OFFSITE DOSE CALCULATION MANUAL

for

GEORGIA POWER COMPANY

E. I. HATCH NUCLEAR PLANT

SEPTEMBER 1984

OFFSITE DOSE CALCULATION MANUAL

for

GEORGIA POWER COMPANY

E. I. HATCH NUCLEAR PLANT

SEPTEMBER 1984

TABLE OF CONTENTS

SECTION	TITLE	PAGE
	LIST OF TABLES	ii
	LIST OF FIGURES	iii
	REFERENCES	iv
	INTRODUCTION	v
1.	LIQUID EFFLUENTS	1.0- 1
1.1	LIQUID EFFLUENT MONITOR SETPOINTS	1.0- 1
1.1.1	LIQUID RADWASTE EFFLUENT MONITORS	1.0- 2
1.1.2	PLANT SERVICE WATER MONITORS	1.0- 8
1.2	DOSE CALCULATION FOR LIQUID EFFLUENTS	1.0-10
1.3	DOSE PROJECTIONS FOR LIQUID EFFLUENTS	1.0-18
1.3.1	MONTHLY DOSE PROJECTIONS	1.0-18
1.3.2	DOSE PROJECTIONS FOR SPECIFIC RELEASES	1.0-19
1.4	DEFINITIONS OF LIQUID EFFLUENT TERMS	1.0-20
1.5	LIQUID RADWASTE TREATMENT SYSTEMS	1.0-23
1.6	MIXING OF LIQUID WASTE TANKS	1.0-26
2.	GASEOUS EFFLUENTS	2.0- 1
2.1	GASEOUS EFFLUENT MONITOR SETPOINTS	2.0- 1
2.1.1	UNIT 1 REACTOR BUILDING VENT STACK, UNIT 2 REACTOR BUILDING VENT STACK, AND UNIT 1 RECOMBINER BUILDING VENT	2.0- 2
2.1.2	MAIN STACK	2.0- 4
2.1.3	DETERMINATION OF ALLOCATION FACTOR	2.0- 5
2.2	GASEOUS EFFLUENT DOSE RATE AND DOSE CALCULATIONS	2.0-10
2.2.1	UNRESTRICTED AREA BOUNDARY DOSE RATE	2.0-10
2.2.1.a	Dose Rates Due To Noble Gases	2.0-10
2.2.1.b	Dose Rates Due to Radioiodines, Tritium, and Particulates	2.0-10
2.2.2	UNRESTRICTED AREA AIR DOSE AND DOSE TO INDIVIDUAL	2.0-12
2.2.2.a	Air Dose in Unrestricted Area	2.0-12
2.2.2.b	Dose To An Individual In Unrestricted Area	2.0-13
2.2.2.c	Dose Calculations To Support Other Specific Technical Specifications	2.0-19
2.3	METEOROLOGICAL MODEL	2.0-57
2.3.1	ATMOSPHERIC DISPERSION	2.0-57
2.3.1.a	Ground Level Releases	2.0-57
2.3.1.b	Elevated Releases	2.0-58
2.3.2	RELATIVE DEPOSITION	2.0-61
2.4	DEFINITIONS OF GASEOUS EFFLUENT PARAMETERS	2.0-69
2.5	GASEOUS RADWASTE EFFLUENT TREATMENT SYSTEM	2.0-77
3.	RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM	3.0- 1
4.	TOTAL DOSE DETERMINATIONS	4.0- 1
5.	POTENTIAL DOSES TO MEMBERS OF THE PUBLIC DUE TO THEIR ACTIVITIES INSIDE THE SITE BOUNDARY	5.0- 1

LIST OF TABLES

TABLE	TITLE	PAGE
1.2-1	Bioaccumulation Factors	1.0-13
1.2-2	Adult Ingestion Dose Factors	1.0-14
1.2-3	Site Related Ingestion Dose Commitment Factors, $A_{i\tau}$ (Fisn Consumption)	1.0-16
2.1-1	Dose Factors for Exposure to a Semi-Infinite Cloud of Noble Gases	2.0- 8
2.1-2	Dose Factors for Exposure to Direct Radiation from Noble Gases in the Elevated Finite Plume	2.0- 9
2.2-1	Inhalation Dose Factors For Infant	2.0-26
2.2-2	Inhalation Dose Factors for Child	2.0-29
2.2-3	Inhalation Dose Factors For Teenager	2.0-32
2.2-4	Inhalation Dose Factors For Adults	2.0-35
2.2-5	Ingestion Dose Factors for Infant	2.0-38
2.2-6	Ingestion Dose Factors for Child	2.0-41
2.2-7	Ingestion Dose Factors For Teenager	2.0-44
2.2-8	Ingestion Dose Factors For Adults	2.0-47
2.2-9	External Dose Factors for Standing on Contaminated Ground	2.0-50
2.2-10	Individual Usage Factors	2.0-52
2.2-11	Stable Element Transfer Data	2.0-53
2.2-12	Site-Specific (or Default) Values to be used in Pathway Factor Calculations	2.0-54
2.2-13	Site-Specific (or Default) Values to be used in Additional Pathway Factor Calculations	2.0-55
3.0-1	Radiological Environmental Sampling Locations	3.0- 3

LIST OF FIGURES

FIGURE	TITLE	PAGE
1.0-1	Example Calibration Curve for Liquid Effluent Monitor	1.0-9
1.5-1	Liquid Radwaste Treatment System (Unit 1)	1.0-24
1.5-2	Liquid Radwaste Treatment System (Unit 2)	1.0-25
2.3-1	Vertical Standard Deviation of Material in a Plume (σ_Z)	2.0-63
2.3-2	Open Terrain Recirculation Factor	2.0-64
2.3-3	Plume Depletion Effect for Ground-Level Releases	2.0-65
2.3-4	Plume Depletion Effect for Greater Than 100-m Releases	2.0-66
2.3-5	Relative Deposition for Ground-Level Releases	2.0-67
2.3-6	Relative Deposition for Greater Than 100-m Releases	2.0-68
2.5-1	Condenser Offgas Treatment System	2.0-78
3.0-1	Radiological Environmental Sampling Location Map (Site Periphery)	3.0- 5
3.0-2	Radiological Environmental Sampling Location Map (Beyond the Site Vicinity)	3.0- 6

<u>References</u>

1. J. S. Boegli, R. R. Bellamy, W. L. Britz, and R. L. Waterfield, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants", NUREG-0133 (October 1978).

2. Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR 50, Appendix I, U.S. NRC Regulatory Guide 1.109 (March 1976).

3. Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR 50, Appendix I, U.S. NRC Regulatory Guide 1.109, Rev. 1 (October 1977).

4. HNP-2 Environmental Report - Operating License Stage, Georgia Power Company, July 1975; (including Appendix A "Edwin I. Hatch Plant Unit-1 Preoperational Environmental Surveillance Report Number 1; submitted March 1, 1975.")

5. "Final Safety Analysis Report", Georgia Power Company, Hatch Nuclear Plant, Unit 1 (HNP-1).

6. "Final Safety Analysis Report," Georgia Power Company, Hatch Nuclear Plant, Unit 2 (HNP-2).

7. Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors, U.S. NRC Regulatory Guide 1.111 (March 1976).

8. Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors, U.S. NRC Regulatory Guide 1.111, Rev. 1 (July 1977).

9. Handbook of Mathematical Functions with Formulas, Graphs and Mathematical Tables; Edited by Abramowitz, M. and Stegun, I.A.; National Bureau of Standards; U.S. Department of Commerce (1965).

10. Meteorology and Atomic Energy; Edited by Slade, D.H.; U.S. Department of Commerce (July 1968).

11. Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I, U.S. NRC Regulatory Guide 1.113, Rev. 1 (April 1977).

12. Plant Edwin I. Hatch Units 1 and 2 Thermal Plume Model Verification; M. C. Nichols and S. D. Holder; Georgia Power Company Environmental Affairs Center; March 1981.

13. Effect of Eductors in Plant Hatch Liquid Waste Tanks; Georgia Power Company; October 1978.

INTRODUCTION

The OFFSITE DOSE CALCULATION manual is a supporting document of the RADIOLOGICAL EFFLUENT TECHNICAL SPECIFICATIONS. As such the ODCM describes the methodology and parameters to be used in the calculation of offsite doses due to radioactive liquid and gaseous effluents and in the calculation of liquid and gaseous effluent monitoring instrumentation alarm/trip setpoints. The ODCM contains a list and graphical description of the specific sample locations for the radiological environmental monitoring program. Schematic configurations of liquid and gaseous radwaste effluent systems releases to unrestricted areas are also included.

The ODCM will be maintained at the plant for use as a reference guide and training document of accepted methodologies and calculations. Changes in the calculational methods or parameters will be incorporated into the ODCM in order to assure that the ODCM represents the present methodology in all applicable areas. Computer software to perform the described calculations will be maintained current with the ODCM.

SECTION 1.
LIQUID EFFLUENTS

The E. I. Hatch Nuclear Plant is located on the Altamaha River which supplies make-up water to the Circulating Water System and receives decant from the Cooling Tower. There are two Boiling Water Reactors on the site; each unit is served by its own Liquid Radwaste System. The two units release liquid radwaste to separate discharge lines from the Circulating Water Systems. Additional dilution flow is furnished by the Cooling Tower blowdown, Turbine Building service water, and the Plant Service Water System, if necessary. Since each unit is served by a separate dilution stream, liquid releases may be made independently from each of the two units. Releases from the Plant Service Water Systems are to the Main Condenser Circulating Flume or to the Cooling Tower Blowdown Discharge Line when needed for additional dilution. Although no significant releases of radioactivity are expected from the Plant Service Water Systems, these effluent pathways are monitored as a precautionary measure.

1.1 LIQUID EFFLUENT MONITOR SETPOINTS

Although each unit has unique liquid release sources, a separate radwaste system, independent liquid effluent radiation monitors and separate dilution streams, the radiation monitor setpoint methodology presented below is appropriate for both units.

The calculated liquid monitor setpoint values will be regarded as upper bounds for the actual setpoint adjustments. Setpoint adjustments are not required to be performed if the existing setpoint level corresponds to a lower count rate than the calculated value. The actual monitor setpoint, which corresponds to the calculated concentration plus background for the specific monitor, is determined from calibration data or from operational data associated with liquid sample analysis data. (See Section 1.1.1). If no release is planned for a particular pathway, or if there is no detectable activity in the planned release, the monitor setpoint should be established as close to background as practical to prevent spurious alarms and yet alarm should an inadvertent release occur.

1.1.1 LIQUID RADWASTE EFFLUENT RADIATION MONITORS

The liquid radwaste effluent line monitors provide alarm and automatic termination of release functions prior to exceeding the concentration limits specified in 10CFR 20, Appendix B, Table II, Column 2 at the release point to the unrestricted area. To meet this specification, the alarm/trip setpoints for the liquid effluent monitors and flow measurement devices are set to assure that the following equation is satisfied:

$$\frac{cf}{F + f} \leq C_{MPC} \qquad (1)$$

C_{MPC} = the effluent concentration limit (RETS 3.15.1.1 for Unit 1; 3.11.1.1 for Unit 2) implementing 10CFR 20 for the site, corresponding to the specific mix of radionuclides in the waste tank being considered for discharge, in μCi/ml.

c = the setpoint, in μCi/ml, of the radioactivity monitor which measures the radioactivity concentration in the effluent line prior to dilution and subsequent release; the setpoint, which is inversely proportional to the volumetric flow of the effluent line and proportional to the volumetric flow of the dilution stream plus the effluent stream, represents a value which, if exceeded, would result in concentrations exceeding the limits of 10CFR 20 in the unrestricted area.

f = the flow setpoint as determined at the radiation monitor location, in volume per unit time, but in the same units as F, below.

F = the dilution water flow setpoint as determined prior to the release point, in volume per unit time.

As stated earlier, at Plant Hatch, each of the two units is served by its own independent Liquid Radwaste System; the two Liquid Radwaste Systems discharge to separate dilution streams. If additional dilution flow is needed for either dilution stream, it is available from the Plant Service Water System. The two dilution streams release to the Altamaha River.

The sources of liquid radioactive effluents from Unit-1 are Waste Sample Tank A, Waste Sample Tank B, Chemical Waste Sample Tank A, Chemical Waste Sample Tank B, Floor Drain Sample Tank, Laundry Drain Tank A, Laundry Drain Tank B, and Demineralizer Feed Tank. All of these sources discharge to a common line which is served by Radiation Monitor 1D11-N007. These Unit-1 sources release to a dilution stream served by flow element FE N-501, which is capable of isolating liquid radwaste discharges from Unit-1 if pre-defined minimum dilution flow is not available in the dilution stream.

The sources of liquid radioactive effluents from Unit-2 are Waste Sample Tank A, Waste Sample Tank B, Chemical Waste Sample Tank A, Chemical Waste Sample Tank B, and Floor Drain Sample Tank. All of these sources discharge to a common line which is served by Radiation Monitor 2D11-N007. These Unit-2 sources release to a dilution stream served by flow element FE N-502, which is capable of isolating liquid radwaste discharges from Unit-2 if pre-defined minimum dilution flow is not available in the dilution stream.

Liquid radwaste releases from the two units may proceed independently and concurrently. Liquid radwaste releases from each unit, however, will be administratively controlled so that only one source of liquid radwaste will be released at a time from that unit.

The maximum liquid radwaste effluent flow from the source selected for release and the setpoint for the radiation monitor serving the discharge pathway are determined and set to meet the general conditions of equation (1) for a given effluent concentration. The method by which this is accomplished is as follows:

Step 1) The radionuclide concentration for a waste tank to be released is obtained from the sum of measured concentrations as determined by the analyses required in RETS Tables 4.15.1-1 (Unit-1) and 4.11.1-1 (Unit-2):

$$\sum_i C_i = \sum_g C_g + (C_a + C_s + C_f + C_t) \qquad (2)$$

where

C_g = the concentration of each measured gamma emitter observed by gamma-ray spectroscopy of the particular waste sample.

C_a = the concentration of alpha emitters in liquid waste as measured in the MONTHLY composite sample. (NOTE: Sample is analyzed for gross α).

C_s = the measured concentrations of Sr-89 and Sr-90 in liquid waste as observed in the QUARTERLY composite sample.

C_f = The measured concentrations of Fe-55 in liquid waste as observed in the QUARTERLY composite sample.

C_t = the measured concentration of H-3 in liquid waste as determined from analysis of the MONTHLY composite sample.

The C_g term will be included in the analysis of each batch; terms for alpha, strontiums, iron, and tritium will be included in accordance with RETS Tables 4.15.1-1 and 4.11.1-1 as appropriate.

Step 2) The measured radionuclide concentrations are used to calculate a Dilution Factor, DF, which is the ratio of total dilution flow rate to tank flow rate required to assure that the limiting concentration of 10CFR 20, Appendix B, Table II, Column 2 are met at the point of discharge.

$$DF = \left[\sum_i \frac{C_i}{MPC_i}\right] \div SF$$

$$= \left[\sum_g \frac{C_g}{MPC_g} + \frac{C_a}{MPC_a} + \frac{C_s}{MPC_s} + \frac{C_f}{MPC_f} + \frac{C_t}{MPC_t}\right] \div SF \qquad (3)$$

where

C_i = measured concentrations of C_g, C_a, C_s, C_f and C_t as defined in Step 1. Terms C_a, C_s, C_f, and C_t will be included in the calculation as appropriate.

MPC_i = MPC_g, MPC_a, MPC_s, MPC_f, and MPC_t are limiting concentrations of the appropriate radionuclide from 10CFR 20, Appendix B, Table II, Column 2. For dissolved or entrained noble gases, the concentration shall be limited to 2×10^{-4} µCi/ml total activity.

SF = the safety factor; a conservative factor selected to compensate for statistical fluctuations and errors of measurements. (For example, SF = 0.5 corresponds to a 100 percent variation.)

Step 3) The dilution flow monitor setpoint is determined for the minimum dilution flow rate, F_d; for Plant Hatch, F_d is normally established at 10,000 gpm.

Step 4) For the case DF < 1, the waste tank effluent concentration meets the limits of 10CFR 20 without dilution and effluent discharge flow rate may be assigned any desired value. For DF > 1, the maximum permissible discharge flow rate, f_t, must be calculated:

$$f_t = \frac{F_d + f_p}{DF} \sim \frac{F_d}{DF} \quad \text{for } F_d \gg f_p \qquad (4)$$

where

F_d = Minimum dilution flow rate to be used in effluent monitor setpoint calculations which is normally 10,000 gpm.

DF = Dilution Factor from step 2.

f_p = Flow rate of waste tank discharge. (This value will have an upper limit of the maximum discharge capacity of the particular waste tank pump.)

NOTE: If radioactivity from plant operations is detected in the dilution stream, the equation for calculation of f_t must include a term to account for radioactivity present in the dilution stream prior to the introduction of the waste tank effluent:

$$f_t = \frac{F_d\left[1-\sum_i\left(\frac{C_i}{MPC_i}\right)_d\right]}{DF} \qquad (5)$$

where,

$\sum_i\left(\frac{C_i}{MPC_i}\right)_d$ is the MPC fraction of the dilution stream prior to introduction of waste tank effluent.

Step 5) The liquid radwaste effluent radiation monitor setpoint may now be determined based on the values of $\sum_i C_i$, f_t and F_d which were specified to provide compliance with the limits of 10CFR 20, Appendix B, Table II, Column 2. The monitor response is primarily to gamma radiation, therefore, the actual setpoint is based on $\sum_g C_g$. The monitor setpoint which corresponds to the particular setpoint concentration, c, is determined based on monitor calibration data or on operational data which correlates monitor response to sample analyses associated with actual effluent releases. (Example of monitor calibration graph is shown in Figure 1.0-1.)

The setpoint concentration, c, is determined as follows:

$$c = A\sum_g C_g \frac{\mu Ci}{ml} \qquad (6)$$

where

A = Adjustment factor which will allow the setpoint to be established in a practical manner for convenience and to prevent spurious alarms.

$$= \frac{f_t}{f_{(actual)}} \qquad \text{(See Note 2 below)} \qquad (7)$$

If $A \geq 1$, Calculate c and determine the maximum value for the actual monitor setpoint (μCi/ml).

If $A < 1$, No release may be made. Re-evaluate Steps 2, 3, and 4.

NOTE 1: The calculated setpoint concentration, c, establishes the base value for the monitor setpoint. However, in establishing the actual monitor setpoint for a particular monitor, background radiation levels must be considered. Normally, the actual monitor setpoint includes the calculated setpoint value plus background. Background levels must be controlled such that radioactivity levels in the effluent stream being monitored can be accurately assessed at or below the calculated setpoint value.

NOTE 2: If DF < 1, A = (1/DF). As stated earlier, if DF=0 the radiation monitor setpoint should be established as close to background as practicable to prevent spurious alarms and yet alarm should an inadvertent radioactive release occur.

If calculated setpoint values are near actual concentrations planned for release, it may be impractical to set the monitor alarm based on this value. In this case a new setpoint may be calculated by decreasing the effluent flow, increasing the dilution flow, or by decreasing $\sum_i C_i$ by further processing of the liquid radwaste planned for release, and by following the methodology presented in Steps 2, 3, and 4.

Within the limits of the conditions stated above, monitor setpoints for Liquid Radwaste Effluent Radiation Monitors may be determined as follows:

Liquid Radwaste Effluent Radiation Monitor 1D11 - N007 (Unit 1) or 2D11-N007 (Unit 2)

Perform Step 2), solving equation (3) for DF using the appropriate values in the concentration term from the sample analyses for the particular waste tank batch to be discharged. Then perform Steps 3), 4), and 5) to determine the monitor setpoint.

If no discharge is planned for this pathway, or if the planned release contains no measurable radioactivity, the monitor setpoint should be established as close to background as practical to prevent spurious alarms and yet alarm should an inadvertent radioactive release occur.

1.1.2 PLANT SERVICE WATER MONITORS

Monitors: 1D11-N008 (Unit 1) and 2D11-N008 (Unit 2)

Concentration of radioactivity in these effluent lines normally is expected to be insignificant. Therefore, the monitor setpoints should be established as close to background as practical to prevent spurious alarms and yet alarm should an inadvertent release occur.

If either of these effluent streams should become contaminated with radioactivity, radionuclide concentrations must be determined and a radiation monitor setpoint determined as follows:

$$c = \left(\sum_g C_g \right) \div DF \qquad (8)$$

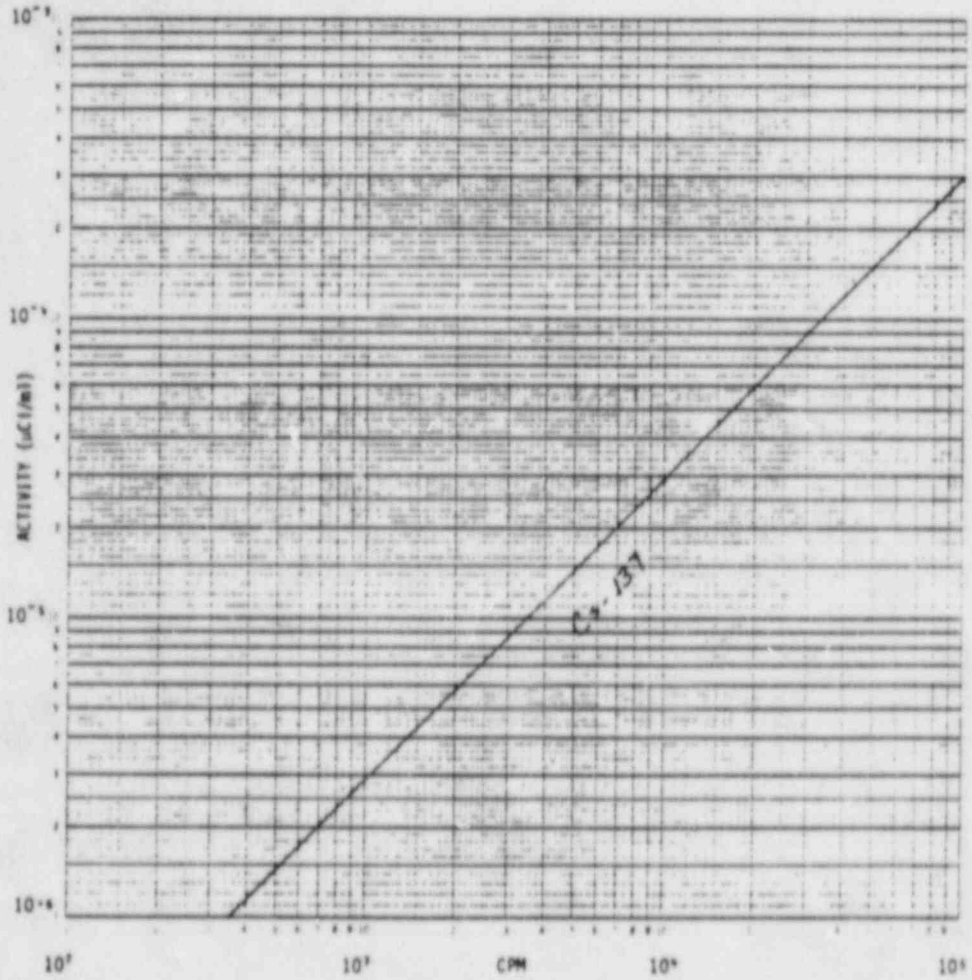
where

$\sum_g C_g$ and DF are determined using the sample analysis results for this effluent stream and applying the methodology of Section 1.1.1 Step 1 and Step 2.

For these release pathways no additional dilution is taken into account. Therefore, no releases are permissible if DF > 1.

FIGURE 1.0-1

EXAMPLE CALIBRATION CURVE FOR LIQUID EFFLUENT MONITOR



1.2 DOSE CALCULATION FOR LIQUID EFFLUENTS

For liquid releases from Plant Hatch to the Altamaha River, the only human exposure pathway is due to consumption of fish taken from the river. No drinking water is taken from the Altamaha River downstream from Plant Hatch. The methodology for calculating doses to an individual due to fish consumption is presented in this section.

The dose contribution to the maximum exposed individual by way of fish consumption from radionuclides identified in liquid effluents released to unrestricted areas will be calculated for the purpose of implementation of RETS 3.15.1.2 (Unit 1) and 3.11.1.2 (Unit 2). In accordance with Appendix A of Reference 3, noble gases are excluded from these dose calculations. Doses to an individual are calculated as follows:

$$D_\tau = \sum_i A_{i\tau} \sum_{\ell=1}^{m} \Delta t_\ell \, C_{i\ell} \, e^{-\lambda_i t_c} F_\ell \qquad (9)$$

where

D_τ = The cumulative dose commitment to the total body or any organ, τ, due to radioactivity in liquid effluents for the total time period $\sum_{\ell=1}^{m} \Delta t_\ell$, in mrem (Reference 1).

Δt_ℓ = The length of the ℓth time period over which $C_{i\ell}$ and F_ℓ are averaged for all liquid releases, in hours.

$C_{i\ell}$ = The average concentration of radionuclide i, in undiluted liquid effluent during time period Δt_ℓ from any liquid release, in μCi/ml.

λ_i = The decay constant for radionuclide i. (sec.$^{-1}$)

t_c = The transit time from release to receptor. (24 hours; Table E-15, Reference 3).

F_ℓ = The near field average dilution factor in the receiving water body during any liquid effluent release. Defined as the ratio of the undiluted liquid waste flow during release to the product of the average flow from the discharge structure to unrestricted receiving water times Z.

$$F_\ell = \frac{\text{(average undiluted liquid waste flow)}}{\text{(average flow from the discharge structure during periods of radioactive materials release)} \times (Z)} \qquad (10)$$

NOTE: The denominator of equation (10) is limited to 1000 cfs or less. (Reference 1, Section 4.3).

where

Z = Applicable dilution factor for the receiving water body.

Z = 10 (Reference 4, Section 5.1; Reference 11, Section B; Reference 12).

$A_{i\tau}$ = The site related fish ingestion dose commitment factor to the total body or any organ τ for each identified principal gamma and beta emitter listed in Table 1.2-3 in mrem-ml per hr-μCi.

$$A_{i\tau} = K_o \, (U_F \, BF_i) \, DF_{i\tau} \qquad (11)$$

where

K_o = Units conversion factor 1.14×10^5

$$10^6 \frac{\text{pCi}}{\mu\text{Ci}} \times 10^3 \frac{\text{ml}}{\text{l}} \div 8760 \frac{\text{hr}}{\text{yr}}$$

U_F = Adult fish consumption (21 kg/yr).

BF_i = Bioaccumulation factor for radionuclide i, in fish, in pCi/kg per pCi/l from Table 1.2-1 (taken from Table 2.3-1 of Appendix A of Reference 4).

$DF_{i\tau}$ = Dose conversion factor for radionuclide i, for adults in preselected organ, τ, in mrem/pCi, from Table 1.2-2 (taken from Reference 3, Table E-11).

At Plant Hatch no measurable radioactivity is expected to be present in the dilution stream prior to the junction with the Liquid Radwaste Discharge Line. However, if radioactivity due to plant operations should be detected in the dilution stream prior to the junction with the Liquid Radwaste Discharge Line, the concentrations of those radionuclides found to be present must be included in the dose determination. For this part of the dose calculation, equation (9) is used with $F_{\ell} = 1/Z$ and Δt = the entire time period for which the dose is being calculated.

TABLE 1.2-1
BIOACCUMULATION FACTORS
(pCi/kg per pCi/liter)*

ELEMENT	FRESHWATER FISH
H	9.0E-01
C	4.6E 03
NA	6.6E 01
P	2.5E 04
CR	1.5E 02
MN	8.9E 01
FE	6.0E 00
CO	1.7E 02
NI	1.0E 02
CU	4.4E 01
ZN	2.9E 02
BR	4.2E 02
RB	2.0E 03
SR	3.8E 00
Y	2.5E 01
ZR	1.9E 02
NB	4.1E 01
MO	1.8E 02
TC	1.5E 01
RU	4.6E 00
RH	1.0E 01
AG	3.5E 02
TE	4.0E 02
I	4.3E 01
CS	5.8E 02
BA	5.0E 00
LA	2.5E 01
CE	8.4E 01
PR	2.5E 01
ND	4.6E 01
W	1.2E 03
NP	1.0E 01

*Values in Table 1.2-1 are taken from Table 2.3-1 of Appendix A of Reference 4.

ADULT INGESTION DOSE FACTORS*

(mrem/pCi ingested)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
C 14	2.84E-06	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07
NA 24	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06
P 32	1.93E-04	1.20E-05	7.46E-06	NO DATA	NO DATA	NO DATA	2.17E-05
CR 51	NO DATA	NO DATA	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
MN 54	NO DATA	4.57E-06	8.72E-07	NO DATA	1.36E-06	NO DATA	1.40E-05
MN 56	NO DATA	1.15E-07	2.04E-08	NO DATA	1.46E-07	NO DATA	3.67E-06
FE 55	2.75E-06	1.90E-06	4.43E-07	NO DATA	NO DATA	1.06E-06	1.09E-06
FE 59	4.34E-06	1.02E-05	3.91E-06	NO DATA	NO DATA	2.85E-06	3.40E-05
CO 58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05
CO 60	NO DATA	2.14E-06	4.72E-06	NO DATA	NO DATA	NO DATA	4.02E-05
NI 63	1.30E-04	9.01E-06	4.36E-06	NO DATA	NO DATA	NO DATA	1.88E-06
NI 65	5.28E-07	6.86E-08	3.13E-08	NO DATA	NO DATA	NO DATA	1.74E-06
CU 64	NO DATA	8.33E-08	3.91E-08	NO DATA	2.10E-07	NO DATA	7.10E-06
ZN 65	4.84E-06	1.54E-05	6.96E-06	NO DATA	1.03E-05	NO DATA	9.70E-06
ZN 69	1.03E-08	1.97E-08	1.37E-09	NO DATA	1.28E-08	NO DATA	2.96E-09
BR 83	NO DATA	NO DATA	4.02E-08	NO DATA	NO DATA	NO DATA	5.79E-08
BR 84	NO DATA	NO DATA	5.21E-08	NO DATA	NO DATA	NO DATA	4.09E-13
BR 85	NO DATA	NO DATA	2.14E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	2.11E-05	9.83E-06	NO DATA	NO DATA	NO DATA	4.16E-06
RB 88	NO DATA	6.05E-08	3.21E-08	NO DATA	NO DATA	NO DATA	8.36E-19
RB 89	NO DATA	4.01E-08	2.82E-08	NO DATA	NO DATA	NO DATA	2.33E-21
SR 89	3.08E-04	NO DATA	8.84E-06	NO DATA	NO DATA	NO DATA	4.94E-05
SR 90	7.58E-03	NO DATA	1.86E-03	NO DATA	NO DATA	NO DATA	2.19E-04
SR 91	5.67E-06	NO DATA	2.29E-07	NO DATA	NO DATA	NO DATA	2.70E-05
SR 92	2.15E-06	NO DATA	9.30E-08	NO DATA	NO DATA	NO DATA	4.26E-05
Y 90	9.62E-09	NO DATA	2.58E-10	NO DATA	NO DATA	NO DATA	1.02E-04
Y 91M	9.09E-11	NO DATA	3.52E-12	NO DATA	NO DATA	NO DATA	2.67E-10
Y 91	1.41E-07	NO DATA	3.77E-09	NO DATA	NO DATA	NO DATA	7.76E-05
Y 92	8.45E-10	NO DATA	2.47E-11	NO DATA	NO DATA	NO DATA	1.48E-05
Y 93	2.68E-09	NO DATA	7.40E-11	NO DATA	NO DATA	NO DATA	8.50E-05
ZR 95	3.04E-08	9.75E-09	6.60E-09	NO DATA	1.53E-08	NO DATA	3.09E-05
ZR 97	1.68E-09	3.39E-10	1.55E-10	NO DATA	5.12E-10	NO DATA	1.05E-04
NB 95	6.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-05
MO 99	NO DATA	4.31E-06	8.20E-07	NO DATA	9.76E-06	NO DATA	9.99E-06
TC 99M	2.47E-10	6.98E-10	8.89E-09	NO DATA	1.06E-08	3.42E-10	4.13E-07
TC101	2.54E-10	3.66E-10	3.59E-09	NO DATA	6.59E-09	1.87E-10	1.10E-21
RU103	1.85E-07	NO DATA	7.97E-08	NO DATA	7.06E-07	NO DATA	2.16E-05
RU105	1.54E-08	NO DATA	6.08E-09	NO DATA	1.99E-07	NO DATA	9.42E-06

*Values in Table 1.2-2 are taken from Reference 3, Table E-11.

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
RU106	2.75E-06	NO DATA	3.48E-07	NO DATA	5.31E-06	NO DATA	1.78E-04
AG110M	1.60E-07	1.48E-07	8.79E-08	NO DATA	2.91E-07	NO DATA	6.04E-05
TE125M	2.68E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	NO DATA	1.07E-05
TE127M	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	NO DATA	2.27E-05
TE127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	NO DATA	8.68E-06
TE129M	1.15E-05	4.29E-06	1.82E-06	3.95E-06	4.80E-05	NO DATA	5.79E-05
TE129	3.14E-08	1.18E-08	7.65E-09	2.41E-08	1.32E-07	NO DATA	2.37E-08
TE131M	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	NO DATA	8.40E-05
TE131	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	NO DATA	2.79E-09
TE132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	NO DATA	7.71E-05
I 130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	NO DATA	1.92E-06
I 131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	NO DATA	1.57E-06
I 132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	NO DATA	1.02E-07
I 133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	NO DATA	2.22E-06
I 134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	NO DATA	2.51E-10
I 135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	NO DATA	1.31E-06
CS134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06
CS136	6.51E-06	2.57E-05	1.85E-05	NO DATA	1.43E-05	1.96E-06	2.92E-06
CS137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06
CS138	5.52E-08	1.09E-07	5.40E-08	NO DATA	8.01E-08	7.91E-09	4.65E-13
BA139	9.70E-08	6.91E-11	2.84E-09	NO DATA	6.46E-11	3.92E-11	1.72E-07
BA140	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.46E-08	4.18E-05
BA141	4.71E-08	3.56E-11	1.59E-09	NO DATA	3.31E-11	2.02E-11	2.22E-17
BA142	2.13E-08	2.19E-11	1.34E-09	NO DATA	1.85E-11	1.24E-11	3.00E-26
LA140	2.50E-09	1.26E-09	3.33E-10	NO DATA	NO DATA	NO DATA	9.25E-05
LA142	1.28E-10	5.82E-11	1.45E-11	NO DATA	NO DATA	NO DATA	4.25E-07
CE141	9.36E-09	6.33E-09	7.18E-10	NO DATA	2.94E-09	NO DATA	2.42E-05
CE143	1.65E-09	1.22E-06	1.35E-10	NO DATA	5.37E-10	NO DATA	4.56E-05
CE144	4.88E-07	2.04E-07	2.62E-08	NO DATA	1.21E-07	NO DATA	1.65E-04
PR143	9.20E-09	3.69E-09	4.56E-10	NO DATA	2.13E-09	NO DATA	4.03E-05
PR144	3.01E-11	1.25E-11	1.53E-12	NO DATA	7.05E-12	NO DATA	4.33E-18
ND147	6.29E-09	7.27E-09	4.35E-10	NO DATA	4.25E-09	NO DATA	3.49E-05
W 187	1.03E-07	8.61E-08	3.01E-08	NO DATA	NO DATA	NO DATA	2.82E-05
NP239	1.19E-09	1.17E-10	6.45E-11	NO DATA	3.65E-10	NO DATA	2.40E-05

*Values in Table 1.2-2 are taken from Reference 3, Table E-11.

TABLE 1.2-3

Page 1 of 2

SITE RELATED INGESTION DOSE COMMITMENT FACTOR, A_{iT} (FISH CONSUMPTION)

(mrem/hr per μCi/ml)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.26E-01	2.26E-01	2.26E-01	2.26E-01	2.26E-01	2.26E-01
C-14	3.13E+04	6.26E+03	6.26E+03	6.26E+03	6.26E+03	6.26E+03	6.26E+03
Na-24	2.69E+02	2.69E+02	2.69E+02	2.69E+02	2.69E+02	2.69E+02	2.69E+02
P-32	1.16E+07	7.18E+05	4.46E+05	0.00E+00	0.00E+00	0.00E+00	1.30E+06
Cr-51	0.00E+00	0.00E+00	9.55E-01	5.71E-01	2.10E-01	1.27E+00	2.40E+02
Mn-54	0.00E+00	9.74E+02	1.86E+02	0.00E+00	2.90E+02	0.00E+00	2.98E+03
Mn-56	0.00E+00	2.45E+01	4.35E+00	0.00E+00	3.11E+01	0.00E+00	7.82E+02
Fe-55	3.95E+01	2.73E+01	6.36E+00	0.00E+00	0.00E+00	1.52E+01	1.57E+01
Fe-59	6.23E+01	1.47E+02	5.62E+01	0.00E+00	0.00E+00	4.09E+01	4.88E+02
Co-58	0.00E+00	3.03E+02	6.80E+02	0.00E+00	0.00E+00	0.00E+00	6.15E+03
Co-60	0.00E+00	8.71E+02	1.92E+03	0.00E+00	0.00E+00	0.00E+00	1.64E+04
Ni-63	3.11E+04	2.16E+03	1.04E+03	0.00E+00	0.00E+00	0.00E+00	4.50E+02
Ni-65	1.26E+02	1.64E+01	7.49E+00	0.00E+00	0.00E+00	0.00E+00	4.17E+02
Cu-64	0.00E+00	8.77E+00	4.12E+00	0.00E+00	2.21E+01	0.00E+00	7.48E+02
Zn-65	3.36E+03	1.07E+04	4.83E+03	0.00E+00	7.15E+03	0.00E+00	6.73E+03
Zn-69	7.15E+00	1.37E+01	9.51E-01	0.00E+00	6.89E+00	0.00E+00	2.06E+00
Br-83	0.00E+00	0.00E+00	4.04E+01	0.00E+00	0.00E+00	0.00E+00	5.82E+01
Br-84	0.00E+00	0.00E+00	5.24E+01	0.00E+00	0.00E+00	0.00E+00	4.11E-04
Br-85	0.00E+00	0.00E+00	2.15E+00	0.00E+00	0.00E+00	0.00E+00	1.01E-15
Rb-86	0.00E+00	1.01E+05	4.71E+04	0.00E+00	0.00E+00	0.00E+00	1.99E+04
Rb-88	0.00E+00	2.90E+02	1.54E+02	0.00E+00	0.00E+00	0.00E+00	4.00E-09
Rb-89	0.00E+00	1.92E+02	1.35E+02	0.00E+00	0.00E+00	0.00E+00	1.12E-11
Sr-89	2.80E+03	0.00E+00	8.04E+01	0.00E+00	0.00E+00	0.00E+00	4.49E+02
Sr-90	6.90E+04	0.00E+00	1.69E+04	0.00E+00	0.00E+00	0.00E+00	1.99E+03
Sr-91	5.16E+01	0.00E+00	2.08E+00	0.00E+00	0.00E+00	0.00E+00	2.46E+02
Sr-92	1.96E+01	0.00E+00	8.46E-01	0.00E+00	0.00E+00	0.00E+00	3.89E+02
Y-90	5.76E-01	0.00E+00	1.54E-02	0.00E+00	0.00E+00	0.00E+00	6.10E+03
Y-91m	5.44E-03	0.00E+00	2.11E-04	0.00E+00	0.00E+00	0.00E+00	1.60E-02
Y-91	8.44E+00	0.00E+00	2.26E-01	0.00E+00	0.00E+00	0.00E+00	4.64E+03
Y-92	5.06E-02	0.00E+00	1.46E-03	0.00E+00	0.00E+00	0.00E+00	8.86E+02
Y-93	1.60E-01	0.00E+00	4.43E-03	0.00E+00	0.00E+00	0.00E+00	5.09E+03
Zr-95	1.39E+01	4.43E+00	3.00E+00	0.00E+00	6.96E+00	0.00E+00	1.41E+04
Zr-97	7.64E-01	1.54E-01	7.05E-02	0.00E+00	2.33E-01	0.00E+00	4.78E+04
Nb-95	6.11E-01	3.40E-01	1.83E-01	0.00E+00	3.36E-01	0.00E+00	2.06E+03
Mo-99	0.00E+00	1.86E+03	3.53E+02	0.00E+00	4.21E+03	0.00E+00	4.30E+03
Tc-99m	8.87E-03	2.51E-02	3.19E-01	0.00E+00	3.81E-01	1.23E-02	1.48E+01
Tc-101	9.12E-03	1.31E-02	1.29E-01	0.00E+00	2.37E-01	6.72E-03	3.95E-14
Ru-103	2.04E+00	0.00E+00	8.78E-01	0.00E+00	7.77E+00	0.00E+00	2.38E+02
Ru-105	1.70E-01	0.00E+00	6.70E-02	0.00E+00	2.19E+00	0.00E+00	1.04E+02

Calculated using Equation (11)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Ru-106	3.03E+01	0.00E+00	3.83E+00	0.00E+00	5.85E+01	0.00E+00	1.96E+03
Ag-110m	1.34E+02	1.24E+02	7.37E+01	0.00E+00	2.44E+02	0.00E+00	5.06E+04
Te-125m	2.57E+03	9.30E+02	3.44E+02	7.72E+02	1.04E+04	0.00E+00	1.02E+04
Te-127m	6.48E+03	2.32E+03	7.90E+02	1.66E+03	2.63E+04	0.00E+00	2.17E+04
Te-127	1.05E+02	3.78E+01	2.28E+01	7.80E+01	4.29E+02	0.00E+00	6.31E+03
Te-129m	1.10E+04	4.11E+03	1.74E+03	3.78E+03	4.60E+04	0.00E+00	5.54E+04
Te-129	3.01E+01	1.13E+01	7.33E+00	2.31E+01	1.26E+02	0.00E+00	2.27E+01
Te-131m	1.66E+03	8.10E+02	6.75E-02	1.28E+03	8.21E+03	0.00E+00	8.04E+04
Te-131	1.99E+01	7.88E+00	5.96E+00	1.55E+01	8.26E+01	0.00E+00	2.67E+00
Te-132	2.41E+03	1.56E+03	1.47E+03	1.72E+03	1.50E+04	0.00E+00	7.38E-04
I-130	7.78E-01	2.30E+02	9.06E+01	1.95E+04	3.58E+02	0.00E+00	1.98E+02
I-131	4.28E+02	6.13E+02	3.51E+02	2.01E+05	1.05E+03	0.00E+00	1.62E+02
I-132	2.09E+01	5.59E+01	1.96E+01	1.96E+03	8.90E+01	0.00E+00	1.05E+01
I-133	1.46E+02	2.54E+02	7.75E+01	3.74E+04	4.44E+02	0.00E+00	2.29E+02
I-134	1.09E+01	2.96E+01	1.06E+01	5.14E+02	4.71E+01	0.00E+00	2.58E-02
I-135	4.56E+01	1.19E+02	4.41E+01	7.88E+03	1.91E+02	0.00E+00	1.35E+02
Cs-134	8.64E+04	2.06E+05	1.68E-05	0.00E+00	6.65E+04	2.21E+04	3.60E+03
Cs-136	9.04E+03	3.57E+04	2.57E+04	0.00E+00	1.99E+04	2.72E+03	4.05E+03
Cs-137	1.11E+05	1.51E+05	9.91E+04	0.00E+00	5.14E+04	1.71E+04	2.93E+03
Cs-138	7.66E+01	1.51E+02	7.50E+01	0.00E+00	1.11E+02	1.10E+01	6.46E-04
Ba-139	1.16E+00	8.27E-04	3.40E-02	0.00E+00	7.73E-04	4.69E-04	2.06E+00
Ba-140	2.43E+02	3.05E-01	1.59E+01	0.00E+00	1.04E-01	1.75E-01	5.00E+02
Ba-141	5.64E-01	4.26E-04	1.90E-02	0.00E+00	3.96E-04	2.42E-04	2.66E-10
Ba-142	2.55E-01	2.62E-04	1.60E-02	0.00E+00	2.21E-04	1.48E-04	3.59E-19
La-140	1.50E-01	7.54E-02	1.99E-02	0.00E+00	0.00E+00	0.00E+00	5.54E+03
La-142	7.66E-03	3.48E-03	8.68E-04	0.00E+00	0.00E+00	0.00E+00	2.54E+01
Ce-141	1.88E+00	1.27E+00	1.44E-01	0.00E+00	5.91E-01	0.00E+00	4.87E+03
Ce-143	3.32E-01	2.45E+02	2.71E-02	0.00E+00	1.08E-01	0.00E+00	9.17E+03
Ce-144	9.81E+01	4.10E+01	5.27E+00	0.00E+00	2.43E+01	0.00E+00	3.32E+04
Pr-143	5.51E-01	2.21E-01	2.73E-02	0.00E+00	1.27E-01	0.00E+00	2.41E+03
Pr-144	1.80E-03	7.48E-04	9.16E-05	0.00E+00	4.22E-04	0.00E+00	2.59E-10
Nd-147	6.93E-01	8.01E-01	4.79E-02	0.00E+00	4.68E-01	0.00E+00	3.84E+03
W-187	2.96E+02	2.47E+02	8.65E+01	0.00E+00	0.00E+00	0.00E+00	8.10E+04
Np-239	2.85E-02	2.80E-03	1.54E-03	0.00E+00	8.74E-03	0.00E+00	5.75E+02

Calculated using Equation (11)

1.3 DOSE PROJECTIONS FOR LIQUID EFFLUENTS

1.3.1 MONTHLY DOSE PROJECTIONS

In order to meet the requirements of RETS 3.15.1.3 (Unit 1) and 3.11.1.3 (Unit 2), which pertain to operation of the liquid radwaste treatment systems, dose projections must be made at least monthly, during periods in which discharge of untreated liquid effluents containing radioactive materials to unrestricted areas occurs or is expected.

Projected quarterly doses to individuals due to liquid effluents may be determined as follows:

$$D_{tb(prj)} = \left(\frac{D_{tb(c)}}{t}\right) \times 91$$

$$D_{o(prj)} = \left(\frac{D_{o(c)}}{t}\right) \times 91$$

where

$D_{tb(c)}$ = the cumulative total body dose for the elapsed portion of the current quarter plus the release under consideration.

t = the number of days into the current quarter.

$D_{o(c)}$ = the cumulative organ doses for the elapsed portion of the current quarter plus the release under consideration.

If activities planned during the remainder of the quarter are expected to contribute a significant dose and the determination can be reasonably made, this contribution should be included in the equations:

$$D_{tb(prj)} = \left[\left(\frac{D_{tb(c)}}{t}\right) \times 91\right] + D_{PA}$$

$$D_{o(prj)} = \left[\left(\frac{D_{o(c)}}{t}\right) \times 91\right] + D_{PA}$$

where D_{PA} is the expected dose due to the particular planned activity.

1.3.2 DOSE PROJECTIONS FOR SPECIFIC RELEASES

Dose projections may be performed for a particular release by performing a pre-release dose calculation assuming that the planned release will proceed as anticipated. For individual dose projections due to liquid releases follow the methodology presented in Section 1.2 using sample analysis values for the source to be released and parametric values expected to exist for the release period.

1.4 DEFINITIONS OF LIQUID EFFLUENT TERMS

Term		Definition	Section of Initial Use
A	=	adjustment factor applied to facilitate setting actual monitor setpoints.	1.1.1
$A_{i\tau}$	=	the site related ingestion dose commitment factor due to fish consumption to the total body or any organ τ for each identified principal gamma and beta emitter listed in Table 1.2-3 in mrem-ml per hr-μCi.	1.2
BF_i	=	Bioaccumulation Factor for nuclide i, in fish, pCi/Kg per pCi/l, from Table 1.2-1.	1.2.1
c	=	the setpoint of the radioactivity monitor which measures the radioactivity concentration in the effluent line prior to dilution and subsequent release.	1.1.1
C_a	=	the effluent concentration of alpha emitting nuclides observed by gross alpha analysis of the MONTHLY composite sample.	1.1.1
C_f	=	the concentration of Fe-55 in liquid wastes as observed in the QUARTERLY composite sample.	1.1.1
C_g	=	the effluent concentration of a gamma emitting nuclide, g, observed by gamma-ray spectroscopy of the waste sample.	1.1.1
C_i	=	the concentration of nuclide i as determined by the analysis of the waste sample.	1.1.1
$C_{i\ell}$	=	the average concentration of radionuclide i, in undiluted liquid effluent during time period Δt_ℓ, in μCi/ml.	1.2.1

Term	Definition	Section of Initial Use
C_{MPC}	= the effluent concentration limit (RETS 3.15.1.1 for Unit 1; 3.11.1.1 for Unit 2) implementing 10 CFR 20 for the site, in µCi/ml.	1.1.1
C_s	= the concentration of Sr-89 or Sr-90 in liquid wastes as determined by analysis of the QUARTERLY composite sample.	1.1.1
C_t	= the measured concentration of H-3 in liquid waste as determined by analysis of the MONTHLY composite.	1.1.1
D_τ	= the cumulative dose commitment to the total body or any organ, τ, from the liquid effluents for the total time period.	1.2.1
DF	= the dilution factor, which is the ratio of the total dilution flow rate to the effluent stream flow rate(s) required to assure that the limiting concentration of 10CFR, Part 20, Appendix B, Table II, Column 2 are met at the point of discharge to the Unrestricted Area.	1.1.1
$DF_{i\tau}$	= a dose conversion factor for nuclide, i, for adults in preselected organ, τ, in mrem/pCi found in Table 1.2-2.	1.2.1
f	= the flow setpoint as determined for the radiation monitor location. (General expression for equation 1.)	1.1.1
F	= the dilution water flow monitor setpoint as determined prior to the release point, in volume per unit time. (General expression for equation 1.)	1.1.1
F_d	= the minimum flow rate of the dilution stream used for setpoint calculations during the time of release.	1.1.1

Term	Definition	Section of Initial Use
F_ℓ	= the near field average dilution factor for $C_{i\ell}$ during any liquid effluent release.	1.2.1
f_p	= effluent flow rate (actual pump value).	1.1.1
f_t	= maximum permissible effluent flow rate.	1.1.1
K_o	= 1.14×10^5, units conversion factor.	1.2.1
m	= number of liquid releases.	1.2.1
MPC_i	= MPC_g, MPC_a, MPC_s, MPC_f, and MPC_t which are the limiting concentrations of the appropriate gamma emitting radionuclides, alpha emitting radionuclides, strontium, iron and tritium, respectively, from 10CFR, Part 20, Appendix B, Table II, Column 2.	1.1.1
SF	= the safety factor; a conservative factor used to compensate for statistical fluctuations and errors of measurements.	1.1.1
t_c	= The transit time from release to receptor.	1.2.1
Δt	= duration of release under consideration.	1.2.1
U_F	= 21 kg/yr, fish consumption (adult).	1.2.1
Z	= Applicable factor when additional receiving water body dilution is considered; Z = 10.	1.2.1
λ_i	= The decay constant for radionuclide i. (sec^{-1})	1.2.1

1.5 LIQUID RADWASTE TREATMENT SYSTEMS

FIGURES 1.5-1 and 1.5-2 are schematics of the Liquid Radwaste Treatment Systems for Unit 1 and Unit 2 respectively. The dotted lines indicate alternate pathways through which liquid radwaste may be routed. These alternate routes increase the operational flexibility of the Liquid Radwaste Treatment Systems.

FIGURE 1.5-1 Liquid Radwaste Treatment System (Unit 1)

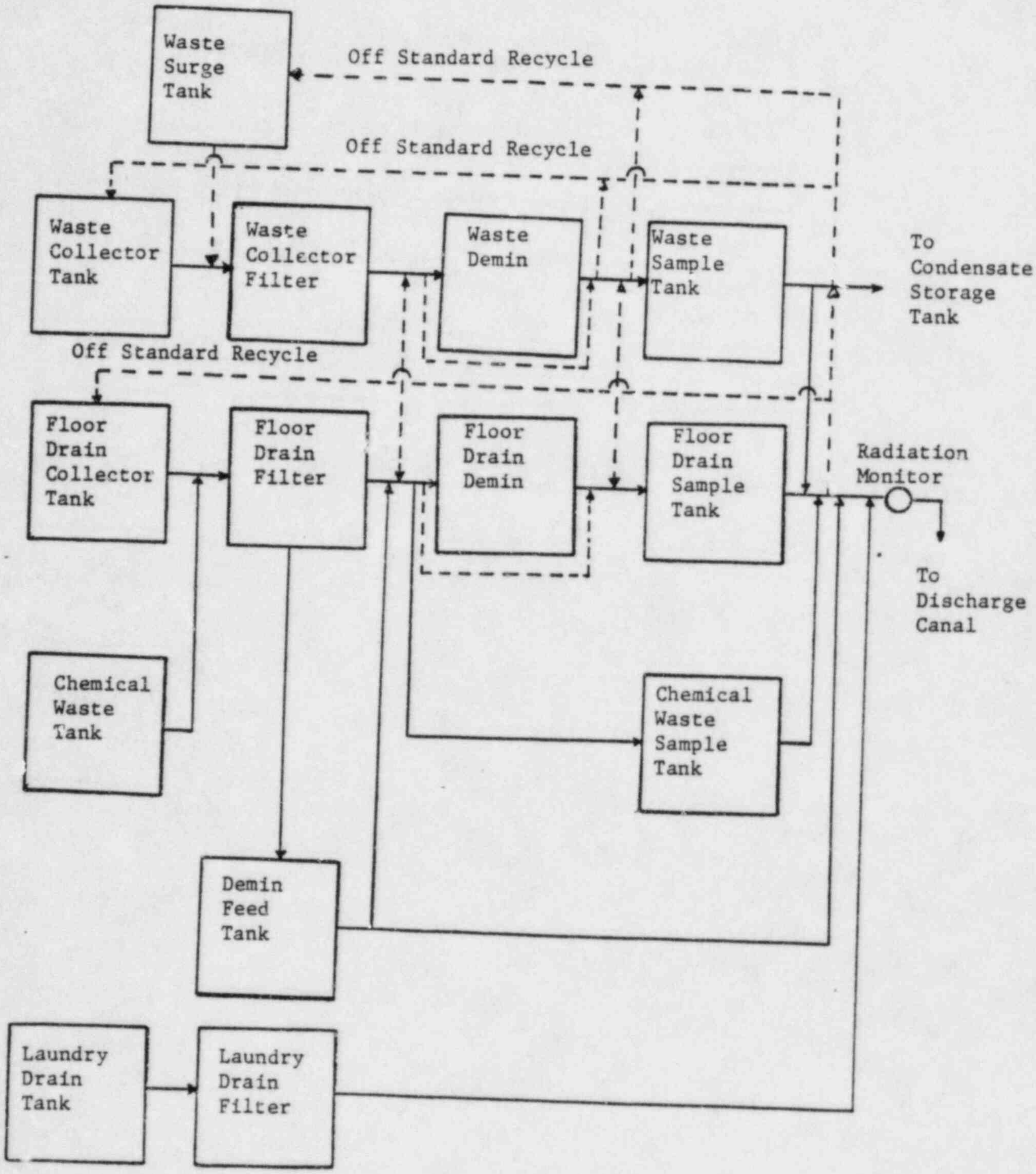
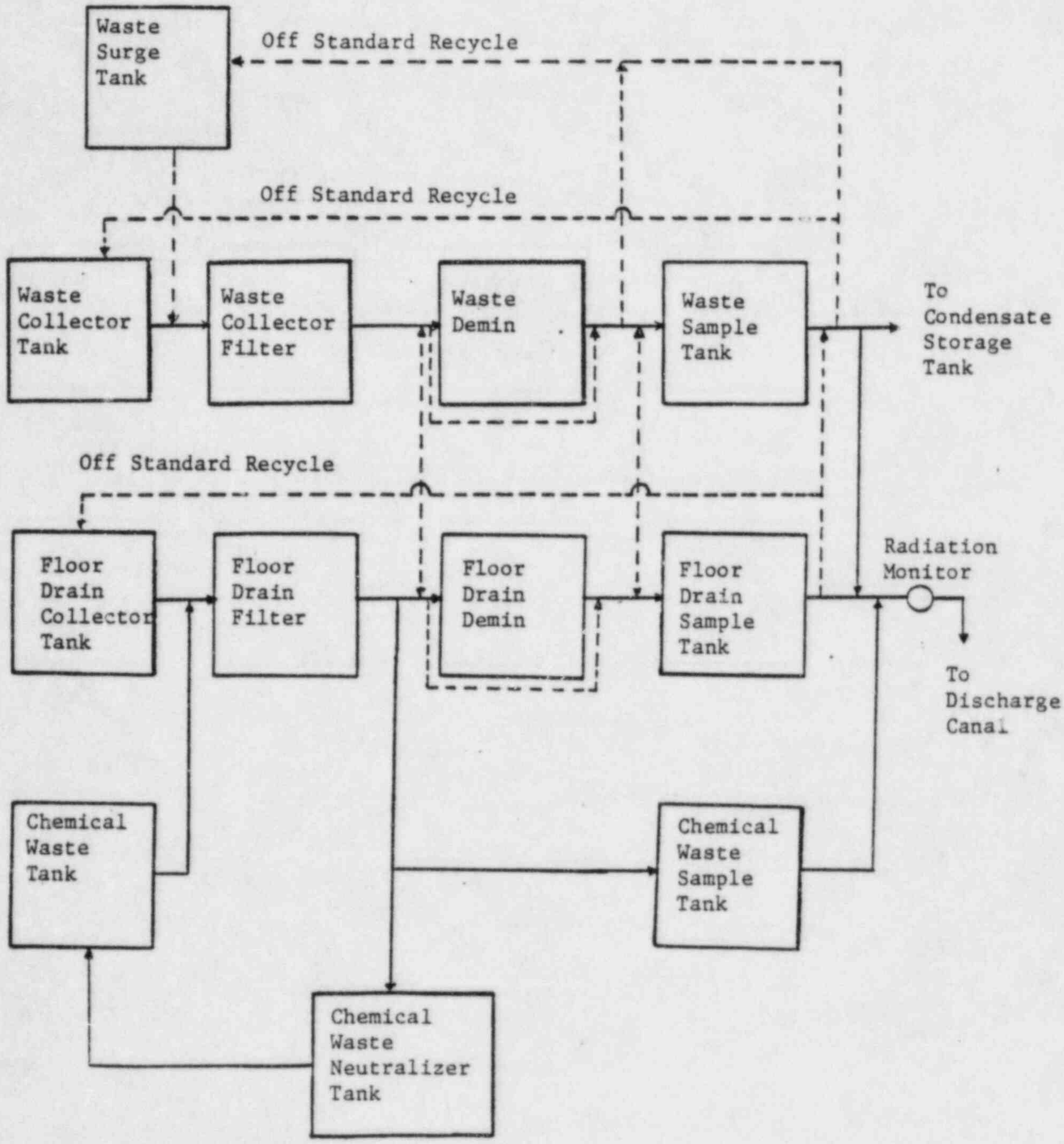


FIGURE 1.5-2 Liquid Radwaste Treatment System (Unit 2)



1.6 MIXING OF LIQUID WASTE TANKS

In order to assure that samples taken from liquid waste tanks planned for release are representative, the contents of the tank to be sampled will be recirculated for a minimum time period to allow adequate mixing of the tank contents. Recirculation times are as follows (Reference 13):

Tank(s)	Recirculation Times	
	Unit 1	Unit 2
Waste Sample Tanks	40 minutes	40 minutes
Floor Drain Sample Tanks	70 minutes	105 minutes
Chemical Waste Sample Tanks	65 minutes	65 minutes
Demin Feed Tank	115 minutes	NA
Laundry Drain Tanks	50 minutes	NA

SECTION 2.
GASEOUS EFFLUENTS

At Plant Hatch there are four points where radioactivity is released to the atmosphere in gaseous discharges. These four release points are: (1) The main stack which serves both units; (2) Unit 1 reactor building vent stack; (3) Unit 2 reactor building vent stack; and (4) Unit 1 recombiner building vent.

The main stack serves as the discharge point for the following release sources from each unit: mechanical vacuum pumps, off-gas system, gland seal exhaust, and standby gas treatment system, through which drywell purges are discharged. The waste gas treatment building ventilation also discharges through the main stack.

Each reactor building vent stack serves as the discharge point for the reactor building, refueling floor ventilation, turbine building, and radwaste building of each respective unit.

The Unit 1 recombiner building vent discharges directly to the atmosphere.

Gaseous effluent monitor setpoints are required only for noble gas monitors serving these four release points; methodology for calculating noble gas monitor setpoints is presented in Section 2.1. Although setpoint calculations are not required for radioiodine and particulate monitors, the methodology for assuring the potential organ dose rates due to radioiodines, tritium and particulates in gaseous releases from the site do not exceed the limits of RETS 3.15.2.1.(b) (Unit 1) and 3.11.2.1(b) (Unit 2) is presented in the Note following section 2.2.1.b.

2.1 GASEOUS EFFLUENT MONITOR SETPOINTS

The gaseous monitor setpoint values determined in the following sections will be regarded as upper bounds for the actual setpoint adjustments. That is, setpoint adjustments are not required to be performed if the existing setpoint level corresponds to a lower count rate than the calculated value. Setpoints may be established at values lower than the calculated values if desired.

If no release is planned for a particular pathway, or if there is no detectable activity in the planned release, the monitor setpoint should be established as close to background as practical to prevent spurious alarms and yet alarm should an inadvertent release occur.

If a calculated setpoint is less than the monitor reading associated with the particular release pathway, no release may be made under current conditions. Under such circumstances, the number of simultaneous release pathways may be reduced or contributing source terms may be reduced and the setpoint recalculated.

2.1.1 UNIT 1 REACTOR BUILDING VENT STACK, UNIT 2 REACTOR BUILDING VENT STACK, AND UNIT 1 RECOMBINER BUILDING VENT

Monitors: D11-K619 A and B, 2D11-K636 A and B, D11-P003 A and B

For the purpose of implementation of RETS 3.14.2 (Unit 1) and 3.3.6.10 (Unit 2), the alarm setpoint level for these noble gas monitors will be calculated as follows:

C_S = monitor reading of the noble gas monitor at the alarm setpoint concentration.

$$C_S = \text{the lesser of } \begin{cases} (AG \times SF) \times R_{tv} \times D_{TB} & (1) \\ \text{or} \\ (AG \times SF) \times R_{sv} \times D_{ss} & (2) \end{cases}$$

SF = safety factor; a conservative factor applied to each noble gas monitor to compensate for statistical fluctuations and errors of measurement. (For example, SF = 0.5 corresponds to a 100 percent variation.)

AG = an administrative allocation factor applied to apportion the release setpoints among all gaseous release discharge pathways (normally four) to assure that release limits will not be exceeded by simultaneous releases. The allocation factor for a particular discharge pathway may be assigned any desired value between 0 and 1 under the condition that the sum of the allocation factors for all simultaneous release pathways does not exceed 1. For ease of implementation, AG may be set equal to 1/n, where n is the number of simultaneous final gaseous release points. For a more exact determination of allocation factors, see Section 2.1.3.

D_{TB} = Dose rate limit to the total body of an individual which is 500 mrem/year.

R_{tv} = monitor reading per mrem/yr to the total body for vent releases

$$R_{tv} = C \div \left((\overline{X/Q})_G \sum_i K_i Q_{iv} \right) \qquad (3)$$

where

C = monitor reading of a noble gas monitor corresponding to the grab sample radionuclide concentrations taken in accordance with RETS Tables 4.15.2-1 (Unit 1) and 4.11-2 (Unit 2). The monitor response corresponding to the measured concentration is determined from the monitor calibration curve for the particular monitor.

$(\overline{X/Q})_G$ = the highest annual average relative concentration at the site boundary. (If desired, the annual average relative concentration at the site boundary for the particular release point may be used.) The release points addressed in this section are ground-level releases.

$(\overline{X/Q})_G$ = 6.8×10^{-6} sec/m^3 in the W sector.

K_i = total body dose factor due to gamma emissions from radionuclide i (mrem/yr per µCi/m^3) from Table 2.1-1.

Q_{iv} = rate of release of noble gas radionuclide i (µCi/sec) from the vent release pathway under consideration, which is the product of X_{iv} and F_v, where X_{iv} is the concentration of radionuclide i for the particular release and F_v is the maximum expected release flowrate for this release point. (X_{iv} in µCi/ml and F_v in ml/sec.)

D_{ss} = Dose rate limit to the skin of the body of an individual in an unrestricted area which is 3000 mrem/year.

R_{sv} = monitor reading per mrem/yr to the skin

$$R_{sv} = C \div \left(\overline{(X/Q)}_G \sum_i (L_i + 1.1\, M_i)\, Q_{iv} \right) \qquad (4)$$

where

L_i = skin dose factor due to beta emissions from radionuclide i (mrem/yr per $\mu Ci/m^3$) from Table 2.1-1.

1.1 = mrem skin dose per mrad air dose.

M_i = air dose factor due to gamma emissions from radionuclide i (mrad/yr per $\mu Ci/m^3$) from Table 2.1-1.

2.1.2 MAIN STACK

Monitor: D11-K600 A and B

For the purpose of implementation of RETS 3.14.2 (Unit 1) and 3.3.6.10 (Unit 2), the alarm setpoint level for the main stack noble gas monitor will be calculated as follows:

C_S = monitor reading of the noble gas monitor at the alarm setpoint concentration.

$$C_S = \text{the lesser of} \begin{cases} (AG \times SF) \times R_{ts} \times D_{TB} & (5) \\ \text{or} & \\ (AG \times SF) \times R_{ss} \times D_{ss} & (6) \end{cases}$$

$$R_{ts} = C \div \sum_i V_i Q_{is} \qquad (7)$$

$$R_{ss} = C \div \sum_i \left[\left(L_i\, \overline{(X/Q)}_E + 1.1\, B_i \right) Q_{is} \right] \qquad (8)$$

where

V_i = constant, which includes the dose factor, for each identified noble gas radionuclide accounting for the gamma radiation from the elevated finite plume resulting from the main stack release in mrem/year per μCi/sec from Table 2.1-2.

B_i = constant, which includes the air dose factor, for each identified noble gas radionuclide accounting for the gamma radiation from the elevated finite plume resulting from the main stack release in mrad/year per μCi/sec from Table 2.1-2.

Q_{is} = rate of release of noble gas radionuclide i (μCi/sec) from the main stack, which is equal to the product of X_{is} and F_s, where X_{is} is the concentration of radionuclide i for the main stack release and F_s is the maximum expected main stack release flowrate. (X_{is} in μCi/ml and F_s in ml/sec.)

$(\overline{X/Q})_E$ = the highest annual average relative concentration in the unrestricted area associated with releases from the main stack. The main stack is an elevated release.

$(\overline{X/Q})_E$ = 1.0×10^{-7} sec/m^3 in the W sector.

All other terms were identified previously in Section 2.1.1.

2.1.3 DETERMINATION OF ALLOCATION FACTOR, AG

When simultaneous gaseous releases are made to the environment, an (administrative) allocation factor must be applied to each discharge pathway. This is to ensure that simultaneous gaseous releases from the site to unrestricted areas will not exceed the dose rate limits specified in RETS 3.15.2.1 (Unit 1) or 3.11.2.1 (Unit 2). For Plant Hatch, final discharge pathways which may be released simultaneously are the main stack, Unit 1 reactor building vent stack, Unit 2 reactor building vent stack, and Unit 1 recombiner building vent. The allocation factor for each discharge pathway must be between 0 and 1 and the sum of the allocation factors for the simultaneous releases must not exceed 1.

There are three methods by which allocation factors may be determined:

1. The allocation factor for a particular release pathway may be administratively selected based on an estimate of the fraction of the total dose rate (from all simultaneous releases) which is contributed by the particular release pathway.

2. The allocation factor may be calculated using the expression

   $$AG = 1/n$$

   where n = the number of release pathways to be released simultaneously.

3. The allocation factor may be determined for a particular discharge pathway by calculating the ratio of the total body dose rate due to noble gases released from the particular discharge pathway under consideration to the total body dose rate due to noble gases in all simultaneous releases.

   For the Main Stack:

$$AG = \frac{\sum_i V_i Q_{is}}{\left[\sum_i V_i Q_{is}\right] + \left[\sum_n \overline{(X/Q)}_G \sum_i K_i Q_{iv}\right]}$$

where n is the number of simultaneous vent releases.

For Vent releases:

$$AG = \frac{\overline{(X/Q)}_G \sum_i K_i Q_{iv(r)}}{\left[\sum_i V_i Q_{is}\right] + \left[\sum_n \overline{(X/Q)}_G \sum_i K_i Q_{iv}\right]}$$

Where n is the number of simultaneous vent releases and (r) is the particular discharge pathway number for which an allocation factor is being determined.

TABLE 2.1-1

DOSE FACTORS FOR EXPOSURE TO A SEMI-INFINITE CLOUD OF NOBLE GASES*

Nuclide	γ-Body*** (K)	β-Skin***(L)	γ-Air**(M)	β-Air**(N)
Kr-83m	7.56E-02****	--------	1.93E+01	2.88E+02
Kr-85m	1.17E+03	1.46E+03	1.23E+03	1.97E+03
Kr-85	1.61E+01	1.34E+03	1.72E+01	1.95E+03
Kr-87	5.92E+03	9.73E+03	6.17E+03	1.03E+04
Kr-88	1.47E+04	2.37E+03	1.52E+04	2.93E+03
Kr-89	1.66E+04	1.01E+04	1.73E+04	1.06E+04
Kr-90	1.56E+04	7.29E+03	1.63E+04	7.83E+03
Xe-131m	9.15E+01	4.76E+02	1.56E+02	1.11E+03
Xe-133m	2.51E+02	9.94E+02	3.27E+02	1.48E+03
Xe-133	2.94E+02	3.06E+02	3.53E+02	1.05E+03
Xe-135m	3.12E+03	7.11E+02	3.36E+03	7.39E+02
Xe-135	1.81E+03	1.86E+03	1.92E+03	2.46E+03
Xe-137	1.42E+03	1.22E+04	1.51E+03	1.27E+04
Xe-138	8.83E+03	4.13E+03	9.21E+03	4.75E+03
Ar-41	8.84E+03	2.69E+03	9.30E+03	3.28E+03

*Values taken from Reference 3, Table B-1

** $\frac{\text{mrad-m}^3}{\mu\text{Ci-yr}}$

*** $\frac{\text{mrem-m}^3}{\mu\text{Ci-yr}}$

**** 7.56E-02 = 7.56×10^{-2}

TABLE 2.1-2

DOSE FACTORS FOR EXPOSURE TO DIRECT RADIATION

FROM NOBLE GASES IN THE ELEVATED FINITE PLUME*

Location: Site Boundary in West Sector at 1501 meters

Nuclide	γ - Body (V)**	γ - Air (B)***
Kr-85m	6.77E-05	7.13E-05
Kr-85	9.46E-07	1.01E-06
Kr-87	3.59E-04	3.75E-04
Kr-88	9.22E-04	9.58E-04
Kr-89	8.90E-04	9.31E-04
Kr-90	6.39E-04	6.74E-04
Xe-131m	1.41E-06	1.48E-06
Xe-133m	1.54E-05	1.79E-05
Xe-133	1.17E-05	1.21E-05
Xe-135m	1.97E-04	2.10E-04
Xe-135	1.10E-04	1.17E-04
Xe-137	9.11E-05	9.71E-05
Xe-138	5.14E-04	5.37E-04
Ar-41	5.94E-04	6.25E-04

*Values calculated in accordance with methodologies presented in Section 5.2.1 of Reference 1 and Appendix F of Reference 3, with meteorological joint frequency distributions presented in Table E.4-7 of Appendix E of Reference 5.

** $\frac{\text{mrem-sec}}{\mu\text{Ci-yr}}$

*** $\frac{\text{mrad-sec}}{\mu\text{Ci-yr}}$

2.2 GASEOUS EFFLUENT DOSE RATE AND DOSE CALCULATIONS

2.2.1 UNRESTRICTED AREA BOUNDARY DOSE RATES

2.2.1.a Dose Rates Due To Noble Gases

For the purpose of implementation of RETS 3.15.2.1.a (Unit 1) and 3.11.2.1.a (Unit 2), the dose rate in the unrestricted area due to noble gases shall be calculated as follows:

D_t = total body dose rate at time of release (mrem/yr)

$$= \left[\sum_v (\overline{X/Q})_G \sum_i K_i Q_{iv}\right] + \left[\sum_i V_i Q_{is}\right] \quad (9)$$

D_s = skin dose rate at time of release (mrem/yr)

$$= \left[\sum_v (\overline{X/Q})_G \sum_i (L_i + 1.1\, M_i)\, Q_{iv}\right] + \left[\sum_i (L_i(\overline{X/Q})_E + 1.1\, B_i)\, Q_{is}\right] \quad (10)$$

Terms were defined previously in Sections 2.1.1 and 2.1.2.

The dose rate limits are site limits at any point in time; therefore, dose rates are summed over all releases occurring simultaneously. For Plant Hatch the three vent releases are: Unit 1 reactor building vent stack, Unit 2 reactor building vent stack, and the Unit 1 recombiner building vent. The only elevated release is the main stack which serves both units. Simultaneous releases may include any combination of these four release points.

2.2.1.b Dose Rates Due to Radioiodines, Tritium, and Particulates

For the purpose of implementing RETS 3.15.2.1.b (Unit 1) and 3.11.2.1.b (Unit 2), organ dose rates due to radioiodines, tritium and all radioactive materials in particulate form with half lives greater than eight days, are required to be calculated for the inhalation pathway for the child age group. The child age group would experience the highest potential dose rate via the inhalation pathway. In accordance with Appendix C to Reference 3, noble gases are excluded from these calculations. These dose rates are calculated as follows:

D_o = organ dose rate at time of release (mrem/yr)

$$= \left[\sum_{v} (\overline{X/Q})_G \sum_{i} P_{io} Q'_{iv}\right] + \left[(\overline{X/Q})_E \sum_{i} P_{io} Q'_{is}\right] \quad (11)$$

where

$(\overline{X/Q})_G$ = defined in Section 2.1.1.

$(\overline{X/Q})_E$ = defined in Section 2.1.2.

Q'_{iv} = release rate (μCi/sec) of radioiodines, tritium and particulates (required by RETS 3.15.2.1 for Unit 1 and 3.11.2.1 for Unit 2) from the Unit 1 reactor building vent stack, the Unit 2 reactor building vent stack, and the Unit 1 recombiner building vent.

Q'_{is} = release rate (μCi/sec) of radioiodines, tritium, and particulates (required by RETS 3.15.2.1 for Unit 1 and 3.11.2.1 for Unit 2) from the main stack.

P_{io} = organ dose parameter for organ o and radionuclide i, (mrem/yr per $\mu Ci/m^3$) for inhalation determined as follows:

$$P_{io} = K\,(BR)\,DF_{io} \quad (12)$$

and where

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

BR = breathing rate for child age group; 3700 m^3/year (Table 2.2-10) (from Reference 3)

DF_{io} = inhalation pathway dose factor for child age group for organ o and radionuclide i (Table 2.2-2) (from Reference 3)

NOTE: In order to assure that potential dose rates (pre-release) to an organ due to radioiodine, tritium and particulates in simultaneous gaseous releases from the site do not exceed 1500 mrem/year as specified in RETS 3.15.2.1(b) and 3.11.2.1(b), the potential organ dose rate D_o must be limited as follows:

$$D_o \div (AG \times SF) \leq 1500 \text{ mrem/year} \tag{13}$$

re AG and SF are assigned the same values as were used in Se ion 2.1 for the release source pathway under consideration. To further ensure that dose rate limits were not exceeded, (post-release) dose rates from simultaneous releases shall be summed, as shown above.

2.2.2 UNRESTRICTED AREA AIR DOSE AND DOSE TO INDIVIDUAL

2.2.2.a <u>Air Dose in Unrestricted Area</u>

For the purpose of implementation of RETS 3.15.2.2 (Unit 1) and 3.11.2.2 (Unit 2) and 3.15.2.4 (Unit 1) and 3.11.2.4 (Unit 2), the air dose in unrestricted areas shall be determined as follows:

D_γ = air dose due to gamma emissions from noble gas radionuclides (mrad)

$$= 3.17 \times 10^{-8} \left[\left[\sum_v \overline{(X/Q)}_G \sum_i M_i \tilde{Q}_{iv} \right] + \left[\sum_i B_i \tilde{Q}_{is} \right] \right] \tag{14}$$

where

3.17×10^{-8} = the fraction of one year per one second

$\tilde{Q}_{iv}$ = cumulative release of noble gas radionuclide i over the period of interest (μCi) from the vent release under consideration.

$\tilde{Q}_{is}$ = cumulative release of noble gas radionuclide i over the period of interest (μCi) from the main stack.

M_i = defined previously in Section 2.1.1.

B_i = defined previously in Section 2.1.2.

$(\overline{X/Q})_G$ = defined previously in Section 2.1.1.

D_β = air dose due to beta emissions from noble gas radionuclides (mrad).

$$= 3.17 \times 10^{-8} \left[\left[\sum_v (\overline{X/Q})_G \sum_i N_i \tilde{Q}_{iv} \right] + \left[(X/Q)_E \sum_i N_i \tilde{Q}_{is} \right] \right] \quad (15)$$

where

N_i = air dose factor due to beta emissions from noble gas radionuclide i (mrad/yr per $\mu Ci/m^3$ from Table 2.1-1).

$(\overline{X/Q})_E$ = defined previously in Section 2.1.2.

2.2.2.b Dose To An Individual In Unrestricted Area

Dose to an individual from radioiodines, tritium, and radioactive materials in particulate form will be calculated for the purpose of implementation of RETS 3.15.2.3 and 3.15.2.4 (Unit 1) and 3.11.2.3 and 3.11.2.4 (Unit 2). In accordance with Appendix C of Reference 3, noble gases are excluded from these dose calculations. Doses to an individual are calculated as follows:

(Note: At Plant Hatch the controlling receptor is an individual in the infant age group, located in the NNE sector at a distance of 3.2 miles, exposed to inhalation, ground-plane, and grass-cow-milk pathways.)

D_j = dose to an organ j of an individual in age-group a from radioiodines, tritium, and radionuclides in particulate form with half-lives greater than eight days (mrem).

$$= 3.17 \times 10^{-8} \sum_{pi} R_{aipj} [W_{vp}' \tilde{Q}_{iv}' + W_{sp}' \tilde{Q}_{is}'] \qquad (16)$$

where

3.17×10^{-8} = fraction of one year per one second.

W_{vp}' = pathway-dependent relative dispersion or deposition in the unrestricted area at the location of the controlling receptor, associated with plant vent releases.

W_{vp}' =

$(\overline{X/Q'})_{vp}$ = annual average relative dispersion parameter for location of controlling (critical) receptor for plant vent releases. $(\overline{X/Q'})_{vp}$ applies only to inhalation and all tritium pathways. (For all tritium pathways the $\tilde{Q}_i'$ source term is limited to tritium.)

$(\overline{X/Q'})_{vp}$ = 6.1×10^{-7} sec/m³ in the NNE sector for inhalation and all tritium pathways.

$(\overline{D/Q'})_{vp}$ = annual average deposition parameter for the location of controlling (critical) receptor for plant vent releases. $(\overline{D/Q'})_{vp}$ applies to all other pathways.

$(\overline{D/Q'})_{vp}$ = 1.9×10^{-9} m⁻² in NNE sector for all other pathways.

W_{sp}' = pathway-dependent relative dispersion or deposition in the unrestricted area at the location of the controlling receptor, associated with main stack releases.

$W_{sp}' = \begin{cases} (\overline{X/Q'})_{sp} & \text{= annual average relative dispersion parameter for location of controlling (critical) receptor for main stack releases. } (\overline{X/Q'})_{sp} \text{ applies only to inhalation and all tritium pathways. (For all tritium pathways, the } \tilde{Q}_i' \text{ source term is limited to tritium.)} \\ (\overline{X/Q'})_{sp} & = 4.2 \times 10^{-8} \text{ sec/m}^3 \text{ in the NNE sector for inhalation and all tritium pathways.} \\ (\overline{D/Q'})_{sp} & \text{= annual average deposition parameter for the location of controlling (critical) receptor for main stack releases. } (\overline{D/Q'})_{sp} \text{ applies to all other pathways.} \\ (\overline{D/Q'})_{sp} & = 6.9 \times 10^{-10} \text{ m}^{-2} \text{ in NNE sector for all other pathways.} \end{cases}$

The selection of the dispersion or deposition parameter, X/Q or D/Q, is dependent upon the pathway being considered. The dispersion parameter, X/Q, is required for the inhalation pathway. The deposition parameter, D/Q, is required for the ground-plane pathway and the grass-cow-milk pathway. However, since tritium is taken up by vegetation directly from surrounding air, X/Q is required for tritium contributions from the grass-cow-milk pathway.

$\tilde{Q}_{iv}'$ = cumulative release (μCi), from plant vent releases, of radionuclide i as required by RETS 3.15.2.3 (Unit 1) and 3.11.2.3 (Unit 2) over the period of interest. Dose determinations required by RETS 3.15.2.3 and 3.11.2.3 are on a per reactor basis; therefore, cumulative release quantities must also be reactor-specific. (For dose contributions due to tritium from the grass-cow-milk pathway, the Q_{iv}' term is limited to tritium.)

$\tilde{Q}_{is}'$ = cumulative release (μCi), from the main stack releases, of radionuclide i as required by RETS 3.15.2.3 (Unit 1) and 3.11.2.3 (Unit 2) over the period of interest. Dose determinations required by RETS 3.15.2.3 and 3.11.2.3 are on a per reactor basis; therefore, cumulative release quantities must also be reactor-specific. Since the main stack serves both reactors, release quantities must be apportioned between the two units. In absence of evidence that one reactor contributes a greater quantity of radioactivity than the other over the period of interest, release quantities may be apportioned equally between the two units.

R_{aipj} = pathway-specific, individual age-specific, organ dose factor for radionuclide i, pathway p, organ j, and individual age group, a. Routine individual dose calculations address the inhalation, ground-plane, grass-cow (or goat)-milk, grass-cow-meat, and garden vegetation pathways. However, the dose pathways actually present at the controlling location, as well as the controlling individual age group, are determined through the Land Use Census for the site. Pathway factors R_{aipj} are determined as shown in the following sub-sections.

As stated earlier, the controlling receptor for Plant Hatch is an infant exposed to inhalation, ground-plane and grass-cow-milk pathways.

Plant Hatch site-specific values, or appropriate default values, required in the pathway factor determinations for the critical receptor are presented in Table 2.2-12.

Inhalation Pathway Factor

R_{aipj} = $K'(BR)_a \ (DFA_{ij})_a$ mrem/yr per $\mu Ci/m^3$

where

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

$(BR)_a$ = the breathing rate for a particular age group in m^3/year from Table 2.2-10.

DFA_{ija} = the inhalation dose factor for receptor age group a, organ j, and for radionuclide i, in mrem/pCi from Tables 2.2-1 through 2.2-4.

Ground-Plane Pathway Factor

R_{aipj} = $K'K'' \ (SF')(DFG_{ij}) \ ((1-e^{-\lambda_i t})/\lambda_i)$ (m^2 mrem/year per μCi/sec)

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

K'' = constant of unit conversion, 8760 hr/yr.

SF' = shielding factor, 0.7 (dimensionless)

DFG_{ij} = ground plane dose conversion factor for radionuclide i (same for all age groups and specific organs are assumed to receive the same dose as the total body) (mrem/hr per pCi/m^2) Table 2.2-9.

λ_i = decay constant for radionuclide i.

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

Grass-Cow-Milk Pathway Factor

$$R_{aipj} = K' \frac{Q_F(U_{ap})}{\lambda_i + \lambda_w} F_m(r)(DFL_{ij})_a \left[\frac{f_p f_s}{Y_p} + \frac{(1-f_p f_s)e^{-\lambda_i t_h}}{Y_s}\right] e^{-\lambda_i t_f} \qquad (17)$$

(m^2mrem/yr per μCi/sec)

where

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

Q_F = the cow's consumption rate, in kg/day (wet weight).

U_{ap} = the receptor's milk consumption rate for age group (a), in liters/yr from Table 2.2-10.

Y_p = the agricultural productivity by unit area of pasture feed grass, in kg/m^2.

Y_s = the agricultural productivity by unit area of stored feed, in kg/m^2.

F_m = The stable element transfer coefficients, in days/liter. (see Table 2.2-11.)

r = fraction of deposited activity retained on feed grass. (1.0 for radioiodines; 0.2 for particulates)

$(DFL_{ij})_a$ = the organ ingestion dose factor for the ith radionuclide for the receptor in age group (a), in mrem/pCi from Tables 2.2-5 through 2.2-8.

λ_i = the decay constant for the ith radionuclide, in sec^{-1}.

λ_w = the decay constant for removal of activity on leaf and plant surfaces by weathering, 5.73×10^{-7} sec^{-1} (corresponding to a 14 day half-life).

t_f = the transport time from pasture to cow, to milk, to receptor, in sec. (1.73×10^5).

t_h = the transport time from pasture, to harvest, to cow, to milk, to receptor, in sec. (7.78×10^6).

f_p = fraction of the year that the cow is on pasture (dimensionless).

f_s = fraction of the cow feed that is pasture grass while the cow is on pasture (dimensionless).

For tritium in milk, the grass-cow-milk pathway factor is a special case due to the fact that the concentration of tritium in milk is based on airborne concentration rather than deposition:

$$R_{aipj} = K'K'''F_m Q_F U_{ap} (DFL_{ij})_a \quad [0.75(0.5/H)] \text{ (mrem/yr per } \mu Ci/m^3) \qquad (18)$$

where

K''' = a constant of unit conversion, 10^3 gm/kg.

H = absolute humidity of the atmosphere, in gm/m^3.

0.75 = the fraction of total feed that is water.

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

and other parameters and values as previously defined.

2.2.2.c Dose Calculations To Support Other Specific Technical Specifications

In the event radiological impact assessment becomes necessary to implement RETS 6.9.1.12 or 6.9.1.13, dose calculations will be performed using the equations in Section 2.2.2.c with the substitution of average meteorological parameters for the period of the report, and the appropriate pathway receptor dose factors (R_{aipj}).

For the purpose of implementing RETS 3.16.2, dose calculations may be performed using the equations in Section 2.2.2.c substituting the appropriate pathway receptor dose factors (R_{aipj}) and the appropriate dispersion parameters for the location(s) of interest. Annual average dispersion parameters may be used for these calculations.

The receptor for which dose calculations may be required in order to implement RETS 6.9.1.12, 6.9.1.13 or 3.16.2 may not be the previously identified critical receptor. The receptor age group and exposure pathways present (and applicable) at the location of interest must be determined. In addition to the inhalation, ground-plane, and grass-cow-milk pathways presented in Section 2.2.2.b, it may be necessary to consider the grass-cow-meat and/or the garden vegetation pathways. The equations for calculating the pathway factors R_{aipj} for these two additional pathways are presented below. Historically milk goats have not been present within five miles of Plant Hatch. However, in order to facilitate implementation of RETS 3.16.2 in the event milk goats are located within five miles of Plant Hatch, the equation for calculating the grass-goat-milk pathway factor is also presented. Plant Hatch site-specific values, or appropriate default values, required in the pathway factor determinations are presented in Table 2.2-13.

Grass-Cow-Meat Pathway Factor

$$R_{aipj} = K' \frac{Q_F(U_{ap})}{\lambda_i + \lambda_w} F_f(r)(DFL_{ij})_a \left[\frac{f_p f_s}{Y_p} + \frac{(1-f_p f_s)e^{-\lambda_i t_h}}{Y_s}\right] e^{-\lambda_i t_f} \quad (19)$$

(m^2mrem/yr per μCi/sec)

where

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

Q_F = the cow's consumption rate, in kg/day (wet weight).

U_{ap} = the receptor's meat consumption rate for age group (a), in kg/yr from Table 2.2-10.

Y_p = the agricultural productivity by unit area of pasture feed grass, in kg/m^2.

Y_s = the agricultural productivity by unit area of stored feed, in kg/m^2.

F_f = The stable element transfer coefficients, in days/kg. (see Table 2.2-11.)

r = fraction of depc ited activity retained on feed grass. (1.0 for radioiodines; 0.2 for particulates)

$(DFL_{ij})_a$ = the organ ingestion dose factor for the ith radionuclide for the receptor in age group (a), in mrem/pCi from Tables 2.2-5 through 2.2-8.

λ_i = the decay constant for the ith radionuclide, in sec^{-1}.

λ_w = the decay constant for removal of activity on leaf and plant surfaces by weathering, 5.73×10^{-7} sec^{-1} (corresponding to a 14 day half-life).

t_f = the transport time from pasture to cow, to meat, to receptor, in sec. (1.73×10^6)

t_h = the transport time from pasture, to harvest, to cow, to meat, to receptor, in sec. (7.78×10^6)

f_p = fraction of the year that the cow is on pasture (dimensionless).

f_s = fraction of the cow feed that is pasture grass while the cow is on pasture (dimensionless).

For tritium in meat, the grass-cow-meat pathway factor is a special case due to the fact that the concentration of tritium in meat is based on airborne concentration rather than deposition:

$$R_{aipj} = K'K'''F_fQ_FU_{ap}(DFL_{ij})_a\ [0.75(0.5/H)]\ (\text{mrem/yr per } \mu Ci/m^3) \quad (20)$$

where:

K''' = a constant of unit conversion, 10^3 gm/kg.

H = absolute humidity of the atmosphere, in gm/m^3.

0.75 = the fraction of total feed that is water.

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

and other parameters and values are given above.

Vegetation Pathway Factor

$$R_{aipj} = K' \frac{r}{Y_v(\lambda_i + \lambda_w)} (DFL_{ij})_a \left[U_{a\ell} f_\ell e^{-\lambda_i t_\ell} + U_{as} f_g e^{-\lambda_i t_h} \right] \quad (21)$$

where

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

$U_{a\ell}$ = the consumption rate of fresh leafy vegetation by the receptor in age group a, in kg/year. (See Table 2.2-10))

U_{as} = the consumption rate of stored vegetation by the receptor in age group a, in kg/year. (See Table 2.2-10))

f_ℓ = the fraction of the annual intake of fresh leafy vegetation grown locally.

f_g = the fraction of the annual intake of stored vegetation grown locally.

t_ℓ = the average time between harvest of leafy vegetation and its consumption in seconds. (8.6×10^4)

t_h = the average time between harvest of stored vegetation and its consumption in seconds. (5.18×10^6)

Y_v = the vegetation areal density, in kg/m^2.

$(DFL_{ij})_a$ = the organ ingestion dose factor for the ith radionuclide for the receptor in age group (a), in mrem/pCi from Tables 2.2-5 through 2.2-8.

λ_i = the decay constant for the ith radionuclide, in sec^{-1}.

λ_w = the decay constant for removal of activity on leaf and plant surfaces by weathering, 5.73×10^{-7} sec^{-1} (corresponding to a 14 day half-life).

For tritium in vegetation, the vegetation pathway factor is a special case due to the fact that the concentration of tritium in vegetation is based on airborne concentration rather than deposition:

$$R_{aipj} = K'K'''(U_{a\ell} f_\ell + U_{as} f_g)\ (DFL_{ij})_a\ [0.75(0.5/H)]\ (\text{mrem/yr per } \mu Ci/m^3) \quad (22)$$

where

K''' = a constant of unit conversion, 10^3 gm/kg.

H = absolute humidity of the atmosphere, in gm/m^3.

0.75 = the fraction of total vegetation that is water.

0.5 = the ratio of the specific activity of the vegetation water to the atmospheric water.

and other parameters and values are given above.

Grass-Goat-Milk Pathway Factor

$$R_{aipj} = K' \frac{Q_F(U_{ap})}{\lambda_i + \lambda_w} F_m(r)(DFL_{ij})_a \left[\frac{f_p f_s}{Y_p} + \frac{(1-f_p f_s)e^{-\lambda_i t_h}}{Y_s} \right] e^{-\lambda_i t_f} \quad (23)$$

(m^2mrem/yr per μCi/sec)

where

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

Q_F = the goat's consumption rate, in kg/day (wet weight).

U_{ap} = the receptor's milk consumption rate for age group (a), in liters/yr from Table 2.2-10.

Y_p = the agricultural productivity by unit area of pasture feed grass, in kg/m^2.

Y_s = the agricultural productivity by unit area of stored feed, in kg/m^2.

F_m = the stable element transfer coefficients, in days/liter. (see Table 2.2-11.)

r = fraction of deposited activity retained on feed grass. (1.0 for radioiodines; 0.2 for particulates)

$(DFL_{ij})_a$ = the organ ingestion dose factor for the ith radionuclide for the receptor in age group (a), in mrem/pCi from Tables 2.2-5 through 2.2-8.

λ_i = the decay constant for the ith radionuclide, in sec^{-1}.

λ_w = the decay constant for removal of activity on leaf and plant surfaces by weathering, 5.73×10^{-7} sec^{-1} (corresponding to a 14 day half-life).

t_f = the transport time from pasture to goat, to milk, to receptor, in sec. (1.73×10^5)

t_h = the transport time from pasture, to harvest, to goat, to milk, to receptor, in sec. (7.78×10^6)

f_p = fraction of the year that the goat is on pasture (dimensionless).

f_s = fraction of the goat feed that is pasture grass while the goat is on pasture (dimensionless).

For tritium in milk, the grass-goat-milk pathway factor is a special case due to the fact that the concentration of tritium in milk is based on airborne concentration rather than deposition:

$$R_{aipj} = K'K'''F_m Q_F U_{ap} (DFL_{ij})_a \; [0.75(0.5/H)] \text{ (mrem/yr per } \mu\text{Ci/m}^3) \quad (24)$$

where:

K''' = a constant of unit conversion, 10^3 gm/kg.

H = absolute humidity of the atmosphere, in gm/m^3.

0.75 = the fraction of total feed that is water.

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

and other parameters and values are given above.

TABLE 2.2-1

INHALATION DOSE FACTORS FOR INFANT*

(MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07
C 14	1.89E-05	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06
NA 24	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06
P 32	1.45E-03	8.03E-05	5.53E-05	NO DATA	NO DATA	NO DATA	1.15E-05
CR 51	NO DATA	NO DATA	6.37E-08	4.11E-08	9.45E-09	9.17E-06	2.55E-07
MN 54	NO DATA	1.81E-05	3.56E-06	NO DATA	3.56E-06	7.14E-04	5.04E-06
MN 56	NO DATA	1.10E-09	1.58E-10	NO DATA	7.86E-10	8.95E-06	5.17E-05
FE 55	1.41E-05	8.39E-06	2.38E-06	NO DATA	NO DATA	6.21E-05	7.82E-07
FE 59	9.69E-06	1.68E-05	6.77E-06	NO DATA	NO DATA	7.25E-04	1.77E-05
CO 58	NO DATA	8.71E-07	1.30E-06	NO DATA	NO DATA	5.55E-04	7.95E-06
CO 60	NO DATA	5.73E-06	8.41E-06	NO DATA	NO DATA	3.22E-03	2.28E-05
NI 63	2.42E-04	1.46E-05	8.29E-06	NO DATA	NO DATA	1.49E-04	1.73E-06
NI 65	1.71E-09	2.03E-10	8.79E-11	NO DATA	NO DATA	5.80E-06	3.58E-05
CU 64	NO DATA	1.34E-09	5.53E-10	NO DATA	2.84E-09	6.64E-06	1.07E-05
ZN 65	1.38E-05	4.47E-05	2.22E-05	NO DATA	2.32E-05	4.62E-04	3.67E-05
ZN 69	3.85E-11	6.91E-11	5.13E-12	NO DATA	2.87E-11	1.05E-06	9.44E-06
BR 83	NO DATA	NO DATA	2.72E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	2.86E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	1.46E-08	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	1.36E-04	6.30E-05	NO DATA	NO DATA	NO DATA	2.17E-06
RB 88	NO DATA	3.98E-07	2.05E-07	NO DATA	NO DATA	NO DATA	2.42E-07
RB 89	NO DATA	2.29E-07	1.47E-07	NO DATA	NO DATA	NO DATA	4.87E-08
SR 89	2.84E-04	NO DATA	8.15E-06	NO DATA	NO DATA	1.45E-03	4.57E-05
SR 90	2.92E-02	NO DATA	1.85E-03	NO DATA	NO DATA	8.03E-03	9.36E-05
SR 91	6.83E-08	NO DATA	2.47E-09	NO DATA	NO DATA	3.76E-05	5.24E-05
SR 92	7.50E-09	NO DATA	2.79E-10	NO DATA	NO DATA	1.70E-05	1.00E-04
Y 90	2.35E-06	NO DATA	6.30E-08	NO DATA	NO DATA	1.92E-04	7.43E-05
Y 91M	2.91E-10	NO DATA	9.90E-12	NO DATA	NO DATA	1.99E-06	1.68E-06
Y 91	4.20E-04	NO DATA	1.12E-05	NO DATA	NO DATA	1.75E-03	5.02E-05
Y 92	1.17E-08	NO DATA	3.29E-10	NO DATA	NO DATA	1.75E-05	9.04E-05

* Reference 3, Table E-10.

TABLE 2.2-1 CONT'D

INHALATION DOSE FACTORS FOR INFANT*

(MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y 93	1.07E-07	NO DATA	2.91E-09	NO DATA	NO DATA	5.46E-05	1.19E-04
ZR 95	8.24E-05	1.99E-05	1.45E-05	NO DATA	2.22E-05	1.25E-03	1.55E-05
ZR 97	1.07E-07	1.83E-08	8.36E-09	NO DATA	1.85E-08	7.88E-05	1.00E-04
NB 95	1.12E-05	4.59E-06	2.70E-06	NO DATA	3.37E-06	3.42E-04	9.05E-06
MO 99	NO DATA	1.18E-07	2.31E-08	NO DATA	1.89E-07	9.63E-05	3.48E-05
TC 99M	9.98E-13	2.06E-12	2.66E-11	NO DATA	2.22E-11	5.79E-07	1.45E-06
TC101	4.65E-14	5.98E-14	5.80E-13	NO DATA	6.99E-13	4.17E-07	6.03E-07
RU103	1.44E-06	NO DATA	4.85E-07	NO DATA	3.03E-06	3.94E-04	1.15E-05
RU105	8.74E-10	NO DATA	2.93E-10	NO DATA	6.42E-10	1.12E-05	3.46E-05
RU106	6.20E-05	NO DATA	7.77E-06	NO DATA	7.61E-05	8.26E-03	1.17E-04
AG110M	7.13E-06	5.16E-06	3.57E-06	NO DATA	7.80E-06	2.62E-03	2.36E-05
TE125M	3.40E-06	1.42E-06	4.70E-07	1.16E-06	NO DATA	3.19E-04	9.22E-06
TE127M	1.19E-05	4.93E-06	1.48E-06	3.48E-06	2.68E-05	9.37E-04	1.95E-05
TE127	1.59E-09	6.81E-10	3.49E-10	1.32E-09	3.47E-09	7.39E-06	1.74E-05
TE129M	1.01E-05	4.35E-06	1.59E-06	3.91E-06	2.27E-05	1.20E-03	4.93E-05
TE129	5.63E-11	2.48E-11	1.34E-11	4.82E-11	1.25E-10	2.14E-06	1.88E-05
TE131M	7.62E-08	3.93E-08	2.59E-08	6.38E-08	1.89E-07	1.42E-04	8.51E-05
TE131	1.24E-11	5.87E-12	3.57E-12	1.13E-11	2.85E-11	1.47E-06	5.87E-06
TE132	2.66E-07	1.69E-07	1.26E-07	1.99E-07	7.39E-07	2.43E-04	3.15E-05
I 130	4.54E-06	9.91E-06	3.98E-06	1.14E-03	1.09E-05	NO DATA	1.42E-06
I 131	2.71E-05	3.17E-05	1.40E-05	1.06E-02	3.70E-05	NO DATA	7.56E-07
I 132	1.21E-06	2.53E-06	8.99E-07	1.21E-04	2.82E-06	NO DATA	1.36E-06
I 133	9.46E-06	1.37E-05	4.00E-06	2.54E-03	1.60E-05	NO DATA	1.54E-06
I 134	6.58E-07	1.34E-06	4.75E-07	3.18E-05	1.49E-06	NO DATA	9.21E-07
I 135	2.76E-06	5.43E-06	1.98E-06	4.97E-04	6.05E-06	NO DATA	1.31E-06
CS134	2.83E-04	5.02E-04	5.32E-05	NO DATA	1.36E-04	5.69E-05	9.53E-07
CS136	3.45E-05	9.61E-05	3.78E-05	NO DATA	4.03E-05	8.40E-06	1.02E-06
CS137	3.92E-04	4.37E-04	3.25E-05	NO DATA	1.23E-04	5.09E-05	9.53E-07
CS138	3.61E-07	5.58E-07	2.84E-07	NO DATA	2.93E-07	4.67E-08	6.26E-07
BA139	1.06E-09	7.03E-13	3.07E-11	NO DATA	4.73E-13	4.25E-06	3.64E-05

TABLE 2.2-1 CONT'D

INHALATION DOSE FACTORS FOR INFANT*

(MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA140	4.00E-05	4.00E-08	2.07E-06	NO DATA	9.59E-09	1.14E-03	2.74E-05
BA141	1.12E-10	7.70E-14	3.55E-12	NO DATA	4.64E-14	2.12E-06	3.39E-06
BA142	2.84E-11	2.36E-14	1.40E-12	NO DATA	1.36E-14	1.11E-06	4.95E-07
LA140	3.61E-07	1.43E-07	3.68E-08	NO DATA	NO DATA	1.20E-04	6.06E-05
LA142	7.36E-10	2.69E-10	6.46E-11	NO DATA	NO DATA	5.87E-06	4.25E-05
CE141	1.78E-05	1.19E-05	1.42E-06	NO DATA	3.75E-06	3.69E-04	1.54E-05
CE143	2.09E-07	1.38E-07	1.59E-08	NO DATA	4.03E-08	8.30E-05	3.55E-05
CE144	2.28E-03	8.65E-04	1.26E-04	NO DATA	3.84E-04	7.03E-03	1.06E-04
PR143	1.00E-05	3.74E-06	4.97E-07	NO DATA	1.41E-06	3.09E-04	2.66E-05
PR144	3.42E-11	1.32E-11	1.72E-12	NO DATA	4.80E-12	1.15E-06	3.06E-06
ND147	5.67E-06	5.81E-06	3.57E-07	NO DATA	2.25E-06	2.30E-04	2.23E-05
W 187	9.26E-09	6.44E-09	2.23E-09	NO DATA	NO DATA	2.83E-05	2.54E-05
NP239	2.65E-07	2.37E-08	1.34E-08	NO DATA	4.73E-08	4.25E-05	1.78E-05

TABLE 2.2-2

INHALATION DOSE FACTORS FOR CHILD*

(MREM PER PCI INHALED)

Page 1 of 3

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07
C 14	9.70E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06
NA 24	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06
P 32	7.04E-04	3.09E-05	2.67E-05	NO DATA	NO DATA	NO DATA	1.14E-05
CR 51	NO DATA	NO DATA	4.17E-08	2.31E-08	6.57E-09	4.59E-06	2.93E-07
MN 54	NO DATA	1.16E-05	2.57E-06	NO DATA	2.71E-06	4.26E-04	6.19E-06
MN 56	NO DATA	4.48E-10	8.43E-11	NO DATA	4.52E-10	3.55E-06	3.33E-05
FE 55	1.28E-05	6.80E-06	2.10E-06	NO DATA	NO DATA	3.00E-05	7.75E-07
FE 59	5.59E-06	9.04E-06	4.51E-06	NO DATA	NO DATA	3.43E-04	1.91E-05
CO 58	NO DATA	4.77E-07	8.55E-07	NO DATA	NO DATA	2.99E-04	9.29E-06
CO 60	NO DATA	3.55E-06	6.12E-06	NO DATA	NO DATA	1.91E-03	2.60E-05
NI 63	2.22E-04	1.25E-05	7.56E-06	NO DATA	NO DATA	7.43E-05	1.71E-06
NI 65	8.08E-10	7.99E-11	4.44E-11	NO DATA	NO DATA	2.21E-06	2.27E-05
CU 64	NO DATA	5.39E-10	2.90E-10	NO DATA	1.63E-09	2.59E-06	9.92E-06
ZN 65	1.15E-05	3.06E-05	1.90E-05	NO DATA	1.93E-05	2.69E-04	4.41E-06
ZN 69	1.81E-11	2.61E-11	2.41E-12	NO DATA	1.58E-11	3.84E-07	2.75E-06
BR 83	NO DATA	NO DATA	1.28E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	1.48E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	6.84E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	5.36E-05	3.09E-05	NO DATA	NO DATA	NO DATA	2.16E-06
RB 88	NO DATA	1.52E-07	9.90E-08	NO DATA	NO DATA	NO DATA	4.66E-09
RB 89	NO DATA	9.33E-08	7.83E-08	NO DATA	NO DATA	NO DATA	5.11E-10
SR 89	1.62E-04	NO DATA	4.66E-06	NO DATA	NO DATA	5.83E-04	4.52E-05
SR 90	2.73E-02	NO DATA	1.74E-03	NO DATA	NO DATA	3.99E-03	9.28E-05
SR 91	3.28E-08	NO DATA	1.24E-09	NO DATA	NO DATA	1.44E-05	4.70E-05
SR 92	3.54E-09	NO DATA	1.42E-10	NO DATA	NO DATA	6.49E-06	6.55E-05
Y 90	1.11E-06	NO DATA	2.99E-08	NO DATA	NO DATA	7.07E-05	7.24E-05
Y 91M	1.37E-10	NO DATA	4.98E-12	NO DATA	NO DATA	7.60E-07	4.64E-07
Y 91	2.47E-04	NO DATA	6.59E-06	NO DATA	NO DATA	7.10E-04	4.97E-05
Y 92	5.50E-09	NO DATA	1.57E-10	NO DATA	NO DATA	6.46E-05	6.46E-05

* Reference 3, Table E-9.

TABLE 2.2-2 CONT'D

INHALATION DOSE FACTORS FOR CHILD*

(MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y 93	5.04E-08	NO DATA	1.38E-09	NO DATA	NO DATA	2.01E-05	1.05E-04
ZR 95	5.13E-05	1.13E-05	1.00E-05	NO DATA	1.61E-05	6.03E-04	1.65E-05
ZR 97	5.07E-08	7.34E-09	4.32E-09	NO DATA	1.05E-08	3.06E-05	9.49E-05
NB 95	6.35E-06	2.48E-06	1.77E-06	NO DATA	2.33E-06	1.66E-04	1.00E-05
MO 99	NO DATA	4.66E-08	1.15E-08	NO DATA	1.06E-07	3.66E-05	3.42E-05
TC 99M	4.81E-13	9.41E-13	1.56E-11	NO DATA	1.37E-11	2.57E-07	1.30E-06
TC101	2.19E-14	2.30E-14	2.91E-13	NO DATA	3.97E-13	1.58E-07	4.41E-09
RU103	7.55E-07	NO DATA	2.90E-07	NO DATA	1.90E-06	1.79E-04	1.21E-05
RU105	4.13E-10	NO DATA	1.50E-10	NO DATA	3.63E-10	4.30E-06	2.69E-05
RU106	3.68E-05	NO DATA	4.57E-06	NO DATA	4.97E-05	3.87E-03	1.16E-04
AG110M	4.56E-06	3.08E-06	2.47E-06	NO DATA	5.74E-06	1.48E-03	2.71E-05
TE125M	1.82E-06	6.29E-07	2.47E-07	5.20E-07	NO DATA	1.29E-04	9.13E-06
TE127M	6.72E-06	2.31E-06	8.16E-07	1.64E-06	1.72E-05	4.00E-04	1.93E-05
TE127	7.49E-10	2.57E-10	1.65E-10	5.30E-10	1.91E-09	2.71E-06	1.52E-05
TE129M	5.19E-06	1.85E-06	8.22E-07	1.71E-06	1.36E-05	4.76E-04	4.91E-05
TE129	2.64E-11	9.45E-12	6.44E-12	1.93E-11	6.94E-11	7.93E-07	6.89E-06
TE131M	3.63E-08	1.60E-08	1.37E-08	2.64E-08	1.08E-07	5.56E-05	8.32E-05
TE131	5.87E-12	2.28E-12	1.78E-12	4.59E-12	1.59E-11	5.55E-07	3.60E-07
TE132	1.30E-07	7.36E-08	7.12E-08	8.58E-08	4.79E-07	1.02E-04	3.72E-05
I 130	2.21E-06	4.43E-06	2.28E-06	4.99E-04	6.61E-06	NO DATA	1.38E-06
I 131	[illegible]0E-05	1.30E-05	7.37E-06	4.39E-03	2.13E-05	NO DATA	7.68E-07
I 132	5.72E-07	1.10E-06	5.07E-07	5.23E-05	1.69E-06	NO DATA	8.65E-07
I 133	4.48E-06	5.49E-06	2.08E-06	1.04E-03	9.13E-06	NO DATA	1.48E-06
I 134	3.17E-07	5.84E-07	2.69E-07	1.37E-05	8.92E-07	NO DATA	2.58E-07
I 135	1.33E-06	2.36E-06	1.12E-06	2.14E-04	3.62E-06	NO DATA	1.20E-06
CS134	1.76E-04	2.74E-04	6.07E-05	NO DATA	8.93E-05	3.27E-05	1.04E-06
CS136	1.76E-05	4.62E-05	3.14E-05	NO DATA	2.58E-05	3.93E-06	1.13E-06
CS137	2.45E-04	2.23E-04	3.47E-05	NO DATA	7.63E-05	2.81E-05	9.78E-07
CS138	1.71E-07	2.27E-07	1.50E-07	NO DATA	1.68E-07	1.84E-08	7.29E-08
BA139	4.98E-10	2.66E-13	1.45E-11	NO DATA	2.33E-13	1.56E-06	1.56E-05

TABLE 2.2-2 CONT'D

INHALATION DOSE FACTORS FOR CHILD*

(MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA140	2.00E-05	1.75E-08	1.17E-06	NO DATA	5.71E-09	4.71E-04	2.75E-05
BA141	5.29E-11	2.95E-14	1.72E-12	NO DATA	2.56E-14	7.89E-07	7.44E-08
BA142	1.35E-11	9.73E-15	7.54E-13	NO DATA	7.87E-15	4.44E-07	7.41E-10
LA140	1.74E-07	6.08E-08	2.04E-08	NO DATA	NO DATA	4.94E-05	6.10E-05
LA142	3.50E-10	1.11E-10	3.49E-11	NO DATA	NO DATA	2.35E-06	2.05E-05
CE141	1.06E-05	5.28E-06	7.83E-07	NO DATA	2.31E-06	1.47E-04	1.53E-05
CE143	9.89E-08	5.37E-06	7.77E-09	NO DATA	2.26E-08	3.12E-05	3.44E-05
CE144	1.83E-03	5.72E-04	9.77E-05	NO DATA	3.17E-04	3.23E-03	1.05E-04
PR143	4.99E-06	1.50E-06	2.47E-07	NO DATA	8.11E-07	1.17E-04	2.63E-05
PR144	1.61E-11	4.99E-12	8.10E-13	NO DATA	2.64E-12	4.23E-07	5.32E-08
ND147	2.92E-06	2.36E-06	1.84E-07	NO DATA	1.30E-06	8.87E-05	2.22E-05
W 187	4.41E-09	2.61E-09	1.17E-09	NO DATA	NO DATA	1.11E-05	2.46E-05
NP239	1.26E-07	9.04E-09	6.35E-09	NO DATA	2.63E-08	1.57E-05	1.73E-05

TABLE 2.2-3

INHALATION DOSE FACTORS FOR TEENAGER*

(MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07
C 14	3.25E-06	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07
NA 24	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06
P 32	2.36E-04	1.37E-05	8.95E-06	NO DATA	NO DATA	NO DATA	1.16E-05
CR 51	NO DATA	NO DATA	1.69E-08	9.37E-09	3.84E-09	2.62E-06	3.75E-07
MN 54	NO DATA	6.37E-06	1.05E-06	NO DATA	1.59E-06	2.48E-04	8.35E-06
MN 56	NO DATA	2.12E-10	3.15E-11	NO DATA	2.24E-10	1.90E-06	7.18E-06
FE 55	4.18E-06	2.98E-06	6.93E-07	NO DATA	NO DATA	1.55E-05	7.99E-07
FE 59	1.79E-06	4.62E-06	1.79E-06	NO DATA	NO DATA	1.91E-04	2.23E-05
CO 58	NO DATA	2.59E-07	3.47E-07	NO DATA	NO DATA	1.68E-04	1.19E-05
CO 60	NO DATA	1.87E-06	2.48E-06	NO DATA	NO DATA	1.09E-03	3.24E-05
NI 63	7.25E-05	5.43E-06	2.47E-06	NO DATA	NO DATA	3.84E-05	1.77E-06
NI 65	2.73E-10	3.66E-11	1.59E-11	NO DATA	NO DATA	1.17E-06	4.59E-06
CU 64	NO DATA	2.54E-10	1.06E-10	NO DATA	8.01E-10	1.39E-06	7.68E-06
ZN 65	4.82E-06	1.67E-05	7.80E-06	NO DATA	1.08E-05	1.55E-04	5.83E-06
ZN 69	6.04E-12	1.15E-11	8.07E-13	NO DATA	7.53E-12	1.98E-07	3.56E-08
BR 83	NO DATA	NO DATA	4.30E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	5.41E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	2.29E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	2.38E-05	1.05E-05	NO DATA	NO DATA	NO DATA	2.21E-06
RB 88	NO DATA	6.82E-08	3.40E-08	NO DATA	NO DATA	NO DATA	3.65E-15
RB 89	NO DATA	4.40E-08	2.91E-08	NO DATA	NO DATA	NO DATA	4.22E-17
SR 89	5.43E-05	NO DATA	1.56E-06	NO DATA	NO DATA	3.02E-04	4.64E-05
SR 90	1.35E-02	NO DATA	8.35E-04	NO DATA	NO DATA	2.06E-03	9.56E-05
SR 91	1.10E-08	NO DATA	4.39E-10	NO DATA	NO DATA	7.59E-06	3.24E-05
SR 92	1.19E-09	NO DATA	5.08E-11	NO DATA	NO DATA	3.43E-06	1.49E-05
Y 90	3.73E-07	NO DATA	1.00E-08	NO DATA	NO DATA	3.66E-05	6.99E-05
Y 91M	4.63E-11	NO DATA	1.77E-12	NO DATA	NO DATA	4.00E-07	3.77E-09
Y 91	8.26E-05	NO DATA	2.21E-06	NO DATA	NO DATA	3.67E-04	5.11E-05
Y 92	1.84E-09	NO DATA	5.36E-11	NO DATA	NO DATA	3.35E-06	2.06E-05

* Reference 3, Table E-8.

TABLE 2.2-3 CONT'D

INHALATION DOSE FACTORS FOR TEENAGER*

(MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y 93	1.69E-08	NO DATA	4.65E-10	NO DATA	NO DATA	1.04E-05	7.24E-05
ZR 95	1.82E-05	5.73E-06	3.94E-06	NO DATA	8.42E-06	3.36E-04	1.86E-05
ZR 97	1.72E-08	3.40E-09	1.57E-09	NO DATA	5.15E-09	1.62E-05	7.88E-05
NB 95	2.32E-06	1.29E-06	7.08E-07	NO DATA	1.25E-06	9.39E-05	1.21E-05
MO 99	NO DATA	2.11E-08	4.03E-09	NO DATA	5.14E-08	1.92E-05	3.36E-05
TC 99M	1.73E-13	4.83E-13	6.24E-12	NO DATA	7.20E-12	1.44E-07	7.66E-07
TC101	7.40E-15	1.05E-14	1.03E-13	NO DATA	1.90E-13	8.34E-08	1.09E-16
RU103	2.63E-07	NO DATA	1.12E-07	NO DATA	9.29E-07	9.79E-05	1.36E-05
RU105	1.40E-10	NO DATA	5.42E-11	NO DATA	1.76E-10	2.27E-06	1.13E-05
RU106	1.23E-05	NO DATA	1.55E-06	NO DATA	2.38E-05	2.01E-03	1.20E-04
AG110M	1.73E-06	1.64E-06	9.99E-07	NO DATA	3.13E-06	8.44E-04	3.41E-05
TE125M	6.10E-07	2.80E-07	8.34E-08	1.75E-07	NO DATA	6.70E-05	9.38E-06
TE127M	2.25E-06	1.02E-06	2.73E-07	5.48E-07	8.17E-06	2.07E-04	1.99E-05
TE127	2.51E-10	1.14E-10	5.52E-11	1.77E-10	9.10E-10	1.40E-06	1.01E-05
TE129M	1.74E-06	8.23E-07	2.81E-07	5.72E-07	6.49E-06	2.47E-04	5.06E-05
TE129	8.87E-12	4.22E-12	2.20E-12	6.48E-12	3.32E-11	4.12E-07	2.02E-07
TE131M	1.23E-08	7.51E-09	5.03E-09	9.06E-09	5.49E-08	2.97E-05	7.76E-05
TE131	1.97E-12	1.04E-12	6.30E-13	1.55E-12	7.72E-12	2.92E-07	1.89E-09
TE132	4.50E-08	3.63E-08	2.74E-08	3.07E-08	2.44E-07	5.61E-05	5.79E-05
I 130	7.80E-07	2.24E-06	8.96E-07	1.86E-04	3.44E-06	NO DATA	1.14E-06
I 131	4.43E-06	6.14E-06	3.30E-06	1.83E-03	1.05E-05	NO DATA	8.11E-07
I 132	1.99E-07	5.47E-07	1.97E-07	1.89E-05	8.65E-07	NO DATA	1.59E-07
I 133	1.52E-06	2.56E-06	7.78E-07	3.65E-04	4.49E-06	NO DATA	1.29E-06
I 134	1.11E-07	2.90E-07	1.05E-07	4.94E-06	4.58E-07	NO DATA	2.55E-09
I 135	4.62E-07	1.18E-06	4.36E-07	7.76E-05	1.86E-06	NO DATA	8.69E-07
CS134	6.28E-05	1.41E-04	6.86E-05	NO DATA	4.69E-05	1.83E-05	1.22E-06
CS136	6.44E-06	2.42E-05	1.71E-05	NO DATA	1.38E-05	2.22E-06	1.36E-06
CS137	8.38E-05	1.06E-04	3.89E-05	NO DATA	3.80E-05	1.51E-05	1.06E-06
CS138	5.82E-08	1.07E-07	5.58E-08	NO DATA	8.28E-08	9.84E-09	3.38E-11
BA139	1.67E-10	1.18E-13	4.87E-12	NO DATA	1.11E-13	8.08E-07	8.06E-07

TABLE 2.2-3 CONT'D

INHALATION DOSE FACTORS FOR TEENAGER*

(MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA140	6.84E-06	8.38E-09	4.40E-07	NO DATA	2.85E-09	2.54E-04	2.86E-05
BA141	1.78E-11	1.32E-14	5.93E-13	NO DATA	1.23E-14	4.11E-07	9.33E-14
BA142	4.62E-12	4.63E-15	2.84E-13	NO DATA	3.92E-15	2.39E-07	5.99E-20
LA140	5.99E-08	2.95E-08	7.82E-09	NO DATA	NO DATA	2.68E-05	6.09E-05
LA142	1.20E-10	5.31E-11	1.32E-11	NO DATA	NO DATA	1.27E-06	1.50E-06
CE141	3.55E-06	2.37E-06	2.71E-07	NO DATA	1.11E-06	7.67E-05	1.58E-05
CE143	3.32E-08	2.42E-08	2.70E-09	NO DATA	1.08E-08	1.63E-05	3.19E-05
CE144	6.11E-04	2.53E-04	3.28E-05	NO DATA	1.51E-04	1.67E-03	1.08E-04
PR143	1.67E-06	6.64E-07	8.28E-08	NO DATA	3.86E-07	6.04E-05	2.67E-05
PR144	5.37E-12	2.20E-12	2.72E-13	NO DATA	1.26E-12	2.19E-07	2.94E-14
ND147	9.83E-07	1.07E-06	6.41E-08	NO DATA	6.29E-07	4.65E-05	2.28E-05
W 187	1.50E-09	1.22E-09	4.29E-10	NO DATA	NO DATA	5.92E-06	2.21E-05
NP239	4.23E-08	3.99E-09	2.21E-0[illegible]	NO DATA	1.25E-08	8.11E-06	1.65E-05

TABLE 2.2-4

INHALATION DOSE FACTORS FOR ADULTS*

(MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07
C 14	2.27E-06	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07
NA 24	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06
P 32	1.65E-04	9.64E-06	6.26E-06	NO DATA	NO DATA	NO DATA	1.08E-05
CR 51	NO DATA	NO DATA	1.25E-08	7.44E-09	2.85E-09	1.80E-06	4.15E-07
MN 54	NO DATA	4.95E-06	7.87E-07	NO DATA	1.23E-06	1.75E-04	9.67E-06
MN 56	NO DATA	1.55E-10	2.29E-11	NO DATA	1.63E-10	1.18E-06	2.53E-06
FE 55	3.07E-06	2.12E-06	4.93E-07	NO DATA	NO DATA	9.01E-06	7.54E-07
FE 59	1.47E-06	3.47E-06	1.32E-06	NO DATA	NO DATA	1.27E-04	2.35E-05
CO 58	NO DATA	1.98E-07	2.59E-07	NO DATA	NO DATA	1.16E-04	1.33E-05
CO 60	NO DATA	1.44E-06	1.85E-06	NO DATA	NO DATA	7.46E-04	3.56E-05
NI 63	5.40E-05	3.93E-06	1.81E-06	NO DATA	NO DATA	2.23E-05	1.67E-06
NI 65	1.92E-10	2.62E-11	1.14E-11	NO DATA	NO DATA	7.00E-07	1.54E-06
CU 64	NO DATA	1.83E-10	7.69E-11	NO DATA	5.78E-10	8.48E-07	6.12E-06
ZN 65	4.05E-06	1.29E-05	5.82E-06	NO DATA	8.62E-06	1.08E-04	6.68E-06
ZN 69	4.23E-12	8.14E-12	5.65E-13	NO DATA	5.27E-12	1.15E-07	2.04E-09
BR 83	NO DATA	NO DATA	3.01E-08	NO DATA	NO DATA	NO DATA	2.90E-08
BR 84	NO DATA	NO DATA	3.91E-08	NO DATA	NO DATA	NO DATA	2.05E-13
BR 85	NO DATA	NO DATA	1.60E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	1.69E-05	7.37E-06	NO DATA	NO DATA	NO DATA	2.08E-06
RB 88	NO DATA	4.84E-08	2.41E-08	NO DATA	NO DATA	NO DATA	4.18E-19
RB 89	NO DATA	3.20E-08	2.12E-08	NO DATA	NO DATA	NO DATA	1.16E-21
SR 89	3.80E-05	NO DATA	1.07E-06	NO DATA	NO DATA	1.75E-04	4.37E-05
SR 90	1.24E-02	NO DATA	7.62E-04	NO DATA	NO DATA	1.20E-03	9.02E-05
SR 91	7.74E-09	NO DATA	3.13E-10	NO DATA	NO DATA	4.56E-06	2.39E-05
SR 92	8.43E-10	NO DATA	3.64E-11	NO DATA	NO DATA	2.06E-06	5.38E-06
Y 90	2.61E-07	NO DATA	7.01E-09	NO DATA	NO DATA	2.12E-05	6.32E-05
Y 91M	3.26E-11	NO DATA	1.27E-12	NO DATA	NO DATA	2.40E-07	1.66E-10
Y 91	5.78E-05	NO DATA	1.55E-06	NO DATA	NO DATA	2.13E-04	4.81E-05
Y 92	1.29E-09	NO DATA	3.77E-11	NO DATA	NO DATA	1.96E-06	9.19E-06

* Reference 3, Table E-7.

TABLE 2.2-4 CONT'D

INHALATION DOSE FACTORS FOR ADULTS*

(MREM PER PCI INHALED)

Page 2 of 3

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y 93	1.18E-08	NO DATA	3.26E-10	NO DATA	NO DATA	6.06E-06	5.27E-05
ZR 95	1.34E-05	4.30E-06	2.91E-06	NO DATA	6.77E-06	2.21E-04	1.88E-05
ZR 97	1.21E-08	2.45E-09	1.13E-09	NO DATA	3.71E-09	9.84E-06	6.54E-05
NB 95	1.76E-06	9.77E-07	5.26E-07	NO DATA	9.67E-07	6.31E-05	1.30E-05
MO 99	NO DATA	1.51E-08	2.87E-09	NO DATA	3.64E-08	1.14E-05	3.10E-05
TC 99M	1.29E-13	3.64E-13	4.63E-12	NO DATA	5.52E-12	9.55E-08	5.20E-07
TC101	5.22E-15	7.52E-15	7.38E-14	NO DATA	1.35E-13	4.99E-08	1.36E-21
RU103	1.91E-07	NO DATA	8.23E-08	NO DATA	7.29E-07	6.31E-05	1.38E-05
RU105	9.88E-11	NO DATA	3.89E-11	NO DATA	1.27E-10	1.37E-06	6.02E-06
RU106	8.64E-06	NO DATA	1.09E-06	NO DATA	1.67E-05	1.17E-03	1.14E-04
AG110M	1.35E-06	1.25E-06	7.43E-07	NO DATA	2.46E-06	5.79E-04	3.78E-05
TE125M	4.27E-07	1.98E-07	5.84E-08	1.31E-07	1.55E-06	3.92E-05	8.83E-06
TE127M	1.58E-06	7.21E-07	1.96E-07	4.11E-07	5.72E-06	1.20E-04	1.87E-05
TE127	1.75E-10	8.03E-11	3.87E-11	1.32E-10	6.37E-10	8.14E-07	7.17E-06
TE129M	1.22E-06	5.64E-07	1.98E-07	4.30E-07	4.57E-06	1.45E-04	4.79E-05
TE129	6.22E-12	2.99E-12	1.55E-12	4.87E-12	2.34E-11	2.42E-07	1.96E-08
TE131M	8.74E-09	5.45E-09	3.63E-09	6.88E-09	3.86E-08	1.82E-05	6.95E-05
TE131	1.39E-12	7.44E-13	4.49E-13	1.17E-12	5.46E-12	1.74E-07	2.30E-09
TE132	3.25E-08	2.69E-08	2.02E-08	2.37E-08	1.82E-07	3.60E-05	6.37E-05
I 130	5.72E-07	1.68E-06	6.60E-07	1.42E-04	2.61E-06	NO DATA	9.61E-07
I 131	3.15E-06	4.47E-06	2.56E-06	1.49E-03	7.66E-06	NO DATA	7.85E-07
I 132	1.45E-07	4.07E-07	1.45E-07	1.43E-05	6.48E-07	NO DATA	5.08E-08
I 133	1.08E-06	1.85E-06	5.65E-07	2.69E-04	3.23E-06	NO DATA	1.11E-06
I 134	8.05E-08	2.16E-07	7.69E-08	3.73E-06	3.44E-07	NO DATA	1.26E-10
I 135	3.35E-07	8.73E-07	3.21E-07	5.60E-05	1.39E-06	NO DATA	6.56E-07
CS134	4.66E-05	1.06E-04	9.10E-05	NO DATA	3.59E-05	1.22E-05	1.30E-06
CS136	4.88E-06	1.83E-05	1.38E-05	NO DATA	1.07E-05	1.50E-06	1.46E-06
CS137	5.98E-05	7.76E-05	5.35E-05	NO DATA	2.78E-05	9.40E-06	1.05E-06
CS138	4.14E-08	7.76E-08	4.05E-08	NO DATA	6.00E-08	6.07E-09	2.33E-13
BA139	1.17E-10	8.32E-14	3.42E-12	NO DATA	7.78E-14	4.70E-07	1.12E-07

TABLE 2.2-4 CONT'D

INHALATION DOSE FACTORS FOR ADULTS*

(MREM PER PCI INHALED)

Page 3 of 3

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA140	4.88E-06	6.13E-09	3.21E-07	NO DATA	2.09E-09	1.59E-04	2.73E-05
BA141	1.25E-11	9.41E-15	4.20E-13	NO DATA	8.75E-15	2.42E-07	1.45E-17
BA142	3.29E-12	3.38E-15	2.07E-13	NO DATA	2.86E-15	1.49E-07	1.96E-26
LA140	4.30E-08	2.17E-08	5.73E-09	NO DATA	NO DATA	1.70E-05	5.73E-05
LA142	8.54E-11	3.88E-11	9.65E-12	NO DATA	NO DATA	7.91E-07	2.64E-07
CE141	2.49E-06	1.69E-06	1.91E-07	NO DATA	7.83E-07	4.52E-05	1.50E-05
CE143	2.33E-08	1.72E-08	1.91E-09	NO DATA	7.60E-09	9.97E-06	2.83E-05
CE144	4.29E-04	1.79E-04	2.30E-05	NO DATA	1.06E-04	9.72E-04	1.02E-04
PR143	1.17E-06	4.69E-07	5.80E-08	NO DATA	2.70E-07	3.51E-05	2.50E-05
PR144	3.76E-12	1.56E-12	1.91E-13	NO DATA	8.81E-13	1.27E-07	2.69E-18
ND147	6.59E-07	7.62E-07	4.56E-08	NO DATA	4.45E-07	2.76E-05	2.16E-05
W 187	1.06E-09	8.85E-10	3.10E-10	NO DATA	NO DATA	3.63E-06	1.94E-05
NP239	2.87E-08	2.82E-09	1.55E-09	NO DATA	8.75E-09	4.70E-06	1.49E-05

TABLE 2.2-5

INGESTION DOSE FACTORS FOR INFANT*

(MREM PER PCI INGESTED)

Page 1 of 3

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07
C 14	2.37E-05	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06
NA 24	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05
P 32	1.70E-03	1.00E-04	6.59E-05	NO DATA	NO DATA	NO DATA	2.30E-05
CR 51	NO DATA	NO DATA	1.41E-08	9.20E-09	2.01E-09	1.79E-08	4.11E-07
MN 54	NO DATA	1.99E-05	4.51E-06	NO DATA	4.41E-06	NO DATA	7.31E-06
MN 56	NO DATA	8.18E-07	1.41E-07	NO DATA	7.03E-07	NO DATA	7.43E-05
FE 55	1.39E-05	8.98E-06	2.40E-06	NO DATA	NO DATA	4.39E-06	1.14E-06
FE 59	3.08E-05	5.38E-05	2.12E-05	NO DATA	NO DATA	1.59E-05	2.57E-05
CO 58	NO DATA	3.60E-06	8.98E-06	NO DATA	NO DATA	NO DATA	8.97E-06
CO 60	NO DATA	1.08E-05	2.55E-05	NO DATA	NO DATA	NO DATA	2.57E-05
NI 63	6.34E-04	3.92E-05	2.20E-05	NO DATA	NO DATA	NO DATA	1.95E-06
NI 65	4.70E-06	5.32E-07	2.42E-07	NO DATA	NO DATA	NO DATA	4.05E-05
CU 64	NO DATA	6.09E-07	2.82E-07	NO DATA	1.03E-06	NO DATA	1.25E-05
ZN 65	1.34E-05	6.31E-05	2.91E-05	NO DATA	3.06E-05	NO DATA	5.33E-05
ZN 69	9.33E-08	1.68E-07	1.25E-08	NO DATA	6.98E-08	NO DATA	1.37E-05
BR 83	NO DATA	NO DATA	3.63E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	3.82E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	1.94E-08	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	1.70E-04	8.40E-05	NO DATA	NO DATA	NO DATA	4.35E-06
RB 88	NO DATA	4.98E-07	2.73E-07	NO DATA	NO DATA	NO DATA	4.85E-07
RB 89	NO DATA	2.86E-07	1.97E-07	NO DATA	NO DATA	NO DATA	9.74E-08
SR 89	2.51E-03	NO DATA	7.20E-05	NO DATA	NO DATA	NO DATA	5.16E-05
SR 90	1.85E-02	NO DATA	4.71E-03	NO DATA	NO DATA	NO DATA	2.31E-04
SR 91	5.00E-05	NO DATA	1.81E-06	NO DATA	NO DATA	NO DATA	5.92E-05
SR 92	1.92E-05	NO DATA	7.13E-07	NO DATA	NO DATA	NO DATA	2.07E-04
Y 90	8.69E-08	NO DATA	2.33E-09	NO DATA	NO DATA	NO DATA	1.20E-04
Y 91M	8.10E-10	NO DATA	2.76E-11	NO DATA	NO DATA	NO DATA	2.70E-06
Y 91	1.13E-06	NO DATA	3.01E-08	NO DATA	NO DATA	NO DATA	8.10E-05
Y 92	7.65E-09	NO DATA	2.15E-10	NO DATA	NO DATA	NO DATA	1.46E-04

* Reference 3, Table E-14.

TABLE 2.2-5 CONT'D

INGESTION DOSE FACTORS FOR INFANT*

(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y 93	2.43E-08	NO DATA	6.62E-10	NO DATA	NO DATA	NO DATA	1.92E-04
ZR 95	2.06E-07	5.02E-08	3.56E-08	NO DATA	5.41E-08	NO DATA	2.50E-05
ZR 97	1.48E-08	2.54E-09	1.16E-09	NO DATA	2.56E-09	NO DATA	1.62E-04
NB 95	4.20E-08	1.73E-08	1.00E-08	NO DATA	1.74E-08	NO DATA	1.46E-05
MO 99	NO DATA	3.40E-05	6.63E-06	NO DATA	5.08E-05	NO DATA	1.12E-05
TC 99M	1.92E-09	3.96E-09	5.10E-08	NO DATA	4.26E-08	2.07E-09	1.15E-06
TC101	2.27E-09	2.86E-09	2.83E-08	NO DATA	3.40E-08	1.56E-09	4.86E-07
RU103	1.48E-06	NO DATA	4.95E-07	NO DATA	3.08E-06	NO DATA	1.80E-05
RU105	1.36E-07	NO DATA	4.58E-08	NO DATA	1.00E-06	NO DATA	5.41E-05
RU106	2.41E-05	NO DATA	3.01E-06	NO DATA	2.85E-05	NO DATA	1.83E-04
AG110M	9.96E-07	7.27E-07	4.81E-07	NO DATA	1.04E-06	NO DATA	3.77E-05
TE125M	2.33E-05	7.79E-06	3.15E-06	7.84E-06	NO DATA	NO DATA	1.11E-05
TE127M	5.85E-05	1.94E-05	7.08E-06	1.69E-05	1.44E-04	NO DATA	2.36E-05
TE127	1.00E-06	3.35E-07	2.15E-07	8.14E-07	2.44E-06	NO DATA	2.10E-05
TE129M	1.00E-04	3.43E-05	1.54E-05	3.84E-05	2.50E-04	NO DATA	5.97E-05
TE129	2.84E-07	9.79E-08	6.63E-08	2.38E-07	7.07E-07	NO DATA	2.27E-05
TE131M	1.52E-05	6.12E-06	5.05E-06	1.24E-05	4.21E-05	NO DATA	1.03E-04
TE131	1.76E-07	6.50E-08	4.94E-08	1.57E-07	4.50E-07	NO DATA	7.11E-06
TE132	2.08E-05	1.03E-05	9.61E-06	1.52E-05	6.44E-05	NO DATA	3.81E-05
I 130	6.00E-06	1.32E-05	5.30E-06	1.48E-03	1.45E-05	NO DATA	2.83E-06
I 131	3.59E-05	4.23E-05	1.86E-05	1.39E-02	4.94E-05	NO DATA	1.51E-06
I 132	1.66E-06	3.37E-06	1.20E-06	1.58E-04	3.76E-06	NO DATA	2.73E-06
I 133	1.25E-05	1.82E-05	5.33E-06	3.31E-03	2.14E-05	NO DATA	3.08E-06
I 134	8.69E-07	1.78E-06	6.33E-07	4.15E-05	1.99E-06	NO DATA	1.84E-06
I 135	3.64E-06	7.24E-06	2.64E-06	6.49E-04	8.07E-06	NO DATA	2.62E-06
CS134	3.77E-04	7.03E-04	7.10E-05	NO DATA	1.81E-04	7.42E-05	1.91E-06
CS136	4.59E-05	1.35E-04	5.04E-05	NO DATA	5.38E-05	1.10E-05	2.05E-06
CS137	5.22E-04	6.11E-04	4.33E-05	NO DATA	1.64E-04	6.64E-05	1.91E-06
CS138	4.81E-07	7.82E-07	3.79E-07	NO DATA	3.90E-07	6.09E-08	1.25E-06
BA139	8.81E-07	5.84E-10	2.55E-08	NO DATA	3.51E-10	3.54E-10	5.58E-05

TABLE 2.2-5 CONT'D

INGESTION DOSE FACTORS FOR INFANT*

(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA140	1.71E-04	1.71E-07	8.81E-06	NO DATA	4.06E-08	1.05E-07	4.20E-05
BA141	4.25E-07	2.91E-10	1.34E-08	NO DATA	1.75E-10	1.77E-10	5.19E-06
BA142	1.84E-07	1.53E-10	9.06E-09	NO DATA	8.81E-11	9.26E-11	7.59E-07
LA140	2.11E-08	8.32E-09	2.14E-09	NO DATA	NO DATA	NO DATA	9.77E-05
LA142	1.10E-09	4.04E-10	9.67E-11	NO DATA	NO DATA	NO DATA	6.86E-05
CE141	7.87E-08	4.80E-08	5.65E-09	NO DATA	1.48E-08	NO DATA	2.48E-05
CE143	1.48E-08	9.82E-06	1.17E-09	NO DATA	2.96E-09	NO DATA	5.73E-05
CE144	2.98E-06	1.22E-06	1.67E-07	NO DATA	4.93E-07	NO DATA	1.71E-04
PR143	8.13E-08	3.04E-08	4.03E-09	NO DATA	1.13E-08	NO DATA	4.29E-05
PR144	2.74E-10	1.06E-10	1.38E-11	NO DATA	3.84E-11	NO DATA	4.93E-06
ND147	5.53E-08	5.68E-08	3.48E-09	NO DATA	2.19E-08	NO DATA	3.60E-05
W 187	9.03E-07	6.28E-07	2.17E-07	NO DATA	NO DATA	NO DATA	3.69E-05
NP239	1.11E-08	9.93E-10	5.61E-10	NO DATA	1.98E-09	NO DATA	2.87E-05

TABLE 2.2-6

INGESTION DOSE FACTORS FOR CHILD*

(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07
C 14	1.21E-05	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06
NA 24	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06
P 32	8.75E-04	3.86E-05	3.18E-05	NO DATA	NO DATA	NO DATA	2.28E-05
CR 51	NO DATA	NO DATA	8.90E-09	4.94E-09	1.35E-09	9.02E-09	4.72E-07
MN 54	NO DATA	1.07E-05	2.85E-06	NO DATA	3.00E-06	NO DATA	8.98E-06
MN 56	NO DATA	3.34E-07	7.54E-08	NO DATA	4.04E-07	NO DATA	4.84E-05
FE 55	1.15E-05	6.10E-06	1.89E-06	NO DATA	NO DATA	3.45E-06	1.13E-06
FE 59	1.65E-05	2.67E-05	1.33E-05	NO DATA	NO DATA	7.74E-06	2.78E-05
CO 58	NO DATA	1.80E-06	5.51E-06	NO DATA	NO DATA	NO DATA	1.05E-05
CO 60	NO DATA	5.29E-06	1.56E-05	NO DATA	NO DATA	NO DATA	2.93E-05
NI 63	5.38E-04	2.88E-05	1.83E-05	NO DATA	NO DATA	NO DATA	1.94E-06
NI 65	2.22E-06	2.09E-07	1.22E-07	NO DATA	NO DATA	NO DATA	2.56E-05
CU 64	NO DATA	2.45E-07	1.48E-07	NO DATA	5.92E-07	NO DATA	1.15E-05
ZN 65	1.37E-05	3.65E-05	2.27E-05	NO DATA	2.30E-05	NO DATA	6.41E-06
ZN 69	4.38E-08	6.33E-08	5.85E-09	NO DATA	3.84E-08	NO DATA	3.99E-06
BR 83	NO DATA	NO DATA	1.71E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	1.95E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	9.12E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	6.70E-05	4.12E-05	NO DATA	NO DATA	NO DATA	4.31E-06
RB 88	NO DATA	1.90E-07	1.32E-07	NO DATA	NO DATA	NO DATA	9.32E-09
RB 89	NO DATA	1.17E-07	1.04E-07	NO DATA	NO DATA	NO DATA	1.02E-09
SR 89	1.32E-03	NO DATA	3.77E-05	NO DATA	NO DATA	NO DATA	5.11E-05
SR 90	1.70E-02	NO DATA	4.31E-03	NO DATA	NO DATA	NO DATA	2.29E-04
SR 91	2.40E-05	NO DATA	9.06E-07	NO DATA	NO DATA	NO DATA	5.30E-05
SR 92	9.03E-06	NO DATA	3.62E-07	NO DATA	NO DATA	NO DATA	1.71E-04
Y 90	4.11E-08	NO DATA	1.10E-09	NO DATA	NO DATA	NO DATA	1.17E-04
Y 91M	3.82E-10	NO DATA	1.39E-11	NO DATA	NO DATA	NO DATA	7.48E-07
Y 91	6.02E-07	NO DATA	1.61E-08	NO DATA	NO DATA	NO DATA	8.02E-05
Y 92	3.60E-09	NO DATA	1.03E-10	NO DATA	NO DATA	NO DATA	1.04E-04

* Reference 3, Table E-13.

TABLE 2.2-6 CONT'D

INGESTION DOSE FACTORS FOR CHILD*

(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y 93	1.14E-08	NO DATA	3.13E-10	NO DATA	NO DATA	NO DATA	1.70E-04
ZR 95	1.16E-07	2.55E-08	2.27E-08	NO DATA	3.65E-08	NO DATA	2.66E-05
ZR 97	6.99E-09	1.01E-09	5.96E-10	NO DATA	1.45E-09	NO DATA	1.53E-04
NB 95	2.25E-08	8.76E-09	6.26E-09	NO DATA	8.23E-09	NO DATA	1.62E-05
MO 99	NO DATA	1.33E-05	3.29E-06	NO DATA	2.84E-05	NO DATA	1.10E-05
TC 99M	9.23E-10	1.81E-09	3.00E-08	NO DATA	2.63E-08	9.19E-10	1.03E-06
TC101	1.07E-09	1.12E-09	1.42E-08	NO DATA	1.91E-08	5.92E-10	3.56E-09
RU103	7.31E-07	NO DATA	2.81E-07	NO DATA	1.84E-06	NO DATA	1.89E-05
RU105	6.45E-08	NO DATA	2.34E-08	NO DATA	5.67E-07	NO DATA	4.21E-05
RU106	1.17E-05	NO DATA	1.46E-06	NO DATA	1.58E-05	NO DATA	1.82E-04
AG110M	5.39E-07	3.64E-07	2.91E-07	NO DATA	6.78E-07	NO DATA	4.33E-05
TE125M	1.14E-05	3.09E-06	1.52E-06	3.20E-06	NO DATA	NO DATA	1.10E-05
TE127M	2.89E-05	7.78E-06	3.43E-06	6.91E-06	8.24E-05	NO DATA	2.34E-05
TE127	4.71E-07	1.27E-07	1.01E-07	3.26E-07	1.34E-06	NO DATA	1.84E-05
TE129M	4.87E-05	1.36E-05	7.56E-06	1.57E-05	1.43E-04	NO DATA	5.94E-05
TE129	1.34E-07	3.74E-08	3.18E-08	9.56E-08	3.92E-07	NO DATA	8.34E-06
TE131M	7.20E-06	2.49E-06	2.65E-06	5.12E-06	2.41E-05	NO DATA	1.01E-04
TE131	8.30E-08	2.53E-08	2.47E-08	6.35E-08	2.51E-07	NO DATA	4.36E-07
TE132	1.01E-05	4.47E-06	5.40E-06	6.51E-06	4.15E-05	NO DATA	4.50E-05
I 130	2.92E-06	5.90E-06	3.04E-06	6.50E-04	8.82E-06	NO DATA	2.76E-06
I 131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	NO DATA	1.54E-06
I 132	8.00E-07	1.47E-06	6.76E-07	6.82E-05	2.25E-06	NO DATA	1.73E-06
I 133	5.92E-06	7.32E-06	2.77E-06	1.36E-03	1.22E-05	NO DATA	2.95E-06
I 134	4.19E-07	7.78E-07	3.58E-07	1.79E-05	1.19E-06	NO DATA	5.16E-07
I 135	1.75E-06	3.15E-06	1.49E-06	2.79E-04	4.83E-06	NO DATA	2.40E-06
CS134	2.34E-04	3.84E-04	8.10E-05	NO DATA	1.19E-04	4.27E-05	2.07E-06
CS136	2.35E-05	6.46E-05	4.18E-05	NO DATA	3.44E-05	5.13E-06	2.27E-06
CS137	3.27E-04	3.13E-04	4.62E-05	NO DATA	1.02E-04	3.67E-05	1.96E-06
CS138	2.28E-07	3.17E-07	2.01E-07	NO DATA	2.23E-07	2.40E-08	1.46E-07
BA139	4.14E-07	2.21E-10	1.20E-08	NO DATA	1.93E-10	1.30E-10	2.39E-05

TABLE 2.2-6 CONT'D

INGESTION DOSE FACTORS FOR CHILD*

(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA140	8.31E-05	7.28E-08	4.85E-06	NO DATA	2.37E-08	4.34E-08	4.21E-05
BA141	2.00E-07	1.12E-10	6.51E-09	NO DATA	9.69E-11	6.58E-10	1.14E-07
BA142	8.74E-08	6.29E-11	4.88E-09	NO DATA	5.09E-11	3.70E-11	1.14E-09
LA140	1.01E-08	3.53E-09	1.17E-09	NO DATA	NO DATA	NO DATA	9.84E-05
LA142	5.24E-10	1.67E-10	5.23E-11	NO DATA	NO DATA	NO DATA	3.31E-05
CE141	3.97E-08	1.98E-08	2.94E-09	NO DATA	8.68E-09	NO DATA	2.47E-05
CE143	6.99E-09	3.79E-06	5.49E-10	NO DATA	1.59E-09	NO DATA	5.55E-05
CE144	2.08E-06	6.52E-07	1.11E-07	NO DATA	3.61E-07	NO DATA	1.70E-04
PR143	3.93E-08	1.18E-08	1.95E-09	NO DATA	6.39E-09	NO DATA	4.24E-05
PR144	1.29E-10	3.97E-11	6.49E-12	NO DATA	2.11E-11	NO DATA	8.59E-08
ND147	2.79E-08	2.26E-08	1.75E-09	NO DATA	1.24E-08	NO DATA	3.58E-05
W 187	4.29E-07	2.54E-07	1.14E-07	NO DATA	NO DATA	NO DATA	3.57E-05
NP239	5.25E-09	3.77E-10	2.65E-10	NO DATA	1.09E-09	NO DATA	2.79E-05

TABLE 2.2-7

INGESTION DOSE FACTORS FOR TEENAGER*

(MREM PER PCI INGESTED)

Page 1 of 3

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07
C 14	4.06E-06	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07
NA 24	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06
P 32	2.76E-04	1.71E-05	1.07E-05	NO DATA	NO DATA	NO DATA	2.32E-05
CR 51	NO DATA	NO DATA	3.60E-09	2.00E-09	7.89E-10	5.14E-09	6.05E-07
MN 54	NO DATA	5.90E-06	1.17E-06	NO DATA	1.76E-06	NO DATA	1.21E-05
MN 56	NO DATA	1.58E-07	2.81E-08	NO DATA	2.00E-07	NO DATA	1.04E-05
FE 55	3.78E-06	2.68E-06	6.25E-07	NO DATA	NO DATA	1.70E-06	1.16E-06
FE 59	5.87E-06	1.37E-05	5.29E-06	NO DATA	NO DATA	4.32E-06	3.24E-05
CO 58	NO DATA	9.72E-07	2.24E-06	NO DATA	NO DATA	NO DATA	1.34E-05
CO 60	NO DATA	2.81E-06	6.33E-06	NO DATA	NO DATA	NO DATA	3.66E-05
NI 63	1.77E-04	1.25E-05	6.00E-06	NO DATA	NO DATA	NO DATA	1.99E-06
NI 65	7.49E-07	9.57E-08	4.36E-08	NO DATA	NO DATA	NO DATA	5.19E-06
CU 64	NO DATA	1.15E-07	5.41E-08	NO DATA	2.91E-07	NO DATA	8.92E-06
ZN 65	5.76E-06	2.00E-05	9.33E-06	NO DATA	1.28E-05	NO DATA	8.47E-06
ZN 69	1.47E-08	2.60E-08	1.96E-09	NO DATA	1.83E-08	NO DATA	5.16E-08
BR 83	NO DATA	NO DATA	5.74E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	7.22E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	3.05E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	2.98E-05	1.40E-05	NO DATA	NO DATA	NO DATA	4.41E-06
RB 88	NO DATA	8.52E-08	4.54E-08	NO DATA	NO DATA	NO DATA	7.30E-15
RB 89	NO DATA	5.50E-08	3.89E-08	NO DATA	NO DATA	NO DATA	8.43E-17
SR 89	4.40E-04	NO DATA	1.26E-05	NO DATA	NO DATA	NO DATA	5.24E-05
SR 90	8.30E-03	NO DATA	2.05E-03	NO DATA	NO DATA	NO DATA	2.33E-04
SR 91	8.07E-06	NO DATA	3.21E-07	NO DATA	NO DATA	NO DATA	3.66E-05
SR 92	3.05E-06	NO DATA	1.30E-07	NO DATA	NO DATA	NO DATA	7.77E-05
Y 90	1.37E-08	NO DATA	3.69E-10	NO DATA	NO DATA	NO DATA	1.13E-04
Y 91M	1.29E-10	NO DATA	4.93E-12	NO DATA	NO DATA	NO DATA	6.09E-09
Y 91	2.01E-07	NO DATA	5.39E-09	NO DATA	NO DATA	NO DATA	8.24E-05
Y 92	1.21E-09	NO DATA	3.50E-11	NO DATA	NO DATA	NO DATA	3.32E-05

* Reference 3, Table E-12.

TABLE 2.2-7 CONT'D

INGESTION DOSE FACTORS FOR TEENAGER*

(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y 93	3.83E-09	NO DATA	1.05E-10	NO DATA	NO DATA	NO DATA	1.17E-04
ZR 95	4.12E-08	1.30E-08	8.94E-09	NO DATA	1.91E-08	NO DATA	3.00E-05
ZR 97	2.37E-09	4.69E-10	2.16E-10	NO DATA	7.11E-10	NO DATA	1.27E-04
NB 95	8.22E-09	4.56E-09	2.51E-09	NO DATA	4.42E-09	NO DATA	1.95E-05
MO 99	NO DATA	6.03E-06	1.15E-06	NO DATA	1.38E-05	NO DATA	1.08E-05
TC 99M	3.32E-10	9.26E-10	1.20E-08	NO DATA	1.38E-08	5.14E-10	6.08E-07
TC101	3.60E-10	5.12E-10	5.03E-09	NO DATA	9.26E-09	3.12E-10	8.75E-17
RU103	2.55E-07	NO DATA	1.09E-07	NO DATA	8.99E-07	NO DATA	2.13E-05
RU105	2.18E-08	NO DATA	8.46E-09	NO DATA	2.75E-07	NO DATA	1.76E-05
RU106	3.92E-06	NO DATA	4.94E-07	NO DATA	7.56E-06	NO DATA	1.88E-04
AG110M	2.05E-07	1.94E-07	1.12E-07	NO DATA	3.70E-07	NO DATA	5.45E-05
TE125M	3.83E-06	1.38E-06	5.12E-07	1.07E-06	NO DATA	NO DATA	1.13E-05
TE127M	9.67E-06	3.43E-06	1.15E-06	2.30E-06	3.92E-05	NO DATA	2.41E-05
TE127	1.58E-07	5.60E-08	3.40E-08	1.09E-07	6.40E-07	NO DATA	1.22E-05
TE129M	1.63E-05	6.05E-06	2.58E-06	5.26E-06	6.82E-05	NO DATA	6.12E-05
TE129	4.48E-08	1.67E-08	1.07E-08	3.20E-08	1.88E-07	NO DATA	2.45E-07
TE131M	2.44E-06	1.17E-06	9.76E-07	1.76E-06	1.22E-05	NO DATA	9.39E-05
TE131	2.79E-08	1.15E-08	8.72E-09	2.15E-08	1.22E-07	NO DATA	2.29E-09
TE132	3.49E-06	2.21E-06	2.08E-06	2.33E-06	2.12E-05	NO DATA	7.00E-05
I 130	1.03E-06	2.98E-06	1.19E-06	2.43E-04	4.59E-06	NO DATA	2.29E-06
I 131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	NO DATA	1.62E-06
I 132	2.79E-07	7.30E-07	2.62E-07	2.46E-05	1.15E-06	NO DATA	3.18E-07
I 133	2.01E-06	3.41E-06	1.04E-06	4.76E-04	5.98E-06	NO DATA	2.58E-06
I 134	1.46E-07	3.87E-07	1.39E-07	6.45E-06	6.10E-07	NO DATA	5.10E-09
I 135	6.10E-07	1.57E-06	5.82E-07	1.01E-04	2.48E-06	NO DATA	1.74E-06
CS134	8.37E-05	1.97E-04	9.14E-05	NO DATA	6.26E-05	2.39E-05	2.45E-06
CS136	8.59E-06	3.38E-05	2.27E-05	NO DATA	1.84E-05	2.90E-06	2.72E-06
CS137	1.12E-04	1.49E-04	5.19E-05	NO DATA	5.07E-05	1.97E-05	2.12E-06
CS138	7.76E-08	1.49E-07	7.45E-08	NO DATA	1.10E-07	1.28E-08	6.76E-11
BA139	1.39E-07	9.78E-11	4.05E-09	NO DATA	9.22E-11	6.74E-11	1.24E-06

TABLE 2.2-7 CONT'D

INGESTION DOSE FACTORS FOR TEENAGER*

(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA140	2.84E-05	3.48E-09	1.83E-06	NO DATA	1.18E-08	2.34E-08	4.38E-05
BA141	6.71E-08	5.01E-11	2.24E-09	NO DATA	4.65E-11	3.43E-11	1.43E-13
BA142	2.99E-08	2.99E-11	1.84E-09	NO DATA	2.53E-11	1.99E-11	9.18E-20
LA140	3.48E-09	1.71E-09	4.55E-10	NO DATA	NO DATA	NO DATA	9.82E-05
LA142	1.79E-10	7.95E-11	1.98E-11	NO DATA	NO DATA	NO DATA	2.42E-06
CE141	1.33E-08	8.88E-09	1.02E-09	NO DATA	4.18E-09	NO DATA	2.54E-05
CE143	2.35E-09	1.71E-06	1.91E-10	NO DATA	7.67E-10	NO DATA	5.14E-05
CE144	6.96E-07	2.88E-07	3.74E-08	NO DATA	1.72E-07	NO DATA	1.75E-04
PR143	1.31E-08	5.23E-09	6.52E-10	NO DATA	3.04E-09	NO DATA	4.31E-05
PR144	4.30E-11	1.76E-11	2.18E-12	NO DATA	1.01E-11	NO DATA	4.74E-14
ND147	9.38E-09	1.02E-08	6.11E-10	NO DATA	5.99E-09	NO DATA	3.68E-05
W 187	1.46E-07	1.19E-07	4.17E-08	NO DATA	NO DATA	NO DATA	3.22E-05
NP239	1.76E-09	1.66E-10	9.22E-11	NO DATA	5.21E-10	NO DATA	2.67E-05

TABLE 2.2-8

INGESTION DOSE FACTORS FOR ADULTS*

(MREM PER PCI INGESTED)

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

* Reference 3, Table E-11.

TABLE 2.2-8 CONT'D

INGESTION DOSE FACTORS FOR ADULTS*

(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y 93	2.68E-09	NO DATA	7.40E-11	NO DATA	NO DATA	NO DATA	8.50E-05
ZR 95	3.04E-08	9.75E-09	6.60E-09	NO DATA	1.53E-08	NO DATA	3.09E-05
ZR 97	1.68E-09	3.39E-10	1.55E-10	NO DATA	5.12E-10	NO DATA	1.05E-04
NB 95	6.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-05
MO 99	NO DATA	4.31E-06	8.20E-07	NO DATA	9.[illegible]6E-06	NO DATA	9.99E-06
TC 99M	2.47E-10	6.98E-10	8.89E-09	NO DATA	1.06E-08	3.42E-10	4.13E-07
TC101	2.54E-10	3.66E-10	3.59E-09	NO DATA	6.59E-09	1.87E-10	1.10E-21
RU103	1.85E-07	NO DATA	7.97E-08	NO DATA	7.06E-07	NO DATA	2.16E-05
RU105	1.54E-08	NO DATA	6.08E-09	NO DATA	1.99E-07	NO DATA	9.42E-06
RU106	2.75E-06	NO DATA	3.48E-07	NO DATA	5.31E-06	NO DATA	1.78E-04
AG110M	1.60E-07	1.48E-07	8.79E-08	NO DATA	2.91E-07	NO DATA	6.04E-05
TE125M	2.68E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	NO DATA	1.07E-05
TE127M	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	NO DATA	2.27E-05
TE127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	NO DATA	8.68E-06
TE129M	1.15E-05	4.29E-06	1.82E-06	3.95E-06	4.80E-05	NO DATA	5.79E-05
TE129	3.14E-08	1.18E-08	7.65E-09	2.41E-08	1.32E-07	NO DATA	2.37E-08
TE131M	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	NO DATA	8.40E-05
TE131	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	NO DATA	2.79E-09
TE132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	NO DATA	7.71E-05
I 130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	NO DATA	1.92E-06
I 131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	NO DATA	1.57E-06
I 132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	NO DATA	1.02E-07
I 133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	NO DATA	2.22E-06
I 134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	NO DATA	2.51E-10
I 135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	NO DATA	1.31E-06
CS134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06
CS136	6.51E-06	2.57E-05	1.85E-05	NO DATA	1.43E-05	1.96E-06	2.92E-06
CS137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06
CS138	5.52E-08	1.09E-07	5.40E-08	NO DATA	8.01E-08	7.91E-09	4.65E-13
BA139	9.70E-08	6.91E-11	2.84E-09	NO DATA	6.46E-11	3.92E-11	1.72E-07

TABLE 2.2-8 CONT'D

INGESTION DOSE FACTORS FOR ADULTS*

(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA140	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.46E-08	4.18E-05
BA141	4.71E-08	3.56E-11	1.59E-09	NO DATA	3.31E-11	2.02E-11	2.22E-17
BA142	2.13E-08	2.19E-11	1.34E-09	NO DATA	1.85E-11	1.24E-11	3.00E-26
LA140	2.50E-09	1.26E-09	3.33E-10	NO DATA	NO DATA	NO DATA	9.25E-05
LA142	1.28E-10	5.82E-11	1.45E-11	NO DATA	NO DATA	NO DATA	4.25E-07
CE141	9.36E-09	6.33E-09	7.18E-10	NO DATA	2.94E-09	NO DATA	2.42E-05
CE143	1.65E-09	1.22E-06	1.35E-10	NO DATA	5.37E-10	NO DATA	4.56E-05
CE144	4.88E-07	2.04E-07	2.62E-08	NO DATA	1.21E-07	NO DATA	1.65E-04
PR143	9.20E-09	3.69E-09	4.56E-10	NO DATA	2.13E-09	NO DATA	4.03E-05
PR144	3.01E-11	1.25E-11	1.54E-12	NO DATA	7.05E-12	NO DATA	4.33E-18
ND147	6.29E-09	7.27E-09	4.35E-10	NO DATA	4.25E-09	NO DATA	3.49E-05
W 187	1.03E-07	8.61E-08	3.01E-08	NO DATA	NO DATA	NO DATA	2.82E-05
NP239	1.19E-09	1.17E-10	6.45E-11	NO DATA	3.65E-10	NO DATA	2.40E-05

TABLE 2.2-9

EXTERNAL DOSE FACTORS FOR STANDING ON CONTAMINATED GROUND*

(mrem/hr per pci/m^2)

ELEMENT	TOTAL BODY	SKIN
H-3	0.0	0.0
C-14	0.0	0.0
NA-24	2.50E-08	2.90E-08
P-32	0.0	0.0
Cr-51	2.20E-10	2.60E-10
Mn-54	5.80E-09	6.80E-09
Mn-56	1.10E-08	1.30E-08
Fe-55	0.0	0.0
Fe-59	8.00E-09	9.40E-09
Co-58	7.00E-09	8.20E-09
Co-60	1.70E-08	2.00E-08
Ni-63	0.0	0.0
Ni-65	3.70E-09	4.30E-09
Cu-64	1.50E-09	1.70E-09
Zn-65	4.00E-09	4.60E-09
Zn-69	0.0	0.0
Br-83	6.40E-11	9.30E-11
Br-84	1.20E-08	1.40E-08
Br-85	0.0	0.0
Rb-86	6.30E-10	7.20E-10
Rb-88	3.50E-09	4.00E-09
Rb-89	1.50E-08	1.80E-08
Sr-89	5.60E-13	6.50E-13
Sr-91	7.10E-09	8.30E-09
Sr-92	9.00E-09	1.00E-08
Y-90	2.20E-12	2.60E-12
Y-91M	3.80E-09	4.40E-09
Y-91	2.40E-11	2.70E-11
Y-92	1.60E-09	1.90E-09
Y-93	5.70E-10	7.80E-10
Zr-95	5.00E-09	5.80E-09
Zr-97	5.50E-09	6.40E-09
Nb-95	5.10E-09	6.00E-09
Mo-99	1.90E-09	2.20E-09
Tc-99M	9.60E-10	1.10E-09
Tc-101	2.70E-09	3.00E-09
Ru-103	3.60E-09	4.20E-09
Ru-105	4.50E-09	5.10E-09
Ru-106	1.50E-09	1.80E-09
Ag-110M	1.80E-08	2.10E-08
Te-125M	3.50E-11	4.80E-11
Te-127M	1.10E-12	1.30E-12
Te-127	1.00E-11	1.10E-11
Te-129M	7.70E-10	9.00E-10
Te-129	7.10E-10	8.40E-10

*Reference 3, Table E-6

TABLE 2.2-9 (Continued)

ELEMENT	TOTAL BODY	SKIN
Te-131M	8.40E-09	9.90E-09
Te-131	2.20E-09	2.60E-06
Te-132	1.70E-09	2.00E-09
I-130	1.40E-08	1.70E-03
I-131	2.80E-09	3.40E-09
I-132	1.70E-08	2.00E-08
I-133	3.70E-09	4.50E-09
I-134	1.60E-08	1.90E-08
I-135	1.20E-08	1.40E-08
Cs-134	1.20E-08	1.40E-08
Cs-136	1.50E-08	1.70E-08
Cs-137	4.20E-09	4.90E-09
Cs-138	2.10E-08	2.40E-08
Ba-139	2.40E-09	2.70E-09
Ba-140	2.10E-09	2.40E-09
Ba-141	4.30E-09	4.90E-09
Ba-142	7.90E-09	9.00E-09
La-140	1.50E-08	1.70E-08
La-142	1.50E-08	1.80E-08
Ce-141	5.50E-10	6.20E-10
Ce-143	2.20E-09	2.50E-09
Ce-144	3.20E-10	3.70E-10
Pr-143	0.0	0.0
Pr-144	2.00E-10	2.30E-10
Nd-147	1.00E-09	1.20E-09
W-187	3.10E-09	3.60E-09
Np-239	9.50E-10	1.10E-09

TABLE 2.2-10

INDIVIDUAL USAGE FACTORS*

	INFANT	CHILD	TEENAGER	ADULT
Milk Consumption Rate, U_{ap} (liters/year)	330	330	400	310
Meat Consumption Rate, U_{ap} (kg/year)	0	41	65	110
Fresh Leafy Vegetation Consumption Rate, $U_{a\ell}$ (kg/year)	0	26	42	64
Stored Vegetation Consumption Rate, U_{as} (kg/year)	0	520	630	520
Breathing Rate (m^3/year)	1400	3700	8000	8000

*Reference 3, Table E-5.

TABLE 2.2-11

STABLE ELEMENT TRANSFER DATA*

ELEMENT	F_m - MILK (COW)	F_m - MILK (GOAT)	F_f - MEAT
H	1.0E-02	1.7E-01	1.2E-02
C	1.2E-02	1.0E-01	3.1E-02
Na	4.0E-02	4.0E-02	3.0E-02
P	2.5E-02	2.5E-01	4.6E-02
Cr	2.2E-03	2.2E-03	2.4E-03
Mn	2.5E-04	2.5E-04	8.0E-04
Fe	1.2E-03	1.3E-04	4.0E-02
Co	1.0E-03	1.0E-03	1.3E-02
Ni	6.7E-03	6.7E-03	5.3E-02
Cu	1.4E-02	1.3E-02	8.0E-03
Zn	3.9E-02	3.9E-02	3.0E-02
Rb	3.0E-02	3.0E-02	3.1E-02
Sr	8.0E-04	1.4E-02	6.0E-04
Y	1.0E-05	1.0E-05	4.6E-03
Zr	5.0E-06	5.0E-06	3.4E-02
Nb	2.5E-03	2.5E-03	2.8E-01
Mo	7.5E-03	7.5E-03	8.0E-03
Tc	2.5E-02	2.5E-02	4.0E-01
Ru	1.0E-06	1.0E-06	4.0E-01
Rh	1.0E-02	1.0E-02	1.5E-03
Ag	5.0E-02	5.0E-02	1.7E-02
Te	1.0E-03	1.0E-03	7.7E-02
I	6.0E-03	6.0E-02	2.9E-03
Cs	1.2E-02	3.0E-01	4.0E-03
Ba	4.0E-04	4.0E-04	3.2E-03
La	5.0E-06	5.0E-06	2.0E-04
Ce	1.0E-04	1.0E-04	1.2E-03
Pr	5.0E-06	5.0E-06	4.7E-03
Nd	5.0E-06	5.0E-06	3.3E-03
W	5.0E-04	5.0E-04	1.3E-03
Np	5.0E-06	5.0E-06	2.0E-04

*References 3, Table E-1.

TABLE 2.2-12
SITE-SPECIFIC (OR DEFAULT) VALUES TO BE USED IN PATHWAY FACTOR CALCULATIONS

(Supports Section 2.2.2.b)

The critical receptor is an infant exposed to the inhalation, ground-plane, and grass-cow-milk pathways.

Parameter	Description	Value
Inhalation		
$(BR)_a$	Breathing rate for infant	1400 m^3/year
$(DFA)_{ija}$	Inhalation dose factor for infant	Table 2.2-1
Ground plane		
SF'	Shielding factor due to structure	0.7
$(DFG)_{ij}$	Ground plane dose factor (Same for all age groups)	Table 2.2-9
Grass-Cow-Milk		
Q_F	Feed consumption rate for cow	50 kg/day
U_{ap}	Milk consumption rate for infant	330 ℓ/yr
$(DFL)_{ija}$	Ingestion dose factor for infant	Table 2.2-5
Y_p	Pasture grass areal density	0.7 kg/m^2
Y_s	Stored feed areal density	2.0 kg/m^2
f_p	Fraction of year that cow grazes on pasture	1.0
f_s	Fraction of total feed that is pasture grass while cow is on pasture	1.0
H	Absolute humidity of the atmosphere	8.0 gm/m^3

TABLE 2.2-13
SITE-SPECIFIC (OR DEFAULT) VALUES TO
BE USED IN ADDITIONAL PATHWAY FACTOR CALCULATIONS

(Supports Section 2.2.2.c)

Parameter	Description	Value
Inhalation		
$(BR)_a$	Breathing rate for age group	Table 2.2-10
$(DFA)_{ija}$	Inhalation dose factor for age group	Tables 2.2-1 - 2.2-4
Grass-Cow-Meat		
Q_F	Feed consumption rate for cow	50 kg/day
U_{ap}	Meat consumption rate for age group	Table 2.2-10
$(DFL)_{ija}$	Ingestion dose factor for age group	Tables 2.2-6 - 2.2-8
Y_p	Pasture grass areal density	0.7 kg/m^2
Y_s	Stored feed areal density	2.0 kg/m^2
f_p	Fraction of year that cow grazes on pasture	1.0
f_s	Fraction of total feed that is pasture grass while cow is on pasture	1.0
H	Absolute humidity of the atmosphere	8.0 gm/m^3
Garden Vegetation		
Y_v	Garden vegetation areal density	2.0 kg/m^2
$U_{a\ell}$	Leafy vegetation consumption rate for age group	Table 2.2-10
U_{as}	Stored vegetation consumption rate for age group	Table 2.2-10
f_ℓ	Fraction of annual intake of leafy vegetation grown locally	1.0
f_g	Fraction of annual intake of stored vegetation grown locally	0.76
H	Absolute humidity of the atmosphere	8.0 gm/m^3

TABLE 2.2-13
(Continued)

Parameter	Description	Value
Grass-Goat-Milk		
Q_F	Feed consumption rate for goat	6.0 kg/day
U_{ap}	Milk consumption rate for age group	Table 2.2-10
$(DFL)_{ija}$	Ingestion dose factor for age group	Tables 2.2-5 - 2.2-8
Y_p	Pasture grass areal density	0.7 kg/m^2
Y_s	Stored feed areal density	2.0 kg/m^2
f_p	Fraction of year that goat grazes on pasture	1.0
f_s	Fraction of total feed that is pasture grass while goat is on pasture	1.0
H	Absolute humidity of the atmosphere	8.0 gm/m^3

2.3 METEOROLOGICAL MODEL

2.3.1 ATMOSPHERIC DISPERSION

Atmospheric dispersion may be calculated using the appropriate form of the sector averaged Gaussian model. Gaseous releases are considered to be either elevated or at ground-level. Included in the ground-level category are releases from the Reactor Building Vent (Unit 1), the Reactor Building Vent (Unit 2) and the Recombiner Building Vent (Unit 1). Releases from the main stack are considered to be elevated.

2.3.1.a Ground Level Releases

X/Q = The sector-averaged annual average relative concentration at any distance in the given sector.

$$= 2.032 \; \delta \; K_r \sum_{jk} \frac{n_{jk}}{N u_{jk} \, r \, \Sigma_{zk}} \quad (\text{sec m}^{-3})$$

where

2.032 = $(2/\pi)^{1/2}$ divided by the number of radians in a 22.5° sector ($2\pi/16$).

δ = Plume depletion factor for all radionuclides other than noble gases at a distance r shown in Figure 2.3-3. For noble gases the depletion factor is unity. Only depletion by deposition is considered since depletion by decay would be of little significance at the distances considered.

K_r = Terrain recirculation factor corresponding to a distance r taken from Figure 2.3-2.

n_{jk} = Number of hours the wind of wind speed class j is directed into the given sector during the time atmospheric stability category k existed. These values may be obtained from Table E.4-8 of Reference 5.

N = Total hours of valid meteorological data recorded for all sectors, wind speed classes, and stability categories from Table E.4-8 of Reference 5.

r = Distance from the point of release to the receptor location (meters).

u_{jk} = Wind speed (mid-point of wind speed class j) at ground level ($m\ sec^{-1}$) during atmospheric stability k.

Σ_{zk} = The vertical standard deviation of the plume concentration distribution considering the initial dispersion within the building wake.

$$= \text{The lesser of} \begin{cases} (\sigma_z^2 + b^2/2\pi)^{1/2} \\ \text{or} \\ \sqrt{3}\ (\sigma_z) \end{cases}$$

σ_{zk} = The vertical standard deviation of the plume concentration distribution (meters) for a given distance and stability category k as shown in Figure 2.3-1. The stability category is determined by the vertical temperature gradient $\Delta T/\Delta z$ (°C/100m).

π = 3.1416

b = Maximum height of adjacent plant structure (47 meters).

2.3.1.b Elevated Releases

X/Q = The sector-averaged annual average relative concentration at any distance in the given sector for radionuclides other than noble gases.

$$= 2.032\ K_r \sum_{jk} \delta_k \frac{n_{jk} \exp(-h^2/2\sigma_{zk}^2)}{NU_j r \sigma_{zk}}$$

δ_k = The plume depletion factor taken from Figure 2.3-4. For an elevated release this factor is stability dependent.

h = Height of main stack (120 meters).

n = Number of hours the wind of wind speed class j is directed <u>into</u> the given sector during the time atmospheric stability category k existed. These values may be obtained from Table E.4-7 of Reference 5.

U_{jk} = Wind speed (mid-point of wind speed class j) at the height of release h (m sec^{-1}) during atmospheric stability k.

N = Total hours of valid meteorological data recorded for all sectors, wind speed classes, and stability categories from Table E.4-7 of Reference 5.

The remaining symbols are the same as those previously defined.

When considering the direct gamma radiation from an elevated finite plume the constants B_i and V_i defined in Section 2.1.2 for each identified noble gas radionuclide are calculated using the following:

$$B_i = \frac{K}{r} \sum_j \sum_k \sum_\ell \left[\frac{n_{jk} \; A_{\ell i} \; \mu_a \; E_\ell \; I_{(r)k\ell}}{N \; U_j} \right] \frac{\text{mrad/yr}}{\mu\text{Ci/sec}}$$

$$V_i = 1.1 \frac{K}{r} \sum_j \sum_k \sum_\ell \left[\frac{n_{jk} \; A_{\ell i} \; \mu_a \; E_\ell \; I_{(r)k\ell}}{N \; U_j} \right] \exp\left(-\mu_T T_d\right) \frac{\text{mrem/yr}}{\mu\text{Ci/sec}}$$

K = A numerical constant representing the aggregated numerical constants and unit conversions.

= 2.1×10^{4}

$A_{\ell i}$ = The number of photons of energy corresponding to the ℓth energy group emitted per transformation of radionuclide i (number/transformation).

μ_a = The energy absorption coefficient in air for photon energy E_ℓ (meters^{-1}).

E_ℓ = The energy assigned to energy group ℓ (MeV).

μ_T = The tissue energy absorbtion coefficient for photons of energy E_ℓ ($cm^2 gm^{-1}$).

T_d = The tissue density thickness taken to represent the total body dose ($5\ gm\ cm^{-2}$).

1.1 = An average ratio of the tissue to air absorbtion coefficients over the energy range of interest. The ratio converts dose (rad) to dose equivalent (rem).

$I_{(r)k\ell}$ = The results of numerical integration over the plume spatial distribution of airborne activity; this value is dependent on atmospheric stability, downwind distance, and gamma energy.

The above mentioned integral is used in representing the summation of the dose rates from all the points (the concentration within a differential volume element) of a distributed source (plume). For the sector-averaged Gaussian model the integral is given by:

$$\frac{1}{2^3\ ^2\sigma_z} \int\int^{\infty\ \infty} \frac{B_g\,[\mu,\ \mu_a,\ (L^2 + z^2)^{1\ 2}]\ G(z)\ \exp\,[-\mu\ (L^2 + z^2)^{1\ 2}]\ L\ dL\ dz}{L^2 + z^2}$$

where

B_g = Build-up factor.

$= 1 - k\mu(L^2 + z^2)^{1/2}$

μ = Total absorbtion coefficient for air ($meters^{-1}$).

k = $(\mu - \mu_a)/\mu_a$.

L = Horizontal distance from the receptor to the differential volume element.

z = The vertical distance from the receptor to the differential volume element.

G(z) = A function relating the variation of radionuclide concentration with height for a given differential volume element.

$$= \exp\left[-(z-h)^2/2\sigma_z^2\right] + \exp\left[-(z+h)^2/2\sigma_z^2\right]$$

2π L dL dz = The differential volume element of the integral (the 2π is subsequently factored out of the integral leaving L dL dz).

A derivation of the model describing the gamma dose rate from a finite elevated plume is found in Chapter 7 of Reference 10. Numerical methods for evaluating the dose integral are found in Appendix F of Reference 3 in the form of two computer code listings. The first listing performs the integration using a Gauss-Legendre quadrature; the other utilizes a Newton-Cotes formulation. Details of these two methods may be found in Reference 9.

2.3.2 RELATIVE DEPOSITION

Relative deposition per unit area is given by:

D/Q = The sector averaged annual average deposition at any distance for a given sector.

$$= \sum_k \frac{2.55\ K_r D_g n_k}{r\ N} \quad (m^{-2})$$

where

2.55 = The inverse of the number of radians in a 22.5° sector $(2\pi/16)^{-1}$.

K_r = Terrain recirculation factor described in previous section.

D_g = Deposition rate at a given distance taken from Figure 2.3-5 for ground-level releases and Figure 2.3-6 for elevated releases.

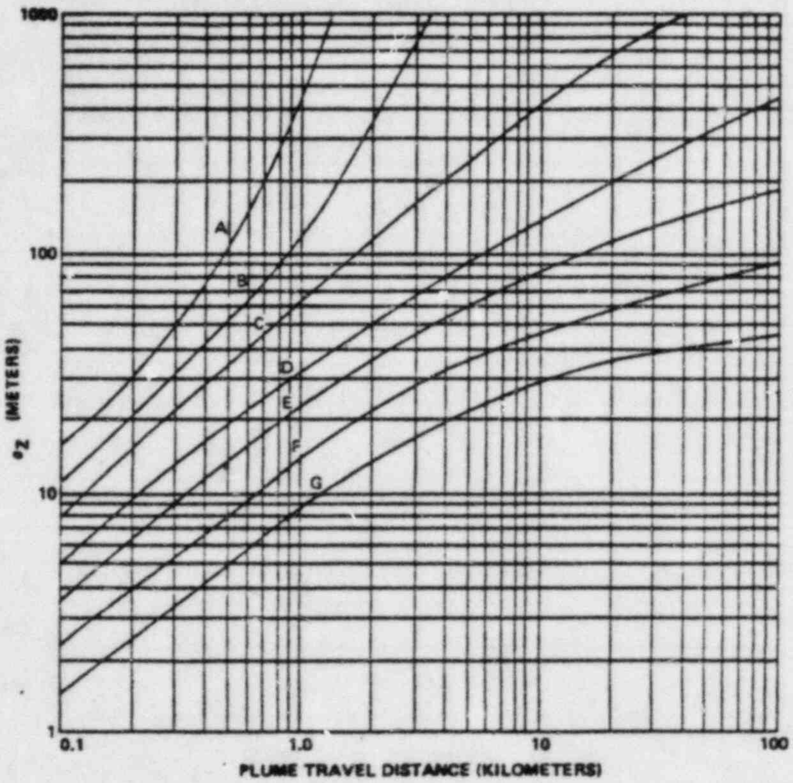
n_k = The number of hours the wind is directed into the sector of interest for a ground-level release or for an elevated release during which time stabilty category k exists. These values may be found in Tables E.4-7 and E.4-8 of Reference 5.

N = The total hours of valid meteorological data.

FIGURE 2.3-1

Vertical Standard Deviation of Material in a Plume (σ_Z)*

(Letters denote Pasquill Stability Class)

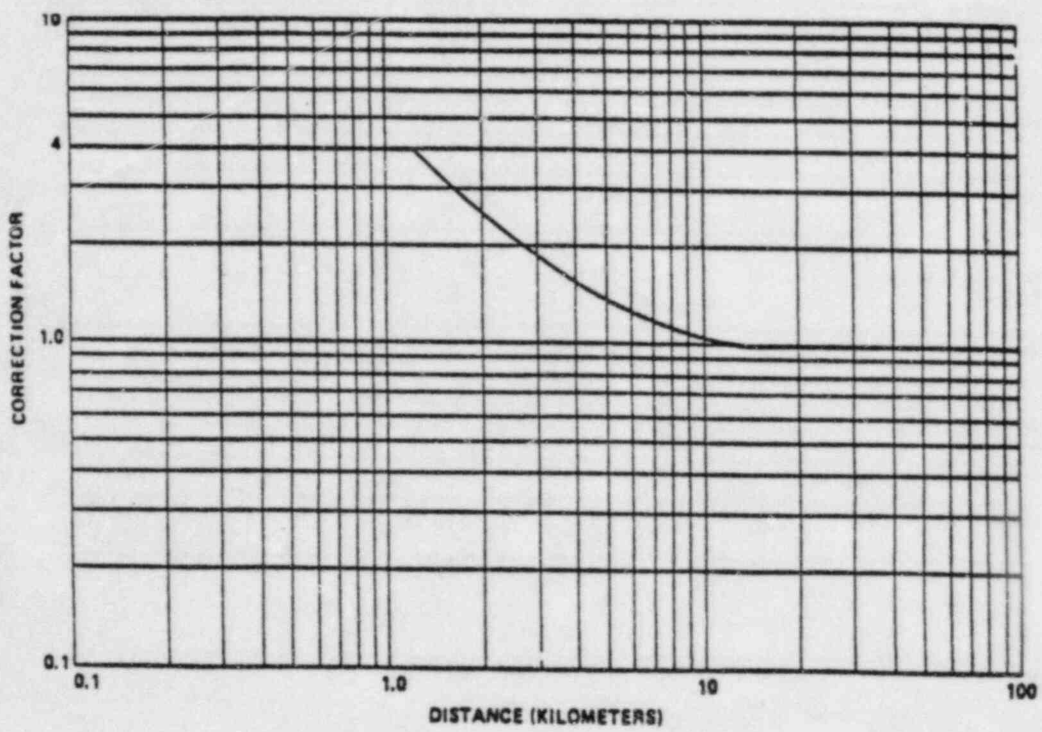


Category	Range of Vertical Temperature Gradient (°C/100m)	Range of Vertical Temperature Gradient (°F/100ft)
A	$\Delta T/\Delta Z < -1.9$	$\Delta T < -1.0$
B	$-1.9 \leq \Delta T/\Delta Z < -1.7$	$-1.0 \leq \Delta T < -0.9$
C	$-1.7 \leq \Delta T/\Delta Z < -1.5$	$-0.9 \leq \Delta T < -0.8$
D	$-1.5 \leq \Delta T/\Delta Z < -0.5$	$-0.8 \leq \Delta T < -0.3$
E	$-0.5 \leq \Delta T/\Delta Z < 1.5$	$-0.3 \leq \Delta T < 0.8$
F	$1.5 \leq \Delta T/\Delta Z < 4.0$	$0.8 \leq \Delta T < 2.2$
G	$4.0 \leq \Delta T/\Delta Z$	$2.2 \leq \Delta T$

*Reference 8

FIGURE 2.3-2

Open Terrain Recirculation Factor*

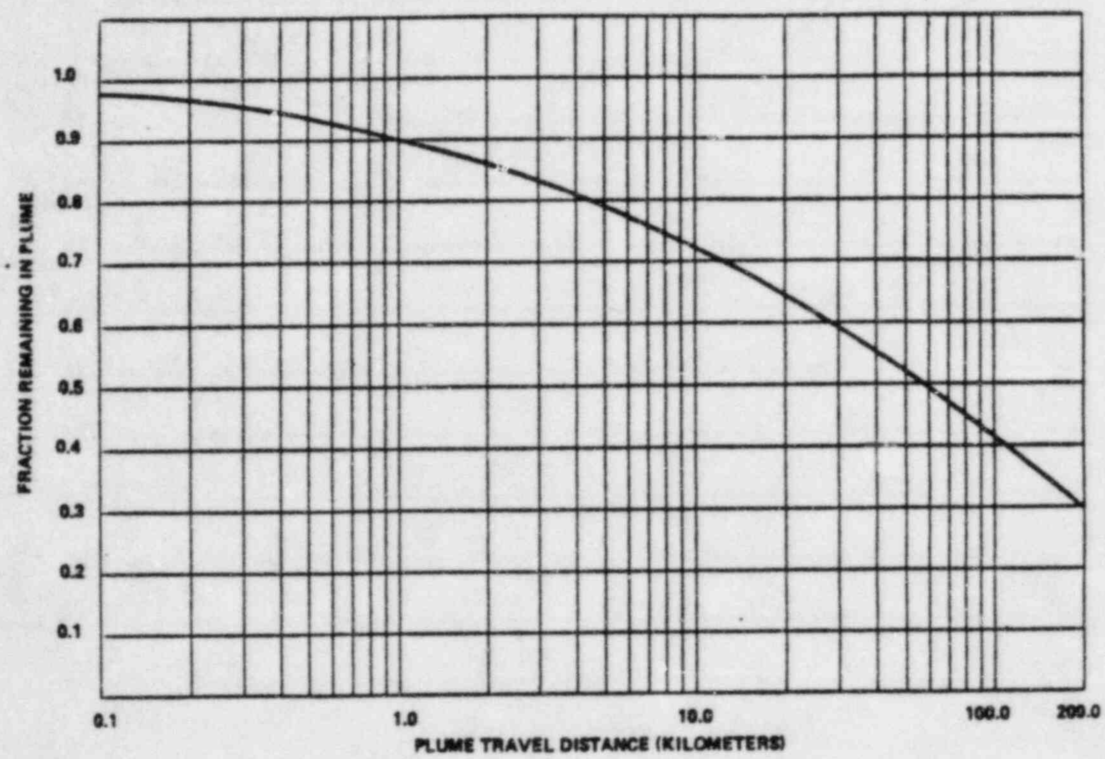


*Reference 7

FIGURE 2.3-3

Plume Depletion Effect for Ground-Level Releases

(All Atmospheric Stability Classes)

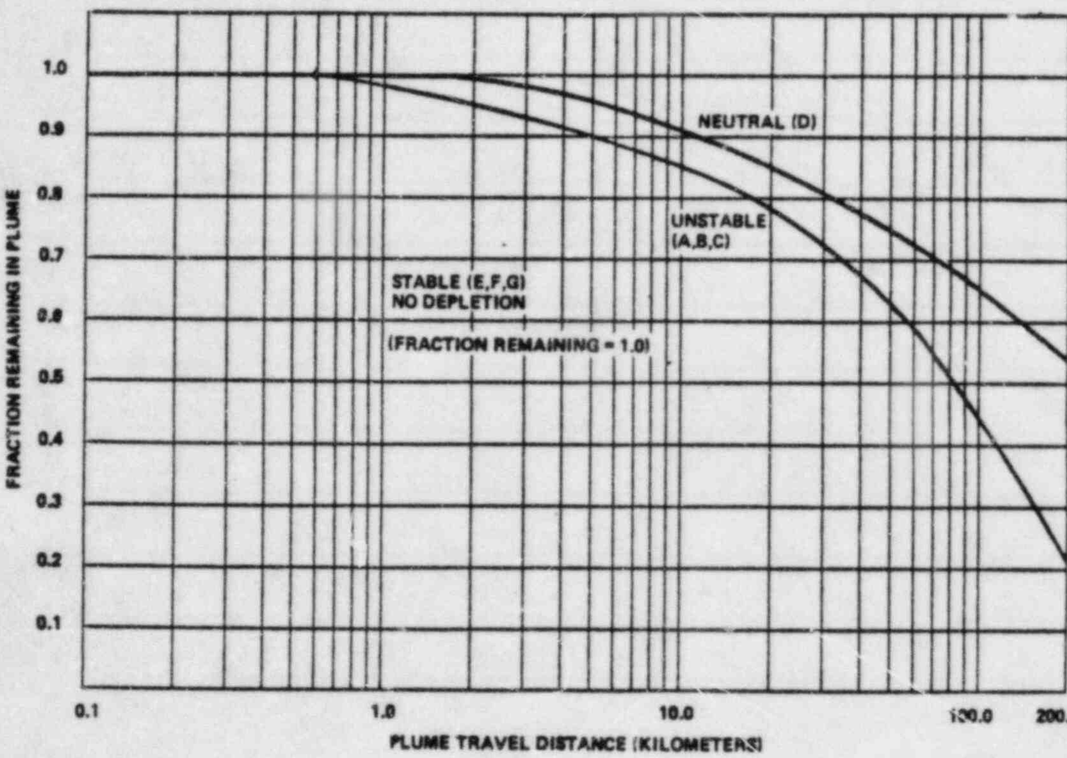


*Reference 8

FIGURE 2.3-4

Plume Depletion Effect for Greater Than 100-m Releases

(Letters denote Pasquill Stability Class)

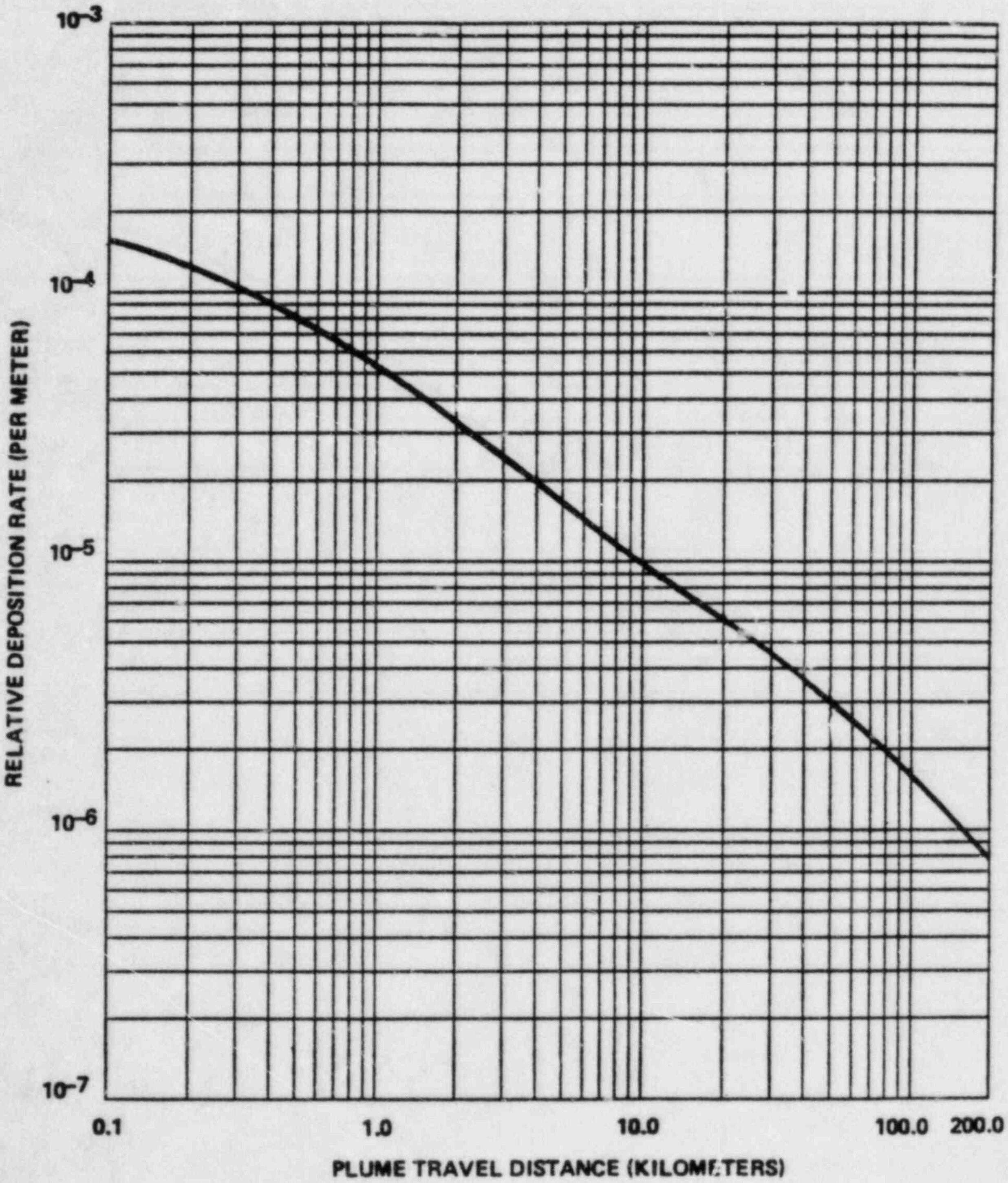


Reference 8

FIGURE 2.3-5

Relative Deposition for Ground-Level Releases

(All Atmospheric Stability Classes)

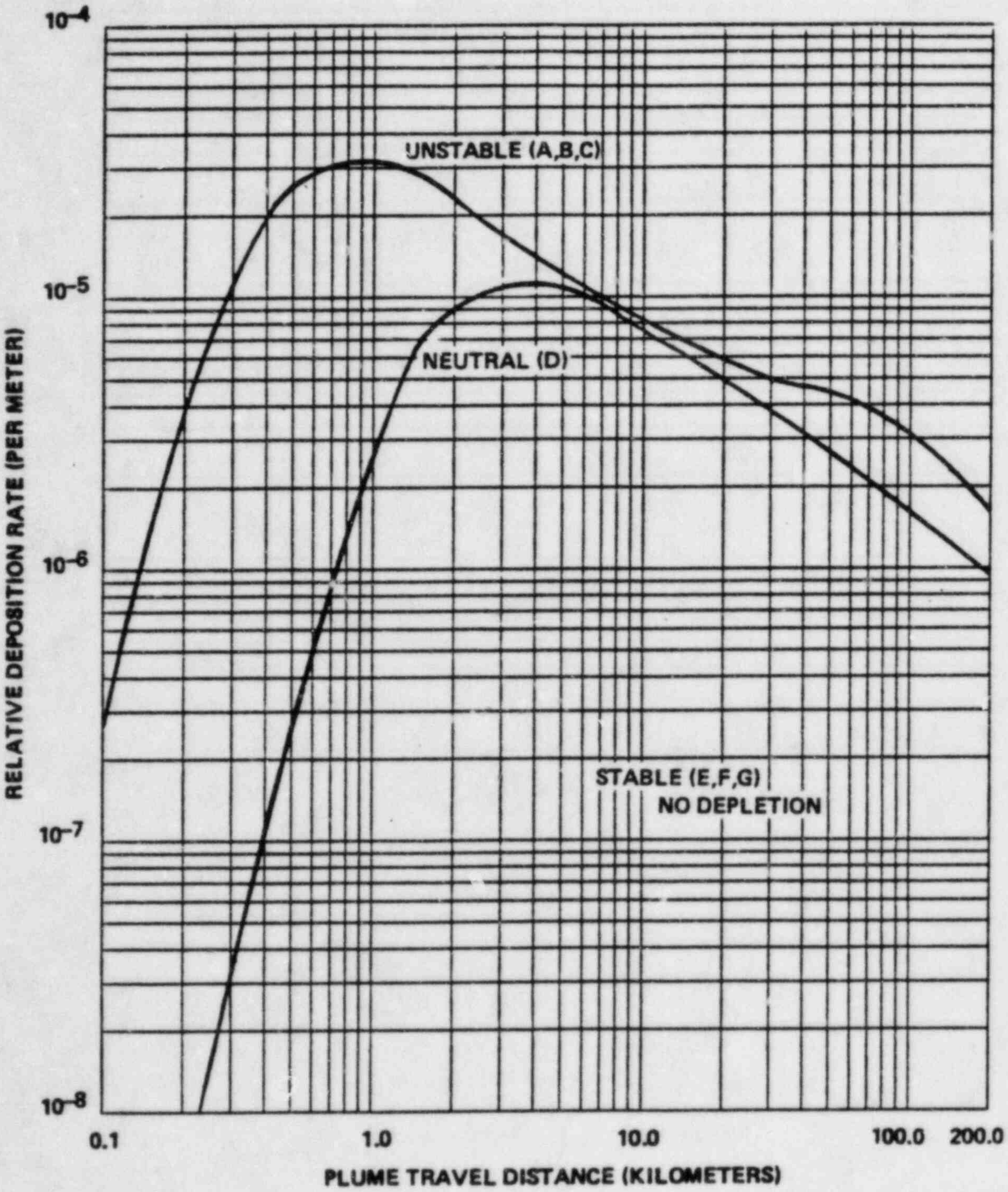


Reference 8

FIGURE 2.3-6

Relative Deposition for Greater Than 100-m Releases

(Letters denote Pasquill Stability Class)



Reference 8

2.4 DEFINITIONS OF GASEOUS EFFLUENTS PARAMETERS

Term		Definition	Section of Initial Use
$A_{\ell i}$	=	Numer of photons of energy corresponding to the ℓth energy group emitted per transformation of radionuclide i (number/transformation).	2.3.1
AG	=	administrative allocation factor for gaseous effluent pathways.	2.1.1
b	=	maximum height of the adjacent building.	2.3.1
B_i	=	constant which includes the air dose factor, for each identified noble gas radionuclide, accounting for the gamma radiation from an elevated finite plume (mrad/yr per μCi/sec).	2.1.2
B_g	=	Build up factor	2.3.1
C	=	monitor reading of a noble gas monitor corresponding to associated grab sample radionuclide concentrations.	2.1.1
C_s	=	monitor reading of the noble gas monitor at the alarm setpoint concentration.	2.1.1
D_g	=	deposition rate at a given distance taken from Figure 2.3-5 for ground-level releases and Figure 2.3-6 for elevated releases.	2.3.1
D_j	=	dose to an organ of individual from radioiodines, tritium, and radionuclides in particulate form with half-lives greater than eight days (mrem).	2.2.2.b
D_o	=	organ dose rate at time of release (mrem/yr).	2.2.1.b

Term	Definition		Section of Initial Use
D_s	=	skin dose rate at time of release (mrem/yr).	2.2.1.a
D_{ss}	=	limiting dose rate to the skin of the body of an individual in an unrestricted area which is 3000 mrem/year.	2.1.1
D_t	=	total body dose rate at time of release (mrem/yr).	2.2.1.a
D_{TB}	=	limiting dose rate to the total body of an individual which is 500 mrem/year.	2.1.1
D_β	=	air dose due to beta emissions from noble gases (mrad).	2.2.2.a
D_γ	=	air dose due to gamma emissions from noble gases (mrad).	2.2.2.a
D/Q	=	the sector averaged relative deposition for any distance in a given sector.	2.3.2
$(\overline{D/Q'})_{vp}$	=	annual average deposition parameter for the location of controlling (critical) receptor for plant vent releases.	2.2.2.b
$(\overline{D/Q'})_{vp}$	=	$1.9 \times 10^{-9}\ m^{-2}$ in the NNE sector.	2.2.2.b
$(\overline{D/Q'})_{sp}$	=	annual average deposition parameter for the location of controlling (critical) receptor for main stack releases.	2.2.2.b
$(\overline{D/Q'})_{sp}$	=	$6.9 \times 10^{-10}\ m^{-2}$ in NNE sector.	2.2.2.b
E_ℓ	=	energy assigned to energy group ℓ (MeV).	2.3.1
h	=	elevated release height (m).	2.3.1

Term	Definition	Section of Initial Use
$I_{(r)k\ell}$	= the results of numerical integration over the spatial distribution of an elevated finite plume.	2.2.1
δ	= plume depletion factor for all radionuclides other than noble gases at distance r.	
δ_k	= plume depletion factor for all radionuclides other than noble gases at a distance r for the appropriate stability class k (radioiodines and particulates).	2.3.1
K	= a constant associated with the K_i and V_i calculation representing a combination of constants and unit conversions.	2.3.1
K_i	= total body dose factor due to gamma emissions from radionuclide i (mrem/year per $\mu Ci/m^3$) from Table 2.1-1.	2.1.1
K_r	= terrain recirculation factor.	2.3.1
L	= horizontal distance from ground-level receptor to the volume element considered as a point source in the evaluation of $I_{(r)k\ell}$.	2.1.1
L_i	= skin dose factor due to beta emissions from radionuclide i (mrem/yr per $\mu Ci/m^3$) from Table 2.1-1.	2.1.1
M_i	= air dose factor due to gamma emissions from radionuclide i (mrad/yr per $\mu Ci/m^3$) from Table 2.1-1.	2.1.1
n	= number of hours the wind of wind speed class j is directed <u>into</u> the given sector during the existence of atmospheric stability class k.	2.3.1

Term	Definition		Section of Initial Use
N_i	=	air dose factor due to beta emissions from noble gas radionuclide i (mrad/yr per $\mu Ci/m^3$) from Table 2.1-1.	2.2.2.a
n_{jk}	=	number of hours meteorological conditions are observed to be in a given wind direction, wind-speed class j, and atmospheric stability class k.	2.3.1
N	=	total hours of valid meteorological data.	2.3.1
P_{io}	=	dose parameter for radionuclide i, (mrem/yr per $\mu Ci\ m^3$) for the inhalation pathway from Table 2.2-1.	2.2.1.b
Q_{iv}	=	rate of release of noble gas radionuclide i ($\mu Ci/sec$) from the vent release pathway under consideration.	2.1.1
Q_{is}	=	rate of release of noble gas radionuclide i ($\mu Ci/sec$) from the main stack.	2.1.2
$\tilde{Q}_{iv}$	=	cumulative release of noble gas radionuclide i over the period of interest (μCi) from the vent release under consideration.	2.2.2.a
$\tilde{Q}_{is}$	=	cumulative release of noble gas radionuclide i over the period of interest (μCi) from the main stack.	2.2.2.a
$\tilde{Q}_{iv}'$	=	cumulative release of radioiodine, tritium or material in particulate form from plant vent releases over the period of interest (μCi).	2.2.2.b
$\tilde{Q}_{is}'$	=	cumulative release of radioiodine, tritium or material in particulate form from the main stack over the period of interest (μCi).	2.2.2.b

Term	Definition	Section of Initial Use
r	= distance from the point of release to the receptor of interest for dispersion calculations (meters).	2.3.1
R_{aipj}	= pathway-specific, individual age-specific, organ dose factor for radionuclide i, pathway p, organ j, and age group a, (mrem/yr per $\mu Ci/m^3$) or (m^2-mrem/yr per $\mu Ci/sec$).	2.2.2.b
R_{sv}	= monitor reading per mrem/yr to the skin for vent releases.	2.1.1
R_{ss}	= monitor reading per mrem/yr to the skin for stack releases.	2.1.1
R_{tv}	= monitor reading per mrem/yr to the total body for vent releases.	2.1.1
R_{ts}	= monitor reading per mrem/yr to the total body for stack releases.	2.1.1
Σ_j	= vertical standard deviation of the plume with building wake correction.	2.3.1
Σ_{zk}	= the vertical standard deviation of the plume concentration distribution considering the initial dispersion within the building wake.	2.3.1
σ_{zk}	= vertical standard deviation of the plume (in meters), for a given distance for ground level releases under the stability category k indicated by $\Delta T/\Delta z$, from Figure 2.3-1.	2.3.1

Term	Definition	Section of Initial Use
$\Delta T/\Delta z$	= vertical temperature gradient used to determine the atmospheric stability category (°C/100m or °F/100 ft.).	2.3.1
τ_d	= tissue density thickness taken to represent the total body dose (5 gm cm^{-2}).	2.1.1
μ	= total absorbtion coefficient for air (m^{-1}).	2.3.1
μ_a	= energy absorbtion coefficient for air (m^{-1}).	2.3.1
μ_T	= the tissue energy absorbtion coefficient for photons of energy E_ℓ ($cm^2 gm^{-1}$).	2.3.1
u_j	= wind speed (midpoint of windspeed class j) at the height of release (h).	2.3.1
u_{jk}	= wind speed (midpoint of windspeed class j) at ground level (m/sec) during atmospheric stability class k.	2.3.1
U_{jk}	= wind speed (midpoint of wind speed class j) at the height of release, h, of an elevated release during atmospheric stability class k.	2.3.1
V_i	= constant, which includes the dose factor, for each identified noble gas radionuclide accouting for the gamma radiation from the elevated finite plume resulting from the main stack release in mrem/year per µCi/sec from Table 2.1-2.	2.1.2
W_{vp}'	= pathway-dependent relative dispersion or deposition in the unrestricted area at the location of the controlling receptor associated with plant vent releases.	2.2.2.b

Term	Definition	Section of Initial Use
W_{sp}'	= pathway-dependent relative dispersion or deposition in the unrestricted area at the location of the controlling receptor, associated with stack releases.	2.2.2.b
X/Q	= the sector-averaged annual average relative concentration at any distance in the given sector.	2.3.1
$\overline{X/Q}_G$	= the highest annual average relative concentration at the site boundary when considering ground-level releases.	2.1.1
$\overline{X/Q}_G$	= 6.8×10^{-6} sec/m^3 in the W sector.	
$\overline{X/Q}_E$	= the highest annual average relative concentration in the unrestricted area associated with releases from the main stack.	2.1.1
$\overline{X/Q}_E$	= 1.0×10^{-7} sec/m^3 in the W sector.	
$(\overline{X/Q'})_{vp}$	= annual average relative dispersion parameter for the location of the controlling receptor for plant vent releases.	2.2.2.b
$(\overline{X/Q'})_{vp}$	= 6.1×10^{-7} sec/m^3 in the NNE sector.	

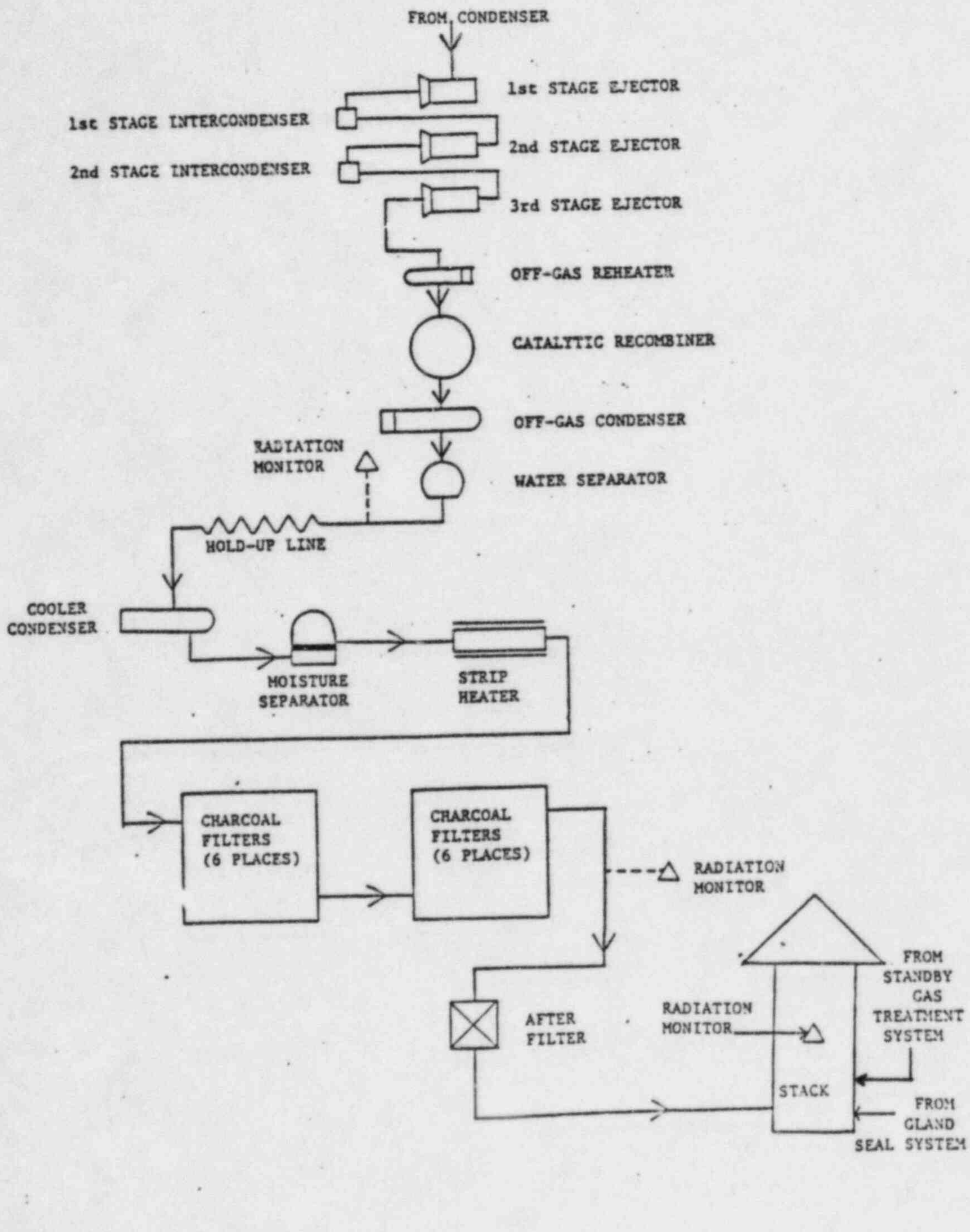
Term	Definition	Section of Initial Use
$(\overline{X/Q'})_{sp}$	= annual average relative dispersion parameter for location of controlling receptor for main stack releases.	2.2.2.b
$(\overline{X/Q'})_{sp}$	= 4.2×10^{-8} sec/m^3 in the NNE sector.	
z	= vertical distance from a ground-level receptor to the volume element considered as a point source in the evaluation of $I_{(r)k\ell}$.	2.3.1

2.5 GASEOUS RADWASTE TREATMENT SYSTEM

Figure 2.5-1 is a schematic of the Condenser Offgas Treatment System showing the release points to unrestricted areas. This schematic is representative of Unit 1 and Unit 2.

FIGURE 2.5-1

Condenser Offgas Treatment System



SECTION 3.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Sampling locations as required by RETS 4.16.1 are described in Table 3.0-1 and shown on maps in Figures 3.0-1 and 3.0-2.

There are no known drinking water users downstream of HNP. Therefore, the LLD for I-131 in water need not be as stringent as that for milk.

The survey of milk animals is based on the requirement in Appendix I to 10 CFR Part 50 that the licensee "Identify changes in the use of unrestricted areas (e.g., for agricultural purposes) to permit modifications in monitoring programs for evaluating doses to individuals from principal pathways of exposure." The consumption of milk from animals grazing on contaminated pasture and the consumption of vegetation contaminated by airborne radioiodine are major potential sources of exposure. Samples from milk animals are considered a better indicator of radioiodine in the environment than vegetation. Because sufficient milk samples frequently are not available within five miles, vegetation samples will be collected also.

Grass is available almost year-round, whereas leafy vegetation is available only for eight months of the year at best. The sampling stations for grass are located near the site boundary in two sectors with high offsite D/Q values where it might be practical to establish a vegetation plot. The highest offsite D/Q for each individual sector occurs approximately at the site boundary.

Although either fish or clam samples may be collected from the river, fish samples are preferred because the maximum dose commitment to a member of the public as a result of liquid effluents is through the fish consumption pathway.

Sediment will be collected annually because shoreline recreational areas are under water and therefore not in use approximately half the year.

Allowing deviations from the sampling schedule is based on the recognition of unavoidable practical difficulties which, in the absence of the allowed deviations, would result in violation of the RETS.

TABLE 3.0-1
RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS

LOCATION NUMBER	DESCRIPTIVE LOCATION	DIRECTION	DISTANCE (MILES)	SAMPLE TYPE (1)
064	Roadside Park	WNW	0.8	D
101	Inner Ring	N	1.9	D
102	Inner Ring	NNE	2.5	D
103	Inner Ring	NE	1.8	AD
104	Inner Ring	ENE	1.6	D
105	Inner Ring	E	3.6	D
106	Inner Ring	ESE	1.1	DV
107	Inner Ring	SE	1.2	AD
108	Inner Ring	SSE	1.6	D
109	Inner Ring	S	0.9	D
110	Inner Ring	SSW	1.1	D
111	Inner Ring	SW	0.9	D
112	Inner Ring	WSW	1.0	ADV
113	Inner Ring	W	1.1	D
114	Inner Ring	WNW	1.2	D
115	Inner Ring	NW	1.1	D
116	Inner Ring	NNW	1.6	AD
152	Williamson's	NNE	3.2	M
170	Upriver	WNW	*	R
172	Downriver	E	*	R
201	Outer Ring	N	5.0	D
202	Outer Ring	NNE	4.9	D
203	Outer Ring	NE	5.0	D
204	Outer Ring	ENE	4.9	D
205	Outer Ring	E	7.2	D
206	Outer Ring	ESE	5.0	D
207	Outer Ring	SE	4.3	D
208	Outer Ring	SSE	4.7	D
209	Outer Ring	S	4.4	D
210	Outer Ring	SSW	4.3	D
211	Outer Ring	SW	4.5	D
212	Outer Ring	WSW	4.4	D
213	Outer Ring	W	4.3	D
214	Outer Ring	WNW	5.4	D
215	Outer Ring	NW	4.5	D
216	Outer Ring	NNW	4.8	D
301	Toombs Central School	N	8.2	D
304	State Prison	ENE	11.3	AD
304	State Prison	ENE	10.8	M
309	Baxley Substation	S	10.0	ADV
311	Johnson Brothers	SW	9.1	M

TABLE NOTATION:

1. Sample Types
   A - Airborne Radioactivity
   D - Direct Radiation
   M - Milk
   R - River (fish or clams, shoreline sediment, and surface water)
   V - Vegetation

* Station 170 is located at approximately 0.8 miles for riverwater, 1.1 miles for sediment and clams, and 0.9 miles for fish.

Station 172 is located at approximately 2.3 miles for riverwater, 0.5 miles for sediment and clams, and 1.7 miles for fish.

The location from which riverwater, and sometimes clams and sediment may be taken can be rather precisely defined. Often, however, the sampling locations for clams have to be extended over a wide area to obtain a sufficient quantity; even then the quantity may not be sufficient. High water adds tn the difficulty in obtaining clam samples; high water might also make an otherwise suitable location for sediment sampling unavailable. A stretch of the river on the order of a mile or so is generally needed to obtain adequate fish samples. The mile locations given above represent approximations of the locations about which the catches are taken.

FIGURE 3.0-1

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATION MAP

(SITE PERIPHERY)

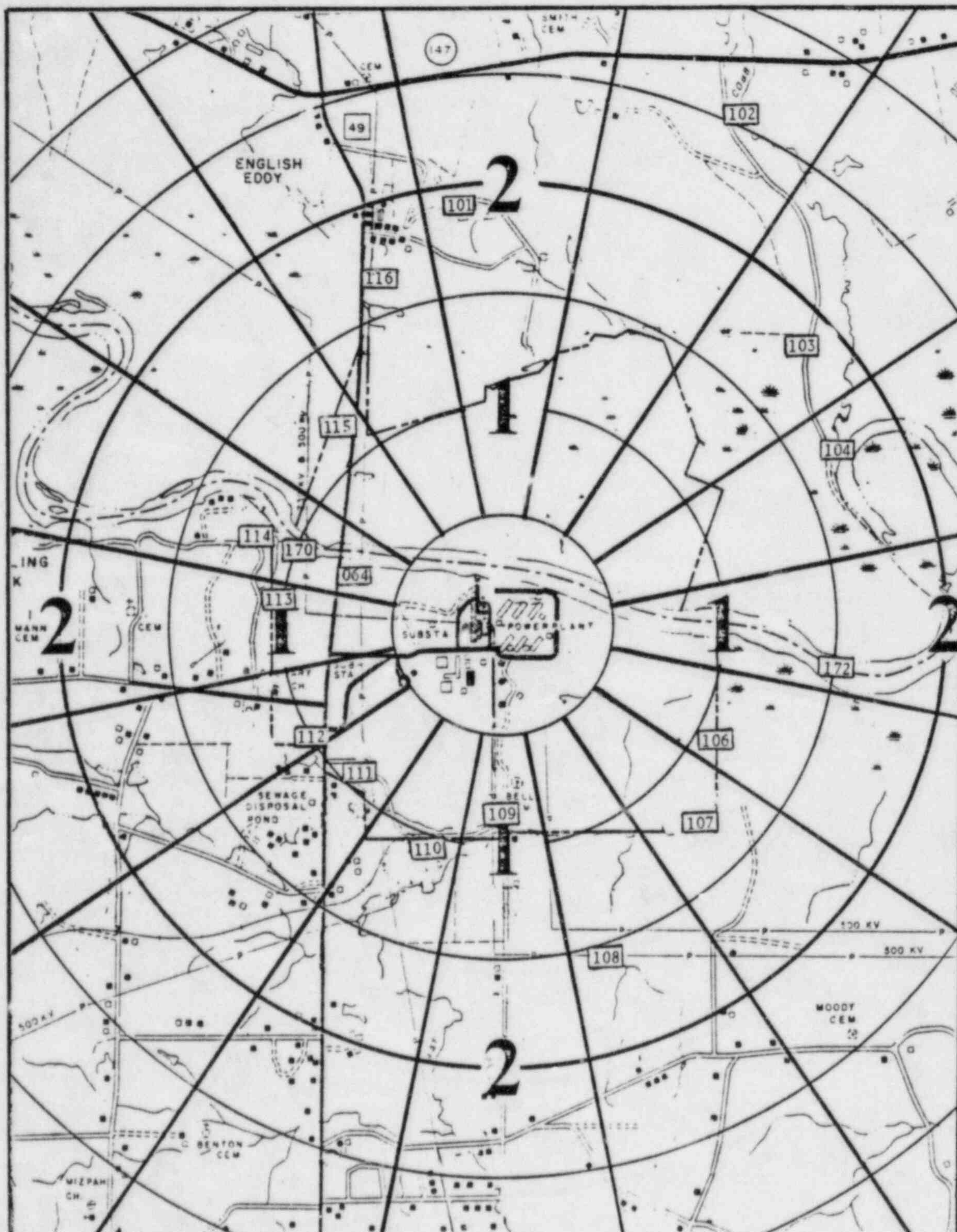


FIGURE 3.0-2 (PART 1)

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATION MAP

(BEYOND THE SITE VICINITY)

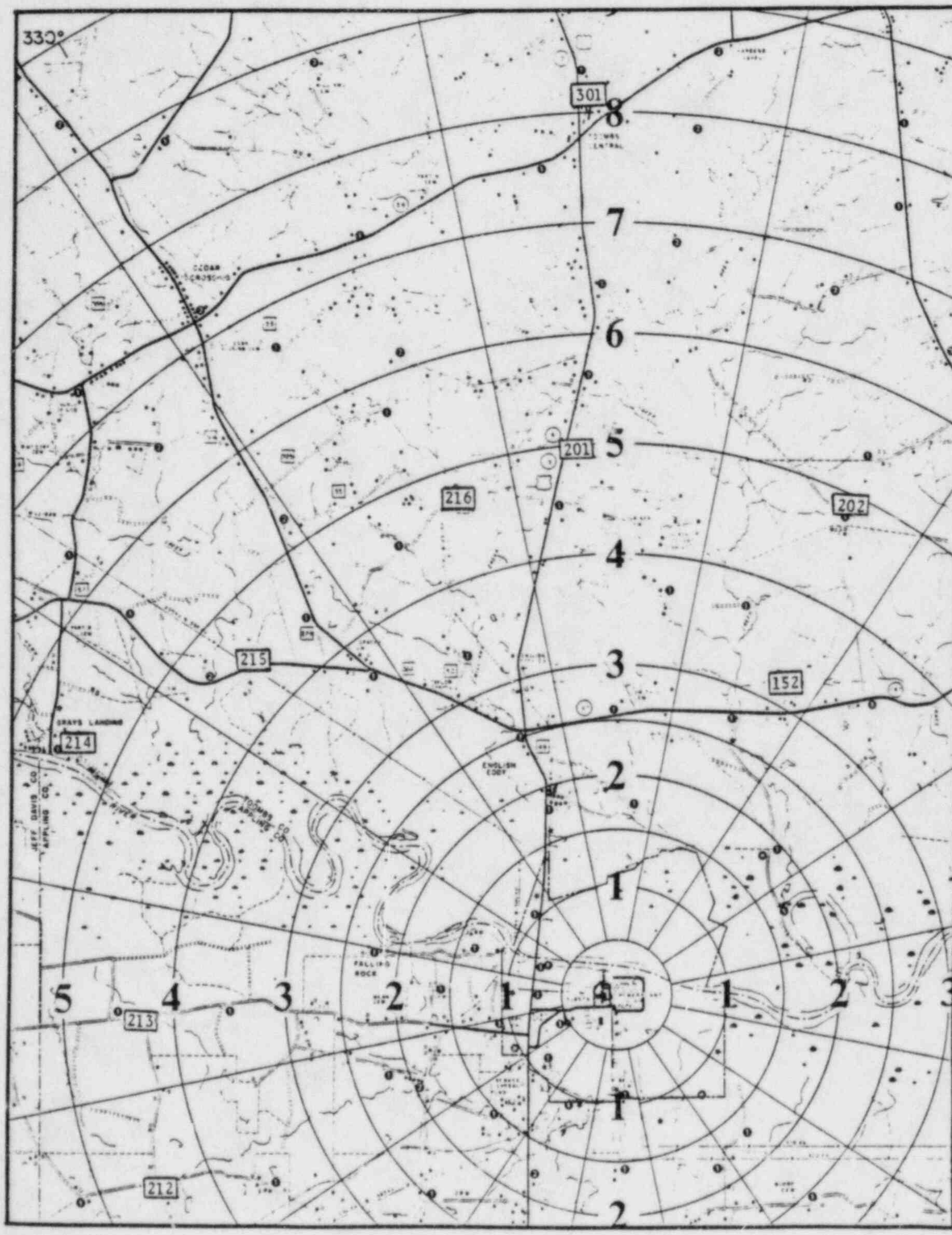


FIGURE 3.0-2 (PART 2)

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATION MAP

(BEYOND THE SITE VICINITY)

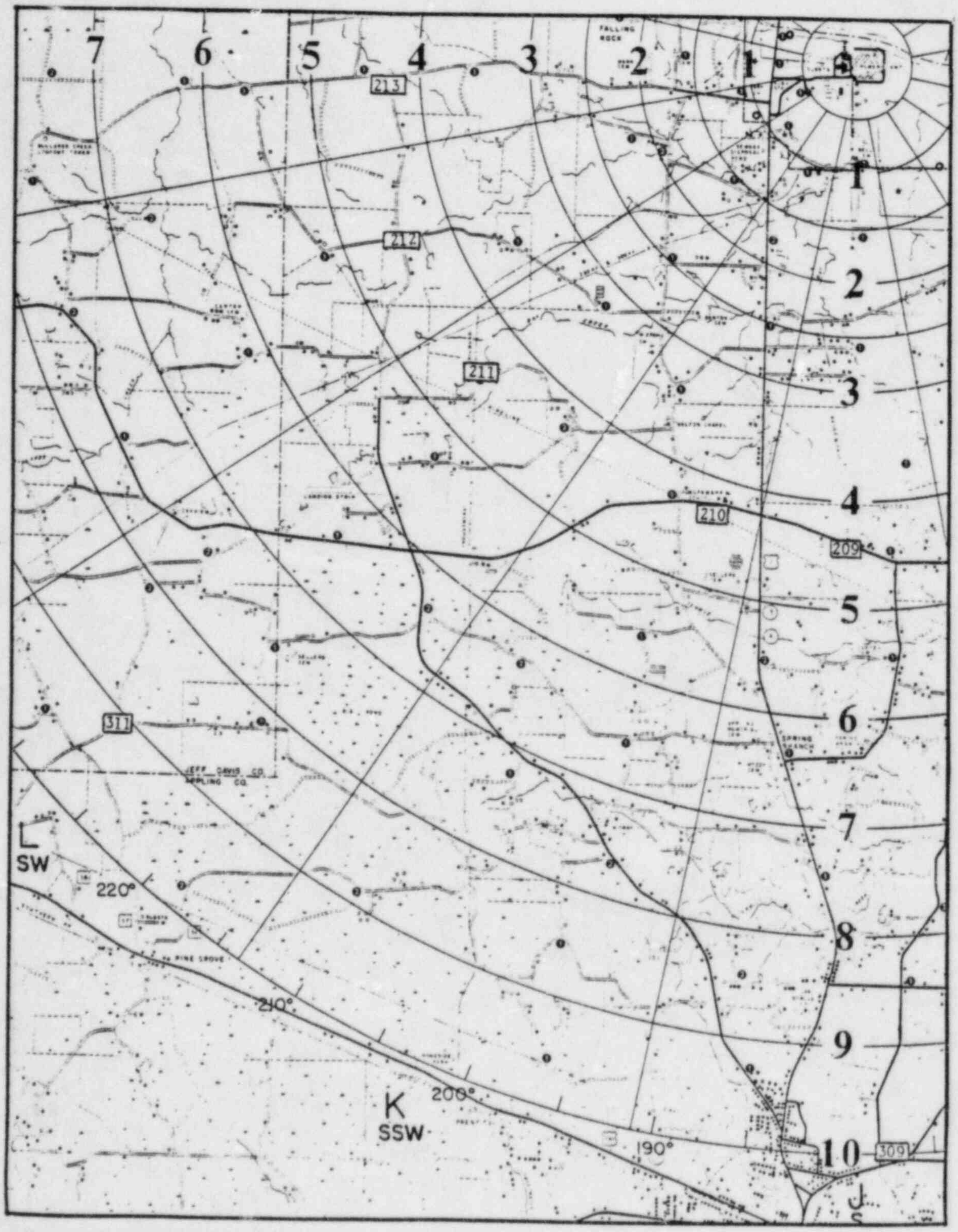
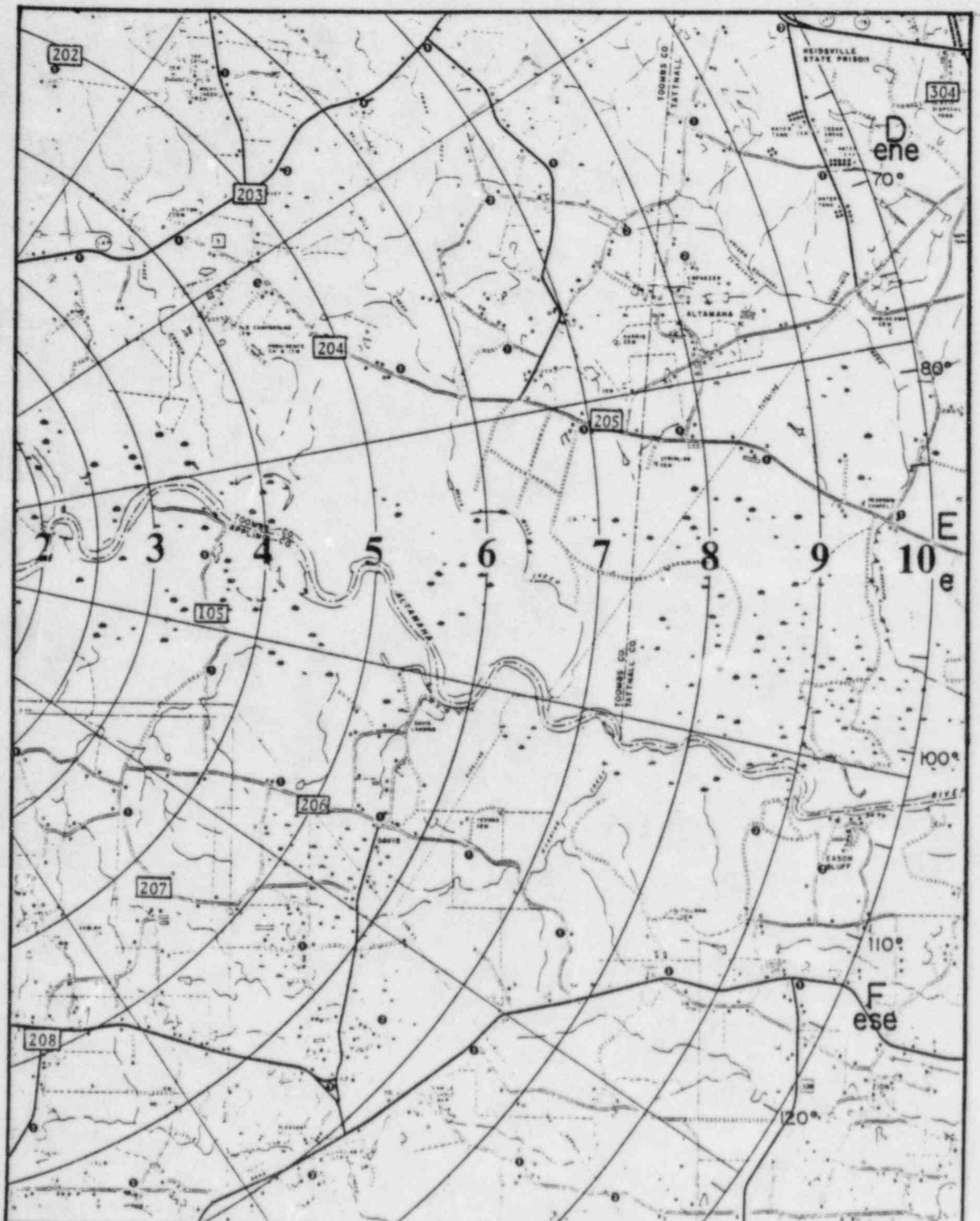


FIGURE 3.0-2 (PART 3)

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATION MAP

(BEYOND THE SITE VICINITY)



SECTION 4.0
TOTAL DOSE DETERMINATIONS

For the purpose of implementing RETS 3.15.2.5 (Unit 1) or 3.11.2.5 (Unit 2), total dose determinations will be made by calculating doses due to liquid effluents in accordance with RETS 3.15.1.2 (Unit 1) and 3.11.1.2 (Unit 2); by calculating doses due to gaseous effluents in accordance with RETS 3.15.2.3 (Unit 1) and 3.11.2.3 (Unit 2); and by combining direct radiation doses based on direct radiation measurements with these effluent doses to determine total dose to a real individual. Methodology for calculating individual doses due to liquid effluents was presented in Section 1.2. Methodology for calculating individual doses due to gaseous effluents was presented in Section 2.2.2.b.

SECTION 5.0

POTENTIAL DOSES TO MEMBERS OF THE PUBLIC DUE TO THEIR ACTIVITIES INSIDE THE SITE BOUNDARY.

For the purpose of implementing RETS 6.9.1.9, an assessment of potential doses to MEMBERS OF THE PUBLIC due to their activities within the SITE BOUNDARY will be performed if circumstances have changed such that any of the limits of RETS 3.11.2.2 (Unit 2), 3.11.2.3 (Unit 2), 3.15.2.2 (Unit 1) or 3.15.2.3 (Unit 1) are exceeded. The locations of concern within the SITE BOUNDARY are the Roadside Park, the Camping Area, Recreation Area and the Visitors Center. The relationships between annual average atmospheric dispersion of airborne radioactive materials at various locations are as follows:

Location	X/Q (Sec/m^3)	Estimated Occupancy Factor (by an individual during a year)
Site Boundary	3.26×10^{-6}	100%
Critical Receptor	6.10×10^{-7}	100%
Roadside Park	3.74×10^{-6}	< 0.1 % (2 hours)
Camping Area	3.36×10^{-6}	< 0.6 % (48 hours)
Visitors Center	1.00×10^{-5}	< 0.1 % (4 hours)
Recreation Area	6.71×10^{-7}	2.4 % (208 hours)

In the event that any limit of RETS 3.11.2.2 or 3.15.2.2 is exceeded, an assessment will be performed considering direct radiation dose to an individual resulting in submersion in the ground level plume. This assessment will take into consideration the annual average dispersion parameters and the estimated occupancy factor stated above, or a more precise value if available, for the locations of interest.

In the event that any limit of RETS 3.11.2.3 or 3.15.2.3 is exceeded, an assessment will be performed considering the internal dose to an individual due to inhalation of airborne radioactive materials suspended in the ground level plume. This assessment will take into consideration the annual average dispersion parameters and the estimated occupancy factor stated above, or a more precise value if available, for the locations of interest.

If none of the limits discussed above is exceeded, potential annual doses to an individual at the Visitors Center are not expected to exceed 0.001 mrem due to inhalation and 0.01 mrem due to direct radiation; potential doses to an individual at the Roadside Park are not expected to exceed 0.001 mrem due to inhalation and 0.01 mrem due to direct radiation; potential doses to an individual at the Camping Area are not expected to exceed 0.003 mrem due to inhalation and 0.06 mrem due to direct radiation; potential doses to an individual at the Recreation Area are not expected to exceed 0.002 mrem due to inhalation and 0.05 mrem due to direct radiation.

These values are based on annual average dispersion parameters and the estimated occupancy factors stated above. Occupancy factors for the Visitors Center, the Roadside Park, and the Camping Area are based on activities observed at these locations over the last several years. The occupancy factor for the Recreation Area is based on anticipated use of this facility.