OFFSITE DOSE CALCULATION MANUAL

Consolidated Edison Company of New York, Inc.

Indian Point Units Nos. 1 & 2

Dockets Nos. 50-3 and 50-247

April 1983

INDIAN POINT UNIT NO. 2

OFFSITE DOSE CALCULATION MANUAL

TABLE OF CONTENTS

		PAGE
INTRODUCTION		1
GLOSSARY		2
1.0	LIQUID EFFLUENT METHODOLOGY	5
1.1	Liquid Effluent Model Assumptions	5
1.2	Determination of the Fraction (F) of 10CFR20 MPC Limits for Radioactive Liquid Releases	5
1.3	Determination of Setpoints for Radioactive Liquid Effluents	7
1.4	Determining the Dose from Radioactive Liquid Effluents	10
1.5	Projecting Dose for Radioactive Liquid Effluents	12
2.0	GASEOUS EFFLUENT METHODOLOGY	14
2.1	Gaseous Effluent Model Assumptions	14
2.2	Determining the Total Body and Skin Dose Rates for Noble Gas Releases and Establishing Setpoints for Effluent Monitors	16
2.3	Determining the Radioiodine and 8 Day Particulate Dose Rate To Any Organ From Instantaneous Gaseous Releases	21

INDIAN POINT UNIT NO. 2

OFFSITE DOSE CALCULATION MANUAL

TABLE OF CONTENTS
(Continued)

			PAGE
	2.4	Determining the Gamma Air Dose for Radioactive Noble Gas Releases	23
	2.5	Determining the Beta Air Dose for Radioactive Noble Gas Releases	26
	2.6	Determining the Radioiodine and 8 Day Particulate Dose To Any Organ From Cumulative Releases	27
	2.7	Projecting Dose For Radioactive Gaseous Effluents	29
3.0	40 CFR 190 Dose Evaluation		33

APPENDIX A: MPC, Dose Factor, Historical Meteorological Tables, Map of Unrestricted Areas, Sampling Locations and Maps

APPENDIX B: Limited Analysis Dose Assessment for Liquid Radioactive Effluents

APPENDIX C: Technical Bases for Effective Dose Factors

APPENDIX D: Derivation of LLD and Discussion of Background Considerations

APPENDIX E: Determination of Release Rate from the Steam Generator Blowdown and Purification System Flash Tank Vent and the Secondary Boiler Blowdown Purification System Flash Tank Vent

INDIAN POINT UNIT NO. 2

OFFSITE DOSE CALCULATION MANUAL (ODCM)

INTRODUCTION

This manual provides the methodology to calculate radiation doses to individuals in the vicinity of the Indian Point site due to routine releases of gaseous and liquid effluents from Unit 2. It also provides methodology for the determination of suitable effluent monitor setpoints and allowable release rates ensuring compliance with the Radiological Effluent Technical Specifications (RETS) of Consolidated Edison, Indian Point Unit 2 Docket No. 50-247. The ODCM implements the Standard Radiological Effluent Technical Specifications for Pressurized Water Reactors (NUREG-0472 Rev. 3 dated 9/3/82) and 10CFR20 release criteria. The ODCM Table of Contents indicates what sections of the ODCM should be used to calculate the dose to an individual.

The ODCM follows the methodology and models suggested by the "Guidance Manual For Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants" (NUREG-0133 dated October, 1978) and "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR PART 50, Appendix I" (Regulatory Guide 1.109 Rev. 1 dated October, 1977). Simplifying assumptions have been made and justified where applicable to provide a more workable document for implementing the Radiological Effluent Technical Specification requirements. Alternate calculational methods to those presented here may be used provided the overall methodology does not change or the results are not less conservative. Additionally, as available, the most up-to-date revision of the Regulatory Guide 1.109 dose conversion factors and site-specific environmental transfer factors may be substituted for those currently included and used in this document.

GLOSSARY

BETA	A beta particle (electron) - the dose from beta emitters in air, etc.
CC	Cubic Centimeter.
Ci	Curies - a unit of radioactivity equal to 3.7×10^{10} disintegrations/sec. See also micro curie (μCi).
C_i	Activity or concentration of a nuclide in the release source. Units of μCi, μCi/cc, or μCi/ml.
CFR	Code of Federal Regulations.
Dose	The energy deposited per unit mass in mrem or mrad, that the organ or the individual receives from radioactive effluents.
Dose Factor	Normally, a factor that converts the effect of ingesting radioactive material into the body, to dose to a specific organ. Body elimination, radioactive decay, and organ uptake are some of the factors that determine a dose factor for a given nuclide.
Dose Pathway	A specific path that radioactive material physically travels through prior to exposing an individual to radiation. The Grass-Cow Milk-Infant is a dose pathway.
Dose Rate	The dose received per unit time.
$\overline{(D/Q)}$	A long term D over Q - a factor with units of $1/m^2$ which describes the deposition of particulate matter from a plume at a point downrange from the source. It can be thought of as the part of the cloud that will fall out and deposit over one square meter of ground.
GAMMA	A gamma photon - the dose from Gammas in air etc.
Ground Plane	Radioactive material deposited uniformly over the ground emits radiation that produces an exposure pathway when an individual is standing, sitting, etc. in the area. It is assumed that an adult receives the same exposure as an infant, regardless of the physical height differences. Only the total body is considered for the ODCM.

GLOSSARY

(Continued)

H-3	Hydrogen-3, or Tritium, an isotope of hydrogen that is a weak BETA emitter.
I&8DP	Radioiodines and particulates with half-lives greater than 8 days.
LLD	The smallest concentration of radioactive material in a sample that will yield a net count, above systems background that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal, as defined in Appendix D.
LCO	Limiting Condition for Operation in RETS-IP2.
m^3	Cubic meters.
m^2	Square meters.
MPC	Maximum Permissible Concentration.
Nuclide	For the purposes of this manual, a radioactive isotope. Nuclide (i) signifies a specific nuclide, the 1st, 2nd, 3rd, etc. one under consideration. If nuclide (i) is I-131, then the M_i (dose factor) under consideration should be M_{I-131}, for example.
Organ	For the ODCM either the bone, liver, thyroid, kidney, lung, GI-LLI, skin, or the T. Body. T. Body (Total Body) is considered an organ for ease of writing the methodology in the ODCM.
$\dot{Q}_i$	Q_i - dotted - Denotes a release rate in µCi/sec for nuclide (i).
Q_i	Denotes μC_i of nuclide (i) released over a specified time interval.
Receptor	The individual receiving the exposure in a given location or who ingests food products from an animal for example. A receptor can receive dose from one or more pathways.
Release Source(s)	A subsystem, tank, or vent where radioactive material can be released independently of other radioactive release points.

GLOSSARY

(Continued)

RETS	The Indian Point Unit 2 Radioactive Effluent Technical Specifications.
μCi	Microcuries. 1 Ci = 10^6 μCuries. The μCi is the standard unit of radioactivity for all dose calculations in the ODCM.
$(\overline{X/Q})$	A long term Chi over Q. It describes the physical dispersion characteristics of a semi-infinite cloud of noble gases as the cloud traverses downrange from the release point.
$(\overline{X/Q})_D$	A long term depleted Chi over Q. It describes the physical dispersion characteristics of a semi-infinite cloud of radioactive iodines and particulates as the cloud travels downrange. Since iodines and particulates tend to settle out (fallout of the cloud) on the ground, the $(X/Q)_D$ represents what physically remains of the cloud and it's dispersion qualities at a given location downrange from the release point.

INDIAN POINT UNIT NO. 2

OFFSITE DOSE CALCULATION MANUAL (ODCM)

1.0 LIQUID EFFLUENT METHODOLOGY

1.1 Liquid Effluent Model Assumptions

The concentration of radionuclides in liquid waste is determined by sampling and analyses in accordance with Table 4.10-1 of the Radiological Effluent Technical Specifications. When a radionuclide concentration is below the lower limit of detection (LLD) for the analysis, it is not reported as being present in the sample.

All liquid discharges from Indian Point 2 are made through a common discharge canal with a minimum of 100,000 gpm dilution water.

1.2 Determination of the Fraction (F) of 10CFR20 MPC Limits for Radioactive Liquid Releases

Technical Specification 3.9.A.1.a necessitates the sampling and analysis of liquid wastes (prior to discharge), and that this information be treated in accordance with the methodology and parameters in the ODCM to assure that the concentration of liquid radioactive material released to Unrestricted Areas (See Figure in Appendix A) will not exceed the concentrations specified in 10CFR20, Appendix B, Table II, column 2 for radionuclides other than dissolved or entrained noble gases.

For dissolved or entrained noble gases, the concentration shall be limited to 2×10^{-4} µCi/ml.

Radioactive material in liquid effluent is diluted successively by water flowing in the discharge canal and in the Hudson River Estuary. The basic equations which determine the fraction F of the 10CFR20 MPC limits are as follows:

EQUATION 1.2-1 $$F = \sum_i F_i$$

EQUATION 1.2-2 $$F_i = \frac{C_{zi}}{(MPC)_i}$$

EQUATION 1.2-3 $$C_{zi} = C_i \frac{f_1}{f_2}$$

Where F	≡	Total or summed fraction of 10CFR20 MPC limits resulting from the release source being discharged.
F_i	≡	Fraction of MPC for nuclide of interest.
$(MPC)_i$	≡	Maximum Permissible Concentration of nuclide 'i' as specified in 10CFR20 Appendix B, Table II, Column 2 [μCi/ml]
C_{zi}	≡	Concentration of the i^{th} radionuclide in the receiving stream (diluted) [μCi/ml]
Ci	≡	Concentration of the i^{th} radionuclide in liquid radwaste release (undiluted) [μCi/ml]
f_1	≡	Release rate of liquid radwaste [ml/sec]
f_2	≡	Dilution flow of receiving stream of water [ml/sec]

For the purpose of calculating the radioactivity concentration, or total fraction 'F', in water at the restricted area boundary, the minimum flow in the discharge canal [100,000 gpm = 6.3×10^6 ml/sec] may be conservatively assigned to f_2. In the river immediately beyond the discharge canal and the restricted area boundary, hence the unrestricted area, the effective dilution is a minimum factor of 5 higher (in accordance with 10CFR PART 50, Appendix I submittal Volume 1 for IP-2) and therefore f_2 is (5) (6.3×10^6 ml/sec) = 3.15×10^7 ml/sec for the unrestricted area calculation.

The fraction of the 10CFR20 MPC limit can thereby be calculated on a per nuclide summed basis as indicated in equations 1.2.1, 1.2.2, and 1.2.3. A simpler, but more restrictive, calculation can be made by a cumulative activity evaluation. The cumulative activity evaluation uses an overall value of 1×10^{-7} μCi/ml (the unidentified MPC value) in lieu of $(MPC)_i$ and the cumulative concentration (sum of all identified radionuclide concentrations) or the gross beta/gamma concentration for C_i. As long as the diluted concentration C_{zi} is less than 1×10^{-7} μCi/ml, the nuclide-by-nuclide calculation is not required to demonstrate compliance with the 10CFR20 MPC limits.

1.3 Determination of Setpoints for Radioactive Liquid Effluent Monitors

Technical Specification 3.9.A.2.(a) requires that the radioactive liquid effluent monitors be operable and set to initiate an alarm or trip in the event that the limits of Technical Specification 3.9.A.1(a) are approached. The alarm and trip setpoints shall be determined and adjusted by the following method. See Appendix "D" for a discussion of background considerations. In all cases, the setpoint values shall be applied on top of normal background level.

The alarm setpoint for the liquid effluent radiation monitors is derived from the concentration limit provided in 10CFR PART 20 Appendix B Table 2 Column 2 applied at the restricted area boundary where the discharge canal flows into the river. The alarm setpoint does not consider dilution, dispersion, or decay of radioactive material beyond the site boundary. That is, the alarm setpoint is based on a concentration limit at the end of the discharge canal. The radiation monitoring and isolation points are located in each line through which radioactive waste effluent is eventually discharged into the discharge canal.

The alarm setpoint for each liquid effluent monitor is based upon measurement, according to Table 4.10-1 of R.E.T.S., of radioactivity in a batch of liquid to be released or in the continuous aqueous discharge. Alternately, the alarm setpoint may be based upon gross beta/gamma activity analysis of the liquid waste provided the unrestricted area MPC for unidentified emitters, $1 \times 10^{-7} \mu$Ci/ml, is observed. [As it is knows that I-129, Ra-226, and RA-228 are not present.]

1.3.1 Setpoint for a Batch Release

A sample of each batch of liquid radwaste is analyzed for I-131 and other principal gamma emitters, or for total activity concentration prior to release. The fraction F of the 10CFR PART 20 MPC limits for the unrestricted area is determined in accordance with the preceding section for the activity concentration to be released. In the event that total or gross beta/gamma (B-γ) analysis alone is used to determine the radioactivity in a batch prior to release, the fraction of the unrestricted area MPC in the batch is just:

EQUATION 1.3.1-1
$$F_{batch} = \frac{C_{iBATCH}}{1x10^{-7}}$$

Where $C_{i\,Batch}$ ≡ The total or gross beta/gamma (B-γ) activity measured in the batch sample [μCi/ml], not including H-3 and dissolved noble gases.

1×10^{-7} ≡ The unrestricted area MPC for unidentified radionuclides [μCi/ml], where is is known that I-129, Ra-226, and Ra-228 are not present.

The maximum concentration of a batch prior to discharge is not to exceed 1×10^{-3} μCi/ml (not including H-3 and dissolved noble gases). Whether radioiodine and primary gamma emitters are identified prior to a batch release or not, the liquid radwaste effluent line radiation monitor alarm setpoint is determined with the equation:

EQUATION 1.3.1-2 $$S_{Batch} = C_{i\,Batch}/f$$

Where

S_{Batch} ≡ Radiation monitor alarm setpoint [cpm]. *For a batch release

$C_{i\,Batch}$ ≡ As defined above

f ≡ Monitor calibration factor [μCi/ml / CPM]

Using a constant set point (nominal value = 100,000 cpm) and having a known batch activity [μCi/ml] in-plant procedures establish the flow rate for the radioactive effluent to be mixed with a known minimum dilution flow to keep the setpoint from being exceeded and to keep the MPC values from being reached. Where the activity concentration is high enough to limit the liquid effluent flowrate to less than its associated pump's ability to be throttled then it cannot be released and as such it must first be diluted in situ.

* The alarm setpoint shall not be set greater than 100,000 cpm (the region of maximum utility on the log scale), nor less than normal background.

1.3.2 Setpoint for a Continuous Release

The alarm setpoint of the radiation monitor on a continuous radioactive discharge line is determined with the equation.

EQUATION 1.3.2-1 $S_{cont} = Ci_{cont}/f$

or by a method which gives a lower setpoint value.

Where:

S_{cont} ≡ Radiation monitor alarm setpoint for continuous release.

Ci_{cont} ≡ The total or gross beta/gamma (B-) activity measured in the sample [Ci/ml] gases *.

f = Monitor calbration factor. [Ci/ml/CPm]

Using a constant setpoint and having a known continuous flow sample activity [Ci/ml] in-plant procedures establish the flowrates for the radioactive effluent to be mixed with a known minimum dilution flow to keep the setpoint from being exceeded and to keep the MPC values from being reached.

* If the measured sample activity is LLD, then the setpoint shall be set as close to normal background as possible. If the measured activity is $3x10^{-5}$ µCi/ml, then the continuous release shall be diverted to the secondary blowdown purification system.

1.4 Determining the Dose for Radioactive Liquid Effluents

Technical Specification 3.9.A.3.a requires calculations be performed at least once per 31 days to verify that cumulative radioactive liquid effluents do not cause a dose in excess of 1.5 mrem to the total body and 5 mrem to any organ. This section presents the calculational method to be used for this verification.

The method is based on the methodology suggested by sections 4.3 and 4.3.1 of NUREG-0133 Rev 1, Nov 1978. The dose factors are a composite of both the fresh water fish and shellfish pathways so that the fish-shellfish pathway is the only pathway for which dose will be calculated. For Indian Point Unit 2, the adult is the most limiting age group, but the dose for child, and teenager can also be calculated by this method provided that their appropriate dose factors are available for the organ of interest. Only those nuclides that appear in the Table 1-1 of this manual will be considered.

This method provides for a dose calculation to the total body or any organ for a given age group based on actual release conditions during a specified time interval for radioactive liquid release sources. The equation is

EQUATION 1.4-1

$$D_{l_\tau} = \frac{A_{i_\tau} \Delta t_l Q_{i_l}}{(DF)_l}$$

where:

D_{l_τ} ≡ Dose commitment in mrem received by organ τ of age group (to be specified) during the release time interval Δt_l.

A_{i_τ} ≡ The composite dose factor for the fresh water fish-shellfish pathway for nuclide (i) for organ of age group (to be specified). The A_{i_τ} values listed in the Table L-2 in this manual are independent of any site specific information and have the units $\left[\frac{\text{mrem-ml}}{\text{Ci-hr}}\right]$.

Δt_l ≡ The number of hours that the release occurs.

Q_{il} ≡ The total quantity of nuclide (i) released during the time period Δt_l (μCi).

$(DF)_l$ ≡ The total volume of dilution that occurred during the release time period Δt_l (ie, the circulating water flow multiplied by the time).

The doses associated with each release may then be summed to provide the cumulative dose over a desired time period (e.g. sum all doses for release during a 31 day period, calendar quarter, or a year).

EQUATION 1.4-2 $$D_{Total_\tau} = \sum_l D_{l\tau}$$

Where:

D_{Total_τ} ≡ The total dose commitment to the organ τ due to all releases during the desired time interval (mrem).

Based on the radionuclide distribution typical of radioactive effluents at Indian Point 2, the calculated doses to individuals are dominated by the radionuclides CS-134, CS-137, MN-54, ZN-65, and FE-55. These nuclides typically contribute over 95% of the critical organ dose, liver, in this case; and over 90% of the total body dose. Therefore, the dose commitment due to radioactivity in liquid effluents may be reasonably evaluated by limiting the dose calculational process to these radionuclides for the adult total body and adult liver dose. To allow for any unexpected variability in the radionuclide distribution a conservatism factor of 0.9 is introduced into the equation. After calculating the dose based on these 5 nuclides, the cumulative dose should be divided by 0.9, the conservatism factor. Refer to Appendix B for a detailed evaluation and explanation of this limited analysis approach.

1.5 Projecting Dose for Radioactive Liquid Effluents

Technical Specification 3.9.A.4.a. requires that appropriate subsystems of the liquid radwaste treatment system be used to reduce radioactive material in liquid effluents when the projected monthly dose due to liquid releases to unrestricted areas when averaged over 31 days would exceed 0.06 mrem to the total body or 0.2 mrem to any organ. Doses are to be projected at least once per 31 days. The method to be used is based on total body dose and critical organ dose (liver) as calculated in Section 1.4. The adult is the critical age group to be used for the dose projection.

TABLE 1-1

CALCULATON OF TOTAL Ci/YR RELEASES FOR LIQUIDS

ISOTOPE	79	80	81	AVERAGE
H-3	2.18 +02	2.75 +02	7.527 +02	4.15 +02
Sr-89	4.63 -03	3.48 -03	4.79 -03	4.30 -03
Sr-90	7.65 -03	2.61 -03	1.29 -03	3.85 -03
Cs-134	1.32 -01	8.64 -02	1.65 -01	1.28 -01
Cs-137	3.97 -01	1.96 -01	2.99 -01	2.97 -01
I-131	7.86 -02	1.31 -01	1.66 +00	6.24 -01
Co-58	2.10 -01	1.57 -01	7.04 -01	3.57 -01
Co-60	1.29 -01	1.19 -01	1.01 +00	4.19 -01
Fe-59	2.46 -02	1.72 -02	2.74 -02	2.30 -02
Zn-65	4.77 -02	1.63 -02	3.19 -02	3.19 -02
Mn-54	2.63 -02	1.76 -02	4.98 -02	3.12 -02
Cr-51	6.96 -02	6.10 -02	2.15 -01	1.15 -01
Zr-95	1.30 -02	1.36 -02	9.64-02	4.10 -02
Mo-99	1.01 -01	4.12 -02	3.26 -01	1.56 -01
Tc-99m	5.04 -03	2.65 -02	2.53 -02	1.90 -02
Ba-140	4.03 -02	3.75 -02	1.09 -01	6.21 -02
Ce-141	1.16 -02	7.74 -03	9.69 -02	3.87 -02
Cs-136	1.41 -03	1.21 -04	9.49 -02	3.21 -02
Fe-55	4.63 -01	6.57 -01	6.86 -01	4.63 -01
Ni-63	1.62 -01	5.28 -02	1.01 -01	1.05 -01
P-32	2.50 -02	2.50 -02	4.43 -02	3.14 -02
Co-57	----	3.77-04	6.50 -03	2.29 -03

2.0 GASEOUS EFFLUENT METHODOLOGY

2.1 Gaseous Effluent Model Assumptions

The unit primarily discharges gaseous effluent through a plant vent and elevated release stack. All gaseous effluent from possible sources of accidental releases of gaseous radioactivity external to the reactor containment (e.g. the spent fuel pit and waste handling equipment) is exhausted from the plant vent, which is monitored. Normal gaseous effluent streams, and effluent discharge points are tabulated in Table 2-1.

For the purpose of estimating offsite radionuclide concentrations and radiation doses, measured radionuclide concentrations in gaseous effluent and in ventilation air exhausted from the unit are used. Table 4.10-3 in the RETS identifies the specific radionuclides in gaseous discharges for which sampling and analysis is done. When a radionuclide concentration is below the LLD for the analysis, it is not reported as being present in the sample.

Dose calculations for RETS Sections 3.9.B.3.a and 3.9.B.4.a dose limit confirmation are normally calculated using historical meteorological data and receptor location(s) which yield calculated doses no lower than the real locations(s) experiencing the most exposure. Historical meterological data for use in performing dose calculations is provided in Appendix A. Real meteorological data factors are calculated and used in dose calculations for the annual Radiological Environmental Monitoring Report to the NRC. On-line meteorological data and hour-by-hour dose calculations are beyond the scope of this manual. Historical information and conservative receptor locations etc., are only used for ease of RETS Limiting Condition of Operation (LCO) dose limit calculations. Dose calculation for RETS dose limits may be performed using real meteorological data, real receptor locations, and sector wind frequency distribution if desired. Any dose calculations performed with real data should note the source of the data in the annual report. Only those radionuclides that appear in the gaseous effluent dose factor tables will be considered in any dose calculations.

2.1.1 Determination of Releases from Unmonitored Sources

This section describes methodology to be used in determining release rates from the Steam Generator Blowdown and Purification System Flash Tank Vent and the Secondary Boiler Blowdown Purification System Flash Tank Vent. This methodology is based on recommendations of NUREG-0133.

A determination of the release of radioiodine-131 via the flash tank vent can be made by calculating from a measured concentration in the secondary water by the following equation:

EQUATION 2.1.1-1 $$Q = \overline{C}\,[R_{SGB}]\,f_{FT}\,(1-SQ_{FTv})$$ where:

Q ≡ The release rate of radioiodine-131 from the steam generator flash tank vent, in [μC_i/sec]

$\overline{C}$ ≡ The concentration of radioiodine-131, in the secondary coolant water in [μC_i/ml]

R_{SGB} ≡ The steam generator blowdown rate to the flash tank, in [ml/sec]

f_{FT} ≡ The fraction of blowdown flashed in the flash tank determined from a heat balance taken around the flash tank at the applicable reactor power level.

SQ_{FT_v} ≡ The measured steam quality in the flash tank vent; or an assumed value of 0.85, based on NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Presurized Water Reactors (PWR-GALE Code).

The methodology to be used in solving for Q and f_{FT} is included in Appendix E.

If this method of determination of releases is used, the calculation should be made when changes in plant parameter are likely to induce significant changes in secondary water radioiodine concentrations. The calculated release shall be assumed at the latest calculated level until the next secondary water analysis is completed.

2.2 Determining the Total Body and Skin Dose Rates for Noble Gas Releases and Establishing Setpoints for Effluent Monitors

Technical Specification 3.9.B.1.a(i) limits the instantaneous dose rate from noble gases in airborne releases to less than 500 mrem/yr - total body, and less than 3000 mrem/yr - skin. Technical Specification 3.9.B.2.a requires that the gaseous radioactive effluent monitoring instrumentation be operable with alarm/trip setpoints set to ensure that these dose rate limits are not exceeded. The results of the sampling and analysis program of Technical Specification Table 4.10-3 are used to demonstrate compliance with these limits.

The following calculational method is provided for determining the instantaneous dose rates to the total body and skin from noble gases in airborne releases. The alarm/trip setpoints are based on the dose rate calculations. The Technical Specification LCO's apply to all airborne releases on the site but all releases may be treated as if discharged from a single release point for ease of calculation and without unduly reducing the conservatism of the calculation. Only those noble gases appearing in Table 2-2 will be considered. The calculational methods are based on Sections 5.1 and 5.2 of NUREG-0133, Nov 1978.

The equations are:

Total Body Dose Rate

EQUATION 2.2-1 $$DR_{TB} = \sum_i K_i \; \overline{(X/Q)} \; \dot{Q}_i$$

Skin Dose Rate

2.2.2 $$DR_{SKIN} = \sum_i [L_i + 1.1 M_i] \; \overline{(X/Q)} \; \dot{Q}_i$$

where

DR_{TB}	≡	Total body dose rate from noble gases in airborne releases [mrem/sec].
DR_{SKIN}	≡	Skin dose rate from noble gases in airborne releases [mrem/sec].
K_i	≡	The total body dose factor due to gamma emissions for each noble gas nuclide (i) reported in the release source. [mrem-m^3/μCi-SEC]
L_i	≡	The skin dose factor due to beta emissions for each noble gas nuclide (i) reported in the assay of the release source. [mrem-m^3/ μCi-SEC]
M_i	≡	The air dose factor due to gamma emissions for each noble gas nuclide (i) reported in the assay of the release source. The constant 1.1 converts 'mrad' to 'mrem' since the units of M_i are in: [mrad-m^3/ μCi-SEC]
$\overline{(X/Q)}$	≡	For ground level, the highest calculated annual long term historic relative concentration for any of the 16 sectors, at or beyond the exclusion area boundary [sec/m^3]
$\dot{Q}_i$	≡	The release rate of noble gas nuclide (i) from the release source of interest in [μC_i/sec]

2.2.1 Simplified Total Body Dose Rate Calculation

From an evaluation of past releases, an effective total body dose factor (K_{eff}) can be derived. This dose factor is, in effect, a weighted average total body dose factor (i.e. weighted by the radionuclide distribution typical of past operation). See Appendix 'C' for a detailed explanation and evaluation of K_{eff}. The value of K_{eff} has been derived from the radioactive noble gas effluents for the years 1979, 1980, and 1981. The value is:

K_{eff} = 1.29×10^{-5} [mrem-m³/μCi-sec] (Ground Release)

K_{eff} = 8.18×10^{-6} [mrem-m³/μCi-sec (Elevated* Release)

Either of these values, as appropriate, may be used in conjunction with the total noble gas release rate ($\sum_i Q_i$) to verify that the instantaneous dose rate is within the allowable limits. To compensate for any unexpected variability in the radionuclide distribution, a conservatism factor of 0.157 is introduced into the calculation. The simplified equation is

EQUATION 2.2.1-1
$$DR_{TB} = \frac{K_{eff}\ \overline{(X/Q)}}{0.157} \sum_i Q_i$$

To further simplify the determination the highest calculated annual long term historic relative concentration for any of the 16 sectors, at or beyond the exclusion area boundary (2.08×10^{-5} sec/m³, from Table M-1) may be substituted into the equation. Also the dose limit of 250 mrem/yr** = 7.925×10^{-6} mrem/sec may be substituted for DR_{TB}. Making these substitutions yields a single cumulative (or gross) noble gas release rate limit. This value is

Noble gas release rate limit = 4.673×10^{3} uCi/sec

As long as the noble gas release rates do not exceed this value (4.673×10^3 uCi/sec), no additional dose rate calculations are needed to verify compliance with Technical Specification 3.9.B.1.a(i).

* NOTE: Nuclide distributions for elevated releases were determined from releases through the plant stack as reported in Regulatory Guide 1.21 reports for the years 1979, 1980, and 1981. However, ODCM dose projection calculations are performed using ground release meteorology in accordance with Consolidated Edison's original Appendix I submittal, Docket Nos. 50-3, 50-247, and 50-286.

**This dose limit of 250 mrem/yr is based upon a regulatory limit of 500 mrem/yr/site and the fact that the Indian Point Site has 2 operating units.

2.2.2 Setpoint Determination

To comply with Technical Specification 3.9.B.2.a, the alarm/trip setpoints are established to ensure that the noble gas releases do not exceed the value of 4.73×10^4 μCi/sec, which conservatively corresponds to a total body dose rate of 500 mrem/yr. The method that follows establishes a procedure for determining setpoints. To allow for multiple sources of releases from different or common release points, the allowable operating setpoints will be administratively controlled to allocate a percentage of the total allowable release to each of the release sources.

a) Determine the maximum volume release rate potential for the release source under consideration.

b) Based upon that release rate [FT^3/MIN or other units of Vol/Time] determine the equivalent activity concentration in [μCi/CC] that would produce a release of 4.73×10^4 μCi/sec

c) Referring to the calibration curve [μCi/CC vs. CPM] for the Release Source's Gaseous Effluent Monitor, determine the CPM value (c) corresponding to the value of activity concentration determined in step b).

d) (C) represents the 100% setpoint assuming no other release sources at the site at the time. To obtain an operational setpoint value SP take (C) in [CPM] and multiply it by the allocated percentage fraction.

EQUATION 2.2.2-1

$$SP = (C)\ CPM \times \frac{\%\ \text{allocated for particular release}}{100\%}$$

The total body dose is more limiting than the calculated skin dose. (See Appendix 'C' for a detailed evaluation.) Therefore, the skin dose rate calculations are not required if the simplified dose rate calculation is used (i.e. using K_{eff} to determine release rate limits).

The calculational processes of the following section (2.2.3) are to be used if the actual releases of noble gases exceed the predetermined limit of 4.73×10^4 μCi/sec.

Under these conditions, a nuclide-by-nuclide evaluation is required to evaluate compliance with the dose rate limits of Technical Specification 3.9.B.1.a(i).

2.2.3 Total Body and Skin Nuclide Specific Dose Rate Calculations

The methods described herein need only be used if the actual releases exceed the value of 4.73×10^4 μCi/sec.

Total Body Dose Rate

EQUATION 2.2.3-1 $$DR_{TB} = \sum_i DR_{TBi} = \sum_i K_i \ (\overline{X/Q}) \ \dot{Q}_i$$

where

DR_{TB} ≡ Dose rate to the Total Body from all noble gas gamma radiation [mrem/sec].

DR_{TBi} ≡ Dose rate to the Total Body from the i^{th} nuclide noble gas gamma radiation [mrem/sec].

K_i ≡ The Total Body dose factor due to gamma emissions from noble gas radionuclide 'i', mrem-m^3/μCi-sec.

$\overline{X/Q}$ ≡ Value of CHI over Q [Sec/m^3] for the most limiting sector at the exclusion area boundary.

$\dot{Q}_i$ ≡ Release rate of the i^{th} nuclide in [μCi/Sec].

Total Skin Dose Rate

EQUATION 2.2.3-2 $$DR_{SKIN} = \sum_i DR_{SKIN} = \sum_i [Li + 1.1 \ Mi] \ (\overline{X/Q}) \ Qi$$

where

DR_{SKIN} ≡ Dose rate to skin from all noble gas beta and gamma radiation [mRem/sec].

DR_{SKIN} ≡ Dose rate to skin from the i^{th} nuclide noble gas beta and gamma radiation [mRem/sec].

Li ≡ The skin dose factor due to beta emissions from noble gas radionuclide 'i' [mrem-m^3/ μCi-sec.]

Mi ≡ The air dose factor due to gamma emissions from noble gas radionuclide 'i' [mRad-m^3/ μCi-sec.]

1.1 ≡ Conversion factor for Mi from mRad to mRem.

$\overline{X/Q}$ ≡ As defined above.

Qi ≡ As defined above

The dose rate contribution of this release source shall be added to all other simultaneous gaseous release sources, if any, to determine overall Total Dose Rate to the Total Body and Skin from noble gas effluents.

2.3 Determining the Radioiodine and 8 Day Particulate Dose Rate to any Organ from Instantaneous Gaseous Releases

Technical Specification 3.9.B.1.a (ii) limits the dose rate from radioiodines and particulates with half lives greater than 8 days to 1,500 mrem/yr to any organ. The following calculational method is provided for determining the dose rate from radioiodines and particulates. It is based on NUREG-0133, November, 1978; Sections 5.2.1, and 5.2.1.1 through 5.2.1.3.

The infant is the controlling age group for the contaminated forage/cow/milk pathway. There is no controlling age group for the ground plane deposition pathway. Children is the controlling age group for the inhalation pathway. These three pathways are the only ones considered for instantaneous releases. The long term ($\overline{X/Q}$) Depleted and ($\overline{D/Q}$) values are based on historical meteorological data. Only those nuclides that appear on Table G-4 will be considered. The equations are:

Inhalation Pathway

EQUATION 2.3-1 $$DR_{I\&8DP_\tau} = \sum_i R_{i_\tau} \, \overline{(X/Q)}_D \, \dot{Q}_i$$

Ground Plane Deposition Pathway

EQUATION 2.3-2 $$DR_{I\&8DP_\tau} = \sum_i P_{i_\tau} \, \overline{(D/Q)} \, \dot{Q}_i$$

Contaminated Forage/Cow/Milk Pathway

EQUATION 2.3-3 $$DR_{I\&8DP_\tau} = \sum_i R_{i_\tau} \, \overline{(D/Q)} \, \dot{Q}_i$$

Total Dose Rate From I&8DP

EQUATION 2.3-4 $$DR_\tau = \sum_i DR_{I\&8DP_\tau}$$

where:

τ ≡ The organ of interest for the age group of interest.

z ≡ All the applicable pathways.

$DR_{I\&8DP_\tau}$ ≡ Dose rate to the organ τ for the age group of interest from iodines and 8 day particulates via the pathway of interest in [mrem/yr].

DR_τ ≡ Total dose rate to organ τ from all applicable pathways for the age group of interest in [mrem/yr].

R_{i_τ} ≡ The dose factor for nuclide (i) for organ τ for the pathway specified [units vary with pathway].

P_{i_τ} ≡ The dose factor for instantaneous ground plane pathway in [mrem-m^2 Sec/ μCi-yr].

From an evaluation of the radioactive releases and environmental pathways, the contaminated forage/cow/milk pathway has been identified as the most limiting pathway with infant's thyroid being the most critical organ. This pathway contributes, on the average, greater than 93% of the total dose received by the infant's thyroid and the radioiodines contribute essentially all of this dose. Therefore, it is possible to demonstrate compliance with the release rate limit of Technical Specification 3.9.B.1.a(ii) for radioiodines and particulates by only evaluating the infant's thyroid dose for the release of radioiodines via the contaminated forage/cow/milk pathway. If this limited analysis approach is used, the dose calculations for other radioactive particulate matter and other pathways need not be performed with only the calculation for radioiodines from the contaminated forage/cow/milk pathway being performed to demonstrate compliance with the Technical Specification dose rate limit.

Including a conservatism factor of 0.8 for atypical radioisotope distribution and dose contribution, the simplified dose rate equation

EQUATION 2.3-4

$$DR_{Thyroid} = (\overline{D/Q}) \sum_{iodines} R_{i\,Thyroid} \; \dot{Q}_i \; / \; 0.8$$

2.4 Determining the Gamma Air Dose for Radioactive Noble Gas Release Source(s)

Technical Specification 3.9.B.3.a limits the yearly dose due to noble gases in the gaseous effluent to less than 10 mRem to the whole body from gamma. This is equivalent to a yearly air dose limit of less than 10 mRad. The following calculation method is provided for determining the noble gas gamma air dose and is based on Section 5.3.1 of NUREG-0133, November 1978. The dose calculation is independent of any age group. The equation may be used for RETS dose calculation, the dose calculation for the annual report, or for projecting dose, provided that the appropriate value of $(\overline{X/Q})$ is used. The equation for gamma air dose is:

EQUATION 2.4-1

$$D_{Gamma-Air} = \sum_i M_i \; (\overline{X/Q}) \; Q_i$$

where

D_{Gamma}-Air	≡	The gamma air dose from radioactive noble gases in [mRad]
Mi	≡	The gamma air dose factor for radioactive noble gas nuclide 'i' in [mRad-m^3/ μCi-SEC] (See Table G-3 in Appendix 'A')
$(\overline{X/Q})$	≡	The long term atmospheric dispersion factor for ground level releases (worst case) in [sec/m^3]. The value of $(\overline{X/Q})$ is the same for all nuclides (i) in the dose calculation, but the value of $(\overline{X/Q})$ does vary depending on the limiting sector that the LCO is based on. See Historical Average X/Q Tables in Appendix A.
Qi	≡	The number of uCi of nuclide 'i' released (or projected) during the dose calculation exposure period. (e.g., month, quarter, or year).

From an evaluation of past releases, a single effective gamma air dose factor (M_{eff}) has been derived, which is representative of the radionuclide abundances and coresponding dose contributions typical of past operation. (See Appendix C for a detailed explanation and evaluation of M_{eff}). The value of M_{eff} has been derived from the radioactive noble gas effluents for the years 1979, 1980, and 1981. The value is

M_{eff} = 1.43×10^{-5} mrad-m^3/ μCi-sec (GROUND RELEASE)

M_{eff} = 9.25×10^{-6} mrad-m^3/ μCi-sec (ELEVATED RELEASE)

The effective gamma air dose factor may be used in conjunction with the total noble gas release ($\sum_i Qi$) to simplify the dose evaluation and to verify that the cumulative gamma air dose is within the equivalence of the limits of Technical Specification 3.9.B.3.a(i). To compensate for any unexpected variability in the radionuclide distribution, a conservatism factor of 0.8 is introduced into the calculation. The simplified equation is

EQUATION 2.4-2 $$D_{Gamma-Air} = \frac{(M_{eff})\ (\overline{X/Q})}{0.8} \sum_i Qi$$

For purposes of calculations, the appropriate meteorological dispersion ($\overline{X/Q}$) should be used. Technical Specification surveillance requirement 4.10.B.4 states that the doses must be evaluated once per 31 days (i.e., monthly). The yearly dose limit is 10 mRads, which corresponds to a monthly allotment of 0.83 mRads. If the .83 mRads is substituted for $D_{Gamma-Air}$, a cumulative noble gas monthly release objective can be calculated. This value is 2,232 Ci/month noble gases. (Based on a ($\overline{X/Q}$) of 2.08×10^{-5} sec/m^3 and a ground release value of M_{eff})

As long as this value is not exceeded in any month, no additional calculations are needed to verify compliance with the quarterly noble gas release limits of Technical Specification 3.9.B.3.a (a). Also, the gamma air dose is more limiting than the beta air dose. Therefore, the beta air dose determined in accordance with Section 2.5 need not be calculated if the M_{eff} dose factor is used to determine the gamma air dose. See Appendix 'C' for a detailed evaluation and explanation.

The calculations of Section 2.5 may be omitted when this limited analysis approach is used but should be performed if the radionuclide specific dose analysis is performed. Also, the radionuclide specific calculations will be performed for inclusion in the annual radiological environmental monitoring report.

When performing the complete radionuclide specific dose calculation, e.g., when the monthly noble gas release exceeds 2,232 Ci, the unsimplified form of the equation, previously mentioned is used.

2.5 Determining the Beta Air Dose for Radioactive Noble Gas Releases

Technical Specification 3.9.B.3.a limits the yearly dose due to noble gases in the gaseous effluent to less than 20 mRems to the skin from beta. This is equivalent to a yearly air dose limit of less than 20 mRad. The following calculational method is provided for determining the beta air dose and is based on Section 5.3.1 of NUREG-0133, November 1978. The dose calculation is independent of any age group. The equation may be used for RETS dose calculation for annual reports, or for projecting dose, provided that the appropriate value of $(\overline{X/Q})$ is used.

The equation for beta air dose is

EQUATION 2.5-1 $$D_{Beta\text{-}Air} = \sum_i Ni\ (\overline{X/Q})\ Qi$$

where,

$D_{Beta\text{-}Air}$ ≡ Beta air dose from radioactive noble gases in [mRad].

Ni ≡ The beta air dose factor for radioactive noble gas nuclide 'i' in mrad-m^3/μCi-SEC (See Table G-3 in Appendix A).

$(\overline{X/Q})$ ≡ The long term atmospheric dispersion factor for ground level releases in [sec/m^3]. The value of (X/Q) is the same for all nuclides 'i' in the dose calculation, but the value of $(\overline{X/Q})$ does vary depending on the limiting sector the LCO is based on.

Qi ≡ The number of uCi of nuclide 'i' released (or projected) during the dose calculation exposure period.

The beta air dose need not be evaluated if the more conservative and limiting noble gas gamma air dose is evaluated by the use of the effective gamma air dose factor (M_{eff}). However, if the nuclide specific dose calculation is used to evaluate compliance with the gamma air dose limits (Section 2.4); then the beta air dose should also be evaluated on a nuclide specific basis.

2.6 Determining the Radioiodine and 8 Day Particulate Dose to any Organ from Cumulative Releases

Technical Specification 3.9.B.4.a(i) limits the dose to the total body or any organ resulting from the release of radioiodines and particulates with half-lives greater than 8 days to less than 7.5 mrem/quarter. The following calculational method is provided for determining the critical organ dose due to releases of radioiodines and particulates. It is based on Section 5.3.1 of NUREG-0133, November 1978. The equation can be used for any age group provided that the appropriate dose factors are used and the total dose reflects only those pathways that are applicable to the age group. The symbol $(\overline{X/Q})_D$ represents a depleted $(\overline{X/Q})$ which is different from the Noble Gas $(\overline{X/Q})$ in that $(\overline{X/Q})_D$ takes into account the loss of iodines, 8 day particulates and tritium from the plume as the semi infinite cloud travels over a given distance. The dispersion factor, $(\overline{D/Q})$, represents the rate of fallout from the cloud that affects a square meter of ground at various distances from the site. The total dose to an organ can then be determined by summing the pathways that apply to the receptor in the sector. The equations are:

Inhalation Pathway

EQUATION 2.6-1 $$D_{I\&8DP_\tau} = \sum_i 3.17 \times 10^{-8} \; R_{i\tau} \, (\overline{X/Q})_D \, Q_i$$

Ground Plane Pathway

EQUATION 2.6-2 $$D_{I\&8DP_\tau} = \sum_i 3.17 \times 10^{-8} \; R_{i\tau} (\overline{D/Q}) \, Q_i$$

Contaminated Forage/Cow/Milk Pathway

EQUATION 2.6-3 $$D_{I\&8DP_\tau} = \sum_i 3.17 \times 10^{-8} \; R_{i\tau} (\overline{D/Q}) \, Q_i$$

Total Dose

EQUATION 2.6-4 $$D_\tau = \sum_\tau D_{I\&8DP_\tau}$$

where

τ	≡	The organ of interest in a specified age group.
z	≡	All the applicable pathways for the age group of interest.
$D_{I\&8DP\tau}$	≡	Dose in mrem to the organ τ of a specified age group from radioiodines and 8 day particulates due to a particular pathway.
D_{τ}	≡	Total dose in mrem to the organ τ of a specified age group from gaseous Iodine and Particulate Effluents.
3.17×10^{-8}	≡	The inverse of the number of seconds per year in [years/sec]
$R_{i\tau}$	≡	The dose factor for nuclide (i) for pathway z to organ τ of the specified age group. The units are either, $\frac{mrem - m^3}{yr - \mu Ci}$ for pathways using $(\overline{X/Q})_D$ or $\frac{mrem - m^2 - Sec}{yr - \mu Ci}$ for pathways using $(\overline{D/Q})$.
$(\overline{X/Q})_D$	≡	The depleted (X/Q) value for a specific location where the receptor is located. The units are [sec/m^3].
(D/Q)	≡	The deposition value for a specific location where the receptor is located. The units are [m^{-2}].
Qi	≡	The number of micro-curies of nuclide (i) released (or projected) during the dose calculation exposure period.

As discussed in Section 2.3, the contaminated forage/cow/milk pathway has been identified as the most limiting pathway with the infant's thyroid being the most critical organ and age group. This pathway contributes, on average, over 90% of the total dose received by infant's thyroid and the radioiodines contribute essentially all of this dose. Therefore, it is possible to demonstrate compliance with the dose limit of Technical specification 3.9.3.4.a(i) for radioiodines and particulates by only evaluating the infant's thyroid dose due to the release of radioiodines via the contaminated forage/cow/milk pathway. The calculational method to be used includes a conservatism factor of 0.8 which assures that the calculated dose is always greater than or equal to the actual dose despite possible atypical distributions of radionuclides in the gaseous effluent. However, for the dose assessment included in the Annual Radiological Environmental Monitoring Report, doses will be evaluated for all designated age groups and organs via all designated pathways from radioiodines and particulates measured in the gaseous effluents according to the sampling and analyses required by Technical Specification Table 4.10-3. The simplified dose equation reduces to:

EQUATION 2.6-5

$$D_{INFANT\ THYROID} = [3.17 \times 10^{-8}\ (\overline{D/Q}) \sum_{iodines} Ri_{INFANT\ THYROID}\ Qi]\ /0.8$$

2.7 Projecting Dose for Radioactive Gaseous Effluents

Technical Specification 3.9.B.5.9 requires that the gaseous radwaste treatment system be used to reduce radioactive material in waste prior to discharge when the projected dose due to gaseous effluents would exceed 0.2 mRad for gamma radiation and 0.4 mRad for beta radiation in a 31 day period. The follow methods may be used for determining projected doses.

A formal dose projection would be based on the latest results of the monthly calculations of the gamma air dose (Section 2.4) and the beta air dose, if performed (Section 2.5). The doses calculated would be divided by the number of days that the plant was operational during that month. The per-day doses (gamma and beta) would be multiplied by the number of days the plant is projected to be operational during the coming month. The product is the projected dose for the coming month. Its value may need to be adjusted to account for any changes in operating conditions that could significantly alter the actual releases, such as failed fuel.

A simpler approach could be based on a linear extrapolation of the most recent 3 month's dose for the coming month, as long as the limits of Technical Specification 3.9.B.5.a are not reached.

TABLE 2-1

ATMOSPHERIC GASEOUS RELEASE POINTS
AT THE
INDIAN POINT UNIT 2 PLANT

EFFLUENT SOURCE	RELEASE POINT
Gas Decay Tanks	Plant Vent
Spent Fuel Pit	Plant Vent
Radwaste Handling Equipment	Plant Stack
Condenser Air Ejectors	Top of Turbine Bldg.
Steam Generator Blowdown	Steam Generator Blowdown Flash Tank Vent or Support Facilities Secondary Boiler Blowdown Flash Tank Vent

TABLE 2-2

RADIONUCLIDE DISTRIBUTION OF GROUND AND ELEVATED RELEASES

RADIONUCLIDE	FRACTION OF TOTAL RELEASES					
	GROUND			ELEVATED		
	1979	1980	1981	1979	1980	1981
Kr-85	.037	.100	.042	.648	.215	.518
Kr-85m	.003	.002	.006	.001	.001	.008
Kr-87	----	----	.003	.011	----	.003
Kr-88	.003	.002	.010	.001	----	.002
Xe-131m	.006	.026	.010	.064	.029	.023
Xe-133m	.002	.007	.011	.009	.007	.012
Xe-133	.907	.842	.862	.243	.748	.411
Xe-135m	----	.001	----	.001	----	.002
Xe-135	.033	.017	.052	.022	----	.006
Xe-137	----	.003	.001	----	----	----
Xe-138	----	----	----	----	----	.014

3.0 40 CFR 190 DOSE EVALUATION

Technical Specifications require that the dose or dose commitment to a real individual from all uranium fuel cycle sources be limited to ≤ 25 mRem to the total body or any organ (except thyroid which is limited to ≤ 75 mRem) over a period of 12 consecutive months. The following approach should be used to demonstrate compliance with these dose limits. It is based on NUREG-0133, Section 3.8.

3.1 Evaluation Bases

Dose evaluation to demonstrate compliance with the above dose limits need only be performed if the quarterly doses calculated in Sections 1.4, 2.4 and 2.6 exceed twice the dose limits of Technical Specifications 3.9.A.3.a(i), 3.9.B.3.a(i) and 3.9.B.4.a(i), respectively, ie., quarterly doses exceeding 3 mrem to the total body (liquid releases), 10 mrem to any organ (liquid releases), 10 mrads equivalent gamma air dose, 20 mrads equivalent beta air dose, or 15 mrem to the thyroid or any organ from radioiodines and particulates (atmospheric releases). Otherwise, no evaluations are required and the remainder of this secion can be omitted.

3.2 Doses From Liquid Releases

For the evaluation of doses to real individuals from liquid releases, the same calculational method as employed in Section 1.4 will be used. However, more realistic assumptions will be made concerning the dilution and ingestion of fish and shellfish by individuals who live and fish in the area. Also, the results of the Radiological Environmental Monitoring program will be included in determining more realistic dose to these real people by providing data on actual measured levels of plant related radionuclides in the environment.

3.3 Doses From Atmospheric Releases

For the evaluation of doses to real individuals from the atmospheric releases, the same calculational methods as employed in Section 2.4 and 2.6 will be used. In Section 2.4, the total body dose factor (K_i) should be substituted for the gamma air dose factor (M_i) to determine the total body dose. Otherwise the same calculational sequence applies. However, more realistic assumptons will be made concerning the actual location of real individuals, the meteorological conditions, and the consumption of food (eg, milk). Data obtained from the latest land use census (Technical Specification 3.12.2) should be used to determine locations for evaluating doses. Also, the results of the Radiological Environmental Monitoring program will be included in determining more realistic doses to these real people by providing data on actual measured levels of radioactivity and radiation at locations of interest.

INDIAN POINT UNITS Nos. 1 & 2

OFFSITE DOSE CALCULATION MANUAL (ODCM)

APPENDIX A

CONTENTS

Table of MPC's
Dose Factor Tables
Annual Average X/Q Tables
Map of Unrestricted Areas
Location of Sampling Station Points
Maps of Environmental Sample Locations

TABLE L-1

Maximum Permissible Concentrations in Water in Unrestricted Areas

Nuclide[1]	MPC(μCi/ml)	Nuclide[1]	MPC(μCi/ml)	Nuclide[1]	MPC(μCi/ml)
H-3	3 E-3	Y-90	2 E-5	Te-129	8 E-4
Na-24	3 E-5	Y-91m	3 E-3	Te-131m	4 E-5
P-32	2 E-5	Y-91	3 E-5	Te-131	None
Cr-51	2 E-3	Y-92	6 E-5	Te-132	2 E-5
Mn-54	1 E-4	Y-93	3 E-5	I-130	3 E-6
Mn-56	1 E-4	Zr-95	6 E-5	I-131	3 E-7
Fe-55	8 E-4	Zr-97	2 E-5	I-132	8 E-6
Fe-59	5 E-5	Nb-95	1 E-4	I-133	1 E-6
Co-57	4 E-4	Nb-97	9 E-4	I-134	2 E-5
Co-58	9 E-5	Mo-99	4 E-5	I-135	4 E-6
Co-60	3 E-5	TC-99m	3 E-3	Cs-134	9 E-6
Ni-65	1 E-4	Tc-101	None	Cs-136	6 E-5
Cu-64	2 E-4	Ru-103	8 E-5	Cs-137	2 E-5
Zn-65	1 E-4	Ru-105	1 E-4	Cs-138	None
Zn-69	2 E-3	Ru-106	1 E-5	Ba-139	None
Br-82	4 E-5	Ag-110m	3 E-5	Ba-140	2 E-5
Br-83	3 E-6	Sn-113	8 E-5	Ba-141	None
Br-84	None[2]	In-113m	1 E-3	Ba-142	None
Br-85	None	Sb-122	3 E-5	La-140	2 E-5
Rb-86	2 E-5	Sb-124	2 E-5	La-142	None
Rb-88	None	Sb-125	1 E-4	Ce-141	9 E-5
Rb-89	None	Te-125M	1 E-4	Ce-143	4 E-5
Sr-89	3 E-6	Te-127m	5 E-5	Ce-144	1 E-5
Sr-90	3 E-7	Te-127	2 E-4	Pr-144	None
Sr-91	5 E-5	Te-129m	2 E-5	W-187	6 E-5
Sr-92	6 E-5			Np-239	1 E-4

(1) If a nuclide is not listed, refer to 10 CFR 20, Appendix B, and use the most conservative insoluble/soluble MPC where they are given in Table II, Column 2.

(2) None-(As per 10 CFR 20, Appendix B)'No MPC limit for any single radionuclide not listed above with decay mode other than apha emission or spontaneous fission and with radioactive half-life less than 2 hours'.

TABLE L-2

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS FOR LIQUID DISCHARGES

PATHWAY - FRESH WATER FISH AND SHELLFISH AGE GROUP - ADULT

NUCLIDE	ORGAN DOSE FACTOR (MREM/HR PER UCI/ML)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
H----3	0.	2.80E-01	2.80E-01	2.80E-01	2.80E-01	2.80E-01	0.	2.80E-01
C---14	0.	0.	0.	0.	0.	0.	0.	0.
F---18	0.	0.	0.	0.	0.	0.	0.	0.
NA--24	0.	0.	0.	0.	0.	0.	0.	0.
P---32	0.	0.	0.	0.	0.	0.	0.	0.
CR--51	0.	0.	2.51E+00	9.26E-01	5.59E+00	1.06E+03	0.	4.21E+00
MN--54	0.	2.39E+05	0.	7.10E+04	0.	7.31E+05	0.	4.55E+04
MN--56	0.	0.	0.	0.	0.	0.	0.	0.
FE--55	5.68E+03	3.92E+03	0.	0.	2.19E+03	2.25E+03	0.	9.15E+02
FE--59	8.83E+03	2.08E+04	0.	0.	5.80E+03	6.92E+04	0.	7.95E+03
CO--57	0.	0.	0.	0.	0.	0.	0.	0.
CO--58	0.	1.73E+02	0.	0.	0.	3.50E+03	0.	3.87E+02
CO--60	0.	9.31E+02	0.	0.	0.	9.40E+03	0.	1.10E+03
NI--63	0.	0.	0.	0.	0.	0.	0.	0.
NI--65	0.	0.	0.	0.	0.	0.	0.	0.
CU--64	0.	0.	0.	0.	0.	0.	0.	0.
ZN--65	5.37E+04	1.61E+05	0.	1.08E+05	0.	1.02E+05	0.	7.29E+04
ZN--69	0.	0.	0.	0.	0.	0.	0.	0.
BR--82	0.	0.	0.	0.	0.	0.	0.	0.
BR--83	0.	0.	0.	0.	0.	6.57E-02	0.	4.56E-02
BR--84	0.	0.	0.	0.	0.	0.	0.	0.
BR--85	0.	0.	0.	0.	0.	0.	0.	0.
RB--86	0.	1.09E+05	0.	0.	0.	2.15E+04	0.	5.08E+04
RB--88	0.	0.	0.	0.	0.	0.	0.	0.
RB--89	3.92E+04	0.	0.	0.	0.	6.29E+03	0.	1.13E+03
KR-83M	0.	0.	0.	0.	0.	0.	0.	0.
SR--89	0.	0.	0.	0.	0.	0.	0.	0.
SR--90	0.	0.	0.	0.	0.	0.	0.	0.
SR--91	2.15E+02	0.	0.	0.	0.	4.93E+04	0.	7.49E+00
SR--92	0.	0.	0.	0.	0.	0.	0.	0.
SR--90	0.	0.	0.	0.	0.	0.	0.	0.
SR--91	2.15E+02	0.	0.	0.	0.	4.93E+04	0.	7.49E+00
SR--92	0.	0.	0.	0.	0.	0.	0.	0.
Y---90	0.	0.	0.	0.	0.	0.	0.	0.
Y--91M	0.	0.	0.	0.	0.	0.	0.	0.
Y---91	0.	0.	0.	0.	0.	0.	0.	0.
Y---92	0.	0.	0.	0.	0.	0.	0.	0.
Y---93	0.	0.	0.	0.	0.	0.	0.	0.
ZR--95	4.40E+02	2.49E+02	0.	2.46E+02	0.	1.51E+06	0.	1.34E+02
ZR--97	0.	0.	0.	0.	0.	0.	0.	0.
NB--95	0.	0.	0.	0.	0.	0.	0.	0.
NB--97	0.	0.	0.	0.	0.	0.	0.	0.
MO--99	7.16E-03	9.94E+01	0.	2.25E+02	9.91E-03	2.43E+02	0.	1.92E+01
TC--99	0.	0.	0.	0.	0.	0.	0.	0.
TC-99M	0.	0.	0.	0.	0.	0.	0.	0.
TC-101	0.	0.	0.	0.	0.	0.	0.	0.
RU-103	3.55E+01	0.	0.	1.35E+02	0.	4.14E+03	0.	1.53E+01
RU-105	0.	0.	0.	0.	0.	0.	0.	0.
RU-106	5.36E+02	0.	0.	1.04E+03	0.	3.47E+04	0.	6.78E+01
RH103M	0.	0.	0.	0.	0.	0.	0.	0.
AG110M	7.10E+01	6.57E+01	0.	1.29E+02	0.	2.68E+04	0.	3.90E+01
AG-110	0.	0.	0.	0.	0.	0.	0.	0.
SB-122	0.	0.	0.	0.	0.	0.	0.	0.
SB-124	0.	0.	0.	0.	0.	0.	0.	0.
SB-125	0.	0.	0.	0.	0.	0.	0.	0.
TE125M	0.	0.	0.	0.	0.	0.	0.	0.
TE127M	3.96E+05	1.42E+05	1.04E+05	1.62E+06	0.	1.80E+06	0.	4.98E+04
TE-127	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN DISCHARGE FLOW OF 1 CC/SEC WITH NO ADDITIONAL DILUTION

TABLE L-2

83/01/31.

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS FOR LIQUID DISCHARGES

PATHWAY - FRESH WATER FISH AND SHELLFISH

AGE GROUP - ADULT

NUCLIDE	ORGAN DOSE FACTOR (MREM/HR PER UCI/ML)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
TE129M	6.55E+05	2.44E+05	2.26E+05	2.73E+06	0.	3.29E+06	0.	1.84E+05
TE-129	0.	0.	0.	0.	0.	0.	0.	0.
TE131M	5.80E+04	2.95E+04	1.19E+05	2.87E+05	0.	2.80E+06	0.	2.37E+04
TE-131	0.	0.	0.	0.	0.	0.	0.	0.
TE-132	1.18E+05	7.64E+04	8.50E+04	7.36E+05	0.	3.62E+06	0.	7.17E+04
I--129	0.	0.	0.	0.	0.	0.	0.	0.
I--130	7.64E+00	2.25E+01	1.51E+03	3.52E+01	0.	1.94E+01	0.	8.89E+00
I--131	0.	0.	0.	0.	0.	0.	0.	0.
I--132	0.	0.	0.	0.	0.	0.	0.	0.
I--133	2.49E+01	4.33E+01	6.26E+03	7.55E+01	0.	3.89E+01	0.	1.32E+01
I--134	2.36E-08	[illegible].92E-08	1.11E-06	1.02E-07	0.	0.	0.	2.29E-08
I--135	1.39E+00	3.63E+00	2.40E+02	5.83E+00	1.56E-06	4.10E+00	0.	1.34E+00
CS-134	3.02E+05	7.17E+05	0.	2.32E+05	7.71E+04	1.26E+04	0.	5.87E+05
CS-135	0.	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.	0.
XE-133	0.	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.	0.
CS-136	3.07E+04	1.18E+05	0.	6.58E+04	9.02E+03	1.34E+04	0.	8.51E+04
CS-137	3.87E+05	5.29E+05	0.	1.80E+05	5.97E+04	1.02E+04	0.	3.46E+05
CS-138	0.	0.	0.	0.	0.	0.	0.	0.
BA137M	0.	0.	0.	0.	0.	0.	0.	0.
BA136M	0.	0.	0.	0.	0.	0.	0.	0.
BA-139	0.	0.	0.	0.	0.	0.	0.	0.
BA-140	2.38E+03	3.78E+00	0.	1.02E+00	1.71E+00	6.27E+04	0.	1.56E+02
BA-141	5.25E+00	3.55E+00	0.	1.65E+00	0.	1.36E+04	0.	4.63E-01
BA-142	0.	0.	0.	0.	0.	0.	0.	0.
LA-140	0.	0.	0.	0.	0.	0.	0.	0.
LA-142	0.	0.	0.	0.	0.	0.	0.	0.
CE-141	0.	0.	0.	0.	0.	0.	0.	0.
CE-143	[illegible]	2.21E+[illegible]	0.	1.28E+00	0.	2.42E+04	0.	2.73E-01
CE-144	2.7[illegible]E+02	1.17E+02	0.	5.92E+01	0.	9.43E+04	0.	1.56E+01
PR-143	0.	0.	0.	0.	0.	0.	0.	0.
PR-144	0.	0.	0.	0.	0.	0.	0.	0.
PR144M	0.	0.	0.	0.	0.	0.	0.	0.
ND-144	0.	0.	0.	0.	0.	0.	0.	0.
ND-147	0.	0.	0.	0.	0.	0.	0.	0.
W--187	0.	0.	0.	0.	0.	0.	0.	0.
NP-239	0.	0.	0.	0.	0.	0.	0.	0.
PU-239	0.	0.	0.	0.	0.	0.	0.	0.
U--235	0.	0.	0.	0.	0.	0.	0.	0.
PA-231	0.	0.	0.	0.	0.	0.	0.	0.
AC-227	0.	0.	0.	0.	0.	0.	0.	0.
TH-227	0.	0.	0.	0.	0.	0.	0.	0.
RA-223	0.	0.	0.	0.	0.	0.	0.	0.
TH-231	0.	0.	0.	0.	0.	0.	0.	0.
FR-223	0.	0.	0.	0.	0.	0.	0.	0.
AT-219	0.	0.	0.	0.	0.	0.	0.	0.
RN-219	0.	0.	0.	0.	0.	0.	0.	0.
BI-215	0.	0.	0.	0.	0.	0.	0.	0.
PO-215	0.	0.	0.	0.	0.	0.	0.	0.
PB-211	0.	0.	0.	0.	0.	0.	0.	0.
BI-211	0.	0.	0.	0.	0.	0.	0.	0.
PO-211	0.	0.	0.	0.	0.	0.	0.	0.
TL-207	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN DISCHARGE FLOW OF 1 CC/SEC WITH NO ADDITIONAL DILUTION

TABLE G-1

Maximum Permissible Concentrations in Air in Unrestricted Areas

Nuclide[1]	MPC μCi/cc	Nuclide[1]	MPC μCi/cc
Ar-41	4 E-8	Y-91	1 E-9
Kr-83m	3 E-8	Zr-95	1 E-9
Kr-85m	1 E-7	Nb-95	3 E-9
Kr-85	3 E-7	Ru-103	3 E-9
Kr-87	2 E-8	Ru-106	2 E-10
Kr-88	2 E-8	Ag-110m	3 E-10
Kr-89	3 E-8	Sn-113	2 E-9
Kr-90	3 E-8	In-113m	2 E-7
Xe-131m	4 E-7	Sn-123	1 E-10
Xe-133m	3 E-7	Sn-126	1 E-10
Xe-133	3 E-7	Sb-124	7 E-10
Xe-135m	3 E-8	Sb-125	9 E-10
Xe-135	1 E-7	Te-125m	4 E-9
Xe-137	3 E-8	Te-127m	1 E-9
Xe-138	3 E-8	Te-129m	1 E-9
H-3	2 E-7	I-130	1 E-10
P-32	2 E-9	I-131	1 E-10
Cr-51	8 E-8	I-132	3 E-9
Mn-54	1 E-9	I-133	4 E-10
Fe-59	2 E-9	I-134	6 E-9
Co-57	6 E-9	I-135	1 E-9
Co-58	2 E-9	Cs-134	4 E-10
Co-60	3 E-10	Cs-136	6 E-9
Zn-65	2 E-9	Cs-137	5 E-10
Rb-86	2 E-9	Ba-140	1 E-9
Sr-89	3 E-10	La-140	4 E-9
Sr-90	3 E-11	Ce-141	5 E-9
Rb-88	3 E-8	Ce-144	2 E-10

(1) If a nuclide is not listed, refer to 10 CFR 20, Appendix B, and use the most conservative insoluble/soluble MPC where they are given in Table II, Column 1.

TABLE G-2

TRANSFER FACTORS FOR MAXIMUM DOSE TO A PERSON OFFSITE DUE TO RADIOACTIVE NOBLE GASES

Radionuclide:	Dose Transfer Factors		
	GAMMA	BETA	BETA+GAMMA
	K_i mrem / uCi sec/m^3	L_i mrem / uCi sec/m^3	(L + 1.1 M)i mrem / uCi sec/m^3
Kr-83m	2.4E-9	--	6.7E-7
Kr-85m	3.7E-5	4.6E-5	8.9E-5
Kr-85	5.1E-7	4.2E-5	4.3E-5
Kr-87	1.9E-4	3.1E-4	5.3E-4
Kr-88	4.7E-4	7.5E-5	6.0E-4
Kr-89	5.3E-4	3.2E-4	9.3E-4
Kr-90	4.9E-4	2.3E-4	8.0E-4
Xe-131m	2.9E-6	1.5E-5	2.0E-5
Xe-133m	8.0E-6	3.1E-5	4.2E-5
Xe-133	9.3E-6	9.7E-6	2.2E-5
Xe-135m	9.9E-5	2.3E-5	1.4E-4
Xe-135	5.7E-5	5.9E-5	1.3E-4
Xe-137	4.5E-5	3.9E-4	4.4E-4
Xe-138	2.8E-4	1.3E-4	4.5E-4
Ar-41	2.8E-4	8.5E-5	4.0E-4
	GAMMA	BETA	BETA + GAMMA

Regulatory Guide 1.109, Revision 1, Table B-1.

TABLE G-3

TRANSFER FACTORS FOR MAXIMUM OFFSITE AIR DOSE

Radionuclide:	Air Dose Transfer Factors GAMMA M_i mrad / uCi sec/m^3	BETA N_i mrad / uCi sec/m^3
Kr-83m	6.1E-7	9.1E-6
Kr-85m	3.9E-5	6.2E-5
Kr-85	5.4E-7	6.2E-5
Kr-87	2.0E-4	3.3E-4
Kr-88	4.8E-4	9.3E-5
Kr-89	5.5E-4	3.4E-4
Kr-90	5.2E-4	2.5E-4
Xe-131m	4.9E-6	3.5E-5
Xe-133m	1.0E-5	4.7E-5
Xe-133	1.1E-5	3.3E-5
Xe-135m	1.1E-4	2.3E-5
Xe-135	6.1E-5	7.8E-5
Xe-137	4.8E-5	4.0E-4
Xe-138	2.9E-4	1.5E-4
Ar-41	2.9E-4	1.0E-4
	GAMMA	BETA

Ref: Regulatory Guide 1.109, Revision 1, Table B-1.

TABLE G-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - GROUND PLANE DEPOSITION

AGE GROUP - ADULT

NUCLIDE	ORGAN DOSE FACTORS (SQ.METER-MREM/YR PER UCI/SEC)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
H----3	0.	0.	0.	0.	0.	0.	0.	0.
C---14	0.	0.	0.	0.	0.	0.	0.	0.
P---32	0.	0.	0.	0.	0.	0.	0.	0.
CR--51	0.	0.	0.	0.	0.	0.	0.	0.
MN--54	1.38E+09	1.38E+09	1.38E+09	1.38E+09	1.38E+09	1.38E+09	1.62E+09	1.38E+09
FE--59	2.72E+08	2.72E+08	2.72E+08	2.72E+08	2.72E+08	2.72E+08	3.20E+08	2.72E+08
CO--57	0.	0.	0.	0.	0.	0.	0.	0.
CO--58	3.78E+08	3.78E+08	3.78E+08	3.78E+08	3.78E+08	3.78E+08	4.43E+08	3.78E+08
CO--60	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.53E+10	2.15E+10
NI--63	0.	0.	0.	0.	0.	0.	0.	0.
ZN--65	0.	0.	0.	0.	0.	0.	0.	0.
KR--85	0.	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.	0.
KR--87	0.	0.	0.	0.	0.	0.	0.	0.
KR--88	0.	0.	0.	0.	0.	0.	0.	0.
RB--86	0.	0.	0.	0.	0.	0.	0.	0.
RB--87	0.	0.	0.	0.	0.	0.	0.	0.
RB--88	1.55E+05	1.55E+05	1.55E+05	1.55E+05	1.55E+05	1.55E+05	1.78E+05	1.55E+05
SR--89	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.50E+04	2.16E+04
SR--90	0.	0.	0.	0.	0.	0.	0.	0.
Y---90	5.35E+06	5.35E+06	5.35E+06	5.35E+06	5.35E+06	5.35E+06	6.33E+06	5.35E+06
Y---91	0.	0.	0.	0.	0.	0.	0.	0.
ZR--95	0.	0.	0.	0.	0.	0.	0.	0.
NB--95	0.	0.	0.	0.	0.	0.	0.	0.
RU-103	0.	0.	0.	0.	0.	0.	0.	0.
RU-106	0.	0.	0.	0.	0.	0.	0.	0.
AG110M	0.	0.	0.	0.	0.	0.	0.	0.
CD115M	0.	0.	0.	0.	0.	0.	0.	0.
SN-123	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABLE G-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - GROUND PLANE DEPOSITION AGE GROUP - ADULT

NUCLIDE	ORGAN DOSE FACTORS (SQ.METER-MREM/YR PER UCI/SEC)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
SN-126	0.	0.	0.	0.	0.	0.	0.	0.
SB-124	0.	0.	0.	0.	0.	0.	0.	0.
SB-125	0.	0.	0.	0.	0.	0.	0.	0.
TE125M	0.	0.	0.	0.	0.	0.	0.	0.
TE127M	0.	0.	0.	0.	0.	0.	0.	0.
TE129M	0.	0.	0.	0.	0.	0.	0.	0.
I--130	0.	0.	0.	0.	0.	0.	0.	0.
I--131	8.50E+06	8.50E+06	8.50E+06	8.50E+06	8.50E+06	8.50E+06	1.03E+07	8.50E+06
I--132	0.	0.	0.	0.	0.	0.	0.	0.
I--133	1.10E+06	1.10E+06	1.10E+06	1.10E+06	1.10E+06	1.10E+06	1.34E+06	1.10E+06
I--134	0.	0.	0.	0.	0.	0.	0.	0.
I--135	1.04E+06	1.04E+06	1.04E+06	1.04E+06	1.04E+06	1.04E+06	8.87E+05	1.04E+06
CS-134	6.86E+09	6.86E+09	6.86E+09	6.86E+09	6.86E+09	6.86E+09	8.01E+09	6.86E+09
CS-135	0.	0.	0.	0.	0.	0.	0.	0.
CS-136	0.	0.	0.	0.	0.	0.	0.	0.
CS-137	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.20E+10	1.03E+10
CS-138	3.60E+03	3.60E+03	3.60E+03	3.60E+03	3.60E+03	3.60E+03	4.12E+03	3.60E+03
XE-133	0.	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.	0.
LA-140	0.	0.	0.	0.	0.	0.	0.	0.
BA137M	0.	0.	0.	0.	0.	0.	0.	0.
BA-140	1.86E+08	1.86E+08	1.86E+08	1.86E+08	1.86E+08	1.86E+08	1.70E+08	1.86E+08
CE-141	0.	0.	0.	0.	0.	0.	0.	0.
CE-144	0.	0.	0.	0.	0.	0.	0.	0.
PR-143	0.	0.	0.	0.	0.	0.	0.	0.
ND-147	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABL[illegible]-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - INHALATION AGE GROUP - ADULT

NUCLIDE	ORGAN DOSE FACTORS (MREM/YR PER UCI/CU.METER)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
H----3	0.	0.	0.	0.	0.	0.	0.	0.
C---14	0.	0.	0.	0.	0.	0.	0.	0.
P---32	0.	0.	0.	0.	0.	0.	0.	0.
CR--51	0.	0.	0.	0.	0.	0.	0.	0.
MN--54	0.	0.	0.	0.	0.	0.	0.	0.
FE--59	0.	0.	0.	0.	0.	0.	0.	0.
CO--57	0.	0.	0.	0.	0.	0.	0.	0.
CO--58	0.	0.	0.	0.	0.	0.	0.	0.
CO--60	0.	0.	0.	0.	0.	0.	0.	0.
NI--63	0.	0.	0.	0.	0.	0.	0.	0.
ZN--65	0.	0.	0.	0.	0.	0.	0.	0.
KR--85	0.	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.	0.
KR--87	0.	0.	0.	0.	0.	0.	0.	0.
KR--88	0.	0.	0.	0.	0.	0.	0.	0.
RB--86	0.	0.	0.	0.	0.	0.	0.	0.
RB--87	0.	0.	0.	0.	0.	0.	0.	0.
RB--88	0.	0.	0.	0.	0.	0.	0.	0.
SR--89	0.	0.	0.	0.	0.	0.	0.	0.
SR--90	0.	0.	0.	0.	0.	0.	0.	0.
Y---90	0.	0.	0.	0.	0.	0.	0.	0.
Y---91	0.	0.	0.	0.	0.	0.	0.	0.
ZR--95	0.	0.	0.	0.	0.	0.	0.	0.
NB--95	0.	0.	0.	0.	0.	0.	0.	0.
RU-103	0.	0.	0.	0.	0.	0.	0.	0.
RU-106	0.	0.	0.	0.	0.	0.	0.	0.
AG110M	0.	0.	0.	0.	0.	0.	0.	0.
CD115M	0.	0.	0.	0.	0.	0.	0.	0.
SN-123	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABLE G-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - INHALATION AGE GROUP - ADULT

NUCLIDE	ORGAN DOSE FACTORS (MREM/YR PER UCI/CU.METER)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
SN-126	0.	0.	0.	0.	0.	0.	0.	0.
SB-124	0.	0.	0.	0.	0.	0.	0.	0.
SB-125	0.	0.	0.	0.	0.	0.	0.	0.
TE125M	0.	0.	0.	0.	0.	0.	0.	0.
TE127M	0.	0.	0.	0.	0.	0.	0.	0.
TE129M	0.	0.	0.	0.	0.	0.	0.	0.
I--130	0.	0.	0.	0.	0.	0.	0.	0.
I--131	1.25E+04	1.77E+04	5.89E+06	3.03E+04	0.	3.10E+03	0.	1.01E+04
I--132	0.	0.	0.	0.	0.	0.	0.	0.
I--133	3.85E+03	6.62E+03	9.62E+05	1.16E+04	0.	3.97E+03	0.	2.02E+03
I--134	0.	0.	0.	0.	0.	0.	0.	0.
I--135	9.41E+02	2.45E+03	1.57E+05	3.91E+03	0.	1.84E+03	0.	9.02E+02
CS-134	0.	0.	0.	0.	0.	0.	0.	0.
CS-135	0.	0.	0.	0.	0.	0.	0.	0.
CS-136	0.	0.	0.	0.	0.	0.	0.	0.
CS-137	0.	0.	0.	0.	0.	0.	0.	0.
CS-138	0.	0.	0.	0.	0.	0.	0.	0.
XE-133	0.	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.	0.
LA-140	0.	0.	0.	0.	0.	0.	0.	0.
BA137M	0.	0.	0.	0.	0.	0.	0.	0.
BA-140	0.	0.	0.	0.	0.	0.	0.	0.
CE-141	0.	0.	0.	0.	0.	0.	0.	0.
CE-144	0.	0.	0.	0.	0.	0.	0.	0.
PR-143	0.	0.	0.	0.	0.	0.	0.	0.
ND-147	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABLE G-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - COWS MILK (CONTAMINATED FORAGE) AGE GROUP - ADULT

NUCLIDE	ORGAN DOSE FACTORS (SQ.METER-MREM/YR PER UCI/SEC)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
H----3	0.	0.	0.	0.	0.	0.	0.	0.
C---14	0.	0.	0.	0.	0.	0.	0.	0.
P---32	0.	0.	0.	0.	0.	0.	0.	0.
CR--51	0.	0.	0.	0.	0.	0.	0.	0.
MN--54	0.	3.36E+06	0.	9.99E+05	0.	1.03E+07	0.	6.40E+05
FE--59	1.27E+07	2.99E+07	0.	0.	8.35E+06	9.96E+07	0.	1.15E+07
CO--57	0.	0.	0.	0.	0.	0.	0.	0.
CO--58	0.	1.96E+06	0.	0.	0.	3.97E+07	0.	4.39E+06
CO--60	0.	6.50E+06	0.	0.	0.	1.22E+08	0.	1.43E+07
NI--63	0.	0.	0.	0.	0.	0.	0.	0.
ZN--65	0.	0.	0.	0.	0.	0.	0.	0.
KR--85	0.	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.	0.
KR--87	0.	0.	0.	0.	0.	0.	0.	0.
KR--88	0.	0.	0.	0.	0.	0.	0.	0.
RB--86	0.	0.	0.	0.	0.	2.59E-07	0.	1.92E-06
RB--87	0.	5.52E-06	0.	0.	0.	0.	0.	0.
RB--88	0.	0.	0.	0.	0.	9.88E+07	0.	1.77E+07
SR--89	6.16E+08	0.	0.	0.	0.	5.61E+08	0.	2.64E+09
SR--90	9.84E+09	0.	0.	0.	0.	2.80E+06	0.	7.07E+00
Y---90	2.64E+02	0.	0.	0.	0.	0.	0.	0.
Y---91	0.	0.	0.	0.	0.	0.	0.	0.
ZR--95	0.	0.	0.	0.	0.	0.	0.	0.
NB--95	0.	0.	0.	0.	0.	0.	0.	0.
RU-103	0.	0.	0.	0.	0.	0.	0.	0.
RU-106	0.	0.	0.	0.	0.	0.	0.	0.
AG110M	0.	0.	0.	0.	0.	0.	0.	0.
CD115M	0.	0.	0.	0.	0.	0.	0.	0.
SN-123	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABLE G-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - COWS MILK (CONTAMINATED FORAGE) AGE GROUP - ADULT

NUCLIDE	ORGAN DOSE FACTORS (SQ.METER-MREM/YR PER UCI/SEC)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
SN-126	0.	0.	0.	0.	0.	0.	0.	0.
SB-124	0.	0.	0.	0.	0.	0.	0.	0.
SB-125	0.	0.	0.	0.	0.	0.	0.	0.
TE125M	0.	0.	0.	0.	0.	0.	0.	0.
TE127M	0.	0.	0.	0.	0.	0.	0.	0.
TE129M	0.	0.	0.	0.	0.	0.	0.	0.
I--130	0.	0.	0.	0.	0.	0.	0.	0.
I--131	7.19E+07	1.03E+08	3.37E+10	1.76E+08	0.	2.71E+07	0.	5.99E+07
I--132	0.	0.	0.	0.	0.	0.	0.	0.
I--133	8.77E+05	1.53E+06	2.24E+08	2.66E+06	0.	1.37E+06	0.	4.65E+05
I--134	0.	0.	0.	0.	0.	0.	0.	0.
I--135	2.27E+03	5.94E+03	3.92E+05	9.52E+03	4.58E-02	6.71E+03	0.	2.19E+03
CS-134	2.23E+09	5.30E+09	0.	1.71E+09	5.69E+08	9.27E+07	0.	4.33E+09
CS-135	0.	0.	0.	0.	0.	0.	0.	0.
CS-136	0.	0.	0.	0.	0.	0.	0.	0.
CS-137	2.98E+09	4.08E+09	0.	1.38E+09	4.60E+08	7.89E+07	0.	2.67E+09
CS-138	0.	0.	0.	0.	0.	0.	0.	0.
XE-133	0.	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.	0.
LA-140	0.	0.	0.	0.	0.	0.	0.	0.
BA137M	0.	0.	0.	0.	0.	0.	0.	0.
BA-140	1.28E+07	1.60E+04	0.	5.44E+03	9.17E+03	2.70E+07	0.	8.35E+05
CE-141	0.	0.	0.	0.	0.	0.	0.	0.
CE-144	0.	0.	0.	0.	0.	0.	0.	0.
PR-143	0.	0.	0.	0.	0.	0.	0.	0.
ND-147	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABLE G-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - GROUND PLANE DEPOSITION

AGE GROUP - TEENAGER

NUCLIDE	ORGAN DOSE FACTORS (SQ.METER-MREM/YR PER UCI/SEC)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
H----3	0.	0.	0.	0.	0.	0.	0.	0.
C---14	0.	0.	0.	0.	0.	0.	0.	0.
P---32	0.	0.	0.	0.	0.	0.	0.	0.
CR--51	0.	0.	0.	0.	0.	0.	0.	0.
MN--54	1.38E+09	1.38E+09	1.38E+09	1.38E+09	1.38E+09	1.38E+09	1.62E+09	1.38E+09
FE--59	2.72E+08	2.72E+08	2.72E+08	2.72E+08	2.72E+08	2.72E+08	3.20E+08	2.72E+08
CO--57	0.	0.	0.	0.	0.	0.	0.	0.
CO--58	3.78E+08	3.78E+08	3.78E+08	3.78E+08	3.78E+08	3.78E+08	4.43E+08	3.78E+08
CO--60	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.53E+10	2.15E+10
NI--63	0.	0.	0.	0.	0.	0.	0.	0.
ZN--65	0.	0.	0.	0.	0.	0.	0.	0.
KR--85	0.	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.	0.
KR--87	0.	0.	0.	0.	0.	0.	0.	0.
KR--88	0.	0.	0.	0.	0.	0.	0.	0.
RB--86	0.	0.	0.	0.	0.	0.	0.	0.
RB--87	0.	0.	0.	0.	0.	0.	0.	0.
RB--88	1.55E+05	1.55E+05	1.55E+05	1.55E+05	1.55E+05	1.55E+05	1.78E+05	1.55E+05
SR--89	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.50E+04	2.16E+04
SR--90	0.	0.	0.	0.	0.	0.	0.	0.
Y---90	5.35E+06	5.35E+06	5.35E+06	5.35E+06	5.35E+06	5.35E+06	6.33E+06	5.35E+06
Y---91	0.	0.	0.	0.	0.	0.	0.	0.
ZR--95	0.	0.	0.	0.	0.	0.	0.	0.
NB--95	0.	0.	0.	0.	0.	0.	0.	0.
RU-103	0.	0.	0.	0.	0.	0.	0.	0.
RU-106	0.	0.	0.	0.	0.	0.	0.	0.
AG110M	0.	0.	0.	0.	0.	0.	0.	0.
CD115M	0.	0.	0.	0.	0.	0.	0.	0.
SN-123	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

AGE GROUP - TEENAGER

PATHWAY - GROUND PLANE DEPOSITION

NUCLIDE	ORGAN DOSE FACTORS (SQ.METER-MREM/YR PER UCI/SEC)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
SN-126	0.	0.	0.	0.	0.	0.	0.	0.
SB-124	0.	0.	0.	0.	0.	0.	0.	0.
SB-125	0.	0.	0.	0.	0.	0.	0.	0.
TE125M	0.	0.	0.	0.	0.	0.	0.	0.
TE127M	0.	0.	0.	0.	0.	0.	0.	0.
TE129M	0.	0.	0.	0.	0.	0.	0.	0.
I--130	0.	0.	0.	0.	0.	0.	0.	0.
I--131	8.50E+06	8.50E+05	8.50E+06	8.50E+06	8.50E+06	8.50E+06	1.03E+07	8.50E+06
I--132	0.	0.	0.	0.	0.	0.	0.	0.
I--133	1.10E+06	1.10E+05	1.10E+06	1.10E+06	1.10E+06	1.10E+06	1.34E+06	1.10E+05
I--134	0.	0.	0.	0.	0.	0.	0.	0.
I--135	1.04E+06	1.04E+06	1.04E+06	1.04E+06	1.04E+06	1.04E+06	8.87E+05	1.04E+05
CS-134	6.86E+09	6.86E+09	6.86E+09	6.86E+09	6.86E+09	6.86E+09	8.01E+09	6.86E+09
CS-135	0.	0.	0.	0.	0.	0.	0.	0.
CS-136	0.	0.	0.	0.	0.	0.	0.	0.
CS-137	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.20E+10	1.03E+10
CS-138	3.60E+03	3.60E+03	3.60E+03	3.60E+03	3.60E+03	3.60E+03	4.12E+03	3.60E+03
XE-133	0.	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.	0.
LA-140	0.	0.	0.	0.	0.	0.	0.	0.
BA137M	0.	0.	0.	0.	0.	0.	0.	0.
BA-140	1.85E+08	1.85E+08	1.86E+08	1.86E+08	1.86E+08	1.86E+08	1.70E+08	1.86E+08
CE-141	0.	0.	0.	0.	0.	0.	0.	0.
CE-144	0.	0.	0.	0.	0.	0.	0.	0.
PR-143	0.	0.	0.	0.	0.	0.	0.	0.
ND-147	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABLE G-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE

PATHWAY - INHALATION

AGE GROUP - TEENAGER

NUCLIDE	ORGAN DOSE FACTORS (MREM/YR PER UCI/CU.METER)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
H----3	0.	0.	0.	0.	0.	0.	0.	0.
C---14	0.	0.	0.	0.	0.	0.	0.	0.
P---32	0.	0.	0.	0.	0.	0.	0.	0.
CR--51	0.	0.	0.	0.	0.	0.	0.	0.
MN--54	0.	0.	0.	0.	0.	0.	0.	0.
FE--59	0.	0.	0.	0.	0.	0.	0.	0.
CO--57	0.	0.	0.	0.	0.	0.	0.	0.
CO--58	0.	0.	0.	0.	0.	0.	0.	0.
CO--60	0.	0.	0.	0.	0.	0.	0.	0.
NI--63	0.	0.	0.	0.	0.	0.	0.	0.
ZN--65	0.	0.	0.	0.	0.	0.	0.	0.
KR--85	0.	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.	0.
KR--87	0.	0.	0.	0.	0.	0.	0.	0.
KR--88	0.	0.	0.	0.	0.	0.	0.	0.
RB--86	0.	0.	0.	0.	0.	0.	0.	0.
RB--87	0.	0.	0.	0.	0.	0.	0.	0.
RB--88	0.	0.	0.	0.	0.	0.	0.	0.
SR--89	0.	0.	0.	0.	0.	0.	0.	0.
SR--90	0.	0.	0.	0.	0.	0.	0.	0.
Y---90	0.	0.	0.	0.	0.	0.	0.	0.
Y---91	0.	0.	0.	0.	0.	0.	0.	0.
ZR--95	0.	0.	0.	0.	0.	0.	0.	0.
NB--95	0.	0.	0.	0.	0.	0.	0.	0.
RU-103	0.	0.	0.	0.	0.	0.	0.	0.
RU-106	0.	0.	0.	0.	0.	0.	0.	0.
AG110M	0.	0.	0.	0.	0.	0.	0.	0.
CD115M	0.	0.	0.	0.	0.	0.	0.	0.
SN-123	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABLE G-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - INHALATION AGE GROUP - TEENAGER

NUCLIDE	ORGAN DOSE FACTORS (MREM/YR PER UCI/CU.METER)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
SN-126	0.	0.	0.	0.	0.	0.	0.	0.
SB-124	0.	0.	0.	0.	0.	0.	0.	0.
SB-125	0.	0.	0.	0.	0.	0.	0.	0.
TE125M	0.	0.	0.	0.	0.	0.	0.	0.
TE127M	0.	0.	0.	0.	0.	0.	0.	0.
TE129M	0.	0.	0.	0.	0.	0.	0.	0.
I--130	0.	0.	0.	0.	0.	0.	0.	0.
I--131	1.75E+04	2.43E+04	7.23E+06	4.15E+04	0.	3.21E+03	0.	1.30E+04
I--132	0.	0.	0.	0.	0.	0.	0.	0.
I--133	5.44E+03	9.16E+03	1.31E+06	1.61E+04	0.	4.62E+03	0.	2.78E+03
I--134	0.	0.	0.	0.	0.	0.	0.	0.
I--135	1.30E+03	3.32E+03	2.18E+05	5.23E+03	0.	2.44E+03	0.	1.23E+03
CS-134	0.	0.	0.	0.	0.	0.	0.	0.
CS-135	0.	0.	0.	0.	0.	0.	0.	0.
CS-136	0.	0.	0.	0.	0.	0.	0.	0.
CS-137	0.	0.	0.	0.	0.	0.	0.	0.
CS-138	0.	0.	0.	0.	0.	0.	0.	0.
XE-133	0.	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.	0.
LA-140	0.	0.	0.	0.	0.	0.	0.	0.
BA137M	0.	0.	0.	0.	0.	0.	0.	0.
BA-140	0.	0.	0.	0.	0.	0.	0.	0.
CE-141	0.	0.	0.	0.	0.	0.	0.	0.
CE-144	0.	0.	0.	0.	0.	0.	0.	0.
PR-143	0.	0.	0.	0.	0.	0.	0.	0.
ND-147	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABLE

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - COWS MILK (CONTAMINATED FORAGE) AGE GROUP - TEENAGER

NUCLIDE	ORGAN DOSE FACTORS (SQ.METER-MREM/YR PER UCI/SEC)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
H----3	0.	0.	0.	0.	0.	0.	0.	0.
C---14	0.	0.	0.	0.	0.	0.	0.	0.
P---32	0.	0.	0.	0.	0.	0.	0.	0.
CR--51	0.	0.	0.	0.	0.	0.	0.	0.
MN--54	0.	5.59E+06	0.	1.67E+06	0.	1.15E+07	0.	1.11E+06
FE--59	2.22E+07	5.18E+07	0.	0.	1.63E+07	1.22E+08	0.	2.00E+07
CO--57	0.	0.	0.	0.	0.	0.	0.	0.
CO--58	0.	3.30E+06	0.	0.	0.	4.55E+07	0.	7.60E+06
CO--60	0.	1.10E+07	0.	0.	0.	1.43E+08	0.	2.48E+07
NI--63	0.	0.	0.	0.	0.	0.	0.	0.
ZN--65	0.	0.	0.	0.	0.	0.	0.	0.
KR--85	0.	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.	0.
KR--87	0.	0.	0.	0.	0.	0.	0.	0.
KR--88	0.	0.	0.	0.	0.	0.	0.	0.
RB--86	0.	0.	0.	0.	0.	0.	0.	0.
RB--87	0.	1.01E-05	0.	0.	0.	3.54E-07	0.	3.54E-06
RB--88	0.	0.	0.	0.	0.	0.	0.	0.
SR--89	1.14E+09	0.	0.	0.	0.	1.35E+08	0.	3.25E+07
SR--90	1.48E+10	0.	0.	0.	0.	7.71E+08	0.	3.97E+09
Y---90	4.94E+02	0.	0.	0.	0.	4.00E+06	0.	1.31E+01
Y---91	0.	0.	0.	0.	0.	0.	0.	0.
ZR--95	0.	0.	0.	0.	0.	0.	0.	0.
NB--95	0.	0.	0.	0.	0.	0.	0.	0.
RU-103	0.	0.	0.	0.	0.	0.	0.	0.
RU-106	0.	0.	0.	0.	0.	0.	0.	0.
AG110M	0.	0.	0.	0.	0.	0.	0.	0.
CD115M	0.	0.	0.	0.	0.	0.	0.	0.
SN-123	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABLE G-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - COWS MILK (CONTAMINATED FORAGE) AGE GROUP - TEENAGER

NUCLIDE	ORGAN DOSE FACTORS (SQ.METER-MREM/YR PER UCI/SEC)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
SN-126	0.	0.	0.	0.	0.	0.	0.	0.
SB-124	0.	0.	0.	0.	0.	0.	0.	0.
SB-125	0.	0.	0.	0.	0.	0.	0.	0.
TE125M	0.	0.	0.	0.	0.	0.	0.	0.
TE127M	0.	0.	0.	0.	0.	0.	0.	0.
TE129M	0.	0.	0.	0.	0.	0.	0.	0.
I--130	0.	0.	0.	0.	0.	0.	0.	0.
I--131	1.31E+08	1.83E+08	5.33E+10	3.14E+08	0.	3.61E+07	0.	9.81E+07
I--132	0.	0.	0.	0.	0.	0.	0.	0.
I--133	1.60E+06	2.72E+06	3.80E+08	4.77E+06	0.	2.06E+06	0.	8.29E+05
I--134	0.	0.	0.	0.	0.	0.	0.	0.
I--135	4.03E+03	1.04E+04	6.67E+05	1.64E+04	1.02E-01	1.15E+04	0.	3.84E+03
CS-134	3.87E+09	9.10E+09	0.	2.89E+09	1.10E+09	1.13E+08	0.	4.22E+09
CS-135	0.	0.	0.	0.	0.	0.	0.	0.
CS-136	0.	0.	0.	0.	0.	0.	0.	0.
CS-137	5.40E+09	7.19E+09	0.	2.45E+09	9.50E+08	1.02E+08	0.	2.50E+09
CS-138	0.	0.	0.	0.	0.	0.	0.	0.
XE-133	0.	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.	0.
LA-140	0.	0.	0.	0.	0.	0.	0.	0.
BA137M	0.	0.	0.	0.	0.	0.	0.	0.
BA-140	2.30E+07	2.82E+04	0.	9.56E+03	1.90E+04	3.65E+07	0.	1.48E+06
CE-141	0.	0.	0.	0.	0.	0.	0.	0.
CE-144	0.	0.	0.	0.	0.	0.	0.	0.
PR-143	0.	0.	0.	0.	0.	0.	0.	0.
ND-147	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABLE G-

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - GROUND PLANE DEPOSITION

AGE GROUP - CHILD

NUCLIDE	ORGAN DOSE FACTORS (SQ.METER-MREM/YR PER UCI/SEC)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
H----3	0.	0.	0.	0.	0.	0.	0.	0.
C---14	0.	0.	0.	0.	0.	0.	0.	0.
P---32	0.	0.	0.	0.	0.	0.	0.	0.
CR--51	0.	0.	0.	0.	0.	0.	0.	0.
MN--54	1.38E+09	1.38E+09	1.38E+09	1.38E+09	1.38E+09	1.38E+09	1.62E+09	1.38E+09
FE--59	2.72E+08	2.72E+08	2.72E+08	2.72E+08	2.72E+08	2.72E+08	3.20E+08	2.72E+08
CO--57	0.	0.	0.	0.	0.	0.	0.	0.
CO--58	3.78E+08	3.78E+08	3.78E+08	3.78E+08	3.78E+08	3.78E+08	4.43E+08	3.78E+08
CO--60	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.53E+10	2.15E+10
NI--63	0.	0.	0.	0.	0.	0.	0.	0.
ZN--65	0.	0.	0.	0.	0.	0.	0.	0.
KR--85	0.	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.	0.
KR--87	0.	0.	0.	0.	0.	0.	0.	0.
KR--88	0.	0.	0.	0.	0.	0.	0.	0.
RB--86	0.	0.	0.	0.	0.	0.	0.	0.
RB--87	0.	0.	0.	0.	0.	0.	0.	0.
RB--88	1.55E+05	1.55E+05	1.55E+05	1.55E+05	1.55E+05	1.55E+05	1.78E+05	1.55E+05
SR--89	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.50E+04	2.16E+04
SR--90	0.	0.	0.	0.	0.	0.	0.	0.
Y---90	5.35E+06	5.35E+06	5.35E+06	5.35E+06	5.35E+06	5.35E+06	6.33E+06	5.35E+06
Y---91	0.	0.	0.	0.	0.	0.	0.	0.
ZR--95	0.	0.	0.	0.	0.	0.	0.	0.
NB--95	0.	0.	0.	0.	0.	0.	0.	0.
RU-103	0.	0.	0.	0.	0.	0.	0.	0.
RU-106	0.	0.	0.	0.	0.	0.	0.	0.
AG110M	0.	0.	0.	0.	0.	0.	0.	0.
CD115M	0.	0.	0.	0.	0.	0.	0.	0.
SN-123	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABLE G-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - GROUND PLANE DEPOSITION AGE GROUP - CHILD

NUCLIDE	ORGAN DOSE FACTORS (SQ.METER-MREM/YR PER UCI/SEC)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
SN-126	0.	0.	0.	0.	0.	0.	0.	0.
SB-124	0.	0.	0.	0.	0.	0.	0.	0.
SB-125	0.	0.	0.	0.	0.	0.	0.	0.
TE125M	0.	0.	0.	0.	0.	0.	0.	0.
TE127M	0.	0.	0.	0.	0.	0.	0.	0.
TE129M	0.	0.	0.	0.	0.	0.	0.	0.
I--130	0.	0.	0.	0.	0.	0.	0.	0.
I--131	8.50E+06	8.50E+06	8.50E+06	8.50E+06	8.50E+06	8.50E+06	1.03E+07	8.50E+06
I--132	0.	0.	0.	0.	0.	0.	0.	0.
I--133	1.10E+06	1.10E+06	1.10E+06	1.10E+06	1.10E+06	1.10E+06	1.34E+06	1.10E+06
I--134	0.	0.	0.	0.	0.	0.	0.	0.
I--135	1.04E+06	1.04E+06	1.04E+06	1.04E+06	1.04E+06	1.04E+06	8.87E+05	1.04E+06
CS-134	6.86E+09	6.86E+09	6.86E+09	6.86E+09	6.86E+09	6.86E+09	8.01E+09	6.86E+09
CS-135	0.	0.	0.	0.	0.	0.	0.	0.
CS-136	0.	0.	0.	0.	0.	0.	0.	0.
CS-137	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.20E+10	1.03E+10
CS-138	3.60E+03	3.60E+03	3.60E+03	3.60E+03	3.60E+03	3.60E+03	4.12E+03	3.60E+03
XE-133	0.	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.	0.
LA-140	0.	0.	0.	0.	0.	0.	0.	0.
BA137M	0.	0.	0.	0.	0.	0.	0.	0.
BA-140	1.86E+08	1.86E+08	1.86E+08	1.86E+08	1.86E+08	1.86E+08	1.70E+08	1.86E+08
CE-141	0.	0.	0.	0.	0.	0.	0.	0.
CE-144	0.	0.	0.	0.	0.	0.	0.	0.
PR-143	0.	0.	0.	0.	0.	0.	0.	0.
ND-147	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABLE G

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - INHALATION

AGE GROUP - CHILD

NUCLIDE	ORGAN DOSE FACTORS (MREM/YR PER UCI/CU.METER)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
H----3	0.	0.	0.	0.	0.	0.	0.	0.
C---14	0.	0.	0.	0.	0.	0.	0.	0.
P---32	0.	0.	0.	0.	0.	0.	0.	0.
CR--51	0.	0.	0.	0.	0.	0.	0.	0.
MN--54	0.	0.	0.	0.	0.	0.	0.	0.
FE--59	0.	0.	0.	0.	0.	0.	0.	0.
CO--57	0.	0.	0.	0.	0.	0.	0.	0.
CO--58	0.	0.	0.	0.	0.	0.	0.	0.
CO--60	0.	0.	0.	0.	0.	0.	0.	0.
NI--63	0.	0.	0.	0.	0.	0.	0.	0.
ZN--65	0.	0.	0.	0.	0.	0.	0.	0.
KR--85	0.	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.	0.
KR--87	0.	0.	0.	0.	0.	0.	0.	0.
KR--88	0.	0.	0.	0.	0.	0.	0.	0.
RB--86	0.	0.	0.	0.	0.	0.	0.	0.
RB--87	0.	0.	0.	0.	0.	0.	0.	0.
RB--88	0.	0.	0.	0.	0.	0.	0.	0.
SR--89	0.	0.	0.	0.	0.	0.	0.	0.
SR--90	0.	0.	0.	0.	0.	0.	0.	0.
Y---90	0.	0.	0.	0.	0.	0.	0.	0.
Y---91	0.	0.	0.	0.	0.	0.	0.	0.
ZR--95	0.	0.	0.	0.	0.	0.	0.	0.
NB--95	0.	0.	0.	0.	0.	0.	0.	0.
RU-103	0.	0.	0.	0.	0.	0.	0.	0.
RU-106	0.	0.	0.	0.	0.	0.	0.	0.
AG110M	0.	0.	0.	0.	0.	0.	0.	0.
CD115M	0.	0.	0.	0.	0.	0.	0.	0.
SN-123	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABLE G-

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - INHALATION

AGE GROUP - CHILD

NUCLIDE	ORGAN DOSE FACTORS (MREM/YR PER UCI/CU.METER)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
SN-126	0.	0.	0.	0.	0.	0.	0.	0.
SB-124	0.	0.	0.	0.	0.	0.	0.	0.
SB-125	0.	0.	0.	0.	0.	0.	0.	0.
TE125M	0.	0.	0.	0.	0.	0.	0.	0.
TE127M	0.	0.	0.	0.	0.	0.	0.	0.
TE129M	0.	0.	0.	0.	0.	0.	0.	0.
I--130	0.	0.	0.	0.	0.	0.	0.	0.
I--131	2.38E+04	2.38E+04	8.02E+06	3.89E+04	0.	1.40E+03	0.	1.35E+04
I--132	0.	0.	0.	0.	0.	0.	0.	0.
I--133	7.41E+03	9.08E+03	1.72E+06	1.51E+04	0.	2.45E+03	0.	3.44E+03
I--134	0.	0.	0.	0.	0.	0.	0.	0.
I--135	1.73E+03	3.07E+03	2.78E+05	4.70E+03	0.	1.56E+03	0.	1.46E+03
CS-134	0.	0.	0.	0.	0.	0.	0.	0.
CS-135	0.	0.	0.	0.	0.	0.	0.	0.
CS-136	0.	0.	0.	0.	0.	0.	0.	0.
CS-137	0.	0.	0.	0.	0.	0.	0.	0.
CS-138	0.	0.	0.	0.	0.	0.	0.	0.
XE-133	0.	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.	0.
LA-140	0.	0.	0.	0.	0.	0.	0.	0.
BA137M	0.	0.	0.	0.	0.	0.	0.	0.
BA-140	0.	0.	0.	0.	0.	0.	0.	0.
CE-141	0.	0.	0.	0.	0.	0.	0.	0.
CE-144	0.	0.	0.	0.	0.	0.	0.	0.
PR-143	0.	0.	0.	0.	0.	0.	0.	0.
ND-147	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABLE G-

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE

PATHWAY - COWS MILK (CONTAMINATED FORAGE) AGE GROUP - CHILD

NUCLIDE	ORGAN DOSE FACTORS (SQ.METER-MREM/YR PER UCI/SEC)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
H----3	0.	0.	0.	0.	0.	0.	0.	0.
C---14	0.	0.	0.	0.	0.	0.	0.	0.
P---32	0.	0.	0.	0.	0.	0.	0.	0.
CR--51	0.	0.	0.	0.	0.	0.	0.	0.
MN--54	0.	8.36E+06	0.	2.35E+06	0.	7.02E+06	0.	2.23E+06
FE--59	5.14E+07	8.33E+07	0.	0.	2.41E+07	8.67E+07	0.	4.15E+07
CO--57	0.	0.	0.	0.	0.	0.	0.	0.
CO--58	0.	5.04E+06	0.	0.	0.	2.94E+07	0.	1.54E+07
CO--60	0.	1.71E+07	0.	0.	0.	9.47E+07	0.	5.04E+07
NI--63	0.	0.	0.	0.	0.	0.	0.	0.
ZN--65	0.	0.	0.	0.	0.	0.	0.	0.
KR--83	0.	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.	0.
KR--87	0.	0.	0.	0.	0.	0.	0.	0.
KR--88	0.	0.	0.	0.	0.	0.	0.	0.
RB--86	0.	0.	0.	0.	0.	0.	0.	0.
RB--87	0.	1.89E-05	0.	0.	0.	2.83E-07	0.	8.75E-06
RB--88	0.	0.	0.	0.	0.	0.	0.	0.
SR--89	2.81E+09	0.	0.	0.	0.	1.09E+08	0.	8.03E+07
SR--90	3.09E+10	0.	0.	0.	0.	6.25E+08	0.	8.27E+09
Y---90	1.20E+03	0.	0.	0.	0.	3.41E+06	0.	3.21E+01
Y---91	0.	0.	0.	0.	0.	0.	0.	0.
ZR--95	0.	0.	0.	0.	0.	0.	0.	0.
NB--95	0.	0.	0.	0.	0.	0.	0.	0.
RU-103	0.	0.	0.	0.	0.	0.	0.	0.
RU-106	0.	0.	0.	0.	0.	0.	0.	0.
AG110M	0.	0.	0.	0.	0.	0.	0.	0.
CD115M	0.	0.	0.	0.	0.	0.	0.	0.
SN-123	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABLE G

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - COWS MILK (CONTAMINATED FORAGE) AGE GROUP - CHILD

NUCLIDE	ORGAN DOSE FACTORS (SQ.METER-MREM/YR PER UCI/SEC)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
SN-126	0.	0.	0.	0.	0.	0.	0.	0.
SB-124	0.	0.	0.	0.	0.	0.	0.	0.
SB-125	0.	0.	0.	0.	0.	0.	0.	0.
TE125M	0.	0.	0.	0.	0.	0.	0.	0.
TE127M	0.	0.	0.	0.	0.	0.	0.	0.
TE129M	0.	0.	0.	0.	0.	0.	0.	0.
I--130	0.	0.	0.	0.	0.	0.	0.	0.
I--131	3.16E+08	3.18E+08	1.05E+11	5.23E+08	0.	2.83E+07	0.	1.81E+08
I--132	0.	0.	0.	0.	0.	0.	0.	0.
I--133	3.89E+06	4.82E+06	8.95E+08	8.02E+06	0.	1.94E+06	0.	1.82E+06
I--134	0.	0.	0.	0.	0.	0.	0.	0.
I--135	9.54E+03	1.72E+04	1.52E+06	2.63E+04	1.63E-01	1.31E+04	0.	8.12E+03
CS-134	8.91E+09	1.46E+10	0.	4.53E+09	1.63E+09	7.89E+07	0.	3.09E+09
CS-135	0.	0.	0.	0.	0.	0.	0.	0.
CS-136	0.	0.	0.	0.	0.	0.	0.	0.
CS-137	1.30E+10	1.25E+10	0.	4.06E+09	1.46E+09	7.80E+07	0.	1.84E+09
CS-138	0.	0.	0.	0.	0.	0.	0.	0.
XE-133	0.	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.	0.
LA-140	0.	0.	0.	0.	0.	0.	0.	0.
BA137M	0.	0.	0.	0.	0.	0.	0.	0.
BA-140	5.56E+07	4.87E+04	0.	1.58E+04	2.90E+04	2.89E+07	0.	3.24E+06
CE-141	0.	0.	0.	0.	0.	0.	0.	0.
CE-144	0.	0.	0.	0.	0.	0.	0.	0.
PR-143	0.	0.	0.	0.	0.	0.	0.	0.
ND-147	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABLE G-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE

PATHWAY - GROUND PLANE DEPOSITION   AGE GROUP - INFANT

NUCLIDE	ORGAN DOSE FACTORS (SQ.METER-MREM/YR PER UCI/SEC)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
H----3	0.	0.	0.	0.	0.	0.	0.	0.
C---14	0.	0.	0.	0.	0.	0.	0.	0.
P---32	0.	0.	0.	0.	0.	0.	0.	0.
CR--51	0.	0.	0.	0.	0.	0.	0.	0.
MN--54	1.38E+09	1.38E+09	1.38E+09	1.38E+09	1.38E+09	1.38E+09	1.62E+09	1.38E+09
FE--59	2.72E+08	2.72E+08	2.72E+08	2.72E+08	2.72E+08	2.72E+08	3.20E+08	2.72E+08
CO--57	0.	0.	0.	0.	0.	0.	0.	0.
CO--58	3.78E+08	3.78E+08	3.78E+08	3.78E+08	3.78E+08	3.78E+08	4.43E+08	3.78E+08
CO--60	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.53E+10	2.15E+10
NI--63	0.	0.	0.	0.	0.	0.	0.	0.
ZN--65	0.	0.	0.	0.	0.	0.	0.	0.
KR--85	0.	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.	0.
KR--87	0.	0.	0.	0.	0.	0.	0.	0.
KR--88	0.	0.	0.	0.	0.	0.	0.	0.
RB--86	0.	0.	0.	0.	0.	0.	0.	0.
RB--87	0.	0.	0.	0.	0.	0.	0.	0.
RB--88	1.55E+05	1.55E+05	1.55E+05	1.55E+05	1.55E+05	1.55E+05	1.78E+05	1.55E+05
SR--89	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.16E+04	2.50E+04	2.16E+04
SR--90	0.	0.	0.	0.	0.	0.	0.	0.
Y---90	5.35E+06	5.35E+06	5.35E+06	5.35E+06	5.35E+06	5.35E+06	6.33E+06	5.35E+06
Y---91	0.	0.	0.	0.	0.	0.	0.	0.
ZR--95	0.	0.	0.	0.	0.	0.	0.	0.
NB--95	0.	0.	0.	0.	0.	0.	0.	0.
RU-103	0.	0.	0.	0.	0.	0.	0.	0.
RU-106	0.	0.	0.	0.	0.	0.	0.	0.
AG110M	0.	0.	0.	0.	0.	0.	0.	0.
CD115M	0.	0.	0.	0.	0.	0.	0.	0.
SN-123	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABLE [illegible]4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - GROUND PLANE DEPOSITION

AGE GROUP - INFANT

NUCLIDE	ORGAN DOSE FACTORS (SQ.METER-MREM/YR PER UCI/SEC)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
SN-126	0.	0.	0.	0.	0.	0.	0.	0.
SB-124	0.	0.	0.	0.	0.	0.	0.	0.
SB-125	0.	0.	0.	0.	0.	0.	0.	0.
TE125M	0.	0.	0.	0.	0.	0.	0.	0.
TE127M	0.	0.	0.	0.	0.	0.	0.	0.
TE129M	0.	0.	0.	0.	0.	0.	0.	0.
I--130	0.	0.	0.	0.	0.	0.	0.	0.
I--131	8.50E+06	8.50E+06	8.50E+06	8.50E+06	8.50E+06	8.50E+06	1.03E+07	8.50E+06
I--132	0.	0.	0.	0.	0.	0.	0.	0.
I--133	1.10E+06	1.10E+06	1.10E+06	1.10E+06	1.10E+06	1.10E+06	1.34E+06	1.10E+06
I--134	0.	0.	0.	0.	0.	0.	0.	0.
I--135	1.04E+06	1.04E+06	1.04E+06	1.04E+06	1.04E+06	1.04E+06	8.87E+05	1.04E+06
CS-134	6.86E+09	6.86E+09	6.86E+09	6.86E+09	6.86E+09	6.86E+09	8.01E+09	6.86E+09
CS-135	0.	0.	0.	0.	0.	0.	0.	0.
CS-136	0.	0.	0.	0.	0.	0.	0.	0.
CS-137	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.20E+10	1.03E+10
CS-138	3.60E+03	3.60E+03	3.60E+03	3.60E+03	3.60E+03	3.60E+03	4.12E+03	3.60E+03
XE-133	0.	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.	0.
LA-140	0.	0.	0.	0.	0.	0.	0.	0.
BA137M	0.	0.	0.	0.	0.	0.	0.	0.
BA-140	1.85E+08	1.86E+08	1.86E+08	1.86E+08	1.86E+08	1.86E+08	1.70E+08	1.86E+08
CE-141	0.	0.	0.	0.	0.	0.	0.	0.
CE-144	0.	0.	0.	0.	0.	0.	0.	0.
PR-143	0.	0.	0.	0.	0.	0.	0.	0.
ND-147	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABLE G-

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - INHALATION

AGE GROUP - INFANT

NUCLIDE	O R G A N D O S E F A C T O R S (MREM/YR PER UCI/CU.METER)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
H----3	0.	0.	0.	0.	0.	0.	0.	0.
C---14	0.	0.	0.	0.	0.	0.	0.	0.
P---32	0.	0.	0.	0.	0.	0.	0.	0.
CR--51	0.	0.	0.	0.	0.	0.	0.	0.
MN--54	0.	0.	0.	0.	0.	0.	0.	0.
FE--59	0.	0.	0.	0.	0.	0.	0.	0.
CO--57	0.	0.	0.	0.	0.	0.	0.	0.
CO--58	0.	0.	0.	0.	0.	0.	0.	0.
CO--60	0.	0.	0.	0.	0.	0.	0.	0.
NI--63	0.	0.	0.	0.	0.	0.	0.	0.
ZN--65	0.	0.	0.	0.	0.	0.	0.	0.
KR--85	0.	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.	0.
KR--87	0.	0.	0.	0.	0.	0.	0.	0.
KR--88	0.	0.	0.	0.	0.	0.	0.	0.
RB--86	0.	0.	0.	0.	0.	0.	0.	0.
RB--87	0.	0.	0.	0.	0.	0.	0.	0.
RB--88	0.	0.	0.	0.	0.	0.	0.	0.
SR--89	0.	0.	0.	0.	0.	0.	0.	0.
SR--90	0.	0.	0.	0.	0.	0.	0.	0.
Y---90	0.	0.	0.	0.	0.	0.	0.	0.
Y---91	0.	0.	0.	0.	0.	0.	0.	0.
ZR--95	0.	0.	0.	0.	0.	0.	0.	0.
NB--95	0.	0.	0.	0.	0.	0.	0.	0.
RU-103	0.	0.	0.	0.	0.	0.	0.	0.
RU-106	0.	0.	0.	0.	0.	0.	0.	0.
AG110M	0.	0.	0.	0.	0.	0.	0.	0.
CD115M	0.	0.	0.	0.	0.	0.	0.	0.
SN-123	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

LE G-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - INHALATION AGE GROUP - INFANT

NUCLIDE	ORGAN DOSE FACTORS (MREM/YR PER UCI/CU.METER)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
SN-126	0.	0.	0.	0.	0.	0.	0.	0.
SB-124	0.	0.	0.	0.	0.	0.	0.	0.
SB-125	0.	0.	0.	0.	0.	0.	0.	0.
TE125M	0.	0.	0.	0.	0.	0.	0.	0.
TE127M	0.	0.	0.	0.	0.	0.	0.	0.
TE129M	0.	0.	0.	0.	0.	0.	0.	0.
I--130	0.	0.	0.	0.	0.	0.	0.	0.
I--131	1.87E+04	2.19E+04	7.33E+06	2.56E+04	0.	5.23E+02	0.	9.68E+03
I--132	0.	0.	0.	0.	0.	0.	0.	0.
I--133	5.92E+03	8.58E+03	1.59E+06	1.00E+04	0.	9.64E+02	0.	2.50E+03
I--134	0.	0.	0.	0.	0.	0.	0.	0.
I--135	1.36E+03	2.67E+03	2.44E+05	2.98E+03	0.	6.44E+02	0.	9.74E+02
CS-134	0.	0.	0.	0.	0.	0.	0.	0.
CS-135	0.	0.	0.	0.	0.	0.	0.	0.
CS-136	0.	0.	0.	0.	0.	0.	0.	0.
CS-137	0.	0.	0.	0.	0.	0.	0.	0.
CS-138	0.	0.	0.	0.	0.	0.	0.	0.
XE-133	0.	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.	0.
LA-140	0.	0.	0.	0.	0.	0.	0.	0.
BA137M	0.	0.	0.	0.	0.	0.	0.	0.
BA-140	0.	0.	0.	0.	0.	0.	0.	0.
CE-141	0.	0.	0.	0.	0.	0.	0.	0.
CE-144	0.	0.	0.	0.	0.	0.	0.	0.
PR-143	0.	0.	0.	0.	0.	0.	0.	0.
ND-147	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

E G-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - COWS MILK (CONTAMINATED FORAGE) AGE GROUP - INFANT

NUCLIDE	ORGAN DOSE FACTORS (SQ.METER-MREM/YR PER UCI/SEC)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
H----3	0.	0.	0.	0.	0.	0.	0.	0.
C---14	0.	0.	0.	0.	0.	0.	0.	0.
P---32	0.	0.	0.	0.	0.	0.	0.	0.
CR--51	0.	0.	0.	0.	0.	0.	0.	0.
MN--54	0.	1.56E+07	0.	3.45E+06	0.	5.71E+06	0.	3.53E+06
FE--59	9.60E+07	1.68E+08	0.	0.	4.96E+07	8.01E+07	0.	6.61E+07
CO--57	0.	0.	0.	0.	0.	0.	0.	0.
CO--58	0.	1.01E+07	0.	0.	0.	2.51E+07	0.	2.51E+07
CO--60	0.	3.49E+07	0.	0.	0.	8.31E+07	0.	8.25E+07
NI--63	0.	0.	0.	0.	0.	0.	0.	0.
ZN--65	0.	0.	0.	0.	0.	0.	0.	0.
KR--85	0.	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.	0.
KR--87	0.	0.	0.	0.	0.	0.	0.	0.
KR--88	0.	0.	0.	0.	0.	0.	0.	0.
RB--86	0.	0.	0.	0.	0.	0.	0.	0.
RB--87	0.	4.25E-05	0.	0.	0.	2.86E-07	0.	1.68E-05
RB--88	0.	0.	0.	0.	0.	0.	0.	0.
SR--89	5.35E+09	0.	0.	0.	0.	1.10E+08	0.	1.53E+08
SR--90	3.41E+10	0.	0.	0.	0.	6.30E+08	0.	9.20E+09
Y---90	2.54E+03	0.	0.	0.	0.	3.50E+06	0.	6.80E+01
Y---91	0.	0.	0.	0.	0.	0.	0.	0.
ZR--95	0.	0.	0.	0.	0.	0.	0.	0.
NB--95	0.	0.	0.	0.	0.	0.	0.	0.
RU-103	0.	0.	0.	0.	0.	0.	0.	0.
RU-106	0.	0.	0.	0.	0.	0.	0.	0.
AG110M	0.	0.	0.	0.	0.	0.	0.	0.
CD115M	0.	0.	0.	0.	0.	0.	0.	0.
SN-123	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

TABLE G-4

ENVIRONMENTAL PATHWAY-DOSE CONVERSION FACTORS P(I) FOR GASEOUS DISCHARGE 12

PATHWAY - COWS MILK (CONTAMINATED FORAGE) AGE GROUP - INFANT

NUCLIDE	ORGAN DOSE FACTORS (SQ.METER-MREM/YR PER UCI/SEC)							
	BONE	LIVER	THYROID	KIDNEY	LUNG	GI-LLI	SKIN	TOTAL BODY
SN-126	0.	0.	0.	0.	0.	0.	0.	0.
SB-124	0.	0.	0.	0.	0.	0.	0.	0.
SB-125	0.	0.	0.	0.	0.	0.	0.	0.
TE125M	0.	0.	0.	0.	0.	0.	0.	0.
TE127M	0.	0.	0.	0.	0.	0.	0.	0.
TE129M	0.	0.	0.	0.	0.	0.	0.	0.
I--130	0.	0.	0.	0.	0.	0.	0.	0.
I--131	6.61E+08	7.78E+08	2.56E+11	9.09E+08	0.	2.78E+07	0.	3.42E+08
I--132	0.	0.	0.	0.	0.	0.	0.	0.
I--133	8.22E+06	1.20E+07	2.18E+09	1.41E+07	0.	2.03E+06	0.	3.51E+06
I--134	0.	0.	0.	0.	0.	0.	0.	0.
I--135	1.98E+04	3.95E+04	3.54E+06	4.40E+04	3.13E-01	1.43E+04	0.	1.44E+04
CS-134	1.44E+10	2.68E+10	0.	5.90E+09	2.83E+09	7.28E+07	0.	2.71E+09
CS-135	0.	0.	0.	0.	0.	0.	0.	0.
CS-136	0.	0.	0.	0.	0.	0.	0.	0.
CS-137	2.09E+10	2.43E+10	0.	6.53E+09	2.64E+09	7.60E+07	0.	1.72E+09
CS-138	0.	0.	0.	0.	0.	0.	0.	0.
XE-133	0.	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.	0.
LA-140	0.	0.	0.	0.	0.	0.	0.	0.
BA137M	0.	0.	0.	0.	0.	0.	0.	0.
BA-140	1.14E+08	1.14E+05	0.	2.71E+04	7.02E+04	2.89E+07	0.	5.89E+06
CE-141	0.	0.	0.	0.	0.	0.	0.	0.
CE-144	0.	0.	0.	0.	0.	0.	0.	0.
PR-143	0.	0.	0.	0.	0.	0.	0.	0.
ND-147	0.	0.	0.	0.	0.	0.	0.	0.

BASED ON 1 UCI/SEC RELEASE RATE OF EACH ISOTOPE IN AND A VALUE OF 1. FOR X/Q, DEPLETED X/Q AND RELATIVE DEPOSITION

INDIAN POINT UNITS Nos. 1 & 2

OFFSITE DOSE CALCULATION MANUAL (ODCM)

TABLE M-1

SECTOR	DISTANCE*	AVERAGE X/Q
N	1100m	5.21 E-06
NNE	1100m	5.00 E-06
NE	604m	9.37 E-06
ENE	590m	5.13 E-06
E	590m	4.75 E-06
ESE	590m	3.16 E-06
SE	590m	3.88 E-06
SSE	590m	3.99 E-06
S	728m	6.13 E-06
SSW	579m	1.34 E-05
SW	579m	2.08 E-05
WSW	579m	1.05 E-05
W	1100m	2.14 E-06
WNW	1100m	9.79 E-07
NW	1100m	1.17 E-06
NNW	1100m	1.62 E-06

* To Site Boundary

Overall Average Site Boundary X/Q = 6.08 E-06

Worst Average Site Boundary X/Q = 2.08 E-05

AVERAGE X/Q BY SECTOR NAME AT MIDPOINT OF EACH RADIAL SEGMENT

DOWN WIND DISTANCE IN METERS	SECTOR NAME							
	NORTH	NORTH NORTH-EAST	NORTH-EAST	EAST NORTH-EAST	EAST	EAST SOUTH-EAST	SOUTH-EAST	SOUTH SOUTH-EAST
600	1.31E-05	1.26E-05	9.37E-06	5.13E-06	4.75E-06	3.16E-06	3.88E-06	3.99E-06
730	9.70E-06	9.34E-06	6.95E-06	3.80E-06	3.52E-06	2.35E-06	2.89E-06	2.98E-06
1,070	5.43E-06	5.21E-06	3.89E-06	2.13E-06	1.98E-06	1.32E-06	1.62E-06	1.68E-06
1,100	5.21E-06	5.00E-06	3.73E-06	2.04E-06	1.90E-06	1.27E-06	1.56E-06	1.62E-06
1,200	4.58E-06	4.39E-06	3.28E-06	1.79E-06	1.67E-06	1.11E-06	1.36E-06	1.42E-06
1,220	4.47E-06	4.29E-06	3.20E-06	1.75E-06	1.63E-06	1.09E-06	1.38E-06	1.39E-06
1,280	4.16E-06	3.99E-06	2.98E-06	1.63E-06	1.52E-06	1.01E-06	1.24E-06	1.29E-06
1,370	3.76E-06	3.60E-06	2.69E-06	1.47E-06	1.38E-06	9.15E-07	1.12E-06	1.17E-06
1,525	3.21E-06	3.07E-06	2.29E-06	1.25E-06	1.17E-06	7.80E-07	9.51E-07	9.93E-07
1,740	2.64E-06	2.52E-06	1.88E-06	1.03E-06	9.67E-07	6.41E-07	7.80E-07	8.16E-07

AVERAGE X/Q BY SECTOR NAME AT MIDPOINT OF EACH RADIAL SEGMENT

DOWN WIND DISTANCE IN METERS	SECTOR NAME							
	NORTH	NORTH NORTH-EAST	NORTH-EAST	EAST NORTH-EAST	EAST	EAST SOUTH-EAST	SOUTH-EAST	SOUTH SOUTH-EAST
1,830	2.45E-06	2.34E-06	1.75E-06	9.55E-07	8.98E-07	5.95E-07	7.23E-07	7.57E-07
1,890	2.34E-06	2.23E-06	1.67E-06	9.11E-07	8.57E-07	5.68E-07	6.90E-07	7.21E-07
1,950	2.23E-06	2.13E-06	1.59E-06	8.70E-07	8.18E-07	5.42E-07	6.58E-07	6.89E-07
2,135	1.95E-06	1.87E-06	1.39E-06	7.62E-07	7.17E-07	4.74E-07	5.76E-07	6.02E-07
2,400	1.65E-06	1.57E-06	1.17E-06	6.42E-07	6.05E-07	4.00E-07	4.85E-07	5.06E-07
2,745	1.35E-06	1.29E-06	9.61E-07	5.28E-07	4.98E-07	3.28E-07	3.98E-07	4.15E-07
3,050	1.16E-06	1.11E-06	8.23E-07	4.52E-07	4.27E-07	2.81E-07	3.41E-07	3.55E-07
4,000	7.80E-07	7.43E-07	5.51E-07	3.04E-07	2.88E-07	1.89E-07	2.28E-07	2.37E-07
5,280	5.19E-07	4.93E-07	3.65E-07	2.02E-07	1.91E-07	1.25E-07	1.51E-07	1.57E-07
5,600	4.76E-07	4.52E-07	3.35E-07	1.85E-07	1.76E-07	1.15E-07	1.38E-07	1.43E-07

AVERAGE X/Q BY SECTOR NAME AT MIDPOINT OF EACH RADIAL SEGMENT

DOWN WIND DISTANCE IN METERS	SECTOR NAME							
	NORTH	NORTH NORTH-EAST	NORTH-EAST	EAST NORTH-EAST	EAST	EAST SOUTH-EAST	SOUTH-EAST	SOUTH SOUTH-EAST
7,200	3.29E-07	3.13E-07	2.31E-07	1.28E-07	1.22E-07	7.93E-08	9.55E-08	9.86E-08
11,200	1.73E-07	1.64E-07	1.21E-07	6.75E-08	6.41E-08	4.15E-08	4.98E-08	5.12E-08
12,000	1.57E-07	1.49E-07	1.09E-07	6.11E-08	5.80E-08	3.76E-08	4.50E-08	4.62E-08
20,000	7.76E-08	7.33E-08	5.38E-08	3.02E-08	2.88E-08	1.85E-08	2.21E-08	2.26E-08
28,000	4.99E-08	4.71E-08	3.45E-08	1.95E-08	1.86E-08	1.19E-08	1.42E-08	1.44E-08
40,000	3.12E-08	2.95E-08	2.15E-08	1.22E-08	1.17E-08	7.43E-09	8.86E-09	8.96E-09
56,000	2.01E-08	1.89E-08	1.38E-08	7.88E-09	7.52E-09	4.77E-09	5.70E-09	5.72E-09
72,000	1.45E-08	1.36E-08	9.92E-09	5.68E-09	5.42E-09	3.43E-09	4.10E-09	4.10E-09

AVERAGE X/Q BY SECTOR NAME AT MIDPOINT OF EACH RADIAL SEGMENT

DOWN WIND DISTANCE IN METERS	SECTOR NAME							
	SOUTH	SOUTH SOUTH-WEST	SOUTH-WEST	WEST SOUTH-WEST	WEST	WEST NORTH-WEST	NORTH-WEST	NORTH NORTH-WEST
600	8.30E-06	1.34E-05	2.08E-05	1.05E-05	5.27E-06	2.45E-06	2.92E-06	4.06E-06
730	6.13E-06	9.81E-06	1.52E-05	7.73E-06	3.92E-06	1.82E-06	2.16E-06	3.01E-06
1,070	3.42E-06	5.46E-06	8.52E-06	4.36E-06	2.22E-06	1.02E-06	1.22E-06	1.69E-06
1,100	3.28E-06	5.25E-06	8.18E-06	4.19E-06	2.14E-06	9.79E-07	1.17E-06	1.62E-06
1,200	2.88E-06	4.61E-06	7.22E-05	3.70E-05	1.88E-06	8.61E-07	1.03E-06	1.43E-06
1,220	2.81E-06	4.50E-06	7.05E-06	3.61E-06	1.84E-06	8.40E-07	1.00E-06	1.39E-06
1,280	2.61E-06	4.19E-06	6.57E-06	3.37E-06	1.71E-06	7.82E-07	9.33E-07	1.30E-06
1,370	2.36E-06	3.79E-06	5.96E-06	3.05E-06	1.55E-06	7.07E-07	8.44E-07	1.17E-06
1,525	2.01E-06	3.23E-06	5.10E-06	2.61E-06	1.33E-06	6.03E-07	7.20E-07	1.00E-06
1,740	1.65E-06	2.66E-06	4.21E-06	2.15E-06	1.09E-06	4.96E-07	5.93E-07	8.24E-07

AVERAGE X/Q BY SECTOR NAME AT MIDPOINT OF EACH RADIAL SEGMENT

DOWN WIND DISTANCE IN METERS	SECTOR NAME							
	SOUTH	SOUTH SOUTH-WEST	SOUTH-WEST	WEST SOUTH-WEST	WEST	WEST NORTH-WEST	NORTH-WEST	NORTH NORTH-WEST
1,830	1.53E-06	2.47E-06	3.91E-06	2.00E-06	1.02E-06	4.60E-07	5.50E-07	7.65E-07
1,890	1.46E-06	2.36E-06	3.74E-06	1.91E-07	9.71E-07	4.39E-07	5.25E-07	7.30E-07
1,950	1.39E-06	2.25E-06	3.58E-06	1.83E-06	9.28E-07	4.20E-07	5.02E-07	6.97E-07
2,135	1.22E-06	1.98E-06	3.14E-06	1.61E-06	8.13E-07	3.68E-07	4.40E-07	6.11E-07
2,400	1.03E-06	1.67E-06	2.66E-06	1.36E-06	6.87E-07	3.10E-07	3.71E-07	5.15E-07
2,745	8.49E-07	1.38E-06	2.20E-06	1.12E-06	5.65E-07	2.56E-07	3.05E-07	4.24E-07
3,050	7.29E-07	1.18E-06	1.90E-06	9.63E-07	4.85E-07	2.19E-07	2.62E-07	3.64E-07
4,000	4.91E-07	8.01E-07	1.29E-06	6.52E-07	3.27E-07	1.48E-07	1.76E-07	2.45E-07
5,280	3.27E-07	5.36E-07	8.71E-07	4.37E-07	2.18E-07	9.84E-08	1.17E-07	1.63E-07
5,600	3.00E-07	4.92E-07	8.01E-07	4.02E-07	2.00E-07	9.02E-07	1.08E-07	1.49E-07

AVERAGE X/Q BY SECTOR NAME AT MIDPOINT OF EACH RADIAL SEGMENT

DOWN WIND DISTANCE IN METERS	SECTOR NAME							
	SOUTH	SOUTH SOUTH-WEST	SOUTH-WEST	WEST SOUTH-WEST	WEST	WEST NORTH-WEST	NORTH-WEST	NORTH NORTH-WEST
7,200	2.08E-07	3.43E-07	5.61E-07	2.80E-07	1.39E-07	6.26E-08	7.46E-08	1.04E-07
11,200	1.10E-07	1.83E-07	3.03E-07	1.50E-07	7.33E-08	3.30E-08	3.94E-08	5.45E-08
12,000	9.98E-08	1.66E-07	2.75E-07	1.36E-07	6.64E-08	2.99E-08	3.57E-08	4.94E-08
20,000	4.95E-08	8.28E-08	1.39E-07	6.80E-08	3.30E-08	1.48E-08	1.77E-08	2.44E-08
28,000	3.19E-08	5.35E-08	9.01E-08	4.40E-08	2.13E-08	9.54E-09	1.14E-08	1.57E-08
40,000	2.01E-08	3.37E-08	5.70E-08	2.78E-08	1.34E-08	5.98E-09	7.13E-09	9.85E-09
56,000	1.30E-08	2.18E-08	3.70E-08	1.80E-08	8.61E-09	3.86E-09	4.59E-09	6.34E-09
72,000	9.37E-09	1.58E-08	2.68E-08	1.30E-08	6.21E-09	2.78E-09	3.31E-09	4.57E-09

RELATIVE DEPOSITON PER UNIT AREA AT FIXED POINTS BY DOWNWIND SECTORS

DISTANCE IN METERS	DIRECTION FROM SITE					
	SOUTH	SOUTH SOUTH-WEST	SOUTH-WEST	WEST SOUTH-WEST	WEST	WEST NORTH-WEST
400	4.731E-08	7.336E-08	8.323E-08	3.817E-08	1.639E-08	7.353E-09
730	1.855E-08	2.877E-08	3.264E-08	1.497E-08	6.426E-09	2.884E-09
800	1.601E-08	2.482E-08	2.816E-08	1.291E-08	5.545E-09	2.488E-09
1,070	9.971E-09	1.546E-08	1.754E-08	8.045E-09	3.454E-09	1.550E-09
1,100	9.519E-09	1.476E-08	1.675E-08	7.680E-09	3.297E-09	1.480E-09
1,200	8.222E-09	1.275E-08	1.447E-08	6.633E-09	2.848E-09	1.278E-09
1,220	7.996E-09	1.240E-08	1.407E-08	6.451E-09	2.770E-09	1.243E-09
1,280	7.373E-09	1.143E-08	1.297E-08	5.949E-09	2.554E-09	1.146E-09
1,370	6.572E-09	1.019E-08	1.156E-08	5.303E-09	2.277E-09	1.022E-09
1,525	5.479E-09	8.496E-09	9.640E-09	4.421E-09	1.898E-09	8.517E-10

RELATIVE DEPOSITON PER UNIT AREA AT FIXED POINTS BY DOWNWIND SECTORS

DISTANCE IN METERS	DIRECTION FROM SITE					
	SOUTH	SOUTH SOUTH-WEST	SOUTH-WEST	WEST SOUTH-WEST	WEST	WEST NORTH-WEST
1,600	5.049E-09	7.830E-09	8.884E-09	4.074E-09	1.749E-09	7.848E-10
1,740	4.376E-09	6.785E-09	7.699E-09	3.530E-09	1.516E-09	6.802E-10
1,830	4.014E-09	6.225E-09	7.063E-09	3.239E-09	1.391E-09	6.240E-10
1,890	3.798E-09	5.890E-09	6.683E-09	3.064E-09	1.316E-09	5.904E-10
1,950	3.600E-09	5.583E-09	6.334E-09	2.905E-09	1.247E-09	5.596E-10
2,135	3.081E-09	4.777E-09	5.420E-09	2.486E-09	1.067E-09	4.789E-10
2,400	2.518E-09	3.904E-09	4.429E-09	2.031E-09	8.721E-10	3.913E-10
2,745	1.995E-09	3.093E-09	3.510E-09	1.609E-09	6.910E-10	3.101E-10
3,050	1.661E-09	2.575E-09	2.922E-09	1.340E-09	5.752E-10	2.581E-10
3,200	1.527E-09	2.368E-09	2.687E-09	1.232E-09	5.290E-10	2.374E-10

RELATIVE DEPOSITON PER UNIT AREA AT FIXED POINTS BY DOWNWIND SECTORS

DISTANCE IN METERS	DIRECTION FROM SITE					
	SOUTH	SOUTH SOUTH-WEST	SOUTH-WEST	WEST SOUTH-WEST	WEST	WEST NORTH-WEST
4,000	1.033E-09	1.601E-09	1.817E-09	8.331E-10	3.577E-10	1.605E-10
4,800	7.483E-10	1.160E-09	1.317E-09	6.037E-10	2.592E-10	1.163E-10
5,280	6.318E-10	9.798E-10	1.112E-09	5.098E-10	2.189E-10	9.821E-11
5,600	5.690E-10	8.824E-10	1.001E-09	4.591E-10	1.971E-10	8.845E-11
6,400	4.483E-10	6.952E-10	7.888E-10	3.617E-10	1.553E-10	6.968E-11
7,200	3.629E-10	5.628E-10	6.386E-10	2.928E-10	1.257E-10	5.648E-11
8,000	3.002E-10	4.656E-10	5.282E-10	2.422E-10	1.040E-10	4.667E-11
11,200	1.640E-10	2.542E-10	2.885E-10	1.323E-10	5.680E-11	2.548E-11
12,000	1.470E-10	2.279E-10	2.585E-10	1.186E-10	5.091E-11	2.284E-11
16,000	9.223E-11	1.430E-10	1.623E-10	7.441E-11	3.195E-11	1.434E-11

RELATIVE DEPOSITON PER UNIT AREA AT FIXED POINTS BY DOWNWIND SECTORS

DISTANCE IN METERS	DIRECTION FROM SITE					
	SOUTH	SOUTH SOUTH-WEST	SOUTH-WEST	WEST SOUTH-WEST	WEST	WEST NORTH-WEST
24,000	4.664E-11	7.232E-11	8.206E-11	3.763E-11	1.616E-11	7.249E-12
32,000	2.824E-11	4.379E-11	4.968E-11	2.278E-11	9.781E-12	4.381E-12
40,000	1.894E-11	2.936E-11	3.332E-11	1.528E-11	6.560E-12	2.943E-12
48,000	1.357E-11	2.105E-11	2.388E-11	1.095E-11	4.701E-12	2.110E-12
56,000	1.019E-11	1.581E-11	1.793E-11	8.223E-12	3.531E-12	1.584E-12
64,000	7.926E-12	1.229E-11	1.395E-11	6.395E-12	2.746E-12	1.232E-12
72,000	6.332E-12	9.819E-12	1.114E-11	5.109E-12	2.193E-12	9.843E-13
80,000	5.169E-12	8.016E-12	9.095E-12	4.170E-12	1.791E-12	8.035E-13

RELATIVE DEPOSITON PER UNIT AREA AT FIXED POINTS BY DOWNWIND SECTORS

DISTANCE IN METERS	DIRECTION FROM SITE					
	NORTH-WEST	NORTH NORTH-WEST	NORTH	NORTH NORTH-EAST	NORTH-EAST	EAST NORTH-EAST
400	8.544E-09	1.348E-08	5.228E-08	5.806E-08	4.317E-08	2.052E-08
730	3.350E-09	5.286E-09	2.050E-08	2.277E-08	1.693E-08	8.046E-09
800	2.891E-09	4.562E-09	1.769E-08	1.964E-08	1.461E-08	6.948E-09
1,070	1.801E-09	2.842E-09	1.108E-08	1.284E-08	9.325E-09	4.325E-09
1,100	1.719E-09	2.713E-09	1.052E-08	1.168E-08	8.677E-09	4.129E-09
1,200	1.485E-09	2.343E-09	9.086E-09	1.009E-08	7.504E-09	3.566E-09
1,220	1.444E-09	2.279E-09	8.836E-09	9.813E-09	7.297E-09	3.468E-09
1,280	1.332E-09	2.101E-09	8.148E-09	9.049E-09	6.729E-09	3.198E-09
1,370	1.187E-09	1.873E-09	7.263E-09	8.066E-09	5.998E-09	2.887E-09
1,525	9.896E-10	1.561E-09	6.055E-09	6.724E-09	5.001E-09	2.377E-09

RELATIVE DEPOSITON PER UNIT AREA AT FIXED POINTS BY DOWNWIND SECTORS

DISTANCE IN METERS	DIRECTION FROM SITE					
	NORTH-WEST	NORTH NORTH-WEST	NORTH	NORTH NORTH-EAST	NORTH-EAST	EAST NORTH-EAST
1,600	9.119E-10	1.439E-09	5.580E-09	6.196E-09	4.608E-09	2.190E-09
1,740	7.903E-10	1.247E-09	4.836E-09	5.370E-09	3.994E-09	1.898E-09
1,830	7.250E-10	1.144E-09	4.436E-09	4.926E-09	3.663E-09	1.741E-09
1,890	6.860E-10	1.082E-09	4.197E-09	4.661E-09	3.467E-09	1.648E-09
1,950	6.502E-10	1.026E-09	3.978E-09	4.418E-09	3.286E-09	1.562E-09
2,135	5.564E-10	8.779E-10	3.404E-09	3.781E-09	2.812E-09	1.336E-09
2,400	4.547E-10	7.174E-10	2.782E-09	3.090E-09	2.298E-09	1.092E-09
2,745	3.603E-10	5.684E-10	2.204E-09	2.448E-09	1.821E-09	8.652E-10
3,050	2.999E-10	4.732E-10	1.835E-09	2.038E-09	1.515E-09	7.203E-10
3,200	2.758E-10	4.352E-10	1.688E-09	1.874E-09	1.394E-09	6.624E-10

RELATIVE DEPOSITON PER UNIT AREA AT FIXED POINTS BY DOWNWIND SECTORS

DISTANCE IN METERS	DIRECTION FROM SITE					
	NORTH-WEST	NORTH NORTh-WEST	NORTH	NORTH NORTH-EAST	NORTH-EAST	EAST NORTH-EAST
4,000	1.865E-10	2.942E-10	1.141E-09	1.267E-09	9.424E-10	4.479E-10
4,800	1.351E-10	2.132E-10	8.269E-10	9.183E-10	6.829E-10	3.246E-10
5,280	1.141E-10	1.801E-10	6.982E-10	7.754E-10	5.766E-10	2.741E-10
5,600	1.028E-10	1.622E-10	6.288E-10	6.983E-10	5.193E-10	2.468E-10
6,400	8.097E-11	1.278E-10	4.954E-10	5.502E-10	4.091E-10	1.945E-10
7,200	6.555E-11	1.034E-10	4.011E-10	4.454E-10	3.312E-10	1.574E-10
8,000	5.422E-11	8.556E-11	3.318E-10	3.685E-10	2.740E-10	1.302E-10
11,200	2.961E-11	4.672E-11	1.812E-10	2.012E-10	1.496E-10	7.112E-11
12,000	2.654E-11	4.188E-11	1.624E-10	1.803E-10	1.341E-10	6.374E-11
16,000	1.666E-11	2.628E-11	1.019E-10	1.132E-10	8.418E-11	4.001E-11

RELATIVE DEPOSITON PER UNIT AREA AT FIXED POINTS BY DOWNWIND SECTORS

DISTANCE IN METERS	DIRECTION FROM SITE					
	NORTH-WEST	NORTH	NORTH	NORTH NORTH-EAST	NORTH-EAST	EAST NORTH-EAST
24,000	8.423E-12	1.329E-11	5.154E-11	5.742E-11	4.256E-11	2.023E-11
32,000	5.100E-12	8.047E-12	3.120E-11	3.465E-11	2.577E-11	1.225E-11
40,000	3.420E-12	5.396E-12	2.093E-11	2.324E-11	1.728E-11	8.214E-12
48,000	2.451E-12	3.868E-12	1.500E-11	1.666E-11	1.239E-11	5.887E-12
56,000	1.841E-12	2.905E-12	1.126E-11	1.251E-11	9.302E-12	4.421E-12
64,000	1.431E-12	2.259E-12	8.759E-12	9.727E-12	7.234E-12	3.438E-12
72,000	1.144E-12	1.804E-12	6.998E-12	7.771E-12	5.779E-12	2.747E-12
80,000	9.336E-13	1.473E-12	5.712E-12	6.344E-12	4.718E-12	2.242E-12

RELATIVE DEPOSITON PER UNIT AREA AT FIXED POINTS BY DOWNWIND SECTORS

DISTANCE IN METERS	DIRECTION FROM SITE			
	EAST	EAST SOUTH-EAST	SOUTH-EAST	SOUTH SOUTH-EAST
400	2.237E-08	2.223E-08	3.848E-08	3.918E-08
730	8.774E-09	8.719E-09	1.509E-08	1.537E-08
800	7.571E-09	7.524E-09	1.302E-08	1.326E-08
1070	4.716E-09	4.687E-09	8.111E-09	8.259E-09
1100	4.502E-09	4.474E-09	7.743E-09	7.884E-09
1200	3.889E-09	3.864E-09	6.688E-09	6.810E-09
1220	3.782E-09	3.758E-09	6.504E-09	6.623E-09

RELATIVE DEPOSITON PER UNIT AREA AT
FIXED POINTS BY DOWNWIND SECTORS

DISTANCE IN METERS	DIRECTION FROM SITE			
	EAST	EAST SOUTH-EAST	SOUTH-EAST	SOUTH SOUTH-EAST
1280	3.487E-09	3.466E-09	5.998E-09	6.107E-09
1370	3.109E-09	3.098E-09	5.346E-09	5.444E-09
1525	2.592E-09	2.575E-09	4.457E-09	4.538E-09
1600	2.388E-09	2.373E-09	4.107E-09	4.182E-09
1740	2.070E-09	2.057E-09	3.560E-09	3.624E-09
1830	1.899E-09	1.887E-09	3.265E-09	3.325E-09
1890	1.797E-09	1.785E-09	3.090E-09	3.146E-09
1950	1.703E-09	1.692E-09	2.929E-09	2.982E-09

RELATIVE DEPOSITON PER UNIT AREA AT FIXED POINTS BY DOWNWIND SECTORS

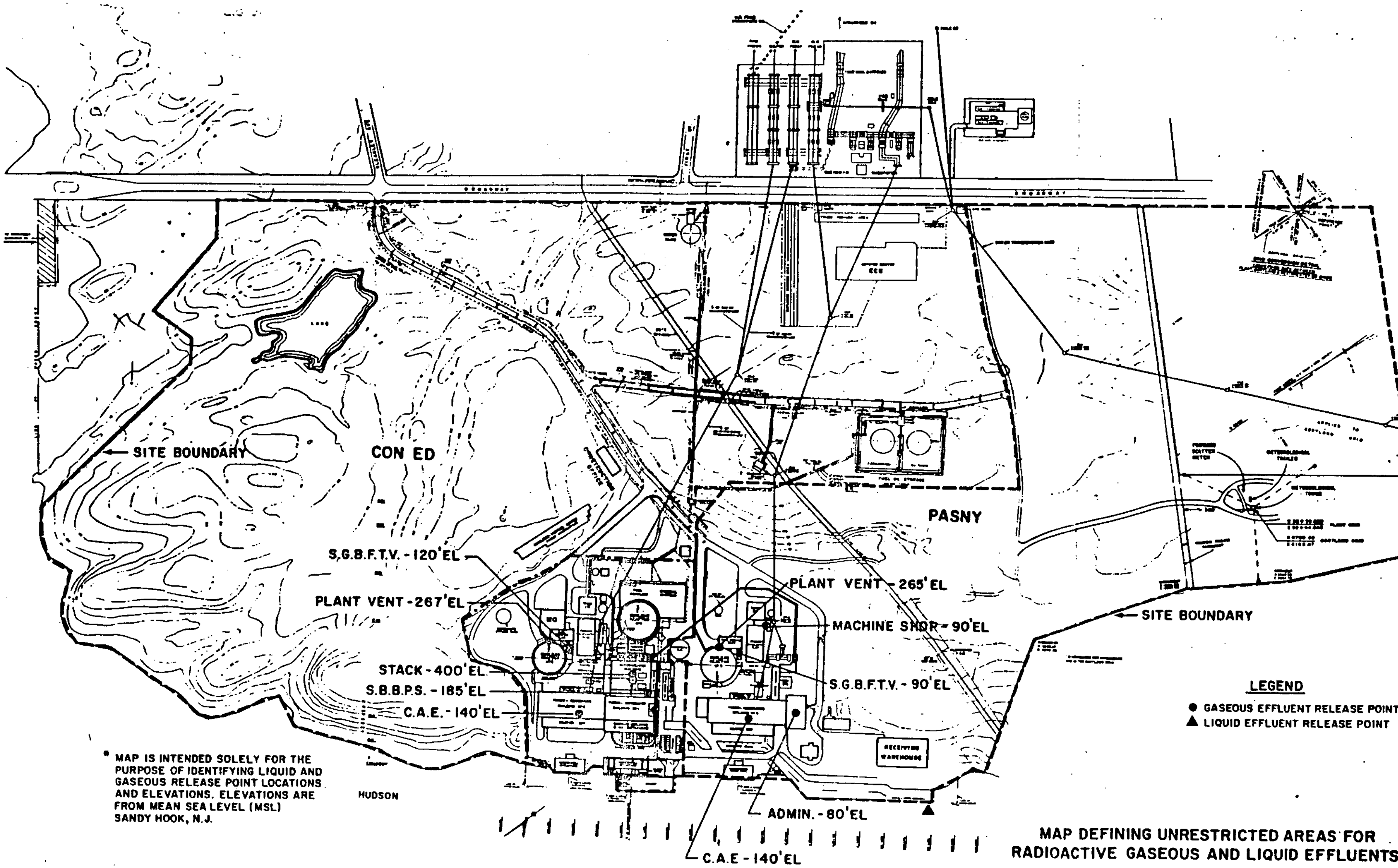
DISTANCE IN METERS	DIRECTION FROM SITE			
	EAST	EAST SOUTH-EAST	SOUTH-EAST	SOUTH SOUTH-EAST
2135	1.457E-09	1.448E-09	2.506E-09	2.552E-09
2400	1.191E-09	1.183E-09	2.048E-09	2.085E-09
2745	9.435E-10	9.376E-10	1.623E-09	1.652E-09
3050	7.854E-10	7.805E-10	1.351E-09	1.375E-09
3200	7.223E-10	7.178E-10	1.242E-09	1.265E-09
4000	4.884E-10	4.853E-10	8.399E-10	8.552E-10
4800	3.539E-10	3.517E-10	6.087E-10	6.198E-10
5280	2.988E-10	2.970E-10	5.140E-10	5.233E-10

RELATIVE DEPOSITON PER UNIT AREA AT FIXED POINTS BY DOWNWIND SECTORS

DISTANCE IN METERS	DIRECTION FROM SITE			
	EAST	EAST SOUTH-EAST	SOUTH-EAST	SOUTH SOUTH-EAST
5600	2.691E-10	2.674E-10	4.629E-10	4.713E-10
6400	2.120E-10	2.107E-10	3.647E-10	3.713E-10
7200	1.717E-10	1.706E-10	2.952E-10	3.006E-10
8000	1.420E-10	1.411E-10	2.442E-10	2.487E-10
11200	7.755E-11	7.706E-11	1.334E-10	1.358E-10
12000	6.951E-11	6.907E-11	1.195E-10	1.217E-10
16000	4.362E-11	4.335E-11	7.503E-11	7.639E-11
24000	2.206E-11	2.192E-11	3.794E-11	3.863E-11

RELATIVE DEPOSITON PER UNIT AREA AT FIXED POINTS BY DOWNWIND SECTORS

DISTANCE IN METERS	DIRECTION FROM SITE			
	EAST	EAST SOUTH-EAST	SOUTH-EAST	SOUTH SOUTH-EAST
32000	1.336E-11	1.327E-11	2.297E-11	2.339E-11
40000	8.957E-12	8.900E-12	1.540E-11	1.568E-11
48000	6.419E-12	6.379E-12	1.104E-11	1.124E-11
56000	4.821E-12	4.791E-12	8.291E-12	8.442E-12
64000	3.749E-12	3.725E-12	6.448E-12	6.565E-12
72000	2.995E-12	2.976E-12	5.151E-12	5.245E-12
80000	2.445E-12	2.430E-12	4.205E-12	4.281E-12



* MAP IS INTENDED SOLELY FOR THE PURPOSE OF IDENTIFYING LIQUID AND GASEOUS RELEASE POINT LOCATIONS AND ELEVATIONS. ELEVATIONS ARE FROM MEAN SEA LEVEL (MSL) SANDY HOOK, N.J.

MAP DEFINING UNRESTRICTED AREAS FOR RADIOACTIVE GASEOUS AND LIQUID EFFLUENTS *

FIGURE 5.1-1

INDIAN POINT STATION - LOCATION OF SAMPLING STATION POINTS

Sample Station Points	Location/Distances	Sample Types
1	Environmental Laboratory, Onsite - SSE	Air Particulate Radioiodine Direct Gamma Precipitation
2	Standard Brands, 0.6 MI - NNE	Air Particulate Radioiodine Direct Gamma Soil
3	Service Building, Onsite - SSE	Air Particulate Radioiodine Direct Gamma Soil
4	Algonquin Gas Line, 0.25 MI - S	Air Particulate Radioiodine Direct Gamma Soil
5	NYU Tower, 1 MI - SSE	Air Particulate Radioiodine Direct Gamma Soil
6	Camp Smith, 2.5 MI - NNE	Well Water Soil
7	Camp Field Reservoir, 3.5 MI - NE	Drinking Water
8	New Croton Reservoir, 7 MI - ESE	Drinking Water
9	Inlet pipe into plants, NNE	HR* Water
10	Discharge Canal, Onsite - SW	HR Aquatic Vegetation HR Water HR Bottom Sediment/Silt HR Shoreline Soil
11	Iroquois Lake, Onsite - E	Surface Lake Water Lake Aquatic Vegetation
12	Trap Rock Lake, 0.75 MI - SSE	Surface Lake Water Lake Aquatic Vegetation

*HR - Hudson River

Sample Station Points	Location/Distances	Sample Types
13	Lake Meahagh, 1 MI - SEE	Surface lake Water Lake Aquatic Vegetati
14	Water Meter House, Onsite - E	Direct Gamma
15	Peekskill Bay, 1.5 MI - NE	HR Aquatic Vegetation HR Bottom Sediment/Si Shoreline Soil
16	Tompkins Cove, 1.5 MI - WSW	HR Aquatic Vegetation HR Bottom Sediment/Si HR Shoreline Soil
17	Off Verplanck, 1 MI - SSW	HR Aquatic Vegetation HR Bottom Sediment/Si HR Shoreline Soil
18	Indian Point - Onsite - SE	Soil Well Water
19	St. Mary's Cemetery, 0.75 - SSE	Soil
20	Montrose Marina, 1.5 MI - S	Soil Direct Gamma
21	George's Island - 2.5 MI - SSE	Soil
22	Lovett, 1.5 MI - WSW	HR Aquatic Vegetation HR Bottom Sediment/ S HR Shoreline Soil
23	Roseton**, 20 MI - N	Fallout** Air Particulate** Radioiodine** Direct Gamma
24	Eastview, 15 MI - SE	Precipitation
25	Where available near site	Fish/Clams/Crabs
26	N.Y.C. Aqueduct-onsite -SSE Environmental Bldg.	Drinking Water

**Control Station

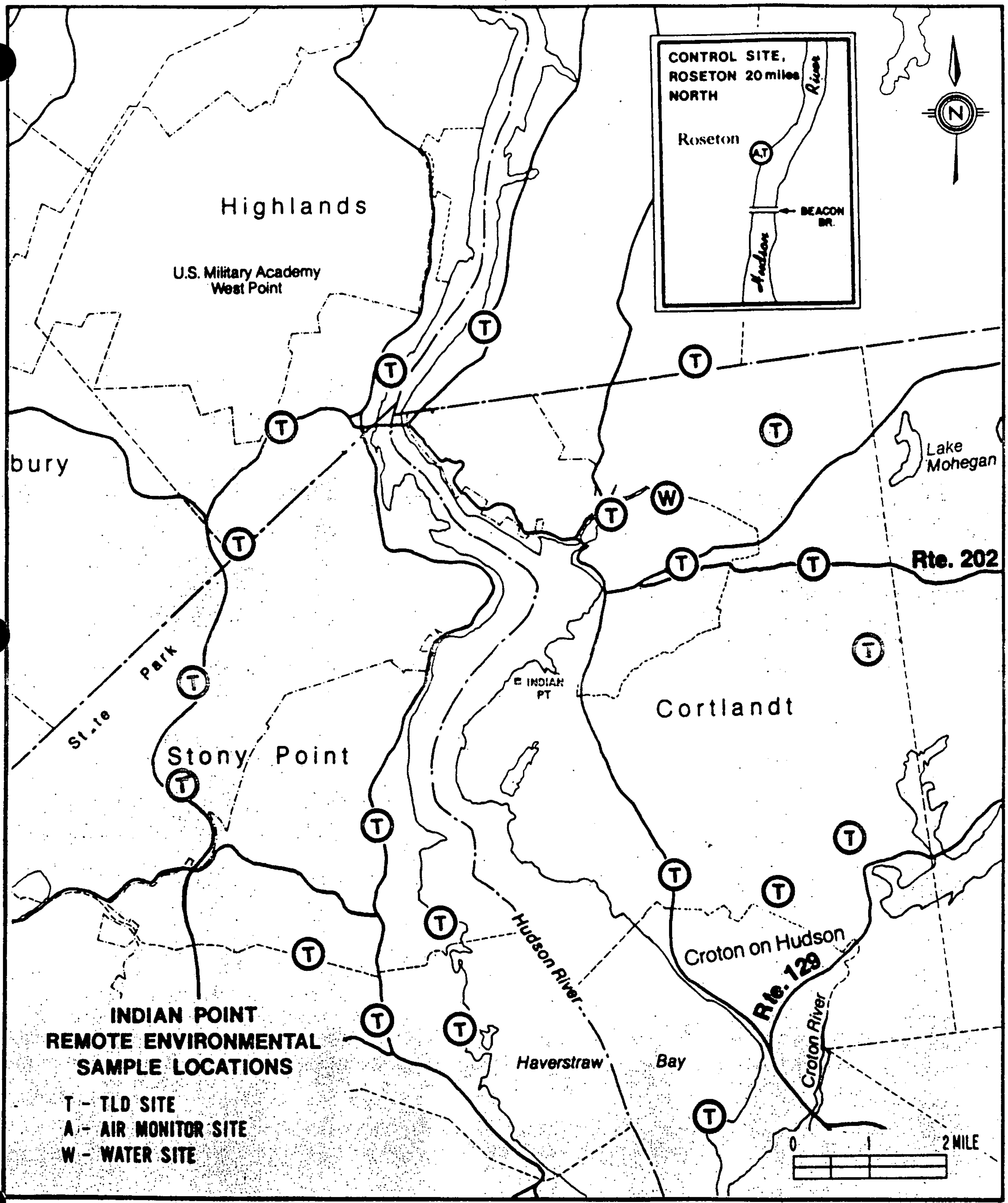
Sample Station Points	Location/Distances	Sample Types
27	Croton Point, 7.5 MI - SSE	Air Particulate Radioiodine Direct Gamma Precipitation HR Aquatic Vegetation HR Bottom Sediment/Silt HR Shoreline Soil
28	Lent's Cove, 0.5 MI - NE	HR Aquatic Vegetation HR Bottom Sediment/Silt HR Shoreline Soil Direct Gamma
29	Grassy Point, 3 MI - S	Air Particulate Radioiodine Direct Gamma Precipitation
30	Dock, Onsite - W	Direct Gamma
31	Onsite Pole - S	Direct Gamma Soil
32	Factory St. SS, 1 MI - ESE	Direct Gamma
33	Hamilton St. SS, 3 MI - NNE	Direct Gamma
34	SE Corner Onsite - SE	Direct Gamma
35	Bleakley & Broadway, Onsite - E	Direct Gamma
36	Old Dump, 0.5 MI - SE	Direct Gamma
37	NE corner, Onsite - NE	Direct Gamma
38	Furnace Dock, 3.5 MI - SE	Air Particulate Radioiodine Direct Gamma Precipitation

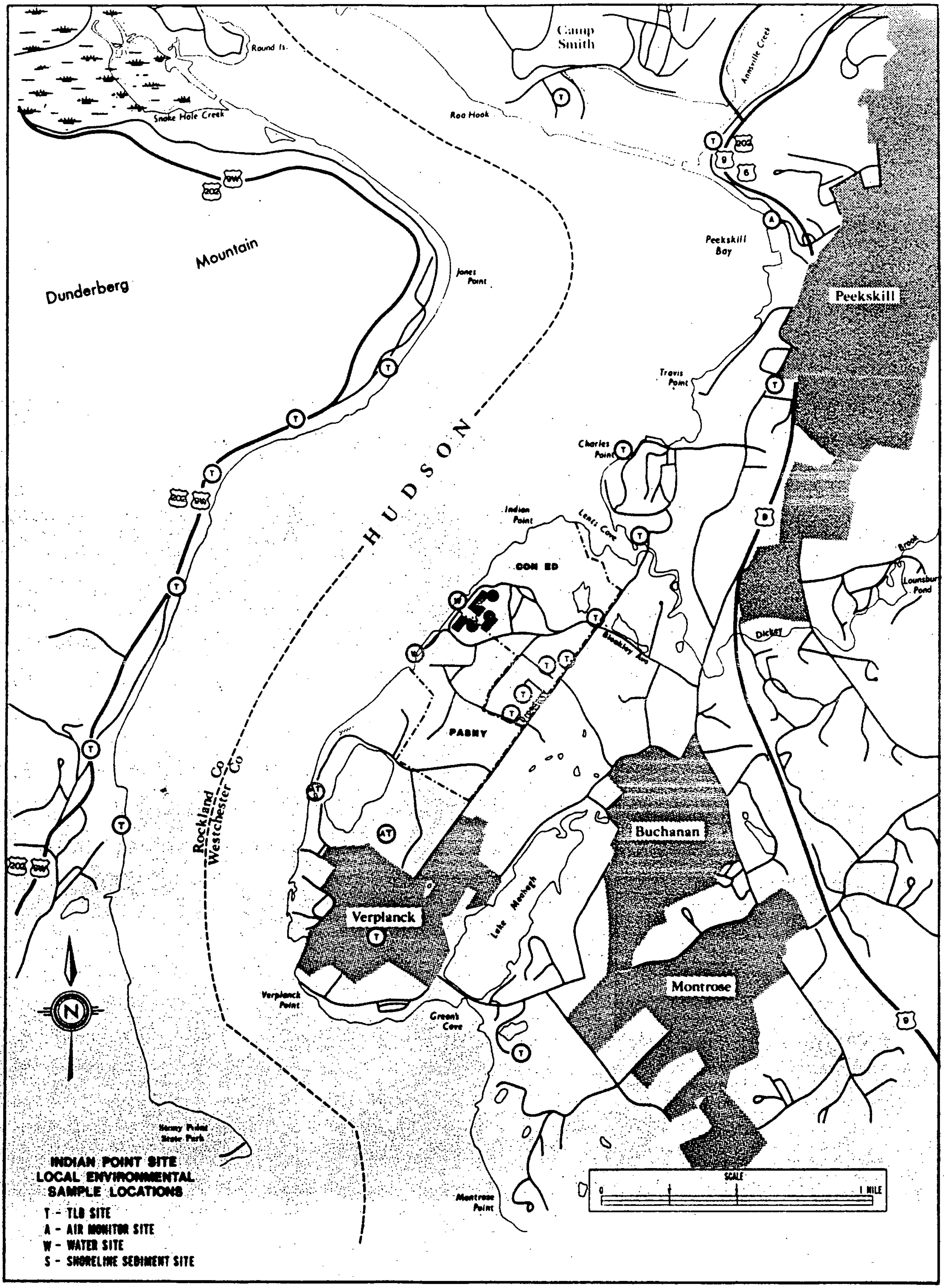
Sample Station Points	Location/Distances	Sample Types
43	Oregon Road, 3.7 MI - NE	Air Particulate Radioiodine
44	Peekskill Gas Holder Bldg., 1.7 MI - NE	Air Particulate Radioiodine
49	Iona Island, 3.2 MI - NNW	HR Shoreline Soil HR Bottom Sediment/Silt HR Aquatic Vegetation
50	Manitou Inlet, 4.5 MI- NNW	HR Shoreline Soil HR Bottom Sediment/Silt HR Aquatic Vegetation
51	Windsor Farms, 10 MI - ENE	Milk/Grass
52	Shenandoah Farms**, 19.6 MI - NNE	Milk/Grass**
53	White Beach 0.9 MI - SSW	HR Shoreline Soil HR Aquatic Vegetation HR Bottom Sediment/Silt
54	Haverstraw Beach, 4.0 MI - SSW	HR Shoreline Soil HR Aquatic Vegetation HR Bottom Sediment/Silt
55	Hilltop-Hanover Farms, 8.9 MI - ESE	Milk/Grass
56	Verplanck 1.0 MI - SSW	Direct Gamma
84	Cold Springs** 10.8 MI - N	HR Aquatic Vegetation** HR Shoreline Soil** HR Bottom Sediment/Silt**

** Control Station

Note: 1. Stations 45-48 used for quality assurance split samples Stations 39, 40, 42 no longer used as sample designations - Milk Farms that for one reason or another have ceased commercial operation.

2. The "Upstream" sampling arrangement near the intake structures as referenced in Table 4.11-1 of the revised radiological Effluent Technical Specifications is being updated with installation of replacement equipment scheduled for 1984 refueling outage. When updated information is available it will be incorporated here.


CONTROL SITE, ROSETON 20 miles NORTH
Roseton
A,T
River
Hudson
BEACON BR.
N
Highlands
U.S. Military Academy
West Point
bury
Lake Mohegan
Rte. 202
State Park
INDIAN PT
Cortlandt
Stony Point
Hudson River
Croton on Hudson
Rte. 129
Croton River
Haverstraw Bay
0 1 2 MILE
INDIAN POINT
REMOTE ENVIRONMENTAL
SAMPLE LOCATIONS
T - TLD SITE
A - AIR MONITOR SITE
W - WATER SITE


Camp Smith
Round Is.
Snake Hole Creek
Roa Hook
Annsville Creek
Peekskill Bay
Peekskill
Dunderberg Mountain
Jones Point
Travis Point
Charles Point
Indian Point
Lents Cove
CON ED
Bleakley Ave
Lounsbury Pond
Brook
PASNY
HUDSON
Rockland Co
Westchester Co
Buchanan
Verplanck
Lake Meahagh
Montrose
Verplanck Point
Green's Cove
Montrose Point
Stony Point State Park
INDIAN POINT SITE
LOCAL ENVIRONMENTAL
SAMPLE LOCATIONS
T - TLD SITE
A - AIR MONITOR SITE
W - WATER SITE
S - SHORELINE SEDIMENT SITE
SCALE
0
1 MILE

APPENDIX B

CONTENTS

Limited Analysis Dose Assessment for
Liquid Radioactive Effluents

APPENDIX B

LIMITED ANALYSIS DOSE ASSESSMENT FOR LIQUID RADIOACTIVE EFFLUENTS

The radioactive liquid effluents for the years 1979, 1980, and 1981 were evaluated to determine the dose contribution of the radionuclide distribution. (See Table 1-1) This analysis was performed to evaluate the use of a limited dose analysis for determing environmental doses. Limiting the dose calculation to a few selected radionuclides that contribute the majority of the dose provides a simplified method of determining compliance with the dose limits of Technical Specification 3.9.A.3.a.

Tables B-1 and B-2 present the results of this evaluation. Table B-1 presents the fraction of the adult total body dose contributed by the major radionuclides as measured through two pathways. Table B-2 presents the same data for the adult liver dose. The adult total body and adult liver were determined to be the limiting doses based on an evaluation of all age groups (adult, teenager, child, and infant) and all organs (bone, liver, kidney, lung, skin, and GI-LLI). As the data in the tables show, the radionuclides CS-134, CS-137, MN-54, FE-55, and ZN-65 dominate both the total body dose and the liver dose. For only one year (1981) does their sum come to less than 95% of the total overall dose to liver and total body. Therefore, the dose committment due to radioactive material in liquid effluents can be reasonably estimated by limiting the dose calculation to these radionuclides; CS-134, CS-137, MN-54, FE-55, and ZN-65 which cumulatively contributes the bulk of the total dose calculated by using all radionuclides detected. This limited analysis dose assessment method is a simplified calculation that provides a reasonable evaluation of doses due to liquid radioactive effluents.

Tritium is not included in the limited analysis dose assessment for liquid releases because the potential dose resulting from normal reactor releases is negligible. Furthermore, the release of tritium is a function of operating time and power level and is essentially unrelated to radwaste system operation.

TABLE B-1

ADULT TOTAL BODY DOSE CONTRIBUTION FRACTION

RADIONUCLIDE	1979		1980		1981	
	FISH	SHELLFISH	FISH	SHELLFISH	FISH	SHELLFISH
CS-137	63.16%	23.98%	56.45%	21.26%	49.07%	16.07%
CS-134	35.61%	13.48%	42-10%	15.96	45.90%	15.08%
MN-54	0.01%	17.40%	0.01%	20.92%	0.02%	29.40%
ZN-65	0.73%	27.88%	0.05%	17.18%	0.51%	16.72%
FE-55	0.02%	5.54%	0.06%	14.14%	0.03%	7.33%
TOTAL	99.53%	88.28%	98.67%	89.36%	95.53%	84.60
Times Fraction of Total Dose Due to Pathway	96.07%	3.02%	96.93%	3.06%	94.89%	3.44%
Overall Fraction of Total Dose Due to the 5 Nuclides in Two Pathways	98.29%		98.37%		93.56%	

TABLE B-2

ADULT LIVER DOSE CONTRIBUTION FRACTION

RADIONUCLIDE	1979		1980		1981	
	FISH	SHELLFISH	FISH	SHELLFISH	FISH	SHELLFISH
CS-137	67.90%	15.39%	61.84%	11.95%	54.15%	8.79%
CS-134	30.66%	6.93%	36.98%	7.13	40.69%	6.56%
MN-54	0.04%	38.36%	0.05%	40.36%	0.08%	55.06%
ZN-65	1.15%	26.02%	0.72%	13.98%	0.81%	13.20%
FE-55	0.07%	10.00%	0.18%	22.32%	0.11%	11.25%
TOTAL	99.82%	96.70%	99.77%	95.74%	95.84%	94.86
Times Fraction of Total Dose Due to Pathway	94.55%	4.98%	94.04%	5.81%	92.08%	6.76%
Overall Fraction of Total Dose Due to the 5 Nuclides in Two Pathways	99.20%		99.38%		94.66%	

APPENDIX C

CONTENTS

Technical Bases for Effective Dose Factors

APPENDIX C

TECHNICAL BASES FOR EFFECTIVE DOSE FACTORS

The evaluation of doses due to releases of radioactive material to the atmosphere can be simplified by the use of effective dose transfer factors instead of using dose factors which are radionuclide specific. These effective factors, which are based on the typical radionuclide distribution in the releases, can be applied to the total radioactivity released to approximate the dose in the environment, i.e., instead of having to sum the isotopic distribution multiplied by the isotope specific dose factor only a single multiplication (K_{eff}, M_{eff} of N_{eff}) times the total quantity of radioactive material released, would be needed. This approach provides a reasonable estimate of the actual dose while eliminating the need for a detailed calculational technique.

Determination of Effective Dose Factors

The effective dose transfer factors are based on past operating data. The radioactive effluent distribution for the past years can be used to derive single effective factors by the following equations.

EQUATION C-1 $$K_{eff} = \sum_i K_i \cdot f_i$$

where

K_{eff} ≡ the effective total body dose factor due to gamma emissions from all noble gases released.

K_i ≡ the total body dose factor due to gamma emissions from each noble gas radionuclide 'i' released.

f_i ≡ the fractional abundance of noble gas radionuclide 'i' is of the total noble gas radionuclides.

EQUATION C-2 $$(L + 1.1\ M)_{eff} = \sum_i (L_i + 1.1\ M_i) \cdot f_i$$

where

$(L + 1.1\ M)_{eff}$ ≡ the effective skin dose factor due to beta and gamma emissions from all noble gases released.

$(L_i + 1.1\ M_i)$ ≡ the skin dose factor due to beta and gamma emissions from each noble gas radionuclide i released.

TECHNICAL BASES FOR EFFECTIVE DOSE FACTORS

EQUATION C-3 $M_{eff} = \sum_i M_i \cdot f_i$

where

M_{eff} $\equiv$ the effective air dose factor due to gamma emissions from all noble gases released.

M_i $\equiv$ the air dose factor due to gamma emissions from each noble gas radionuclide i relaeased.

EQUATION C-4 $N_{eff} = \sum_i N_i \cdot f_i$

where

N_{eff} $\equiv$ the effective air dose factor due to beta emissions from all noble gases released.

N_i $\equiv$ the air dose factor due to beta emissions from each noble gas radionuclide 'i'.

To determine the appropriate effective factors to be used and to evaluate the degree of variability, the atmospheric radioactive effluents for the years 1979, 1980, and 1981 have been evaluated. Tables C-1, C-2, and C-3 present the results of this evaluation.

As can be seen from Tables C-1, C-2 and C-3, the effective dose transfer factors varies little from year to year. This variablility is minor considering other areas of uncertainty and conservatism inherent in the environmental dose calculation models.

To provide an additional degree of conservatism, a factor of 0.8 is introduced into the dose calculation process when the effective dose transfer factor is used. This added conservatism provides additional assurance that the evaluation of doses by the use of a single effective factor will not significantly underestimate any actual doses in the environment.

TABLE C-1

EFFECTIVE DOSE FACTORS FOR NOBLE GASES - TOTAL BODY EFFECTIVE DOSE

[K_{eff}]

YEAR	GROUND RELEASE	ELEVATED RELEASE
	Total Body Effective Dose Factor K_{eff} [mrem/uCi sec/m^3]	Total Body Effective Dose Factor K_{eff} [mrem/uCi sec/m^3]
1979	1.19E-05	6.80E-06
1980	1.02E-05	7.24E-06
1981	1.67E-05	1.05E-05
AVG.	1.29E-05	8.18E-06

TABLE C-2

EFFECTIVE DOSE FACTORS FOR NOBLE GASES - AIR DOSES

M_{eff} & N_{eff}

YEAR	GROUND RELEASE		ELEVATED RELEASE	
	Gamma-Air Effective Dose Factor M_{eff} mrad/uCi-sec/m^3	Beta-Air Effective Dose Factor N_{eff} mrad/uCi-sec/m^3	Gamma-Air Effective Dose Factor M_{eff} mrad/uCi-sec/m^3	Beta-Air Effective Dose Factor N_{eff} mrad/uCi-sec/m^3
1979	1.36E-05	3.56E-05	7.60E-06	2.02E-05
1980	1.18E-05	3.81E-05	8.60E-06	3.94E-05
1981	1.75E-05	3.87E-05	1.155E-05	5.13E-05
AVG	1.43E=05	3.75E-05	9.25E-06	3.70E-05

TABLE C-3

EFFECTIVE DOSE FACTORS FOR NOBLE GASES - SKIN EFFECTIVE DOSE

YEAR	GROUND RELEASE	ELEVATED RELEASE
	Total Skin Effective Dose Factor $(L+1.1\ M)_{eff}$ mrem/uCi-sec/m^3	Total Skin Effective Dose Factor $(L+1.1\ M)_{eff}$ mrem/uCi-sec/m^3
1979	2.81E-05	4.44E-05
1980	2.87E-05	2.67E-05
1981	3.68E-05	4.31E-05
AVG.	3.12E-05	3.81E-05

TABLE C-4

TABLES OF SOURCE TERMS USED FOR DEVELOPMENT OF EFFECTIVE DOSE TRANSFER FACTORS

(Based On Semi-Annual Effluent Data Reports for the years 1979, 1980, 1981)

ELEVATED RELEASE

ISOTOPE	79	80	81
Kr-85	3.04 E+2	3.78 E+2	2.69 E+3
Kr-85m	6.34 E-01	1.19 E+0	3.76 E+0
Kr-87	5.12 E+0	2.08 E-1	1.47 E+0
Kr-88	1.31 E-1	6.52 E-1	1.17 E+0
Xe-133	1.14 E+2	1.31 E+3	1.79 E+2
Xe-135	1.04 E+1	7.98 E-01	1.81 E+0
Xe-135m	3.36 E-1	3.29 E-1	1.77 E+0
Xe-138	----	7.57 E-1	6.92 E+0
Xe-131m	2.98 E+1	5.06 E-1	3.11 E+1
Xe-133m	4.03 E+0	1.22 E-1	7.75 E+0
Sr-89	4.71 E-05	2.01 E-05	2.85 E-05
Sr-90	5.98 E-05	5.12 E-06	8.54 E-6
Cs-134	3.32 E-02	1.54 E-04	1.71 E-04
Cs-137	6.37 E-02	4.88 E-04	7.17 E-04
Ba-140	8.48 E-04	1.35 E-04	2.87 E-04
I-131	4.44 E-04	1.01 E-4	1.07 E-4
Co-58	1.13 E-02	5.22 E-04	6.77 E-4
Co-60	6.27 E-02	4.84 E-4	1.48 -03
Mn-54	3.54 E-03	1.48 E-5	2.68 -05
I-131	9.83 E-2	4.21 E-2	7.36 E-4
I-133	8.09 E-4	7.87 E-3	1.07 E-3
I-135	8.56 -3	1.06 E-2	1.91 E-2

TABLE C-5

TABLES OF SOURCE TERMS USED FOR DEVELOPMENT OF EFFECTIVE DOSE TRANSFER FACTORS

(Based On Semi-Annual Effluent Data Reports for the years 1970, 1980, 1981)

GROUND RELEASE

ISOTOPE	79	80	81
Kr-85	3.15 E+2	7.61 E+2	4.97 E+2
Kr-85m	2.35 E+1	1.22 E+1	5.34 E+1
Kr-87	2.8 E+0	1.50 E-0	2.34 E+1
Kr-88	2.72 E+1	1.83 E+1	8.82 E+1
Xe-133	7.76 E+3	6.41 E+3	8.88 E+3
Xe-135	2.79 E+2	1.28 E+2	4.55 E+2
Xe-135M	4.66 E+0	5.78 E+0	7.42 E+0
Xe-138	1.10 E+0	2.58 E+0	1.61 E+1
Xe-131 M	4.9 E+1	2.00 E+2	1.02 E+2
Xe-133M	1.56 E+1	5.55 E+1	9.69 E+1
Xe-137	7.38 E+0	2.19 E+1	1.07 E+1
Sr-89	8.10 E-6	1.53 E-5	2.27 E-5
SR-90	3.15 E-6	3.38 E-6	6.00 E-6
Ca-134	3.66 E-4	1.13 E-4	1.33 E-4
Cs-137	3.90 E-4	2.39 E-4	2.18 E-3
Ba-140	8.14 E-5	8.56 E-05	2.51 E-4
I-131 0	9.48 E-5	5.31 E-5	6.11 E-4
Co-58	1.75 E-4	3.08 E-4	1.98 E-3
Co-60	2.5 E-4	2.99 E-4	1.42 E-3
Mn-54	1.58 E-6	9.02 E-6	3.46 E-5
Cr-51	2.19 E-5	2.20 E-5	3.49 E-5
Nb-95	----	5.20 E-7	1.99 E-6

TABLE C-5

TABLES OF SOURCE TERMS USED FOR DEVELOPMENT OF EFFECTIVE DOSE TRANSFER FACTORS

(Based On Semi-Annual Effluent Data Reports for the years 1979, 1980, 1981)

GROUND RELEASE (Continued)

ISOTOPE	79	80	81
Fe-55	4.35 E-04	9.70 E-5	1.59 E-3
P-32	1.75 E-5	1.09 E-05	1.96 E-5
NI-63	4.39 E-4	3.74 E-5	1.18 E-4
Zn-65	----	----	5.48 E-6
Co-57	----	----	5.01 E-6
I-131	3.84 E-2	7.48 E-1	3.13 E-2
I-133	1.68 E-2	5.32 E-3	1.40 E-2
I-135	2.85 E-2	2.08 E-2	2.58 E-2

APPENDIX D

CONTENTS

Definition of LLD
Discussion of Background Considerations

APPENDIX D

DEFINITION OF LLD

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

For a particular measurement system which may include radiochemical separation:

EQUATION D-1

$$LLD = \frac{4.66\ s_b}{E \cdot V \cdot 2.22 \times 10^6\ Y \cdot \exp(-\lambda \Delta t)}$$

Where:

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

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

E is the counting efficiency, as counts per distintegration.

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

2.22×10^6 is the number of disintegration per minute per microcurie.

Y is the fractional radiochemical yield, when applicable.

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

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

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.

APPENDIX D

DISCUSSION OF BACKGROUND CONSIDERATIONS

In many instances, radiation counters exhibit a background rate that is not negligible and that should be subtracted from the gross counting rate to make an effective counting rate determination of the sample in question. An estimate of the statistical error due to the background must be included in any final estimate of total combined error. Assuming that the source and background counts are additive, the standard deviation of the net counting rate is,

EQUATION D-2 $$\sigma = \sqrt{\sigma_T^2 + \sigma_B^2} = \sqrt{\frac{\rho_T'}{\tau_T} + \frac{\rho_B'}{\tau_B}}$$

where T refers to the counting of the sample including background (Total)

B refers to the counting of the background alone (Background)

To be assured of the significance of the setpoint level relative to background level they should at least be of the same order of magnitude preferably with the setpoint level at least one order of magnitude higher than the background level. Where setpoint levels cannot be raised due to 10CFR20 MPC level limits then background levels must be reduced in the field.

APPENDIX E

CONTENTS

Determination of Release Rate From The Steam Generator
Blowdown And Purification System Flash Tank
Vent And The Secondary Boiler Blowdown Purification System
Flash Tank Vent

APPENDIX E

DETERMINATION OF RELEASE RATE FROM THE STEAM GENERATOR BLOWDOWN AND PURIFICATION SYSTEM FLASH TANK VENT AND THE SECONDARY BOILER BLOWDOWN PURIFICATION SYSTEM FLASH TANK VENT

A determination of the release of radioiodine-131 via the flash tank vent can be made by calculating from a measured concentration in the secondary water by the following equation:

EQUATION E-1 $Q = \overline{C}\,[R_{SGB}]\,f_{FT}\,(1-SQ_{FT_V})$ where:

Q — the release rate of radioiodine-131 from the steam generator flash tank vent, in [Ci/sec].

$\overline{C}$ — The concentration of radioiodine-131 in the secondary coolant water averaged over not more than one week, in [Ci/ml].

R_{SGB} — The steam generator blowdown rate to the flash tank, in [ml/sec].

f_{FT} — The fraction of blowdown flashed in the flash tank determined from a heat balance taken around the flash tank at the applicable reactor power level.

SQ_{FT_V} — The measured steam quality in the flash tank vent; or an assumed value of 0.85, based on USNRC NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors.

To determine 'Q', one must evaluate the right hand side of the equation. 'C' is a measured quantity, hence it is available and need not be calculated or derived. 'R_{SGB}' is also a known or measured quantity. Skipping 'f_{FT}' for the moment and going to 'SQ_{FT_V} one assumes a value of 0.85 for 'SQ_{FT_V} in the absence of direct measurement to the contrary. This leaves only the one term 'f_{FT}' to be determined prior to a direct calculation of 'Q'.

APPENDIX E
(Continued)

DETERMINATION OF RELEASE RATE FROM THE STEAM GENERATOR BLOWDOWN AND PURIFICATION SYSTEM FLASH TANK VENT AND THE SECONDARY BOILER BLOWDOWN PURIFICATION SYSTEM FLASH TANK VENT

The determination of the release rate from the Steam Generator Blowdown Flash Tank (SGBFT) is different from the Secondary Boiler Blowdown Purification System. This is because the steam generator blowdown flash tank has a spray system which uses cold city water for injection into the steam space. Because of this spray system, steam release via the tank vent is negligible. In addition it also dilutes the iodine concentration in the blowdown liquid that is released. The following equation is to be utilized in case of loss of the city water spray system.

$$f_{FT} = \frac{h_{BD} - h_{con}}{h_{stm}} = \frac{h_{BD} - 180}{970}$$

where

h_{BD} = Enthalphy of blowdown liquid. For this use the value from SOP 15.1 titled, "Calormetric Thermal Power Calculations"

h_{con} = Enthalphy of condensate in the tank. Since the tank is at atmospheric pressure, use a value of 180 Btu/lb

h_{stm} = Evaporation Enthalphy of Steam being vented. and for this use a value of 970 Btu/lb.

With 'f_{FT}', thus determined and inserted into equation E-1, Q can be determined by a straightforward calculation.

If there is a loss of city water spray to the SGBFT, the calculations must be made every time measurements of secondary water radioiodine concentrations are required by Technical Specifications. The calculated release shall be assumed at the latest calculated level until the next secondary water analysis is completed.

APPENDIX E
(Continued)

DETERMINATION OF RELEASE RATE FROM THE STEAM GENERATOR BLOWDOWN AND PURIFICATION SYSTEM FLASH TANK VENT AND THE SECONDARY BOILER BLOWDOWN PURIFICATION SYSTEM FLASH TANK VENT

For purposes of determining releases from the Support Facilities Secondary Boiler Blowdown Purification System flash tank, when used as a receptacle for radioactive steam generator blowdown, may be thought of as an alternate flash tank and can be evaluated in the same way as previously described. The only difference is that this flash tank vents steam at 75psig. The following equation applies:

$$f_{FT} = \frac{h_{BD} - h_{con}}{h_{stm}} = \frac{h_{BD} - 291}{895}$$

where

h_{BD} Enthalphy of blowdown liquid. This information can be gotten from the Control Room Operator.

h_{con} Enthalphy of condensate in the tank. Since the tank is at 75 psig pressure, use a value of 291 Btu/lb

h_{stm} Evaporation Enthalphy of Steam being vented, for this use a value of 895 Btu/lb.