5.92E+01	5.07E+01	9.77E+01	4.00E+02	2.06E+05	3.08E+05
Te-131	2.17E-02	8.44E-03	6.59E-03	1.70E-02	5.88E-02	2.05E+03	1.33E+03
Te-132	4.81E+02	2.72E+02	2.63E+02	3.17E+02	1.77E+03	3.77E+05	1.38E+05
I-130	8.18E+03	1.64E+04	8.44E+03	1.85E+06	2.45E+04	0.00E+00	5.11E+03
I-131	4.81E+04	4.81E+04	2.73E+04	1.62E+07	7.88E+04	0.00E+00	2.84E+03
I-132	2.12E+03	4.07E+03	1.88E+03	1.94E+05	6.25E+03	0.00E+00	3.20E+03
I-133	1.66E+04	2.03E+04	7.70E+03	3.85E+06	3.38E+04	0.00E+00	5.48E+03
I-134	1.17E+03	2.16E+03	9.95E+02	5.07E+04	3.30E+03	0.00E+00	9.55E+02
I-135	4.92E+03	8.73E+03	4.14E+03	7.92E+05	1.34E+04	0.00E+00	4.44E+03
Cs-134	6.51E+05	1.01E+06	2.25E+05	0.00E+00	3.30E+05	1.21E+05	3.85E+03
Cs-136	6.51E+04	1.71E+05	1.16E+05	0.00E+00	9.55E+04	1.45E+04	4.18E+03
Cs-137	9.07E+05	8.25E+05	1.28E+05	0.00E+00	2.82E+05	1.04E+05	3.62E+03
Cs-138	6.33E+02	8.40E+02	5.55E+02	0.00E+00	6.22E+02	6.81E+01	2.70E+02
Ba-139	1.84E+00	9.84E-04	5.36E-02	0.00E+00	8.62E-04	5.77E+03	5.77E+04
Ba-140	7.40E+04	6.48E+01	4.33E+03	0.00E+00	2.11E+01	1.74E+06	1.02E+05
Ba-141	1.96E-01	1.09E-04	6.36E-03	0.00E+00	9.47E-05	2.92E+03	2.75E+02
Ba-142	4.99E-02	3.60E-05	2.79E-03	0.00E+00	2.91E-05	1.64E+03	2.74E+00
La-140	6.44E+02	2.25E+02	7.55E+01	0.00E+00	0.00E+00	1.83E+05	2.26E+05
La-142	1.29E+00	4.11E-01	1.29E-01	0.00E+00	0.00E+00	8.70E+03	7.59E+04
Ce-141	3.92E+04	1.95E+04	2.90E+03	0.00E+00	8.55E+03	5.44E+05	5.66E+04
Ce-143	3.66E+02	1.99E+02	2.87E+01	0.00E+00	8.36E+01	1.15E+05	1.27E+05
Ce-144	6.77E+06	2.12E+06	3.61E+05	0.00E+00	1.17E+06	1.20E+07	3.89E+05
Pr-143	1.85E+04	5.55E+03	9.14E+02	0.00E+00	3.00E+03	4.33E+05	9.73E+04
Pr-144	5.96E-02	1.85E-02	3.00E-03	0.00E+00	9.77E-03	1.57E+03	1.97E+02
Nd-147	1.08E+04	8.73E+03	6.81E+02	0.00E+00	4.81E+03	3.28E+05	8.21E+04
W-187	1.63E+01	9.66E+00	4.33E+00	0.00E+00	0.00E+00	4.11E+04	9.10E+04
Np-239	4.66E+02	3.34E+01	2.35E+01	0.00E+00	9.73E+01	5.81E+04	6.40E+04
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-57	0.00E+00	9.03E+02	1.07E+03	0.00E+00	0.00E+00	5.07E+05	1.32E+04
Sr-85	4.44E+04	0.00E+00	1.18E+04	0.00E+00	0.00E+00	5.55E+05	2.04E+04
Y-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-97	4.29E-01	7.70E-02	3.60E-02	0.00E+00	8.55E-02	3.42E+03	2.78E+04
Cd-109	0.00E+00	7.03E+05	2.96E+04	0.00E+00	6.29E+05	1.11E+06	3.00E+04
Sn-113	1.41E+05	3.29E+03	8.51E+03	2.63E+03	0.00E+00	1.33E+06	4.81E+03
Ba-133	4.07E+05	4.07E+03	3.70E+04	0.00E+00	2.00E+01	1.92E+06	3.07E+04
Te-134	5.66E-02	3.26E-02	3.48E-02	4.59E-02	2.11E-01	4.55E+03	1.80E+03
Ce-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg-203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 3-10d

INFANT INHALATION Ri(I) (mrem/yr per uCi/m^3)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02
Be-7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na-24	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04
P-32	2.03E+06	1.12E+05	7.74E+04	0.00E+00	0.00E+00	0.00E+00	1.61E+04
Cr-51	0.00E+00	0.00E+00	8.95E+01	5.75E+01	1.32E+01	1.28E+04	3.57E+02
Mn-54	0.00E+00	2.53E+04	4.98E+03	0.00E+00	4.98E+03	1.00E+06	7.06E+03
Mn-56	0.00E+00	1.54E+00	2.21E-01	0.00E+00	1.10E+00	1.25E+04	7.17E+04
Fe-55	1.97E+04	1.17E+04	3.33E+03	0.00E+00	0.00E+00	8.69E+04	1.09E+03
Fe-59	1.36E+04	2.35E+04	9.48E+03	0.00E+00	0.00E+00	1.02E+06	2.48E+04
Co-58	0.00E+00	1.22E+03	1.82E+03	0.00E+00	0.00E+00	7.77E+05	1.11E+04
Co-60	0.00E+00	8.02E+03	1.18E+04	0.00E+00	0.00E+00	4.51E+06	3.19E+04
Ni-63	3.39E+05	2.04E+04	1.16E+04	0.00E+00	0.00E+00	2.09E+05	2.42E+03
Ni-65	2.39E+00	2.84E-01	1.23E-01	0.00E+00	0.00E+00	8.12E+03	5.01E+04
Cu-64	0.00E+00	1.88E+00	7.74E-01	0.00E+00	3.98E+00	9.30E+03	1.50E+04
Zn-65	1.93E+04	6.26E+04	3.11E+04	0.00E+00	3.25E+04	6.47E+05	5.14E+04
Zn-69	5.39E-02	9.67E-02	7.18E-03	0.00E+00	4.02E-02	1.47E+03	1.32E+04
Br-83	0.00E+00	0.00E+00	3.81E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	4.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	2.04E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	1.90E+05	8.82E+04	0.00E+00	0.00E+00	0.00E+00	3.04E+03
Rb-88	0.00E+00	5.57E+02	2.87E+02	0.00E+00	0.00E+00	0.00E+00	3.39E+02
Rb-89	0.00E+00	3.21E+02	2.06E+02	0.00E+00	0.00E+00	0.00E+00	6.82E+01
Sr-89	3.98E+05	0.00E+00	1.14E+04	0.00E+00	0.00E+00	2.03E+06	6.40E+04
Sr-90	4.09E+07	0.00E+00	2.59E+06	0.00E+00	0.00E+00	1.12E+07	1.31E+05
Sr-91	9.56E+01	0.00E+00	3.46E+00	0.00E+00	0.00E+00	5.26E+04	7.34E+04
Sr-92	1.05E+01	0.00E+00	3.91E-01	0.00E+00	0.00E+00	2.38E+04	1.40E+05
Y-90	3.29E+03	0.00E+00	8.82E+01	0.00E+00	0.00E+00	2.69E+05	1.04E+05
Y-91m	4.07E-01	0.00E+00	1.39E-02	0.00E+00	0.00E+00	2.79E+03	2.35E+03
Y-91	5.88E+05	0.00E+00	1.57E+04	0.00E+00	0.00E+00	2.45E+06	7.03E+04
Y-92	1.64E+01	0.00E+00	4.61E-01	0.00E+00	0.00E+00	2.45E+04	1.27E+05
Y-93	1.50E+02	0.00E+00	4.07E+00	0.00E+00	0.00E+00	7.64E+04	1.67E+05
Zr-95	1.15E+05	2.79E+04	2.03E+04	0.00E+00	3.11E+04	1.75E+06	2.17E+04
Zr-97	1.50E+02	2.56E+01	1.17E+01	0.00E+00	2.59E+01	1.10E+05	1.40E+05
Nb-95	1.57E+04	6.43E+03	3.78E+03	0.00E+00	4.72E+03	4.79E+05	1.27E+04
Mo-99	0.00E+00	1.65E+02	3.23E+01	0.00E+00	2.65E+02	1.35E+05	4.87E+04
Tc-99m	1.40E-03	2.88E-03	3.72E-02	0.00E+00	3.11E-02	8.11E+02	2.03E+03
Tc-101	6.51E-05	8.23E-05	8.12E-04	0.00E+00	9.79E-04	5.84E+02	8.44E+02
Ru-103	2.02E+03	0.00E+00	6.79E+02	0.00E+00	4.24E+03	5.52E+05	1.61E+04
Ru-105	1.22E+00	0.00E+00	4.10E-01	0.00E+00	8.99E-01	1.57E+04	4.84E+04
Ru-106	8.68E+04	0.00E+00	1.09E+04	0.00E+00	1.07E+05	1.16E+07	1.64E+05
Ag-110m	9.98E+03	7.22E+03	5.00E+03	0.00E+00	1.09E+04	3.67E+06	3.30E+04
Sb-122	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-124	3.79E+04	5.56E+02	1.20E+04	1.01E+02	0.00E+00	2.65E+06	5.91E+04
Sb-125	5.17E+04	4.77E+02	1.09E+04	6.23E+01	0.00E+00	1.64E+06	1.47E+04

Table 3-10d

INFANT INHALATION Ri(I) (mrem/yr per uCi/m^3)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
Te-125m	4.76E+03	1.99E+03	6.58E+02	1.62E+03	0.00E+00	4.47E+05	1.29E+04
Te-127m	1.67E+04	6.90E+03	2.07E+03	4.87E+03	3.75E+04	1.31E+06	2.73E+04
Te-127	2.23E+04	9.53E-01	4.89E-01	1.85E+00	4.86E+00	1.03E+04	2.44E+04
Te-129m	1.41E+04	6.09E+03	2.23E+03	5.47E+03	3.18E+04	1.68E+06	6.90E+04
Te-129	7.88E-02	3.47E-02	1.88E-02	6.75E-02	1.75E-01	3.00E+03	2.63E+04
Te-131m	1.07E+02	5.50E+01	3.63E+01	8.93E+01	2.65E+02	1.99E+05	1.19E+05
Te-131	1.74E-02	8.22E-03	5.00E-03	1.58E-02	3.99E-02	2.06E+03	8.22E+03
Te-132	3.72E+02	2.37E+02	1.76E+02	2.79E+02	1.03E+03	3.40E+05	4.41E+04
I-130	6.36E+03	1.39E+04	5.57E+03	1.60E+06	1.53E+04	0.00E+00	1.99E+03
I-131	3.79E+04	4.44E+04	1.96E+04	1.48E+07	5.18E+04	0.00E+00	1.06E+03
I-132	1.69E+03	3.54E+03	1.26E+03	1.69E+05	3.95E+03	0.00E+00	1.90E+03
I-133	1.32E+04	1.92E+04	5.60E+03	3.56E+06	2.24E+04	0.00E+00	2.16E+03
I-134	9.21E+02	1.88E+03	6.65E+02	4.45E+04	2.09E+03	0.00E+00	1.29E+03
I-135	3.86E+03	7.60E+03	2.77E+03	6.96E+05	8.47E+03	0.00E+00	1.83E+03
Cs-134	3.96E+05	7.03E+05	7.45E+04	0.00E+00	1.90E+05	7.97E+04	1.33E+03
Cs-136	4.83E+04	1.35E+05	5.29E+04	0.00E+00	5.64E+04	1.18E+04	1.43E+03
Cs-137	5.49E+05	6.12E+05	4.55E+04	0.00E+00	1.72E+05	7.13E+04	1.33E+03
Cs-138	5.05E+02	7.81E+02	3.98E+02	0.00E+00	4.10E+02	6.54E+01	8.76E+02
Ba-139	1.48E+00	9.84E-04	4.30E-02	0.00E+00	5.92E-04	5.95E+03	5.10E+04
Ba-140	5.60E+04	5.60E+01	2.90E+03	0.00E+00	1.34E+01	1.60E+06	3.84E+04
Ba-141	1.57E-01	1.08E-04	4.97E-03	0.00E+00	6.50E-05	2.97E+03	4.75E+03
Ba-142	3.98E-02	3.30E-05	1.96E-03	0.00E+00	1.90E-05	1.55E+03	6.93E+02
La-140	5.05E+02	2.00E+02	5.15E+01	0.00E+00	0.00E+00	1.68E+05	8.48E+04
La-142	1.03E+00	3.77E-01	9.04E-02	0.00E+00	0.00E+00	8.22E+03	5.95E+04
Ce-141	2.77E+04	1.67E+04	1.99E+03	0.00E+00	5.25E+03	5.17E+05	2.16E+04
Ce-143	2.93E+02	1.93E+02	2.21E+01	0.00E+00	5.64E+01	1.16E+05	4.97E+04
Ce-144	3.19E+06	1.21E+06	1.76E+05	0.00E+00	5.38E+05	9.84E+06	1.48E+05
Pr-143	1.40E+04	5.24E+03	6.99E+02	0.00E+00	1.97E+03	4.33E+05	3.72E+04
Pr-144	4.79E-02	1.85E-02	2.41E-03	0.00E+00	6.72E-03	1.61E+03	4.28E+03
Nd-147	7.94E+03	8.13E+03	5.00E+02	0.00E+00	3.15E+03	3.22E+05	3.12E+04
W-187	1.30E+01	9.02E+00	3.12E+00	0.00E+00	0.00E+00	3.96E+04	3.56E+04
Np-239	3.71E+02	3.32E+01	1.88E+01	0.00E+00	6.62E+01	5.95E+04	2.49E+04
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-57	0.00E+00	6.51E+02	6.41E+02	0.00E+00	0.00E+00	3.79E+05	4.86E+03
Sr-85	3.78E+04	0.00E+00	7.56E+03	0.00E+00	0.00E+00	4.20E+05	6.72E+03
Y-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-97	3.42E-01	7.29E-02	2.63E-02	0.00E+00	5.70E-02	3.32E+03	2.69E+04
Cd-109	0.00E+00	3.64E+05	1.40E+04	0.00E+00	2.80E+05	8.68E+05	1.12E+04
Sn-113	8.40E+04	2.24E+03	5.04E+03	1.82E+03	0.00E+00	1.09E+06	1.68E+03
Ba-133	2.66E+05	2.38E+03	1.82E+04	0.00E+00	1.25E+01	1.27E+06	1.08E+04
Te-134	4.45E-02	2.86E-02	2.35E-02	4.07E-02	1.34E-01	4.10E+03	3.54E+03
Ce-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg-203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 3-11a

ADULT INGESTION (Leafy Vegetable) Ri(V)

m^2 * mrem/yr per uCi/sec (H-3: m^3 mrem/yr per uCi/m)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	2.26E+03	2.26E+03	2.26E+03	2.26E+03	2.26E+03	2.26E+03
Be-7	9.36E+04	2.11E+05	1.05E+05	0.00E+00	2.22E+05	0.00E+00	3.65E+07
Na-24	2.69E+05	2.69E+05	2.69E+05	2.69E+05	2.69E+05	2.69E+05	2.69E+05
P-32	1.40E+09	8.73E+07	5.43E+07	0.00E+00	0.00E+00	0.00E+00	1.58E+08
Cr-51	0.00E+00	0.00E+00	4.64E+04	2.78E+04	1.02E+04	6.16E+04	1.17E+07
Mn-54	0.00E+00	3.13E+08	5.97E+07	0.00E+00	9.31E+07	0.00E+00	9.58E+08
Mn-56	0.00E+00	1.59E+01	2.82E+00	0.00E+00	2.02E+01	0.00E+00	5.07E+02
Fe-55	2.10E+08	1.45E+08	3.38E+07	0.00E+00	0.00E+00	8.08E+07	8.31E+07
Fe-59	1.26E+08	2.96E+08	1.13E+08	0.00E+00	0.00E+00	8.27E+07	9.86E+08
Co-58	0.00E+00	3.07E+07	6.89E+07	0.00E+00	0.00E+00	0.00E+00	6.23E+08
Co-60	0.00E+00	1.67E+08	3.69E+08	0.00E+00	0.00E+00	0.00E+00	3.14E+09
Ni-63	1.04E+10	7.21E+08	3.49E+08	0.00E+00	0.00E+00	0.00E+00	1.50E+08
Ni-65	6.15E+01	7.99E+00	3.64E+00	0.00E+00	0.00E+00	0.00E+00	2.03E+02
Cu-64	0.00E+00	9.20E+03	4.32E+03	0.00E+00	2.32E+04	0.00E+00	7.84E+05
Zn-65	3.17E+08	1.01E+09	4.56E+08	0.00E+00	6.75E+08	0.00E+00	6.36E+08
Zn-69	8.73E-06	1.67E-05	1.16E-06	0.00E+00	1.09E-05	0.00E+00	2.51E-06
Br-83	0.00E+00	0.00E+00	3.11E+00	0.00E+00	0.00E+00	0.00E+00	4.47E+00
Br-84	0.00E+00	0.00E+00	2.48E-11	0.00E+00	0.00E+00	0.00E+00	1.94E-16
Br-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	2.19E+08	1.02E+08	0.00E+00	0.00E+00	0.00E+00	4.33E+07
Rb-88	0.00E+00	3.43E-22	1.82E-22	0.00E+00	0.00E+00	0.00E+00	4.74E-33
Rb-89	0.00E+00	1.39E-26	9.74E-27	0.00E+00	0.00E+00	0.00E+00	8.05E-40
Sr-89	9.96E+09	0.00E+00	2.86E+08	0.00E+00	0.00E+00	0.00E+00	1.60E+09
Sr-90	6.05E+11	0.00E+00	1.48E+11	0.00E+00	0.00E+00	0.00E+00	1.75E+10
Sr-91	3.05E+05	0.00E+00	1.23E+04	0.00E+00	0.00E+00	0.00E+00	1.45E+06
Sr-92	4.27E+02	0.00E+00	1.85E+01	0.00E+00	0.00E+00	0.00E+00	8.45E+03
Y-90	1.33E+04	0.00E+00	3.56E+02	0.00E+00	0.00E+00	0.00E+00	1.41E+08
Y-91m	5.22E-09	0.00E+00	2.02E-10	0.00E+00	0.00E+00	0.00E+00	1.53E-08
Y-91	5.11E+06	0.00E+00	1.37E+05	0.00E+00	0.00E+00	0.00E+00	2.81E+09
Y-92	9.15E-01	0.00E+00	2.68E-02	0.00E+00	0.00E+00	0.00E+00	1.60E+04
Y-93	1.70E+02	0.00E+00	4.68E+00	0.00E+00	0.00E+00	0.00E+00	5.38E+06
Zr-95	1.17E+06	3.77E+05	2.55E+05	0.00E+00	5.91E+05	0.00E+00	1.19E+09
Zr-97	3.37E+02	6.81E+01	3.11E+01	0.00E+00	1.03E+02	0.00E+00	2.11E+07
Nb-95	1.43E+05	7.94E+04	4.27E+04	0.00E+00	7.85E+04	0.00E+00	4.82E+08
Mo-99	0.00E+00	6.15E+06	1.17E+06	0.00E+00	1.39E+07	0.00E+00	1.43E+07
Tc-99m	3.10E+00	8.77E+00	1.12E+02	0.00E+00	1.33E+02	4.30E+00	5.19E+03
Tc-101	8.22E-31	1.18E-30	1.16E-29	0.00E+00	2.13E-29	6.05E-31	3.56E-42
Ru-103	4.76E+06	0.00E+00	2.05E+06	0.00E+00	1.82E+07	0.00E+00	5.56E+08
Ru-105	5.39E+01	0.00E+00	2.13E+01	0.00E+00	6.96E+02	0.00E+00	3.29E+04
Ru-106	1.93E+08	0.00E+00	2.44E+07	0.00E+00	3.72E+08	0.00E+00	1.25E+10
Ag-110m	1.05E+07	9.75E+06	5.79E+06	0.00E+00	1.92E+07	0.00E+00	3.98E+09
Sb-122	2.80E+05	6.43E+03	9.65E+04	4.34E+03	0.00E+00	1.68E+05	1.06E+08
Sb-124	1.04E+08	1.96E+06	4.07E+07	2.52E+05	0.00E+00	8.07E+07	2.94E+09
Sb-125	1.37E+08	1.53E+06	3.25E+07	1.39E+05	0.00E+00	1.05E+08	1.50E+09

Table 3-11a

ADULT INGESTION (Leafy Vegetable) Ri(V)

m^2 * mrem/yr per uCi/sec (H-3: mrem/yr per uCi/m^3)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
Te-125m	9.66E+07	3.50E+07	1.29E+07	2.90E+07	3.93E+08	0.00E+00	3.86E+08
Te-127m	3.49E+08	1.25E+08	4.26E+07	8.92E+07	1.42E+09	0.00E+00	1.17E+09
Te-127	5.66E+03	2.03E+03	1.22E+03	4.19E+03	2.31E+04	0.00E+00	4.47E+05
Te-129m	2.51E+08	9.38E+07	3.98E+07	8.63E+07	1.05E+09	0.00E+00	1.27E+09
Te-129	7.62E-04	2.87E-04	1.86E-04	5.85E-04	3.20E-03	0.00E+00	5.75E-04
Te-131m	9.12E+05	4.46E+05	3.72E+05	7.06E+05	4.52E+06	0.00E+00	4.43E+07
Te-131	1.50E-15	6.27E-16	4.74E-16	1.23E-15	6.57E-15	0.00E+00	2.13E-16
Te-132	4.30E+06	2.78E+06	2.61E+06	3.07E+06	2.68E+07	0.00E+00	1.32E+08
I-130	3.92E+05	1.16E+06	4.57E+05	9.81E+07	1.81E+06	0.00E+00	9.96E+05
I-131	8.08E+07	1.16E+08	6.62E+07	3.79E+10	1.98E+08	0.00E+00	3.05E+07
I-132	5.76E+01	1.54E+02	5.39E+01	5.39E+03	2.45E+02	0.00E+00	2.89E+01
I-133	2.09E+06	3.63E+06	1.11E+06	5.33E+08	6.33E+06	0.00E+00	3.26E+06
I-134	9.65E-05	2.62E-04	9.38E-05	4.54E-03	4.17E-04	0.00E+00	2.29E-07
I-135	3.90E+04	1.02E+05	3.77E+04	6.73E+06	1.64E+05	0.00E+00	1.15E+05
Cs-134	4.67E+09	1.11E+10	9.08E+09	0.00E+00	3.59E+09	1.19E+09	1.94E+08
Cs-136	4.24E+07	1.68E+08	1.21E+08	0.00E+00	9.32E+07	1.28E+07	1.90E+07
Cs-137	6.36E+09	8.70E+09	5.70E+09	0.00E+00	2.95E+09	9.81E+08	1.68E+08
Cs-138	3.91E-11	7.73E-11	3.83E-11	0.00E+00	5.68E-11	5.61E-12	3.30E-16
Ba-139	2.68E-02	1.91E-05	7.86E-04	0.00E+00	1.79E-05	1.08E-05	4.76E-02
Ba-140	1.28E+08	1.61E+05	8.38E+06	0.00E+00	5.46E+04	9.20E+04	2.63E+08
Ba-141	1.15E-21	8.70E-25	3.89E-23	0.00E+00	8.09E-25	4.94E-25	5.43E-31
Ba-142	2.46E-39	2.53E-42	1.55E-40	0.00E+00	2.14E-42	1.43E-42	0.00E+00
La-140	1.98E+03	9.98E+02	2.64E+02	0.00E+00	0.00E+00	0.00E+00	7.33E+07
La-142	1.41E-04	6.43E-05	1.60E-05	0.00E+00	0.00E+00	0.00E+00	4.69E-01
Ce-141	1.97E+05	1.33E+05	1.51E+04	0.00E+00	6.19E+04	0.00E+00	5.10E+08
Ce-143	9.98E+02	7.38E+05	8.16E+01	0.00E+00	3.25E+02	0.00E+00	2.76E+07
Ce-144	3.29E+07	1.38E+07	1.77E+06	0.00E+00	8.16E+06	0.00E+00	1.11E+10
Pr-143	6.26E+04	2.51E+04	3.10E+03	0.00E+00	1.45E+04	0.00E+00	2.74E+08
Pr-144	3.09E-26	1.28E-26	1.57E-27	0.00E+00	7.23E-27	0.00E+00	4.44E-33
Nd-147	3.33E+04	3.85E+04	2.31E+03	0.00E+00	2.25E+04	0.00E+00	1.85E+08
W-187	3.82E+04	3.19E+04	1.12E+04	0.00E+00	0.00E+00	0.00E+00	1.05E+07
Np-239	1.43E+03	1.41E+02	7.76E+01	0.00E+00	4.39E+02	0.00E+00	2.89E+07
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-57	0.00E+00	1.17E+07	1.95E+07	0.00E+00	0.00E+00	0.00E+00	2.97E+08
Sr-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-97	2.15E-06	5.45E-07	1.99E-07	0.00E+00	6.35E-07	0.00E+00	2.01E-03
Cd-109	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-113	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba-133	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-134	3.56E-08	2.33E-08	1.43E-08	3.11E-08	2.25E-07	0.00E+00	3.95E-11
Ce-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg-203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 3-11b

TEEN INGESTION (Leafy Vegetable) Ri(V)

m^2 * mrem/yr per uCi/sec (H-3: mrem/yr per uCi/m^3)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	2.59E+03	2.59E+03	2.59E+03	2.59E+03	2.59E+03	2.59E+03
Be-7	1.43E+05	3.20E+05	1.60E+05	0.00E+00	3.39E+05	0.00E+00	3.90E+07
Na-24	2.39E+05	2.39E+05	2.39E+05	2.39E+05	2.39E+05	2.39E+05	2.39E+05
P-32	1.61E+09	9.97E+07	6.24E+07	0.00E+00	0.00E+00	0.00E+00	1.35E+08
Cr-51	0.00E+00	0.00E+00	6.17E+04	3.43E+04	1.35E+04	8.81E+04	1.04E+07
Mn-54	0.00E+00	4.54E+08	9.01E+07	0.00E+00	1.36E+08	0.00E+00	9.32E+08
Mn-56	0.00E+00	1.43E+01	2.55E+00	0.00E+00	1.81E+01	0.00E+00	9.44E+02
Fe-55	3.26E+08	2.31E+08	5.39E+07	0.00E+00	0.00E+00	1.47E+08	1.00E+08
Fe-59	1.79E+08	4.18E+08	1.61E+08	0.00E+00	0.00E+00	1.32E+08	9.88E+08
Co-58	0.00E+00	4.36E+07	1.00E+08	0.00E+00	0.00E+00	0.00E+00	6.01E+08
Co-60	0.00E+00	2.49E+08	5.60E+08	0.00E+00	0.00E+00	0.00E+00	3.24E+09
Ni-63	1.61E+10	1.13E+09	5.45E+08	0.00E+00	0.00E+00	0.00E+00	1.81E+08
Ni-65	5.72E+01	7.31E+00	3.33E+00	0.00E+00	0.00E+00	0.00E+00	3.97E+02
Cu-64	0.00E+00	8.34E+03	3.92E+03	0.00E+00	2.11E+04	0.00E+00	6.47E+05
Zn-65	4.24E+08	1.47E+09	6.86E+08	0.00E+00	9.42E+08	0.00E+00	6.23E+08
Zn-69	8.18E-06	1.56E-05	1.09E-06	0.00E+00	1.02E-05	0.00E+00	2.87E-05
Br-83	0.00E+00	0.00E+00	2.91E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	2.25E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	2.74E+08	1.29E+08	0.00E+00	0.00E+00	0.00E+00	4.05E+07
Rb-88	0.00E+00	3.17E-22	1.69E-22	0.00E+00	0.00E+00	0.00E+00	2.71E-29
Rb-89	0.00E+00	1.25E-26	8.82E-27	0.00E+00	0.00E+00	0.00E+00	1.91E-35
Sr-89	1.51E+10	0.00E+00	4.33E+08	0.00E+00	0.00E+00	0.00E+00	1.80E+09
Sr-90	7.51E+11	0.00E+00	1.85E+11	0.00E+00	0.00E+00	0.00E+00	2.11E+10
Sr-91	2.85E+05	0.00E+00	1.13E+04	0.00E+00	0.00E+00	0.00E+00	1.29E+06
Sr-92	3.97E+02	0.00E+00	1.69E+01	0.00E+00	0.00E+00	0.00E+00	1.01E+04
Y-90	1.24E+04	0.00E+00	3.34E+02	0.00E+00	0.00E+00	0.00E+00	1.02E+08
Y-91m	4.86E-09	0.00E+00	1.86E-10	0.00E+00	0.00E+00	0.00E+00	2.29E-07
Y-91	7.84E+06	0.00E+00	2.10E+05	0.00E+00	0.00E+00	0.00E+00	3.21E+09
Y-92	8.60E-01	0.00E+00	2.49E-02	0.00E+00	0.00E+00	0.00E+00	2.36E+04
Y-93	1.59E+02	0.00E+00	4.36E+00	0.00E+00	0.00E+00	0.00E+00	4.86E+06
Zr-95	1.72E+06	5.43E+05	3.73E+05	0.00E+00	7.98E+05	0.00E+00	1.25E+09
Zr-97	3.12E+02	6.18E+01	2.85E+01	0.00E+00	9.37E+01	0.00E+00	1.67E+07
Nb-95	1.93E+05	1.07E+05	5.89E+04	0.00E+00	1.04E+05	0.00E+00	4.57E+08
Mo-99	0.00E+00	5.65E+06	1.08E+06	0.00E+00	1.29E+07	0.00E+00	1.01E+07
Tc-99m	2.74E+00	7.63E+00	9.89E+01	0.00E+00	1.14E+02	4.24E+00	5.01E+03
Tc-101	7.64E-31	1.09E-30	1.07E-29	0.00E+00	1.97E-29	6.62E-31	1.86E-37
Ru-103	6.81E+06	0.00E+00	2.91E+06	0.00E+00	2.40E+07	0.00E+00	5.69E+08
Ru-105	5.00E+01	0.00E+00	1.94E+01	0.00E+00	6.31E+02	0.00E+00	4.04E+04
Ru-106	3.10E+08	0.00E+00	3.90E+07	0.00E+00	5.97E+08	0.00E+00	1.48E+10
Ag-110m	1.52E+07	1.43E+07	8.72E+06	0.00E+00	2.74E+07	0.00E+00	4.03E+09
Sb-122	3.03E+05	5.89E+03	8.85E+04	3.85E+03	0.00E+00	1.89E+05	6.35E+07
Sb-124	1.54E+08	2.84E+06	6.02E+07	3.50E+05	0.00E+00	1.34E+08	3.11E+09
Sb-125	2.14E+08	2.34E+06	5.00E+07	2.04E+05	0.00E+00	1.86E+08	1.66E+09

Table 3-11b

TEEN INGESTION (Leafy Vegetable) Ri(V)

m^2 * mrem/yr per uCi/sec (H-3: mrem/yr per uCi/m^3)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
Te-125m	1.48E+08	5.34E+07	1.98E+07	4.14E+07	0.00E+00	0.00E+00	4.37E+08
Te-127m	5.51E+08	1.96E+08	6.56E+07	1.31E+08	2.24E+09	0.00E+00	1.37E+09
Te-127	5.34E+03	1.89E+03	1.15E+03	3.68E+03	2.16E+04	0.00E+00	4.12E+05
Te-129m	3.62E+08	1.34E+08	5.73E+07	1.17E+08	1.51E+09	0.00E+00	1.36E+09
Te-129	7.14E-04	2.66E-04	1.74E-04	5.10E-04	3.00E-03	0.00E+00	3.90E-03
Te-131m	8.44E+05	4.05E+05	3.38E+05	6.09E+05	4.22E+06	0.00E+00	3.25E+07
Te-131	1.39E-15	5.75E-16	4.36E-16	1.07E-15	6.10E-15	0.00E+00	1.14E-16
Te-132	3.91E+06	2.47E+06	2.33E+06	2.61E+06	2.37E+07	0.00E+00	7.84E+07
I-130	3.51E+05	1.01E+06	4.05E+05	8.28E+07	1.56E+06	0.00E+00	7.80E+05
I-131	7.69E+07	1.08E+08	5.78E+07	3.14E+10	1.85E+08	0.00E+00	2.13E+07
I-132	5.19E+01	1.36E+02	4.88E+01	4.58E+03	2.14E+02	0.00E+00	5.92E+01
I-133	1.94E+06	3.29E+06	1.00E+06	4.59E+08	5.76E+06	0.00E+00	2.49E+06
I-134	8.73E-05	2.31E-04	8.31E-05	3.85E-03	3.65E-04	0.00E+00	3.05E-06
I-135	3.52E+04	9.07E+04	3.36E+04	5.83E+06	1.43E+05	0.00E+00	1.00E+05
Cs-134	7.10E+09	1.67E+10	7.75E+09	0.00E+00	5.31E+09	2.03E+09	2.08E+08
Cs-136	4.34E+07	1.71E+08	1.15E+08	0.00E+00	9.30E+07	1.47E+07	1.37E+07
Cs-137	1.01E+10	1.35E+10	4.69E+09	0.00E+00	4.59E+09	1.78E+09	1.92E+08
Cs-138	3.61E-11	6.93E-11	3.47E-11	0.00E+00	5.12E-11	5.96E-12	3.15E-14
Ba-139	2.52E-02	1.78E-05	7.35E-04	0.00E+00	1.67E-05	1.22E-05	2.25E-01
Ba-140	1.37E+08	1.68E+05	8.85E+06	0.00E+00	5.70E+04	1.13E+05	2.12E+08
Ba-141	1.08E-21	8.04E-25	3.59E-23	0.00E+00	7.46E-25	5.50E-25	2.29E-27
Ba-142	2.27E-39	2.27E-42	1.40E-40	0.00E+00	1.92E-42	1.51E-42	0.00E+00
La-140	1.81E+03	8.89E+02	2.37E+02	0.00E+00	0.00E+00	0.00E+00	5.11E+07
La-142	1.30E-04	5.76E-05	1.43E-05	0.00E+00	0.00E+00	0.00E+00	1.75E+00
Ce-141	2.83E+05	1.89E+05	2.17E+04	0.00E+00	8.89E+04	0.00E+00	5.40E+08
Ce-143	9.33E+02	6.79E+05	7.58E+01	0.00E+00	3.04E+02	0.00E+00	2.04E+07
Ce-144	5.27E+07	2.18E+07	2.83E+06	0.00E+00	1.30E+07	0.00E+00	1.33E+10
Pr-143	7.00E+04	2.80E+04	3.49E+03	0.00E+00	1.63E+04	0.00E+00	2.30E+08
Pr-144	2.89E-26	1.18E-26	1.47E-27	0.00E+00	6.80E-27	0.00E+00	3.19E-29
Nd-147	3.62E+04	3.94E+04	2.36E+03	0.00E+00	2.31E+04	0.00E+00	1.42E+08
W-187	3.55E+04	2.90E+04	1.02E+04	0.00E+00	0.00E+00	0.00E+00	7.84E+06
Np-239	1.39E+03	1.31E+02	7.28E+01	0.00E+00	4.11E+02	0.00E+00	2.11E+07
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-57	0.00E+00	1.79E+07	3.00E+07	0.00E+00	0.00E+00	0.00E+00	3.33E+08
Sr-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-97	2.00E-06	4.95E-07	1.81E-07	0.00E+00	5.79E-07	0.00E+00	1.18E-02
Cd-109	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-113	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba-133	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-134	3.23E-08	2.07E-08	2.17E-08	2.65E-08	1.98E-07	0.00E+00	1.20E-09
Ce-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg-203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 3-11c

CHILD INGESTION (Leafy Vegetable) Ri(V)

m^2 * mrem/yr per uCi/sec (H-3: mrem/yr per uCi/m^3)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	4.01E+03	4.01E+03	4.01E+03	4.01E+03	4.01E+03	4.01E+03
Be-7	3.37E+05	5.72E+05	3.77E+05	0.00E+00	5.63E+05	0.00E+00	3.20E+07
Na-24	3.73E+05	3.73E+05	3.73E+05	3.73E+05	3.73E+05	3.73E+05	3.73E+05
P-32	3.37E+09	1.58E+08	1.30E+08	0.00E+00	0.00E+00	0.00E+00	9.31E+07
Cr-51	0.00E+00	0.00E+00	1.17E+05	6.50E+04	1.78E+04	1.19E+05	6.21E+06
Mn-54	0.00E+00	6.65E+08	1.77E+08	0.00E+00	1.86E+08	0.00E+00	5.58E+08
Mn-56	0.00E+00	1.88E+01	4.24E+00	0.00E+00	2.27E+01	0.00E+00	2.72E+03
Fe-55	8.01E+08	4.25E+08	1.32E+08	0.00E+00	0.00E+00	2.40E+08	7.87E+07
Fe-59	3.97E+08	6.42E+08	3.20E+08	0.00E+00	0.00E+00	1.86E+08	6.68E+08
Co-58	0.00E+00	6.44E+07	1.97E+08	0.00E+00	0.00E+00	0.00E+00	3.76E+08
Co-60	0.00E+00	3.78E+08	1.12E+09	0.00E+00	0.00E+00	0.00E+00	2.10E+09
Ni-63	3.95E+10	2.11E+09	1.34E+09	0.00E+00	0.00E+00	0.00E+00	1.42E+08
Ni-65	1.05E+02	9.89E+00	5.77E+00	0.00E+00	0.00E+00	0.00E+00	1.21E+03
Cu-64	0.00E+00	1.10E+04	6.64E+03	0.00E+00	2.66E+04	0.00E+00	5.16E+05
Zn-65	8.12E+08	2.16E+09	1.35E+09	0.00E+00	1.36E+09	0.00E+00	3.80E+08
Zn-69	1.51E-05	2.18E-05	2.02E-06	0.00E+00	1.32E-05	0.00E+00	1.37E-03
Br-83	0.00E+00	0.00E+00	5.37E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	0.00E+00	0.00E+00	3.82E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rb-86	0.00E+00	4.52E+08	2.78E+08	0.00E+00	0.00E+00	0.00E+00	2.91E+07
Rb-88	0.00E+00	4.37E-22	3.04E-22	0.00E+00	0.00E+00	0.00E+00	2.15E-23
Rb-89	0.00E+00	1.64E-26	1.46E-26	0.00E+00	0.00E+00	0.00E+00	1.43E-28
Sr-89	3.59E+10	0.00E+00	1.03E+09	0.00E+00	0.00E+00	0.00E+00	1.39E+09
Sr-90	1.24E+12	0.00E+00	3.15E+11	0.00E+00	0.00E+00	0.00E+00	1.67E+10
Sr-91	5.24E+05	0.00E+00	1.98E+04	0.00E+00	0.00E+00	0.00E+00	1.16E+06
Sr-92	7.28E+02	0.00E+00	2.92E+01	0.00E+00	0.00E+00	0.00E+00	1.38E+04
Y-90	2.30E+04	0.00E+00	6.17E+02	0.00E+00	0.00E+00	0.00E+00	6.56E+07
Y-91m	8.91E-09	0.00E+00	3.24E-10	0.00E+00	0.00E+00	0.00E+00	1.74E-05
Y-91	1.86E+07	0.00E+00	4.99E+05	0.00E+00	0.00E+00	0.00E+00	2.48E+09
Y-92	1.58E+00	0.00E+00	4.53E-02	0.00E+00	0.00E+00	0.00E+00	4.58E+04
Y-93	2.93E+02	0.00E+00	8.04E+00	0.00E+00	0.00E+00	0.00E+00	4.37E+06
Zr-95	3.86E+06	8.48E+05	7.55E+05	0.00E+00	1.21E+06	0.00E+00	8.84E+08
Zr-97	5.70E+02	8.24E+01	4.86E+01	0.00E+00	1.18E+02	0.00E+00	1.25E+07
Nb-95	4.12E+05	1.60E+05	1.15E+05	0.00E+00	1.51E+05	0.00E+00	2.97E+08
Mo-99	0.00E+00	7.71E+06	1.91E+06	0.00E+00	1.65E+07	0.00E+00	6.38E+06
Tc-99m	4.71E+00	9.24E+00	1.53E+02	0.00E+00	1.34E+02	4.69E+00	5.26E+03
Tc-101	1.41E-30	1.47E-30	1.87E-29	0.00E+00	2.51E-29	7.78E-31	4.68E-30
Ru-103	1.53E+07	0.00E+00	5.88E+06	0.00E+00	3.85E+07	0.00E+00	3.96E+08
Ru-105	9.16E+01	0.00E+00	3.32E+01	0.00E+00	8.05E+02	0.00E+00	5.98E+04
Ru-106	7.45E+08	0.00E+00	9.30E+07	0.00E+00	1.01E+09	0.00E+00	1.16E+10
Ag-110m	3.21E+07	2.17E+07	1.73E+07	0.00E+00	4.04E+07	0.00E+00	2.58E+09
Sb-122	5.58E+05	8.24E+03	1.64E+05	7.16E+03	0.00E+00	2.27E+05	4.30E+07
Sb-124	3.52E+08	4.56E+06	1.23E+08	7.73E+05	0.00E+00	1.95E+08	2.20E+09
Sb-125	4.99E+08	3.84E+06	1.05E+08	4.63E+05	0.00E+00	2.78E+08	1.19E+09

Table 3-11c

CHILD INGESTION (Leafy Vegetable) Ri(V)

m^2 * mrem/yr per uCi/sec (H-3: mrem/yr per uCi/m^3)

Isotope	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
Te-125m	3.51E+08	9.50E+07	4.67E+07	9.84E+07	0.00E+00	0.00E+00	3.38E+08
Te-127m	1.32E+09	3.56E+08	1.57E+08	3.16E+08	3.77E+09	0.00E+00	1.07E+09
Te-127	9.85E+03	2.65E+03	2.11E+03	6.81E+03	2.80E+04	0.00E+00	3.85E+05
Te-129m	8.41E+08	2.35E+08	1.31E+08	2.71E+08	2.47E+09	0.00E+00	1.03E+09
Te-129	1.32E-03	3.69E-04	3.14E-04	9.43E-04	3.87E-03	0.00E+00	8.23E-02
Te-131m	1.54E+06	5.33E+05	5.68E+05	1.10E+06	5.16E+06	0.00E+00	2.16E+07
Te-131	2.57E-15	7.83E-16	7.64E-16	1.97E-15	7.77E-15	0.00E+00	1.35E-14
Te-132	7.00E+06	3.10E+06	3.74E+06	4.51E+06	2.88E+07	0.00E+00	3.12E+07
I-130	6.16E+05	1.24E+06	6.41E+05	1.37E+08	1.86E+06	0.00E+00	5.82E+05
I-131	1.43E+08	1.44E+08	8.17E+07	4.75E+10	2.36E+08	0.00E+00	1.28E+07
I-132	9.22E+01	1.69E+02	7.79E+01	7.86E+03	2.59E+02	0.00E+00	1.99E+02
I-133	3.53E+06	4.37E+06	1.65E+06	8.11E+08	7.28E+06	0.00E+00	1.76E+06
I-134	1.55E-04	2.88E-04	1.32E-04	6.62E-03	4.40E-04	0.00E+00	1.91E-04
I-135	6.26E+04	1.13E+05	5.33E+04	9.97E+06	1.73E+05	0.00E+00	8.58E+04
Cs-134	1.60E+10	2.63E+10	5.55E+09	0.00E+00	8.15E+09	2.93E+09	1.42E+08
Cs-136	8.17E+07	2.25E+08	1.45E+08	0.00E+00	1.20E+08	1.78E+07	7.90E+06
Cs-137	2.39E+10	2.29E+10	3.38E+09	0.00E+00	7.46E+09	2.68E+09	1.43E+08
Cs-138	6.57E-11	9.13E-11	5.79E-11	0.00E+00	6.43E-11	6.91E-12	4.21E-11
Ba-139	4.65E-02	2.48E-05	1.35E-03	0.00E+00	2.17E-05	1.46E-05	2.69E+00
Ba-140	2.75E+08	2.41E+05	1.60E+07	0.00E+00	7.84E+04	1.44E+05	1.39E+08
Ba-141	1.99E-21	1.11E-24	6.47E-23	0.00E+00	9.62E-25	6.53E-24	1.13E-21
Ba-142	4.11E-39	2.96E-42	2.29E-40	0.00E+00	2.39E-42	1.74E-42	5.36E-41
La-140	3.25E+03	1.14E+03	3.83E+02	0.00E+00	0.00E+00	0.00E+00	3.17E+07
La-142	2.35E-04	7.49E-05	2.35E-05	0.00E+00	0.00E+00	0.00E+00	1.48E+01
Ce-141	6.56E+05	3.27E+05	4.86E+04	0.00E+00	1.43E+05	0.00E+00	4.08E+08
Ce-143	1.72E+03	9.31E+05	1.35E+02	0.00E+00	3.91E+02	0.00E+00	1.36E+07
Ce-144	1.27E+08	3.98E+07	6.78E+06	0.00E+00	2.21E+07	0.00E+00	1.04E+10
Pr-143	1.46E+05	4.37E+04	7.23E+03	0.00E+00	2.37E+04	0.00E+00	1.57E+08
Pr-144	5.37E-26	1.66E-26	2.70E-27	0.00E+00	8.79E-27	0.00E+00	3.58E-23
Nd-147	7.15E+04	5.79E+04	4.48E+03	0.00E+00	3.18E+04	0.00E+00	9.17E+07
W-187	6.47E+04	3.83E+04	1.72E+04	0.00E+00	0.00E+00	0.00E+00	5.38E+06
Np-239	2.57E+03	1.84E+02	1.29E+02	0.00E+00	5.33E+02	0.00E+00	1.36E+07
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-57	0.00E+00	2.99E+07	6.04E+07	0.00E+00	0.00E+00	0.00E+00	2.45E+08
Sr-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-97	3.64E-06	6.57E-07	3.07E-07	0.00E+00	7.29E-07	0.00E+00	2.03E-01
Cd-109	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-113	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ba-133	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Te-134	5.76E-08	2.59E-08	3.46E-08	4.56E-08	2.40E-07	0.00E+00	2.63E-07
Ce-139	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hg-203	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 3-12

Total Body & Skin Ground Plane Dose Factors Ri(G) and Ri(S)

Isotope	Decay Constant (sec^{-1})	Ri(G) (m^2 * mrem/yr per uCi/sec)	Ri(S) (m^2 * mrem/yr per uCi/sec)
H-3	1.780E-09	0.00E+00	0.00E+00
Be-7	1.505E-07	0.00E+00	0.00E+00
Na-24	1.284E-05	1.19E+07	1.39E+07
P-32	5.614E-07	0.00E+00	0.00E+00
Cr-51	2.896E-07	4.66E+06	5.51E+06
Mn-54	2.567E-08	1.39E+09	1.62E+09
Mn-56	7.467E-05	9.03E+05	1.07E+06
Fe-55	8.141E-09	0.00E+00	0.00E+00
Fe-59	1.802E-07	2.72E+08	3.20E+08
Co-58	1.133E-07	3.79E+08	4.44E+08
Co-60	4.170E-09	2.15E+10	2.53E+10
Ni-63	2.290E-10	0.00E+00	0.00E+00
Ni-65	7.641E-05	2.97E+05	3.45E+05
Cu-64	1.516E-05	6.07E+05	6.88E+05
Zn-65	3.289E-08	7.46E+08	8.58E+08
Zn-69	2.027E-04	0.00E+00	0.00E+00
Br-83	8.056E-05	4.87E+03	7.08E+03
Br-84	3.633E-04	2.03E+05	2.36E+05
Br-85	3.851E-03	0.00E+00	0.00E+00
Rb-86	4.299E-07	8.99E+06	1.03E+07
Rb-88	6.490E-04	3.31E+04	3.78E+04
Rb-89	7.600E-04	1.21E+05	1.45E+05
Sr-89	1.589E-07	2.16E+04	2.51E+04
Sr-90	7.548E-10	0.00E+00	0.00E+00
Sr-91	2.027E-05	2.15E+06	2.51E+06
Sr-92	7.105E-05	7.77E+05	8.63E+05
Y-90	3.008E-06	4.48E+03	5.30E+03
Y-91m	2.324E-04	1.00E+05	1.16E+05
Y-91	1.371E-07	1.07E+06	1.21E+06
Y-92	5.439E-05	1.80E+05	2.14E+05
Y-93	1.906E-05	1.83E+05	2.51E+05
Zr-95	1.254E-07	2.45E+08	2.84E+08
Zr-97	1.139E-05	2.96E+06	3.44E+06
Nb-95	2.282E-07	1.37E+08	1.61E+08
Mo-99	2.917E-06	3.99E+06	4.62E+06
Tc-99m	3.198E-05	1.84E+05	2.11E+05
Tc-101	8.136E-04	2.04E+04	2.26E+04
Ru-103	2.042E-07	1.08E+08	1.26E+08
Ru-105	4.337E-05	6.36E+05	7.21E+05
Ru-106	2.179E-08	4.22E+08	5.07E+08
Ag-110m	3.210E-08	3.44E+09	4.01E+09
Sb-122	2.971E-06	0.00E+00	0.00E+00
Sb-124	1.333E-07	5.98E+08	6.90E+08
Sb-125	7.935E-09	2.34E+09	2.64E+09

Table 3-12

Total Body & Skin Ground Plane Dose Factors Ri(G) and Ri(S)

Isotope	Decay Constant (sec^{-1})	Ri(G) (m^2 * mrem/yr per uCi/sec)	Ri(S) (m^2 * mrem/yr per uCi/sec)
Te-125m	1.383E-07	1.55E+06	2.13E+06
Te-127m	7.360E-08	9.16E+04	1.08E+05
Te-127	2.059E-05	2.98E+03	3.28E+03
Te-129m	2.388E-07	1.98E+07	2.31E+07
Te-129	1.660E-04	2.62E+04	3.10E+04
Te-131m	6.418E-06	8.03E+06	9.46E+06
Te-131	4.621E-04	2.92E+04	3.45E+07
Te-132	2.462E-06	4.23E+06	4.98E+06
I-130	1.558E-05	5.51E+06	6.69E+06
I-131	9.978E-07	1.72E+07	2.09E+07
I-132	8.371E-05	1.25E+06	1.46E+06
I-133	9.257E-06	2.45E+06	2.98E+06
I-134	2.196E-04	4.47E+05	5.30E+05
I-135	2.913E-05	2.53E+06	2.95E+06
Cs-134	1.066E-08	6.86E+09	8.00E+09
Cs-136	6.124E-07	1.50E+08	1.70E+08
Cs-137	7.327E-10	1.03E+10	1.20E+10
Cs-138	3.588E-04	3.59E+05	4.10E+05
Ba-139	1.397E-04	1.05E+05	1.19E+05
Ba-140	6.297E-07	2.04E+07	2.34E+07
Ba-141	6.323E-04	4.17E+04	4.75E+04
Ba-142	1.090E-03	4.44E+04	5.06E+04
La-140	4.781E-06	1.92E+07	2.18E+07
La-142	1.249E-04	7.36E+05	8.84E+05
Ce-141	2.468E-07	1.37E+07	1.54E+07
Ce-143	5.835E-06	2.31E+06	2.63E+06
Ce-144	2.822E-08	6.95E+07	8.04E+07
Pr-143	5.916E-07	0.00E+00	0.00E+00
Pr-144	6.685E-04	1.83E+03	2.11E+03
Nd-147	7.306E-07	8.39E+06	1.01E+07
W-187	8.056E-06	2.36E+06	2.74E+06
Np-239	3.399E-06	1.71E+06	1.98E+06
K-40	1.717E-17	0.00E+00	0.00E+00
Co-57	2.961E-08	1.88E+08	2.07E+08
Sr-85	1.237E-07	0.00E+00	0.00E+00
Y-88	7.523E-08	0.00E+00	0.00E+00
Nb-94	1.083E-12	0.00E+00	0.00E+00
Nb-97	1.602E-04	1.76E+05	2.07E+05
Cd-109	1.729E-08	0.00E+00	0.00E+00
Sn-113	6.970E-08	0.00E+00	0.00E+00
Ba-133	2.047E-09	0.00E+00	0.00E+00
Te-134	2.764E-04	2.22E+04	2.66E+04
Ce-139	5.828E-08	0.00E+00	0.00E+00
Hg-203	1.722E-07	0.00E+00	0.00E+00

APPENDIX A

CALCULATION OF ALLOWABLE RELEASE RATES FOR INDIAN POINT UNITS 2 and 3

Primary Assumptions:

1. Units 2 and 3 effective dose factors (KLMN) are equivalent, except for site-specific finite cloud correction, as required.

2. Each unit shares 50% of the total allowable release rate, $\dot{Q}$, in Ci/sec.
   Therefore, $\dot{Q}3 = \dot{Q}2$ for instantaneous releases.

Given the following long-term meteorological data:

Unit 1/2:

Unit 1 or 2 Release Points	Receptor	Concentration X/Q (sec/m³)	Finite-Cloud Gamma X/Q (sec/m³) - Xe133	Deposition D/Q (1/m²)
Primary Vent Releases	Site Boundary	2.219E-06 [SSW, 755 m]	1.974E-06 [SSW, 755 m]	1.407E-08 [SSW, 755 m]
	Nearest Residence	1.030E-06 [SSW, 1574 m]	9.714E-07 [SSW, 1574 m]	7.517E-09 [S, 1133 m]
Ground Level Releases	Site Boundary	2.873E-05 [SSW, 440 m]	1.215E-05 [SSW, 440 m]	8.759E-08 [SSW, 440 m]
	Nearest Residence	5.158E-06 [SSW, 1374 m]	3.068E-06 [SSW, 1374 m]	1.878E-08 [S, 933 m]

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Unit 3:

Unit 3 Release Point	Receptor	Concentration X/Q (sec/m³)	Finite-Cloud Gamma X/Q (sec/m³) - Xe133	Deposition D/Q (1/m²)
Primary Vent Releases	Site Boundary	4.473E-06 [SW, 350 m]	3.171E-06 [SSW, 480 m]	2.599E-08 [SSW, 480 m]
	Nearest Residence	1.016E-06 [SSW, 1574 m]	9.606E-07 [SSW, 1574 m]	7.451E-09 [S, 1133 m]
Ground Level Releases	Site Boundary	6.980E-05 [SSW, 250 m]	2.350E-05 [SSW, 250 m]	2.012E-07 [SSW, 250 m]
	Nearest Residence	5.158E-06 [SSW, 1374 m]	3.068E-06 [SSW, 1374 m]	1.878E-08 [S, 933 m]

CALCULATION OF ALLOWABLE RELEASE RATES FOR INDIAN POINT UNITS 2 and 3

Instantaneous Release Rates vs Dose Rates

Indian Point units 2 and 3 share a common site boundary limit of 500 mrem/yr. This 500 mrem/yr limit was divided between the units based upon a 50-50 split of the release rate in μCi/sec. Because each unit has its own X/Q and K-bar, equal μCi/sec discharges from each plant will result in different dose rates for each plant at the most restrictive site boundary location. In order to define the split of the 500 mrem/yr limit, IPEC units 2 and 3 must base the dose split on the mixture presented in Table 3-8.

Dose Split Between IP2 and IP3

A. Instantaneous Dose Rates and Calculation of Allowable Release Rate in uCi/sec:

i. Whole Body Dose Rate Calculations:

Given:

a) site limit is 500 mrem/yr

b) IP3 worst sector X/Q = 4.47E-6 sec/m^3

c) IP3 K-bar for instantaneous mixture = 849 $\frac{mrem \bullet m^3}{\mu Ci \bullet yr}$

d) IP2 worst sector X/Q = 2.22E-6 sec/m^3

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e) IP2 K-bar for instantaneous mixture = 1507 $\frac{mrem \bullet m^3}{\mu Ci \bullet yr}$

f) $\dot{Q}$ = μCi/sec

Solve for $\dot{Q}$:

$\dot{Q}$ [(X/Q_3) $(K\ bar_3)$ + (X/Q_2) $(K\ bar_2)$] = 500 mrem/yr

$\dot{Q}$ [(4.47E-6) (849) + (2.22E-6) (1507)] = 500 mrem/yr

Solving for $\dot{Q}$, a default back-calculated instantaneous release rate for either unit:

$$\dot{Q} = \mathbf{7.00E+4\ \mu Ci/sec}$$

In other words, if both units were releasing at this rate, with the default instantaneous mixture identified in Table 3-8, IPEC would be releasing at 500 mrem/yr (the RECS and 10CFR20 release rate limit).

Since this value assumes ALL releases are included (per unit), a partitioning factor should be applied for each applicable release point when this limit is used. Should it become necessary to "borrow" from the other unit, isotopic mixtures from specific sample results should replace the dose factors used in this default calculation. Without specific sample data, the default SITE release rate limit is then: **1.40E5 uCi/sec.**

APPENDIX A

CALCULATION OF ALLOWABLE RELEASE RATES FOR INDIAN POINT UNITS 2 and 3

ii. Skin Dose Rate Calculations:

Given:

a) site limit is 3,000 mrem/yr

b) IP3 worst sector X/Q = 4.47E-6 sec/m^3

c) IP3 (Li + 1.1 Mi) = 2306 $\frac{mrem \bullet m^3}{\mu Ci \bullet yr}$

d) IP2 X/Q for SSW sector = 2.22E-6 sec/m^3

e) IP2 (Li + 1.1 Mi) = 3071 $\frac{mrem \bullet m^3}{\mu Ci \bullet yr}$

f) $\dot{Q}$ = uCi/sec

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Solve for $\dot{Q}$:

$\dot{Q}$ [$(X/Q)_3$ (Li + 1.1 $Mi)_3$ + $(X/Q)_2$ (Li + 1.1 $Mi)_2$] = 3,000 mrem/yr

$\dot{Q}$ [(4.47E-6) (2306) + (2.22E-6) (3071)] = 3,000 mrem/yr

$\dot{Q}$ = 1.75E+5 µCi/sec (less restrictive than Whole Body)

iii. Solve for WB dose rate commitments per site (with $\dot{Q}$ = 7.00E+4 uCi/sec)

Indian Point 2:

(7.00E+4 µCi/sec) (2.22E-6 sec/m^3) (1507 $\frac{mrem \bullet m^3}{\mu Ci \bullet yr}$) = **234 mrem/yr**

Indian Point 3:

(7.00E+4 µCi/sec) (4.47E-6 sec/m^3) (849 $\frac{mrem \bullet m^3}{\mu Ci \bullet yr}$) = **266 mrem/yr**

The less restrictive skin dose rate limit for each unit (information only):

Unit 2: (1.75E+5 uCi/sec) (2.22E-6 sec/m^3) (3071 $\frac{mrem \bullet m^3}{\mu Ci \bullet yr}$) = 1194 mrem/yr

Unit 3: (1.75E+5 uCi/sec) (4.47E-6 sec/m^3) (2306 $\frac{mrem \bullet m^3}{\mu Ci \bullet yr}$) = 1806 mrem/yr

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CALCULATION OF ALLOWABLE RELEASE RATES FOR INDIAN POINT UNITS 2 and 3

RELEASE RATE LIMITS FOR QUARTERLY AND ANNUAL AVERAGE NOBLE GAS RELEASES

	For a Calendar Quarter	For a Calendar Year
Gamma air dose	5 mrad limit	10 mrad limit
Beta air dose	10 mrad limit	20 mrad limit

I. Assumptions:

1. Doses are delivered to the air at the site boundary.
2. Finite cloud geometry is assumed for noble gas releases at site boundary.
3. X/Q for Unit 2 = 2.22E-6 sec/m^3, ($\dot{Q}$ = release rate uCi/sec)
4. X/Q for Unit 3 = 4.47E-6 sec/m^3, ($\dot{Q}$ = release rate uCi/sec)
5. Gamma and Beta air dose factors (M and N), Corrected for finite cloud geometry (as described on Table 3-8) are as follows:

Unit 2 effective average dose factors	Unit 3 effective average dose factors	Units
$\overline{M}$ = 281	$\overline{M}$ = 181	mrad/yr per uCi/m^3
$\overline{N}$ = 1254	$\overline{N}$ = 1254	mrad/yr per uCi/m^3

II. Calculation of Quarterly Release Rates:

a) for gamma dose: ($\dot{Q}$)*[(M)(X/Q)] less than or equal to 5 mrad/qtr

b) for beta dose: ($\dot{Q}$)*[(N)(X/Q)] less than or equal to 10 mrad/qtr

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			unit 2	unit 3
gamma dose rate	$\dot{Q} = \frac{5mrad/qtr}{(1/4yr)(M)(X/Q)}$	=	3.21E+4 µCi/sec	2.47E+4 µCi/sec
beta dose rate	$\dot{Q} = \frac{10mrad/qtr}{(1/4yr)(N)(X/Q)}$	=	1.44E+4 µCi/sec	7.14E+3 µCi/sec

Based on the above analysis, the beta dose is limiting for time average doses. Therefore, the allowable quarterly average release rates are 1.44E+4 µCi/sec for unit 2 and 7.14E+3 µCi/sec for unit 3.

III. Calculation of Calendar Year Release Rate

Annual limits are one half of quarterly limits. Therefore, using Beta air dose as most limiting, the maximum annual average release rates are 7.20E+3 µCi/sec for unit 2 and 3.57E+3 µCi/sec for unit 3.

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CALCULATION OF ALLOWABLE RELEASE RATES FOR INDIAN POINT UNITS 2 and 3

ALLOWABLE INSTANTANEOUS RELEASE RATE for I-131 & Particulates w/ T½ > 8 DAYS)

Given: Wv(in): X/Q at the Site Boundary for IP3 = 4.47E-6 sec/m^3

Wv(in): X/Q at the Site Boundary for IP2 = 2.22E-6 sec/m^3

$$Pl(c) = 1.62\ E7\ \frac{mrem/yr}{\mu Ci/m^3}$$

Assumed Pathway: Child Inhalation at Unrestricted Area Boundary

Solve the following equation for $\dot{Q}$:

[($\dot{Q}$)Pl(c)(Wv(in)) Unit 3] + [($\dot{Q}$)Pl(c)(Wv(in)) Unit 2] = 1500 mrem/yr

IP3: $(\dot{Q})Pl(c)(Wv(in))3 = \dot{Q} * 1.62E7\ \frac{mrem/yr}{\mu Ci/m^3}\ 4.47E\text{-}6\ s/m^3 = \dot{Q} * 72.4\ \frac{mrem/yr}{\mu Ci/sec}$

IP2: $(\dot{Q})Pl(c)(Wv(in))2 = \dot{Q} * 1.62E7\ \frac{mrem/yr}{\mu Ci/m^3}\ 2.22E\text{-}6\ s/m^3 = \dot{Q} * 36.0\ \frac{mrem/yr}{\mu Ci/sec}$

9/05

The sum equals : (108) ($\dot{Q}$) mrem/yr per uCi/sec

Limit is 1500 mrem/yr per site:

Therefore: $108 * \dot{Q}\ \frac{mrem/yr}{\mu Ci/sec} = 1500$ mrem/yr

$\dot{Q}$ = 1.38E+1 µCi/sec (for each unit)

IP3 Dose Contribution: $1.38E+1\ \frac{\mu Ci}{sec} * 1.62E7 \frac{mrem}{yr}\frac{m^3}{\mu Ci} * 4.47E-6\frac{sec}{m^3}$ = 1003 mrem/yr

IP2 Dose Contribution: $1.38E+1\ \frac{\mu Ci}{sec} * 1.62E7 \frac{mrem}{yr}\frac{m^3}{\mu Ci} * 2.22E-6\frac{sec}{m^3}$ = 497 mrem/yr

Sum = 1500 mrem/yr

Approximately a 67 / 33 % dose split for IP3 and IP2 respectively.

APPENDIX A

CALCULATION OF ALLOWABLE RELEASE RATES FOR INDIAN POINT UNITS 2 and 3

ALLOWABLE RELEASE RATES FOR IODINE / PARTICULATE

TIME AVERAGE QUARTERLY AND ANNUAL DOSE LIMITS AT THE NEAREST RESIDENT

Dose factors for the child, thyroid (for Iodine 131) are used for this category as a conservative assumption since this nuclide has the highest thyroid dose factor of all iodines and particulates, and its most significant effect in on the child age group. The H-3 dose factor is about 4 orders of magnitude less significant and its contribution to the total dose is considered negligible. The back-calculated release rate for Iodine and Particulate is as follows:

Given:	Unit 2	Unit 3
X/Q (in sec/m^3 at the nearest resident)	1.03E-6	1.02E-6
D/Q (in m^{-2} at the nearest resident)	7.52E-9	7.45E-9

RI(c) = 1.62E+7 $\frac{mrem/yr}{\mu Ci/m^3}$, child thyroid inhalation dose factor for I-131 (for both units)

RG = 1.72E+7 m^2 $\frac{mrem/yr}{\mu Ci/sec}$, ground plane dose factor for I-131 (for both units)

RV(c) = 4.75E+10 m^2 $\frac{mrem/yr}{\mu Ci/sec}$, child thyroid vegetation dose factor for I-131 (for both units)

Calculating the allowable time average release rate by solving the following equation for $\dot{Q}$:

$\dot{Q}$ [(RIc)(X/Q) + (RG)(D/Q) + (RVc)(D/Q)] = limit in mrem/yr

	Unit 2	Unit 3
$\dot{Q}$ (RIc)(X/Q) in mrem/yr per uCi/sec =	16.7 * $\dot{Q}$	16.5 * $\dot{Q}$
$\dot{Q}$ (RG) (D/Q) in mrem/yr per uCi/sec =	0.129 * $\dot{Q}$	0.128 * $\dot{Q}$
$\dot{Q}$ (RVc)(D/Q) in mrem/yr per uCi/sec =	357 * $\dot{Q}$	354 * $\dot{Q}$
The sum for each unit (X * $\dot{Q}$) in mrem/yr per uCi/sec.	**374 * $\dot{Q}$**	**371 * $\dot{Q}$**

Quarterly time average limit is 7.5 mrem to any organ (or 30 mrem/yr). Solving for $\dot{Q}$ yields:

(IP2) $\dot{Q}$ * 374 $\frac{mrem/yr}{\mu Ci/sec}$ = 30 mrem/yr $\dot{Q}$ = 8.02E-2 µCi/sec **(Quarterly Limit)**

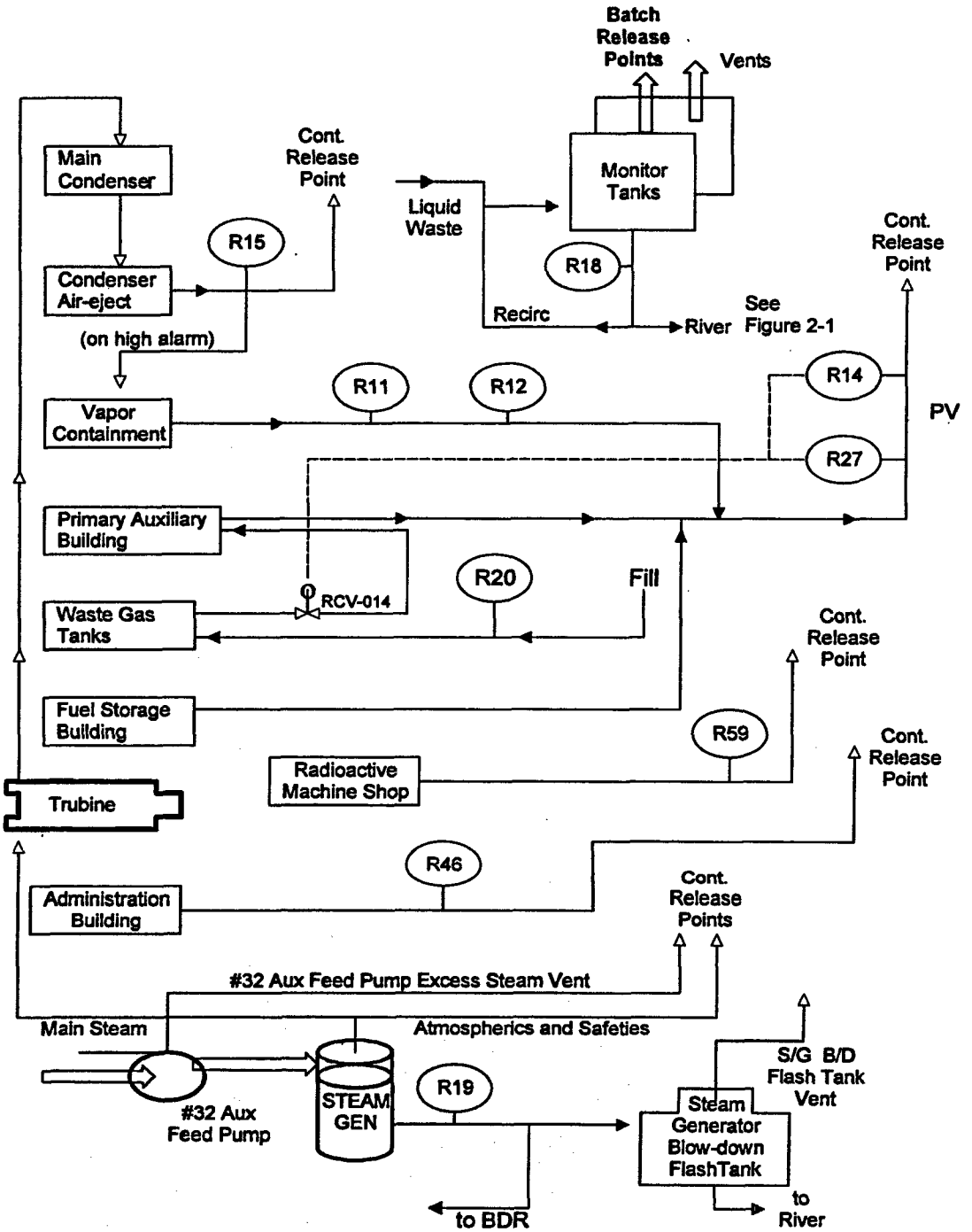
Annual limit is ½ quarterly limit, or 15 mrem to any organ/yr = 4.01E-2 µCi/sec **(Annual Limit)**

(IP3) $\dot{Q}$ * 371 $\frac{mrem/yr}{\mu Ci/sec}$ = 30 mrem/yr $\dot{Q}$ = 8.10E-2 µCi/sec **(Quarterly Limit)**

Annual limit is ½ quarterly limit, or 15 mrem to any organ/yr = 4.05E-2 µCi/sec **(Annual Limit)**

Figure 3-1

Gaseous Radioactive Waste Effluent System Flow Diagram



4.0 SAMPLE LOCATIONS

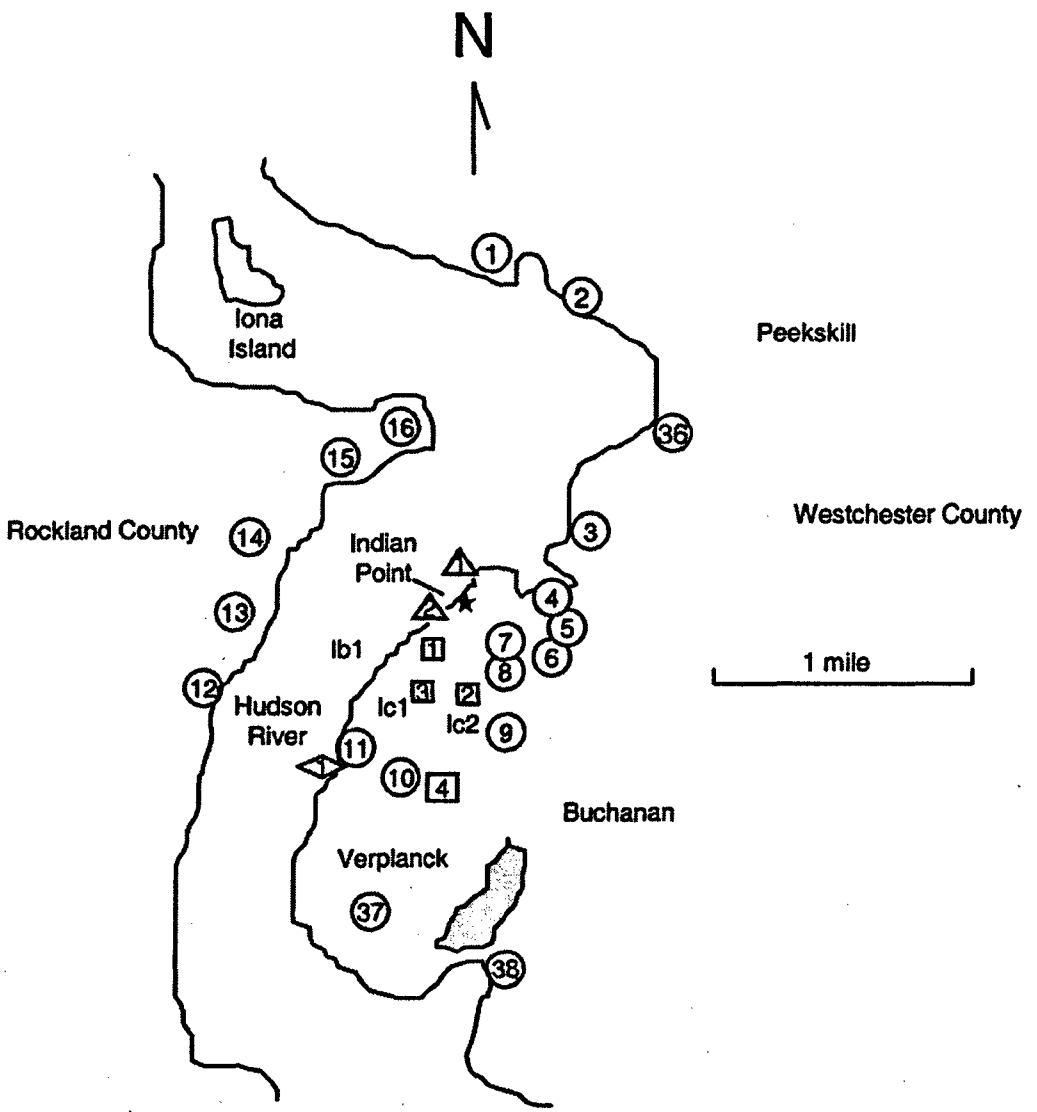
Figure 4-1 is a map which shows the location of environmental sampling points within 2 miles of the Indian Point Plant. Figure 4-2 is a map providing the same information for points at greater distances from the plant. Figure 4-3 shows environmental sample points not associated with the RECS.

Table 4-1 provides a description of all environmental sample locations and the sample types collected at each of these locations. The air sample locations were chosen considering the highest average annual D/Q sectors and the practicality of locating continuous air samplers.

FIGURE 4-1

ENVIRONMENTAL SAMPLING POINTS

RECS SAMPLING LOCATIONS
Within Two Miles of Indian Point



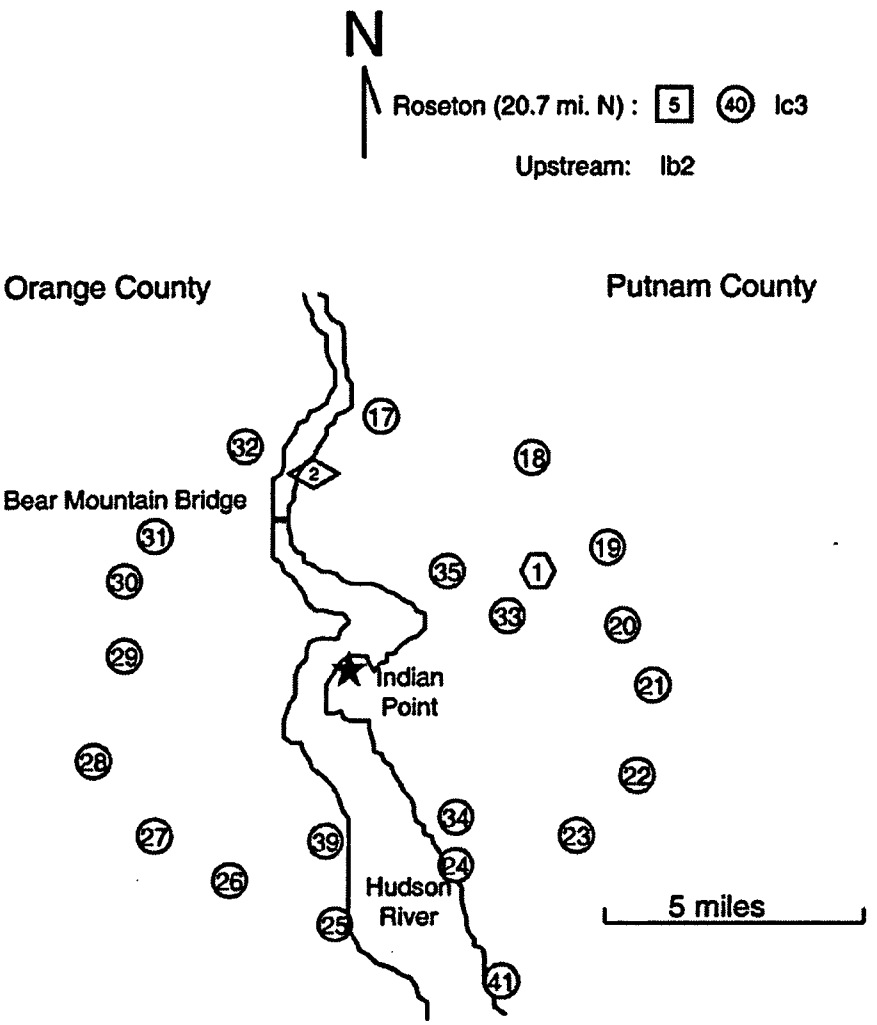
Key:
- △ - Waterborne: Surface (HR) Wa#
- O - Direct Radiation Sample Location DR#
- □ - Air Particulate & Radioiodine A#
- ◇ - HR Shoreline Sediment Wc#

lc# - Broadleaf Vegetation
lb1 - Fish and Invertebrates (where available downstream)

FIGURE 4-2

ENVIRONMENTAL SAMPLING POINTS

RECS SAMPLING LOCATIONS
Within Ten Miles of Indian Point



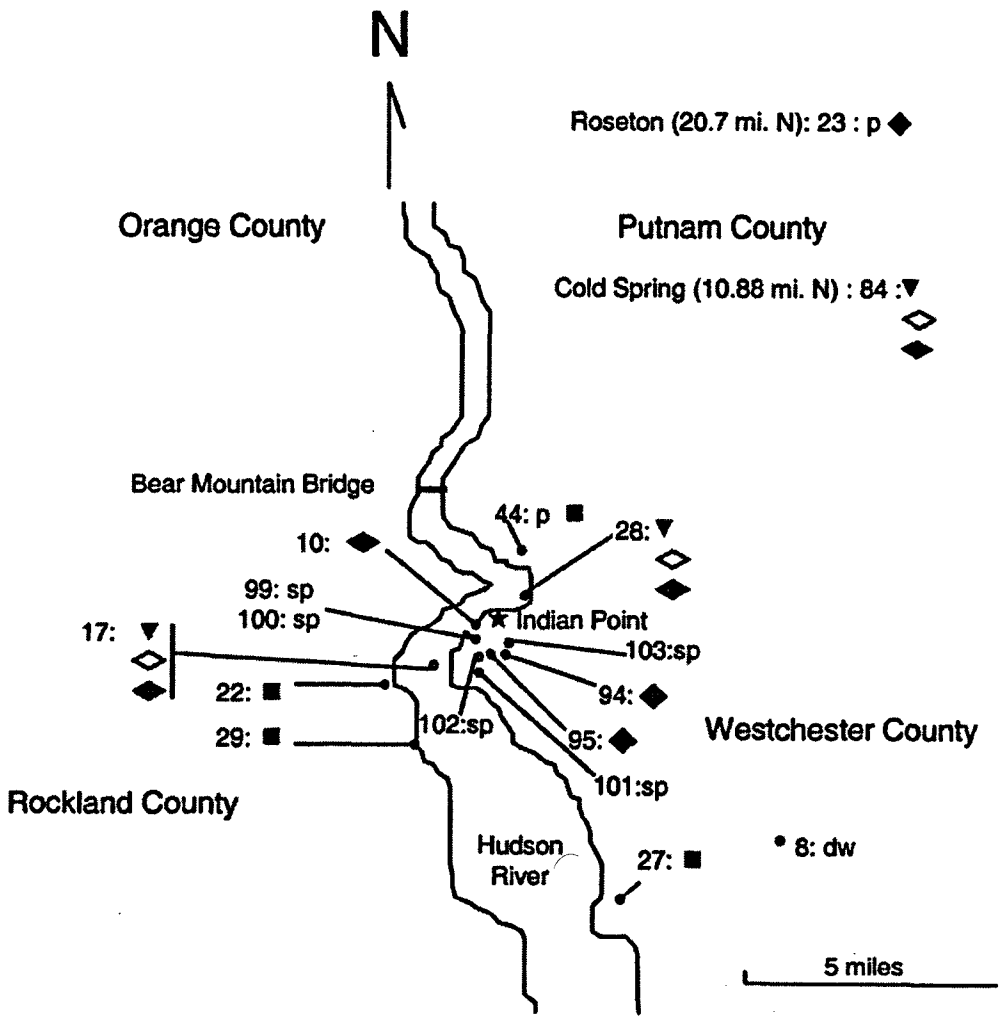
Key:
- ○ - Direct Radiation Sample Location DR#
- □ - Air Particulate & Radioiodine A#
- ◇ - HR Shoreline Sediment Wc#
- ⬡ - Waterborne: Drinking Wb#

lc3 - Broadleaf Vegetation
lb2 - Fish and Invertebrates (where available upstream)

FIGURE 4-3

ENVIRONMENTAL SAMPLING POINTS

NON RECS SAMPLING LOCATIONS



Key:

- ■ - Air Particulate & Radioiodine
- ▼ - Aquatic Vegetation
- ◆ - HR Bottom Sediment
- p - Precipitation
- ◇ - HR Shoreline Sediment
- ◆ - Soil
- sp - Special Water
- dw – Drinking Water

TABLE 4-1
(Page 1 of 4)

ENVIRONMENTAL SAMPLING POINTS

RECS SAMPLE DESIGNATION/ STATION	LOCATION	DISTANCE
DR1/57	Roa Hook	2.0 mi – N
DR2/59	Old Pemart Avenue	1.8 mi – NNE
DR3/90	Charles Point	0.88 mi – NE
DR4/28	Lents Cove	0.45 mi – ENE
DR5/35	Broadway and Bleakley Avenue	0.37 mi – E
DR6/88	Reuter-Stokes Pole #6	0.32 mi – ESE
DR7/14	Water Meter House	0.3 mi – SE
DR8/03	Service Center Building	0.35 mi – SSE
DR9/34	South East Corner of Site	0.52 mi – S
DR10/05	NYU Tower	0.88 mi – SSW
DR11/53	White Beach	0.92 mi – SW
DR12/74	West Shore Drive – South	1.59 mi – WSW
DR13/76	West Shore Drive – North	1.21 mi – W
DR14/78	Rt. 9W, across from R/S #14	1.2 mi – WNW
DR15/80	Rt. 9W - South of Ayers Road	1.02 mi – NW
DR16/82	Ayers Road	1.01 mi – NNW
DR17/58	Rt. 9D – Garrison	5.41 mi – N
DR18/60	Gallows Hill Road and Sprout Brook Road	5.02 mi – NNE
DR19/62	West Brook Drive (near the Community Center)	5.03 mi – NE
DR20/64	Lincoln Road – Cortlandt (School Parking Lot)	4.6 mi – ENE
DR21/66	Croton Ave. – Cortlandt	4.87 mi – E
DR22/67	Colabaugh Pond Rd. – Cortlandt	4.5 mi – ESE
DR23/69	Mt. Airy & Windsor Road	4.97 mi – SE
DR24/92	Warren Rd. – Cortlandt	3.84 mi – SSE
DR25/71	Warren Ave. – Haverstraw	4.83 mi – S
DR26/72	Railroad Ave. & 9W Haverstraw	4.53 mi – SSW
DR27/73	Willow Grove Rd. & Captain Faldermeyer Drive	4.97 mi – SW
DR28/81	Palisades Parkway, Lake Welch Exit	4.96 mi – WSW
DR29/77	Palisades Parkway	4.15 mi – W
DR30/79	Anthony Wayne Park	4.57 mi – WNW
DR31/75	Palisades Parkway	4.65 mi – NW
DR32/83	Rt. 9W Fort Montgomery	4.82 mi – NNW
DR33/33	Hamilton Street (Substation)	2.88 mi – NE
DR34/38	Furnace Dock (Substation)	3.43 mi – SE
DR35/89	Highland Ave. & Sprout Brook Rd. (near Rock Cut)	2.89 mi – NNE
DR36/61	Lower South Street and Franklin Street	1.3 mi – NE
DR37/56	Verplanck – Broadway & 6th St.	1.25 mi – SSW
DR38/20	Cortlandt Yacht Club (aka Montrose Marina)	1.5 mi – S
DR39/29	Grassy Point	3.37 mi – SSW
DR40/23	*Roseton	20.7 mi – N
DR41/27	Croton Point	6.36 mi – SSE

- Control Station

TABLE 4-1
(Page 2 of 4)

ENVIRONMENTAL SAMPLING POINTS

RECS SAMPLE DESIGNATION/ STATION	LOCATION	DISTANCE
	Airborne	
A1/4	Algonquin Gas Line	0.28 mi – SW
A2/94	IPEC Training Center	0.39 mi – S
A3/95	Meteorological Tower	0.46 mi – SSW
A4/5	NYU Tower	0.88 mi – SSW
A5/23	*Roseton	20.7 mi – N
	Waterborne – Surface (Hudson River Water)	
Wa1/9	*Plant Inlet (Hudson River Intake)	0.16 mi – W
Wa2/10	Discharge Canal (Mixing Zone)	0.3 mi – WSW
	Waterborne – Drinking	
Wb1/7	Camp Field Reservoir	3.4 mi – NE
	Soil From Shoreline	
Wc1/53	White Beach	0.92 mi – SW
Wc2/50	*Manitou Inlet	4.48 mi – NNW

Exposure Pathway/Sample: Milk

There are no milch animals whose milk is used for human consumption within 8 km distance of Indian Point; therefore, no milk samples are taken.

Exposure Pathway/Sample: Ingestion-Fish and Invertebrates

The RECS designate two required sample locations labeled Ib1/25 and Ib2/23. The downstream Ib1 location and samples will be chosen where it is likely to be affected by plant discharge. Ib2 will be a location upstream that is not likely to be affected by plant discharge. The following species along with other commercially/recreationally important species are considered acceptable:

Striped Bass	Pumpkin Seed	American Eel
Bluegill Sunfish	White Catfish	Crabs
White Perch	Blueback Herring	

Exposure Pathway/Sample: Ingestion-Food Products (Broad Leaf Vegetation)

Ic1/95	Meteorological Tower	0.46 mi - SSW
Ic2/94	IPEC Training Center	0.39 mi - S
Ic3/23	*Roseton	20.7 mi - N

*Control Station

TABLE 4-1
(Page 3 of 4)

ENVIRONMENTAL SAMPLING POINTS

RECS SAMPLE DESIGNATION/ STATION	LOCATION	DISTANCE	SAMPLE TYPES
DR8/3	Service Center Building	0.35 mi – SSE	3
A1/4	Algonquin Gas Line	0.28 mi – SW	1,2
A4, DR10/5	NYU Tower	0.88 mi – SSW	1,2,3
Wb1/7	Camp Field Reservoir	3.4 mi – NE	6
-/8	Croton Reservoir	6.3 mi - SE	6
Wa1/9	*Plant Inlet (Hudson River Intake)	0.16 mi - W	7
Wa2/10	Discharge Canal (Mixing Zone)	0.3 mi - WSW	7,8
DR7/14	Water Meter House	0.3 mi – SE	3
-/17	Off Verplanck	1.5 mi – SSW	8,9,10
DR38/20	Cortlandt Yacht Club (AKA Montrose Marina)	1.5 mi – S	3
-/22	Lovett Power Plant	1.6 mi – WSW	1,2
Ib2,A5,DR40,Ic3/23	*Roseton	20.7 mi – N	1,2,3,4,5,11,12
Ib1/25	where available, downstream	N/A	12
DR41/27	Croton Point	6.36 mi – SSE	1,2,3
DR4/28	Lents Cove	0.45 mi - ENE	3,8,9,10
DR39/29	Grassy Point	3.37 mi – SSW	1,2,3
DR33/33	Hamilton Street (Substation)	2.88 mi – NE	3
DR9/34	South East Corner of Site	0.52 mi – S	3
DR5/35	Broadway & Bleakley Avenue	0.37 mi – E	3
DR34/38	Furnace Dock (Substation)	3.43 mi – SE	3
-/44	Peekskill Gas Holder Building	1.84 mi – NE	1,2,11
Wc2/50	*Manitou Inlet	4.48 mi – NNW	10
Wc1, DR11/53	White Beach	0.92 mi – SW	3,10
DR37/56	Verplanck – Broadway & 6th Street	1.25 mi - SSW	3
DR1/57	Roa Hook	2.0 mi – N	3
DR17/58	Rt. 9D Garrison	5.41 mi – N	3
DR2/59	Old Pemart Ave.	1.8 mi – NNE	3
DR18/60	Gallows Hill Road and Sprout Brook Road	5.02 mi – NNE	3
DR36/61	Lower South Street and Franklin Street	1.3 mi – NE	3
DR19/62	West Brook Drive (near the Community Center)	5.03 mi – NE	3
DR20/64	Lincoln Road – Cortlandt (School Parking Lot)	4.6 mi – ENE	3
DR21/66	Croton Ave. – Cortlandt	4.87 mi – E	3
DR22/67	Colabaugh Pond Rd. – Cortlandt	4.5 mi – ESE	3
DR23/69	Mt. Airy & Windsor Road	4.97 mi – SE	3

* Control Station

TABLE 4-1
(Page 4 of 4)

ENVIRONMENTAL SAMPLING POINTS

RECS SAMPLE DESIGNATION/ STATION	LOCATION	DISTANCE	SAMPLE TYPES
DR25/71	Warren Avenue – Haverstraw	4.83 mi – S	3
DR26/72	Railroad Ave. & 9W – Haverstraw	4.53 mi – SSW	3
DR27/73	Willow Grove Rd. & Captain Faldermeyer Dr	4.97 mi – SW	3
DR12/74	West Shore Drive – South	1.59 mi – WSW	3
DR31/75	Palisades Parkway	4.65 mi – NW	3
DR13/76	West Shore Drive – North	1.21 mi – W	3
DR29/77	Palisades Parkway	4.15 mi – W	3
DR14/78	Rte. 9W, across from R/S #14	1.2 mi – WNW	3
DR30/79	Anthony Wayne Park	4.57 mi – WNW	3
DR15/80	Rte. 9W – South of Ayers Road	1.02 mi – NW	3
DR28/81	Palisades Parkway, Lake Welch Exit	4.96 mi – WSW	3
DR16/82	Ayers Road	1.01 mi – NNW	3
DR32/83	Rte. 9W – Fort Montgomery	4.82 mi – NNW	3
-/84	Cold Spring	10.88 mi – N	8,9,10
-/85	Quality Control		6
DR6/88	Reuter-Stokes Pole #6	0.32 mi – ESE	3
DR35/89	Highland Ave. & Sprout Brook Road (near rock cut)	2.89 mi – NNE	3
DR3/90	Charles Point	0.88 mi – NE	3
DR24/92	Warren Rd. – Cortlandt	3.84 mi – SSE	3
A2, lc2/94	IPEC Training Center	0.39 mi – S	1,2,4,5
A3, lc1/95	Meteorological Tower	0.46 mi - SSW	1,2,4,5
-/99	Algonquin outfall	0.34 mi - SW	13
-/100	Gypsum Plant Stream	0.34 mi - SW	13
-/101	5th Street Well – Verplanck	1.3 mi - S	13
-/102	Trap Rock Quarry	0.7 mi - SSW	13
-/103	IP3 Trailer Well	0.4 mi - S	13

Some sampling and some locations are in excess of RECS.

Sample types are:

1. Air particulates
2. Radioiodine
3. Direct gamma
4. Broadleaf vegetation
5. Soil
6. Drinking water
7. Hudson River (H.R.) water
8. H.R. bottom sediment-silt
9. H.R. aquatic vegetation
10. H.R. shoreline soil
11. Fallout
12. Fish and invertebrates
13. Special water, sample

APPENDIX B

DETECTION CAPABILITIES

The LLD is the smallest concentration of radioactive material in a sample that will be detected with 95% probability with 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{\frac{2.71}{T_s} + 3.29 s_b * \sqrt{1+(\frac{T_b}{T_s})}}{E * V * k * Y * e^{-\lambda t}}$$

where:

LLD = The lower limit of detection as defined above (as picocurie per unit mass or volume)

T_s = The sample counting time in minutes

s_b = The standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute)

T_b = The background count time in minutes

E = The counting efficiency (as counts per transformation)

V = The sample size (in units of mass or volume)

k = A constant for the number of transformations per minute per unit of activity (normally, 2.22E+6 dpm per μCi)

Y = The fractional radiochemical yield (when applicable)

λ = The radioactive decay constant for the particular radionuclide

t = The elapsed time between midpoint of sample collection and time of counting

Note: The above LLD formula accounts for differing background and sample count times. The IP3 Radiological Environmental Monitoring Program, REMP, uses an LLD formula that assumes equal background and sample count times, in accordance with the RECS. When the above LLD formula is more appropriate for the effluents program, it may be used.

The constants 2.71 and 3.29 and the general LLD equation were derived from the following two sources:

1) Currie, L.A. "Limits for Qualitative Detection of Quantitative Determination". (Anal. Chem. 40:586-593, 1968); and,

2) Mayer, Dauer "Application of Systematic Error Bounds to Detection Limits for Practical Counting". (HP Journal 65(1): 89-91, 1993)

The value of Sb used in the calculation of the LLD for a detection system shall be based on the actual observed variance of the background counting rate or of the counting rate of the blank samples (as appropriate) rather than on an unverified theoretically predicted variance. In calculating the LLD for a radionuclide determined by gamma ray spectrometry, the background shall include the typical contributions of other radionuclides normally present in the samples. Typical values of E, V, Y, and t shall be used in the calculation. The background count rate is calculated from the background counts that are determined to be within ± one FWHM (Full-Width-at-Half-Maximum) energy band about the energy of the gamma ray peak used for the quantitative analysis for that radionuclide.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement process and not as an a posteriori (after the fact) limit for a particular measurement.

To handle the a posteriori problem, a decision level must be defined. The remainder of Appendix B discusses the use of the Critical Level concept. Following an experimental observation, one must decide whether or not a real signal was, in fact, detected. This type of binary qualitative decision is subject to two kinds of error: deciding that the radioactive material is present when it is not (a: Type I error), and the converse, failing to decide that it is present when it is (b: Type II error). The maximum acceptable Type I error (a), together with the standard deviation, Snet, of the net signal when the net signal equals zero, establish the Critical Level, Lc, upon which decisions may be based.

Operationally, an observed signal, S, must exceed L_c to yield the decision, detected.

$$L_c = k_a s_b (1+T_b/T_s)^{0.5}$$

where:

k_a is related to the standardized normal distribution and corresponds to a probability level of 1-a. For instance, selection of a = 0.01 corresponds to a 99% confidence level that activity is present. When determining the Lc for different measurement processes, it is allowable to set a at less than or equal to 0.05 as long as the following condition is met:

To set a for L_c determination at less than 0.05, the equation for the LLD (which places a less than or equal to 0.05) should be employed to verify that the calculated LLD is less than or equal to the LLDs specified in the IP-3 RECS. This calculation, if necessary, will be performed on a case by case basis.