ZION STATION UNITS 1 AND 2

NRC DOCKET NOS. 50-295 AND 50-304

ATTACHMENT 2

ZION STATION

OFFSITE DOSE CALCULATION MANUAL

COMMONWEALTH EDISON COMPANY

FEBRUARY 1979

P

Zion Station
Errata to Offsite Dose Calculation Manual (Feb. 1979)

Page	Section	Correction
1.0-2	Figure 1.1	Under "Frequency of Calculation" change the three entries labeled "weekly" to "monthly".
2.1-10		Under "D/Q)s" change Subsection 3.2.2.3 to 3.2.3.3.
2.1-11		Under "$(D/Q)_V$" change Subsection 3.2.2.3 to 3.2.3.3.
2.1-11		Under "(D/Q)g" change Subsection 3.2.2.3 to 3.2.3.3.
2.2-4		Change the symbol "t" to "t_w, t^f"
3.2-8	3.2.3.3	In the next to last paragraph change "... Appendix 7.1 and Figure 7.1-5 to 7.1-8." to "... Appendix 7.1 as Figures 7.1-5 to 7.1-8."
5.1-1	5.1.1	In the first paragraph, 8th line, change "... calculate the doses weekly, ..." to "... calculate the doses monthly, ..."
5.2-1	5.2.2	In the first paragraph under 5.2.2 change "The concentrations of non-noble gas ..." to "The concentration of non-noble gas ..."
-	Table 7.1-10	Replace the given table with the following table and footnote.

Nuclide	MPC (uCi/ml)*
Kr 85 m	2E-4
85	5E-4
87	4E-5
88	9E-5
Ar 41	7E-5
Xe 131 m	7E-4
133 m	5E-4
133	6E-4
135 m	2E-4
135	2E-4

*Computed from Equation 20 of ICRP Publication 2 (1959), adjusted for infinite cloud submersion in water, and R = 0.01 rem/week, ρ_w = 1.0 gm/cm^3, and P_w/P_t = 1.0.

-	Table 7.1-12	In the footnote change "... Table A-1, unless otherwise indicated." to "... Table A-1."

Zion Station

Errata - Continued

Page		Section	Correction
i		2.2.2	Change to read "10 CFR 20 Maximum Permissible Concentrations in the Unrestricted Area".
i	add	2.2.3	10 CFR 20 Maximum Permissible Concentrations at the Nearest Surface Water Supply.
2.2-3		2.2.2	Change title to read "10 CFR 20 Maximum Permissible Concentrations in the Unrestricted Area".
2.2-3	add	2.2.3	10 CFR 20 Maximum Permissible Concentrations at the Nearest Surface Water Supply.
			(later)
iii	add	8.0	MODELS FOR SETTING GASEOUS AND LIQUID EFFLUENT MONITOR ALARM AND TRIP SETPOINTS
			(later)
-		Table 7.2-7	Change title from "D/A At the Nearest ..." to "D/Q At the Nearest ..."

ZION STATION

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DOCKET NUMBERS

50-295 AND 50-304

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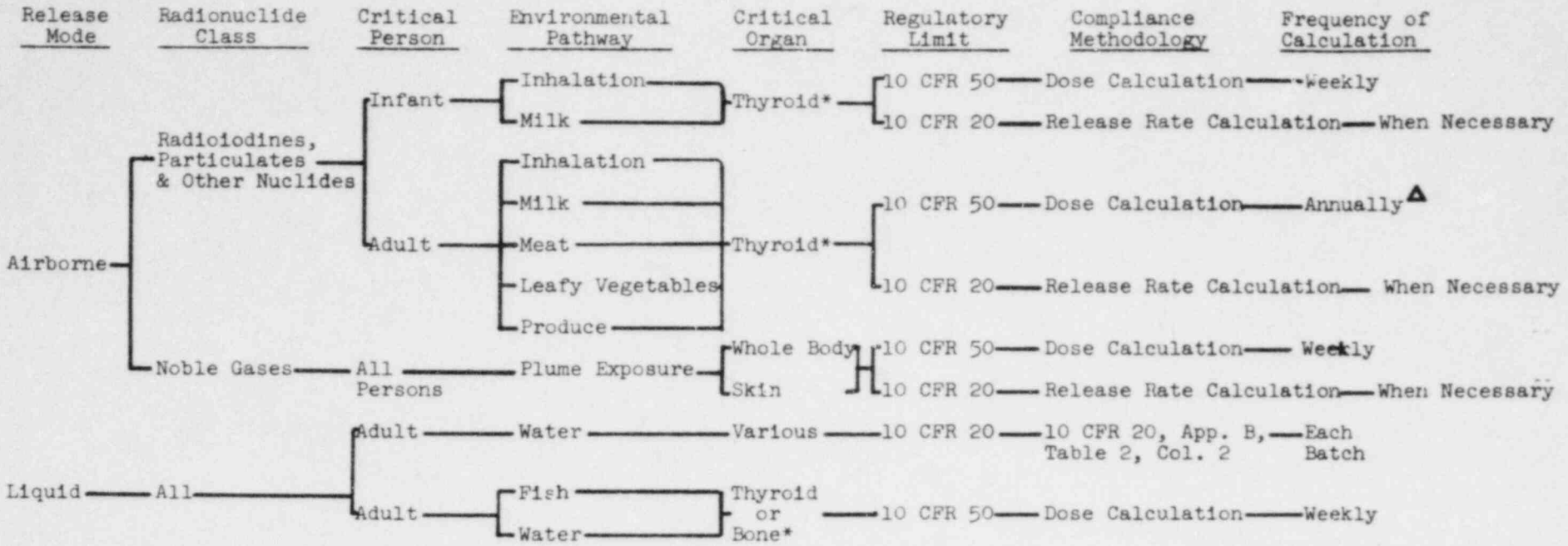
1.0 INTRODUCTION

This document provides a concise description of the environmental dose models and techniques used to calculate the offsite doses resulting from the release of radioactive material from Commonwealth Edison's nuclear power plants. A flow chart of these dose models and techniques is given in Figure 1.1. Documentation for both airborne (Sections 2.1 and 3.0) and aquatic pathways (Sections 2.2 and 4.0) are included.

Compliance with the various regulatory limits for offsite doses is demonstrated with the techniques of Section 5.0.

All site independent data used in the calculations are given in Appendix 7.1. Site specific data are given in Appendix 7.2.



* Most likely critical organ; however, dose is computed for 7 organs.

Δ The computation of dose to the adult is performed annually to confirm the premise that the infant is the critical person.

Figure 1.1
Flow Chart for Off-site Dose Calculations

2.0 OFFSITE DOSE LIMITS

2.1 AIRBORNE RELEASES

2.1.1 Noble Gases

2.1.1.1 10 CFR 50 Appendix I Dose Limits

2.1.1.1.1 Air Dose

The average air dose in unrestricted areas due to noble gases released in gaseous effluents from the site shall be limited to the following expressions:

2.1.1.1.1.1 Gamma Air Dose

####### 2.1.1.1.1.1.1 Gamma Air Dose, Calendar Quarter

$$3.17 \times 10^{-8} \sum_i \left[S_i \, A_{is} + V_i \, A_{iv} + G_i \, A_{ig} \right] \leq 5 \times N \text{ mrad} \qquad (2.1)$$

3.17×10^{-8} Conversion Constant (years/second)

Converts seconds to years.

S_i Gamma Dose Constant, Stack Release (mrad/yr per μCi/sec)

The gamma ray air dose constant for each identified noble gas radionuclide released from a stack (Appendix 7.2). The constant is evaluated for a finite plume using the methods explained in Subsection 3.3.1.2.

A_{is} Accumulative Noble Gas Release, Stack Release (μCi)

The accumulative release of noble gas radionuclide i from a stack. Releases shall

be cumulative over the calendar quarter or year (four consecutive quarters) as appropriate.

V_i Gamma Dose Constant, Vent Release (mrad/yr per μCi/sec)

The gamma ray air dose constant for each identified noble gas radionuclide released from a vent (Appendix 7.2). The plume may be elevated part of the time as determined by the criteria of Regulatory Guide 1.111 (Reference 6.4), part C.2.b. The constant is evaluated for a finite plume using the method explained in Subsection 3.3.1.2.

A_{iv} Accumulative Noble Gas Release, Vent Release (μCi)

The accumulative release of noble gas radionuclide i from a vent. Releases shall be cumulative over the calendar quarter or year (four consecutive quarters) as appropriate.

G_i Gamma Dose Constant, Ground Level Release (mrad/yr per μCi/sec)

The gamma ray air dose constant for each identified noble gas radionuclide released from a ground level release point (Appendix 7.2). The constant is evaluated for a finite plume using the method explained in Subsection 3.3.1.2.

A_{ig} Accumulative Noble Gas Release, Ground Level Release (μCi)

The accumulative release of noble gas radionuclide i from a ground level release point. Releases shall be cumulative over the calendar

quarter or year (four consecutive quarters) as appropriate.

N — Reactor Units
The number of reactor units at a site.

2.1.1.1.1.2 Gamma Air Dose, Calendar Year (Four Consecutive Quarters)

$$3.17 \times 10^{-8} \sum_i \left[S_i A_{is} + V_i A_{iv} + G_i A_{ig} \right] \leq 10 \times N \text{ mrad} \quad (2.2)$$

2.1.1.1.1.2 Beta Air Dose

2.1.1.1.1.2.1 Beta Air Dose, Calendar Quarter

$$3.17 \times 10^{-8} \sum_i L_i \left[(\chi/Q)_s A_{is} + (\chi/Q)_v A_{iv} + (\chi/Q)_g A_{ig} \right] \leq 10 \times N \text{ mrad} \quad (2.3)$$

L_i — Beta Air Dose Constant (mrad/yr per $\mu Ci/m^3$)
The air dose factor due to beta emissions for each identified noble gas radionuclide. (Table 7.1-13)

$(\chi/Q)_s$ — Relative Effluent Concentration, Stack Release (sec/m^3)
The highest calculated annual average relative concentration in a given direction at or beyond the restricted area boundary for stack releases.

$(\chi/Q)_v$ Relative Effluent Concentration, Vent Release (sec/m^3)

The highest calculated annual average relative concentration in a given direction at or beyond the restricted area boundary for vent releases. The partially elevated plume model of Regulatory Guide 1.111, part C.2.b (Reference 6.4) is used when necessary. See Subsection 3.2.2.3.

$(\chi/Q)_g$ Relative Effluent Concentration, Ground Level Release (sec/m^3)

The highest calculated annual average relative concentration in a given direction at or beyond the restricted area boundary for ground level releases.

2.1.1.1.1.2.2 Beta Air Dose, Calendar Year (Four Consecutive Quarters)

$$3.17 \times 10^{-8} \sum_i L_i \left[(\chi/Q)_s A_{is} + (\chi/Q)_v A_{iv} + (\chi/Q)_g A_{ig} \right] \leq 20 \times N \text{ mrad} \quad (2.4)$$

2.1.1.1.2 Whole Body Dose

The average dose to individuals in unrestricted areas due to noble gases released in gaseous effluents from the site shall be limited to the following expressions:

2.1.1.1.2.1 Whole Body Dose, Calendar Quarter

$$(0.7)(1.11)(3.17 \times 10^{-8}) \sum_i \left[\bar{S}_i A_{is} + \bar{V}_i A_{iv} + \bar{G}_i A_{ig} \right] \leq 2.5 \times N \text{ mrem} \quad (2.5)$$

0.7 Shielding and Occupancy Factor

The shielding and occupancy factor for protection against gamma radiation.

1.11 Conversion Constant (mrem/mrad)

Converts rads in air to rems in tissue.

$\bar{S}_i$ Gamma Whole Body Dose Constant, Stack Release (mrad/yr per μCi/sec)

$\bar{S}_i$ is the constant S_i multiplied by the shielding factor afforded by 5 cm of tissue; used to evaluate whole body dose. (See Subsection 3.3.1.2).

$\bar{V}_i$ Gamma Whole Body Dose Constant, Vent Release (mrad/yr per μCi/sec)

The constant V_i multiplied by the shielding factor afforded by 5 cm of tissue; used to evaluate whole body dose. (See Subsection 3.3.1.2).

$\bar{G}_i$ Gamma Whole Body Dose Constant, Ground Level Release (mrad/yr per μCi/sec)

The constant G_i multiplied by the shielding factor afforded by 5 cm of tissue; used to evaluate whole body dose. (See Subsection 3.3.1.2.)

2.1.1.1.2.2 Whole Body Dose, Calendar Year (Four Consecutive Quarters)

$$(0.7)(1.11)(3.17 \times 10^{-8}) \sum_i \left[\bar{S}_i A_{is} + \bar{V}_i A_{iv} + \bar{G}_i A_{ig} \right] \leq 5 \times N \text{ mrem} \quad (2.6)$$

2.1.1.1.3 Skin Dose

The average skin dose to individuals in unrestricted areas due to noble gas released in gaseous effluents from the site shall be limited to the following expressions:

2.1.1.1.3.1 Skin Dose, Calendar Quarter

$$3.17 \times 10^{-8} \sum_i \left[0.5 \bar{L}_i \left((\chi/Q)_s A_{is} + (\chi/Q)_v A_{iv} + (\chi/Q)_g A_{ig} \right) + (0.7)(1.11)(S_i A_{is} + V_i A_{iv} + G_i A_{ig}) \right] \leq 7.5 \times N \text{ mrem} \quad (2.7)$$

0.5 — Shielding and Occupancy Factor

The shielding and occupancy factor for protection against beta radiation.

$\bar{L}_i$ — Beta Skin Dose Constant (mrem/yr per $\mu Ci/m^3$)

The skin dose factor due to beta emissions for each identified noble gas radionuclide (Table 7.1-13). Accounts for attenuation of beta radiation during passage through 7 mg/cm^2 of dead skin.

2.1.1.1.3.2 Skin Dose, Calendar Year (Four Consecutive Quarters)

$$3.17 \times 10^{-8} \sum_i \left[0.5 \bar{L}_i \left((\chi/Q)_s A_{is} + (\chi/Q)_v A_{iv} + (\chi/Q)_g A_{ig} \right) + (0.7)(1.11)(S_i A_{is} + V_i A_{iv} + G_i A_{ig}) \right] \leq 15 \times N \text{ mrem} \quad (2.8)$$

2.1.1.2 10 CFR 20 Release Rate Limits

The maximum dose rate to individuals in unrestricted areas due to noble gases released in gaseous effluents from the site shall be limited to the following expressions:

2.1.1.2.1 Whole Body Dose Rate, Calendar Year (Four Consecutive Quarters)

$$1.11 \times \sum_i \left[\bar{S}_i \, Q_{is} + \bar{V}_i \, Q_{iv} + \bar{G}_i \, Q_{ig} \right] < 500 \text{ mrem/yr} \quad (2.9)$$

(10 CFR 20.105 limit)

Q_{is} Release Rate, Stack Release (μCi/sec)

The release rate for radionuclide i due to a stack release.

Q_{iv} Release Rate, Vent Release (μCi/sec)

The release rate for radionuclide i due to a vent release.

Q_{ig} Release Rate, Ground Level Release (μCi/sec)

The release rate for radionuclide i due to a ground level release.

2.1.1.2.2 Skin Dose Rate, Calendar Year (Four Consecutive Quarters)

$$\sum_i \left[\bar{L}_i \left((\chi/Q)_s \, Q_{is} + (\chi/Q)_v \, Q_{iv} + (\chi/Q)_g \, Q_{ig} \right) + 1.11 \times (S_i \, Q_{is} + V_i \, Q_{iv} + G_i \, Q_{ig}) \right] \leq 300 \text{ mrem/yr} \quad (2.10)$$

(10 CFR 20.105 limit)

2.1.2 Radioiodines, "Particulates", and Other (Non-Noble Gas) Radionuclides

2.1.2.1 10 CFR 50 Appendix I Dose Limits

The average dose to an individual in the unrestricted area from radioiodines, radioactive materials in particulate form, and radionuclides other than noble gases in gaseous effluents released from the site shall be limited to the following expressions:

(The specific model for computing the dose to the various organs of an adult or infant is given in Equation 2.11. For the purpose of demonstrating compliance with the Technical Specifications, the dose to an infant who inhales air and drinks milk containing radioactive material shall be limiting. However, the dose model may be used to compute the dose to an adult who inhales radioactivity and ingests meat, milk, produce, or leafy vegetables containing radioactivity. The choice of the infant as the critical person is based on previous calculations of dose reported in semi-annual or annual reports. Annually, the dose to an adult will be computed to confirm the choice of an infant as "critical person".)

2.1.2.1.1 Inhalation + Food Pathways Dose, Calendar Quarter

$$\text{Inhalation: } 3.17 \times 10^{-8} \times 10^{+6} R_a \sum_i DFA_{ija} \left[(\chi/Q)_s A_{is} + (\chi/Q)_v A_{iv} + (\chi/Q)_g A_{ig} \right]$$

$$\text{Food: } + \frac{t_r}{365} \sum_i DFI_{ija} \left[U_a^P f_P C_i^P + U_a^M C_i^M + U_a^V f_V C_i^V + U_a^F C_i^F \right] \leq 7.5 \times N \text{ mrem} \quad (2.11)$$

10^6 Conversion Constant (pCi/μCi)

Converts μCi to pCi.

$\frac{1}{365}$ — Conversion Constant (yrs/day)

Converts days to years.

R_a — Individual Air Intake Rate (m^3/yr)

The air intake rate for individuals in group a. See Tables 7.1-2 and 7.1-3.

t_r — Deposition Time or Release Period (days)

Length of time for deposition.

DFA_{ija} — Inhalation Dose Factor (mrem/pCi)

The inhalation dose commitment factor for radionuclide i, organ j and age group a. See Table 7.1-1.

DFI_{ija} — Ingestion Dose Factor (mrem/pCi)

The ingestion dose commitment factor for radionuclide i, organ j and age group a. See Table 7.1-1.

U_a^P, U_a^M, U_a^V, U_a^F — Foodstuff Consumption Rates (kg/yr, liters/yr, kg/yr, kg/yr, respectively)

The annual consumption rates (usages) of produce (non-leafy vegetables, fruits, and grain), milk, leafy vegetables, and meat (flesh), respectively, for individuals in age group a. See Tables 7.1-2 and 7.1-3.

f_P, f_V — Produce, Leafy Vegetable Fractions

The respective fractions of the ingested produce and leafy vegetables that are grown in the garden of interest; dimensionless. See Table 7.1-2.

C_i^P, C_i^M, C_i^V, C_i^F — Foodstuff Concentrations (pCi/kg, pCi/liter, pCi/kg, pCi/kg, respectively)

The average concentrations of radionuclide i in produce (non-leafy vegetables, fruits, and grain), milk, leafy vegetables, and meat (flesh), respectively.

C_i^P Produce Concentration (pCi/kg)

The concentration of radionuclide i in produce (non-leafy vegetables)

$$C_i^P = d_i \times r \frac{[1 - \exp(-\lambda_{Ei} t_e)]}{Y_v \lambda_{Ei}} \exp(-\lambda_i t_h) \quad (2.12)$$

d_i Deposition Rate (pCi/m^2- hr)

The deposition rate of radionuclide i onto the ground.

$$d_i = \frac{10^{+6}}{24 \times t_r} \left[A_{is} (D/Q)_s + A_{iv} (D/Q)_v + A_{ig} (D/Q)_g \right] \quad (2.13)$$

24 Conversion Constant (hr/day)

Converts days to hours.

$(D/Q)_s$ Relative Deposition Factor, Stack Release (m^{-2})

The highest calculated annual average relative deposition factor in a given direction at or beyond the restricted area boundary for stack releases. (See Subsection 3.2.2.3.)

$(D/Q)_v$ Relative Deposition Factor, Vent Release (m^{-2})

The highest calculated annual average relative deposition factor in a given direction at or beyond the restricted area boundary for vent releases. The

partially elevated plume model of Regulatory Guide 1.111, part C.2.b is used. (See Subsection 3.2.2.3.)

$(D/Q)_g$ Relative Deposition Factor, Ground Level Release (m^{-2})

The highest calculated annual average relative deposition factor in a given direction at or beyond the restricted area boundary for ground level releases. (See Subsection 3.2.2.3.)

r Crop Retention Fraction

The fraction of deposited activity retained on crops; dimensionless; see Tables 7.1-2 and 7.1-3.

λ_{Ei} Effective Decay Constant (hr^{-1})

The effective removal rate constant for radionuclide i from crops

$$\lambda_{Ei} = \lambda_i + \lambda_w$$

λ_i Radiological Decay Constant (hr^{-1})

The radiological decay constant for radionuclide i. See Table 7.1-11.

λ_w Weathering Decay Constant (hr^{-1})

The removal constant for physical loss by weathering. See Tables 7.1-2 and 7.1-3.

t_e Effective Crop Exposure Time (hr)

The effective crop exposure time. See Tables 7.1-2 and 7.1-3.

t_h Harvest to Consumption Time (hr)
The time between harvest and consumption. See Table 7.1-2.

Y_v Productivity Yield (kg/m^2)
The agricultural productivity yield. See Tables 7.1-2 and 7.1-3.

C_i^M Milk Concentration (pCi/liter)
The concentration of radionuclide i in milk.

C_i^M is calculated from the following equation (after Regulatory Guide 1.109 (Reference 6.5)).

$$C_i^M = F_M C_i^f Q_f \exp(-\lambda_i t_M) \quad (2.14)$$

F_M Milk Fraction (days/liter)
The average fraction of the animal's daily intake of radionuclide i which appears in each liter of milk. See Table 7.1-4.

C_i^f Feed Concentration (pCi/kg)
The average concentration of radionuclide i in animal feed.

For milk and meat pathways, the following expression is to be used (after Regulatory Guide 1.109, (Reference 6.5)).

$$C_i^f = f_f f_g C_i^g + (1-f_f) C_i^s + f_f (1-f_g) C_i^s \quad (2.15)$$

f_f Pasture Fraction
The fraction of the year that animals graze on pasture. See Table 7.1-2.

f_g Pasture Grass Fraction

The fraction of daily feed that is pasture grass when the animal grazes on the pasture. See Table 7.1-2.

C_i^g Pasture Grass Concentration (pCi/kg)

The concentration of radionuclide i in pasture grass (calculated using Equation 2.12 for C_i^P with $t_h = 0$; other parameters are given in Tables 7.1-2 and 7.1-3.

C_i^s Stored Feed Concentration (pCi/kg)

The concentration of radionuclide i in stored feed (calculated using Equation 2.12 for C_i^P with t_h = 90 days; other parameters are given in Tables 7.1-2 and 7.1-3).

Q_f Feed Consumption (kg/day)

The amount of feed consumed by the animal each day. See Table 7.1-3.

t_M Milk Transport Time (hr)

The average time from the production of milk to its consumption; 2 days is assumed.

C_i^V Leafy Vegetable Concentration (pCi/kg)

The concentration of radionuclide i in leafy vegetables.

C_i^V uses the same expression as C_i^P (Equation 2.12) but uses appropriate values for parameters r, Y_v, λ_{Ei}, t_e, t_h. See Tables 7.1-2 and 7.1-3.

C_i^F Meat Concentration (pCi/kg)
The concentration of radionuclide i in meat.

$$C_i^F = F_F \, C_i^f \, Q_f \exp(-\lambda_i t_s) \tag{2.16}$$

F_F Meat Fraction (days/kg)
The fraction of the animal's daily intake of radionuclide i which appears in each kg of flesh. See Table 7.1-4.

t_s Slaughter to Consumption Time (hr)
The time from slaughter to consumption. See Table 7.1-2.

2.1.2.1.2 Inhalation + Food Pathways Dose, Calendar Year (Four Consecutive Quarters)

$$3.17 \times 10^{-8} \times 10^{+6} \, R_a \sum_i DFA_{ija} \left[(\chi/Q)_s \, A_{is} + (\chi/Q)_v \, A_{iv} + (\chi/Q)_g \, A_{ig} \right]$$
$$+ \frac{t_r}{365} \sum_i DFI_{ija} \left[U_a^P \, f_P \, C_i^P + U_a^M \, C_i^M + U_a^V \, f_V \, C_i^V + U_a^F \, C_i^F \right] \tag{2.17}$$
$$\leq 15 \times N \text{ mrem}$$

2.1.2.2 10 CFR 20 Release Rate Limit

The maximum dose rate to an organ of an infant from all radionuclides and radioactive materials in particulate form and radionuclides other than noble gases shall be limited to the values given by the equations below. For purposes of demonstrating compliance with the Technical Specifications, the dose to the infant shall be considered limiting.

Inhalation: (Regulatory Guide 1.109, Eq. 13)

$$10^{+6} R_a \sum_i DFA_{ija} \left[(\chi/Q)_s Q_{is} + (\chi/Q)_v Q_{iv} + (\chi/Q)_g Q_{ig} \right] \quad (2.18)$$

Milk: (Regulatory Guide 1.109 Eq. 14)

$$+ K \sum_i DFI_{ija} U_a^M C_i^M < 1500 \text{ mrem/yr}$$

K Seasonal Adjustment Factor

K is a seasonal adjustment factor to account for nongrazing during the winter and partial grazing during the summer; = 0 for November-April; = 0.5 for May-October.

C_i^M Milk Concentration (pCi/liter)

The concentration of radionuclide i in milk

$$C_i^M = F_M C_i^f Q_f \exp(-\lambda_i t_f) \quad (2.19)$$

C_i^f Feed Concentration (pCi/kg)

The concentration of radionuclide i in feed

$$C_i^f = d_i \times r \left[\frac{1 - \exp(-\lambda_{Ei} t_e)}{Y_v \lambda_{Ei}} \right] \quad (2.20)$$

(Note that this assumes feed to be 100% pasture grass.)

d_i Deposition Rate (pCi/m^2. hr)

$$d_i = 3600 \times 10^{+6} \times \left[Q_{is} (D/Q)_s + Q_{iv} (D/Q)_v + Q_{ig} (D/Q)_g \right] \quad (2.21)$$

SYMBOLS USED IN SECTION 2.1

SYMBOL	NAME	UNIT
S_i	Gamma Dose Constant, Stack Release	(mrad/yr per μCi/sec)
A_{is}	Accumulative Noble Gas Release, Stack	(μCi)
V_i	Gamma Dose Constant, Vent Release	(mrad/yr per μCi/sec)
A_{iv}	Accumulative Noble Gas Release, Vent	(μCi)
G_i	Gamma Dose Constant, Ground Level Release	(mrad/yr per μCi/sec)
A_{ig}	Accumulative Noble Gas Release, Ground Level	(μCi)
N	Reactor Units	
L_i	Beta Dose Constant	(mrad/yr per μCi/m^3)
$(\chi/Q)_s$	Relative Effluent Concentration, Stack Release	(sec/m^3)
$(\chi/Q)_v$	Relative Effluent Concentration, Vent Release	(sec/m^3)
$(\chi/Q)_g$	Relative Effluent Concentration, Ground Level Release	(sec/m^3)
$\overline{S_i}$	Gamma Whole Body Dose Constant, Stack Release	(mrad/yr per μCi/sec)
$\overline{V_i}$	Gamma Whole Body Dose Constant, Vent Release	(mrad/yr per μCi/sec)
$\overline{G_i}$	Gamma Whole Body Dose Constant, Ground Level Release	(mrad/yr per μCi/sec)
$\overline{L_i}$	Beta Skin Dose Constant	(mrem/yr per μCi/m^3)
Q_{is}	Release Rate, Stack Release	(μCi/sec)
Q_{iv}	Release Rate, Vent Release	(μCi/sec)
Q_{ig}	Release Rate, Ground Level Release	(μCi/sec)
R_a	Individual Air Intake Rate	(m^3/yr)
DFA_{ija}	Inhalation Dose Factor	(mrem/pCi)
DFI_{ija}	Ingestion Dose Factor	(mrem/pCi)

SYMBOL	NAME	UNIT
U_a^P	Produce Consumption Rate	(kg/yr)
U_a^M	Milk Consumption Race	(liters/yr)
U_a^V	Leafy Vegetable Consumption Rate	(kg/yr)
U_a^F	Meat Consumption Rate	(kg/yr)
f_p	Produce Fraction	
f_V	Leafy Vegetable Fraction	
C_i^P	Produce Concentration	(pCi/kg)
C_i^M	Milk Concentration	(pCi/liter)
C_i^V	Leafy Vegetable Concentration	(pCi/kg)
C_i^F	Meat Concentration	(pCi/kg)
d_i	Deposition Rate	($pCi/m^2 \cdot hr$)
t_r	Deposition Time	(day)
$(D/Q)_s$	Relative Deposition Factor, Stack Release	(m^{-2})
$(D/Q)_v$	Relative Deposition Factor, Vent Release	(m^{-2})
$(D/Q)_g$	Relative Deposition Factor, Ground Level Release	(m^{-2})
r	Crop Retention Fraction	
λ_{Ei}	Effective Decay Constant	(hr^{-1})
λ_i	Radiological Decay Constant	(hr^{-1})
λ_w	Weathering Decay Constant	(hr^{-1})
t_e	Effective Crop Exposure Time	(hr)
t_h	Harvest to Consumption Time	(hr)
Y_v	Productivity Yield	(kg/m^2)
F_M	Milk Fraction	(days/liter)
C_i^f	Feed Concentration	(pCi/kg)
f_f	Pasture Fraction	
f_g	Pasture Grass Fraction	

SYMBOL	NAME	UNIT
C_i^g	Pasture Grass Concentration	(pCi/kg)
C_i^s	Stored Feed Concentration	(pCi/kg)
Q_f	Feed Consumption	(kg/day)
t_M	Milk Transport Time	(hr)
F_F	Meat Fraction	(day/kg)
t_s	Slaughter to Consumption Time	(hr)
K	Seasonal Adjustment Factor	

CONSTANTS USED IN SECTION 2.1

NUMERICAL VALUE	NAME	UNIT
3.17×10^{-8}	Conversion Constant	(years/second)
0.7	Gamma Radiation Shielding and Occupancy Factor	
0.5	Beta Radiation Shielding and Occupancy Factor	
1.11	Conversion Constant	(mrem/mrad)
10^6	Conversion Constant	(pCi/μCi)
24	Conversion Constant	(hr/day)
365	Conversion Constant	(day/yr)

2.2 RADIOACTIVITY IN LIQUID RELEASES

2.2.1 10 CFR 50 Appendix I Dose Limits

The dose contributions from measured quantities of radioactive materials identified in liquid effluents released to unrestricted areas shall be calculated using the following expression:

$$D_j = (1.1 \times 10^{-3} \times 8760)\left[\frac{U^w M^w}{F^w} \sum_i A_i \, DFI_{ija} \exp(-\lambda_i t^w) + \frac{U^f M^f}{F^f} \sum_i A_i \, DFI_{ija} \, B_i \exp(-\lambda_i t^f)\right] \quad (2.22)$$

D_j Cumulative dose (mrem)

The cumulative dose or dose commitment to the total body or an organ j due to an adult consuming water and fish.

where:

$D_j \leq$ N x 1.5 mrem to the whole body in a calendar quarter (2.23)

$\leq$ N x 5.0 mrem to any organ in a calendar quarter (2.24)

$\leq$ N x 3.0 mrem to the whole body in any four consecutive quarters (2.25)

$\leq$ N x 10.0 mrem to any organ in any four consecutive quarters (2.26)

U^w, U^f Usage Factor (liters/hr, kg/hr)

Average consumption rate of water or fish. See Table 7.2-1.

$1/M^w$, $1/M^f$ Additional Dilution Factor

Additional dilution factor prior to withdrawal of potable water or fish. See Table 7.2-1.

F^w, F^f Flow Rate (ft^3/sec)

Average flow of receiving body of water. See Table 7.2-1.

A_i Total Radionuclide Release (μCi)

Total release of radionuclide i during period of release.

DFI_{ija} Dose Commitment Factor (mrem/pCi)

The ingestion dose commitment factor for each identified gamma and beta emitter i, organ j, and age group a. See Table 7.1-1.

λ_i Decay Constant (hr^{-1})

Radiological decay constant of ith radionuclide. (Table 7.1-11).

t^w, t^f Elapsed Time (hr)

Average elapsed time between release and consumption of potable water or fish. See Table 7.2-1.

B_i Bioaccumulation Factor (liters/kg)

Bioaccumulation factor. See Table 7.1-12.

1.1×10^{-3} = factor to convert from $(\mu Ci/yr)/(ft^3/sec)$ to pCi/liters

8760 = number of hours per year

2.2.2 10 CFR 20 Maximum Permissible Concentrations

The concentration of non-noble gas radioactive material released from the site to unrestricted areas (C_i) shall be limited to the concentrations specified in 10 CFR 20, Appendix B, Table II, Column 2 (MPC_i). The concentrations of dissolved or entrained noble gases shall be limited to the concentrations specified in Table 7.1-10. The sum of the fractional limits ($C_i \div MPC_i$) must not exceed 1.0 for each release.

SYMBOLS USED IN SECTION 2.2

SYMBOL	NAME	UNIT
D_j	Cumulative Dose	(mrem)
U^w, U^f	Usage Factor	(liters/hr, kg/hr)
$1/M^w, 1/M^f$	Additional Dilution Factor	
F^w, F^f	Flow Rate	(ft^3/sec)
A_i	Total Radionuclide Release	(μCi)
DFI_{ija}	Dose Commitment Factor	(mrem/pCi)
λ_i	Decay Constant	(hr^{-1})
t	Elapsed Time	(hr)
B_i	Bioaccumulation Factor	(liters/kg)
C_i	Concentration at Unrestricted Area	(μCi/ml)
MPC_i	Maximum Permissible Concentration	(μCi/ml)

CONSTANTS USED IN SECTION 2.2

NUMERICAL VALUE	NAME	UNIT
1.1×10^{-3}	Conversion Factor	(pCi/liter)/[(uCi/yr)/(ft^3/sec)]
8760	Conversion Factor	(hrs/yr)

2.3 ENVIRONMENTAL STANDARDS FOR THE URANIUM FUEL CYCLE

In accordance with the requirements of 40 CFR 190, the annual dose commitment to a real individual from all uranium fuel cycle sources is limited to 25 millirems to the whole body, 25 millirems to any organ but the thyroid, and 75 millirems to the thyroid in four consecutive quarters.

3.0 ATMOSPHERIC TRANSPORT, DIFFUSION, AND DOSE MODELS

3.1 METEOROLOGICAL DATA FOR MODELS

3.1.1 Current Record

Onsite meteorological data are used as input to all of the airborne dose calculations performed by a contractor. The data are obtained by means of an instrumented meteorological tower that measures wind speed and wind direction at several levels. The stability of the atmosphere is determined by means of the temperature lapse rate (differential temperature) between two levels on the tower. The contractor's analyses are used to supplement dose analyses performed with historical meteorological records.

For elevated releases a joint frequency table (stability wind rose) of wind speed, wind direction, and stability is developed using the upper level wind data and the average lapse rate measured on the tower.

The mixed-mode model for vent stack releases requires two stability wind roses: one to represent the elevated part of the release and one to represent the ground level portion of the release.

These are developed jointly by considering the wind data hour by hour. The criteria for deciding how to proportion each hour's data between a vent release and ground level release depend on the ratio of the exit speed to the wind speed. When the criteria (Subsection 3.2.2.2) indicate part of the release should be considered as ground level, the 10-meter wind data are used.

For ground level releases the stability wind rose is developed using the lower level wind data and lapse rate.

The wind direction, wind speed, and atmospheric stability classification schemes are described in Tables 7.1-5 and 7.1-8. Because the dispersion equations are very sensitive to low wind speeds, the hourly record may require editing to reflect the measuring limitations of the wind sensors at low speeds. If the reported wind speed is less than the anemometer's threshold (Table 7.1-6), it is assigned a value equal to one-half of threshold speed. If the reported speed is less than the vane's threshold (calm), Table 7.1-6, a direction is assigned in proportion to the observed wind direction distribution of the lowest noncalm speed class.

Diffusion estimates for monthly, calendar quarter, or annual releases are determined by combining hourly stability and wind data in the form of stability wind rose tables. Wind speed, direction, and stability classifications are used to group the data and calculate the joint occurrences of the groups.

3.1.2 Historical Record

When current (real time) meteorological data are not available for calculating actual dispersion factors, or to permit the nuclear station operators to demonstrate compliance with the Technical Specifications, historical dispersion factors are used in the dose models. Depending on the station, there may be three classes (elevated, mixed mode, and ground level) of effluent release, each with four types of dispersion factors (1) χ/Q, (2) D/Q, (3) S_i, V_i, or G_i, and (4) $\overline{S_i}$, $\overline{V_i}$, or $\overline{G_i}$ where $i = 1$ to 15 which are wind direction dependent. The first two types of dispersion factors are used with the internal dose models; (χ/Q) and the last two types are used with the external dose models.

3.1.2.1 Internal Dose

The recipient of the internal dose can either be an adult

or an infant. If the recipient is an adult, the internal dose can consist of contributions from inhalation (χ/Q), leafy vegetables or produce (D/Q), milk or meat (D/Q). If the recipient is an infant, the total dose consists of contributions from inhalation (χ/Q) and milk (D/Q). The dispersion factors for inhalation and leafy vegetable doses are calculated for the 16 wind directions. The dispersion factors for the milk cows and meat animals are only calculated for the direction(s) where these animals are located in the unrestricted area and at a distance no greater than 5 miles.

Historical dispersion factors used in the internal dose models are found in Appendix 7.2. There is a set of these tables for each station. Appendix 7.2 contains the dispersion factors for the 3 possible classes of release and the 16 wind directions for which χ/Q (inhalation) and D/Q (leafy vegetables or produce) are calculated. The radius specifies the location at which the dose is calculated. Only maximum χ/Q and D/Q values are used.

Also in Appendix 7.2 are the dispersion factors used to calculate the doses resulting from milk and meat consumption. Entries occur only for those directions where the nearby milk cows and meat animals are located.

The internal dose models are:

1. adult inhalation;
2. adult consuming leafy vegetables;
3. adult consuming produce;
4. adult consuming meat;
5. adult drinking milk;
6. any combination of 1, 2, 3, 4, and 5;
7. infant inhalation;
8. infant drinking milk; and
9. sum of 7 and 8.

3.1.2.2 External Dose

The wind direction dispersion factors used in the whole body and gamma air external dose models are found in Appendix 7.2. For each station, the 15 tables correspond to the 15 radionuclides used to determine total external dose, which is the sum of the dose contributions from each radionuclide. The whole body ($\overline{S}_i$, $\overline{V}_i$, or $\overline{G}_i$) and gamma air (S_i, V_i, or G_i) dose factors are computed for each of the 16 wind directions and each release class.

The dose factors for beta skin dose ($\overline{L}_i$) and beta air dose (L_i), two other types of external dose, are constants which do not vary with wind direction. However, they are combined in the dose models with χ/Q factors, which are wind direction dependent.

3.2 ATMOSPHERIC TRANSPORT AND DIFFUSION MODELS

3.2.1 Numerical Model

The model used is classed as a "constant mean wind direction model" by the NRC. Equation 3.1 shows how the concentration to emission ratio (χ/Q) at any downwind range and direction is calculated.

$$\frac{\chi(R,\theta)}{Q} = \frac{2.032}{R} \sum_{u} \sum_{stab} f(u,\theta,stab)(uS_z)^{-1} \exp\left[-1/2\left(\frac{he}{S_z}\right)^2\right] \quad (3.1)$$

This model assumes that the effluent is uniformally distributed within each downwind sector and that the release rate is constant during the time period modeled.

χ/Q	Relative effluent concentration	(sec/m^3)
R	Range to receptor	(m)
θ	Direction to receptor	(deg or sector)
f( )	Joint frequency table of the parameters within parentheses	
Stab	Stability class	
u	Wind speed	(m/s)
S_z	Corrected vertical dispersion coefficient	(m)
h_e	Effective stack height	(m)

3.2.2 Source Configuration Considerations

The location of the source with respect to the buildings affects how the airborne effluent will disperse. The following describes the criteria used to model airborne releases from nuclear power plants and describes how the model evaluates each case.

3.2.2.1 Elevated Releases

Release locations (chimneys, etc.) that are high enough to be out of the range of the effects caused by neighboring solid structures are classified as elevated releases. The concentrations at any range and direction can be calculated by equation 3.1 when an appropriate value for the effective stack height (h_e) is used to represent the height of the plume centerline above the ground.

The effective stack height is calculated by the following equation:

$$h_e = h_s + h_r - h_t \qquad (3.2)$$

h_s Physical stack height (m)

h_r Plume rise (m)

h_t Terrain correction factor (m)

This equation states that the effective stack height (h_e) is equal to the physical stack height (h_s) plus the plume rise due to buoyancy and momentum (h_r) less a correction for the variation in terrain (h_t).

3.2.2.1.1 Plume Rise (h_r)

The rise of an effluent plume is dependent on the stability

of the atmosphere, the wind speed, the heat content of the plume, and the exit velocity of the plume. The procedure chosen has been selected to provide a conservative (low) estimate of the plume rise in order to maximize the resulting calculated doses.

Under neutral and unstable atmospheric conditions the momentum-dominated plume rise equations are used. Equation (3.3) shows the basic relationship between h_r and other parameters.

$$(h_r)_1 = 1.44d\ (Wo/u)^{2/3}\ (R/d)^{1/3} - C \qquad (3.3)$$

W_o Exit velocity (m/s)

d Stack diameter (m)

C Downwash correction factor (m)

Equation (3.3) would allow the plume to continue rising forever which is contrary to observation. In order to limit the rise, equation (3.4) is evaluated and the lesser of (3.3) and (3.4) is used in the calculations.

$$(h_r)_2 = 3\ (Wo/u)d \qquad (3.4)$$

Therefore, h_r can be represented by the following formula for neutral and unstable conditions.

$$h_r = \text{Min}\left[(h_r)_1\ ,\ (h_r)_2\right] \qquad (3.5)$$

Under stable atmospheric conditions, additional calculations are made as follows:

$$(h_r)_3 = 4\ (F/S)^{\frac{1}{4}} \qquad (3.6)$$

$$(h_r)_4 = 1.5\ (F/u)^{1/3} S^{-1/6} \qquad (3.7)$$

F Momentum flux parameter (m^4/sec^2)

S Stability parameter (sec^{-2})

where $F = W_o^2 \, (d/2)^2$ (3.8)

and S is given in the following table.

Table of Values for Stability Parameter(S) (sec^{-2})

Stability Class	S
E	8.7×10^{-4}
F	1.75×10^{-3}
G	2.45×10^{-3}

The smaller value computed from equations (3.6) and (3.7) is compared to the value obtained from (3.5) and the smallest value is used to represent h_r under stable conditions. In other words,

$$h_r = \text{Min}\left[(h_r)_1 \, , \, (h_r)_2 \, , \, (h_r)_3 \, , \, (h_r)_4\right] \quad (3.9)$$

3.2.2.1.2 Terrain Correction (h_t)

The average difference in elevation H_{rs} is computed for the point to be evaluated by subtracting the height of the terrain (H_s) at the release point from the height of the terrain at the receptor point (H_r). The correction factor h_t is computed by equations (3.10) and (3.11).

$$H_{rs} = H_r - H_s \quad (3.10)$$

$$h_t = \begin{cases} H_{rs} \; ; \; H_{rs} > 0 \\ 0 \quad ; \; H_{rs} \leq 0 \end{cases} \quad (3.11)$$

H_{rs} Terrain height difference (m)

H_r Terrain height at receptor point (m)

H_s Terrain height at source (m)

3.2.2.1.3 Downwash Correction (C)

If the ratio of the exit velocity to the wind speed is less than 1.5, the effluent can get caught in the downwash of the stack and the plume rise would be inhibited. This reduction is accounted for by the term (C) in Equation (3.3) and this term is computed by Equation (3.12).

$$C = 3(1.5 - Wo/u)d \qquad (3.12)$$

3.2.2.2 Vent Stack Releases

The constant mean wind direction model has been modified into a "mixed-mode" model. In a mixed-mode model the height of the release is proportioned between an elevated release (stack height equal to the vent height plus momentum plume rise), and a ground level release (stack height equal to zero). Separate wind and stability data are used for each release height and the χ/Q ratios are calculated. Subsection 3.1.1 describes how the meteorological data are prepared for this calculation. This model is recommended by Regulatory Guide 1.111.

The fraction of the time that the plume is considered to be a ground level release (G_t) is determined, from the ratio of the exit velocity of the vent (Wo) to the wind speed (u), by the use of the following relationships:

$$G_t = \begin{cases} 1.00 & ; Wo/u \leq 1.0 \\ 2.58-1.58\ (Wo/u) & ; 1.0 < Wo/u < 1.5 \\ 0.3-0.06\ (Wo/u) & ; 1.5 < Wo/u < 5.0 \\ 0.00 & ; W_o/u \geq 5.0 \end{cases} \qquad (3.13)$$

G_t Fraction of time a vent release is considered a ground level release.

Therefore, the release can be considered as a ground level release $100G_t$ percent of the time and as an elevated release $100(1-G_t)$ percent of the time.

3.2.2.3 Ground Level Releases

To calculate the downwind concentrations resulting from ground level releases, Equation (3.1) is used with the effective stack height set to zero ($h_e=0$). If the release is from a structure of maximum height (D_z) a correction is made to the dispersion parameter to account for the increased mixing caused by the building's wake effect. Equation (3.14) shows how this is accounted for in the model.

$$S_z = \begin{cases} \sigma_z & ; \text{ no wake effect} \\ \left[\sigma_z^2 + D_z^2/(2\pi)\right]^{\frac{1}{2}} & ; \text{ wake effect} \end{cases} \qquad (3.14)$$

σ_z Vertical dispersion coefficient (m)

D_z Maximum height of neighboring structure (m)

The dispersion parameter (σ_z) is given in Table 7.1-7.

When the wake effect is used the factor S_z will be restricted by the condition:

$$S_z \leq \sqrt{3}\,\sigma_z \qquad (3.15)$$

3.2.3 Removal Mechanism Considerations

3.2.3.1 Radioactive Decay

The loss of activity with time, due to radioactive decay is accounted for by adjusting the source term. This adjustment takes the following form:

$$Q_e = Q_o \exp(-\lambda_i t) = Q_o \exp(-\lambda_i R/3600u) \quad (3.16)$$

Q_e Source strength corrected for radioactive decay (μCi/sec)

Q_o Source Strength (μCi/sec)

λ_i Radiological decay constant (hr^{-1})

t Transport time: point of release to receptor (hr)

3600 Converts hours to seconds (sec/hr)

3.2.3.2 Plume Depletion and Deposition

As the plume travels downwind, the radioiodines and particulate material are deposited on the ground and thus removed from the plume. At all ranges (R) the model accounts for this depletion by multiplying the (χ/Q) ratios by a fraction that is a function of release height and stability.

$$(\chi/Q) = (\chi/Q)_o \; P_d(h_e, \text{stab}) \quad (3.17)$$

P_d Plume depletion coefficient

The function P_d recommended by the NRC (Regulatory Guide 1.111 Figures 2-5) is given in Appendix 7.1, Figures 7.1-1 to 7.1-4. The plume depletion factors for the height closest to the actual release height are used.

3.2.3.3 Relative Deposition Factor (D/Q)

The value of D/Q (m^{-2}) is determined from one of the following equations:

$$D/Q = \frac{1}{R} \frac{16}{2\pi} D_r(\text{stab}, R, h_s) \quad (3.18)$$

$$D/Q = \frac{1}{R} \frac{16}{2\pi} \sum_{\text{stab}} f(\theta, \text{stab}) D_r(\text{stab}, R, h_s) \quad (3.19)$$

where:

D_r Relative Deposition Rate (m^{-1})

The relative deposition rate is the deposition rate per unit downwind distance ($\mu Ci\ s^{-1}\ m^{-1}$) divided by the source strength ($\mu Ci\ s^{-1}$)

For time periods $\Delta t \leq 8$ hours Equation (3.18) is used. For time period $\Delta t > 8$ hours, when the meteorological data are in the form of a stability wind rose, Equation (3.19) is used.

The values of D_r from Regulatory Guide 1.111, Figures 6-9, are reproduced in Appendix 7.1 and Figures 7.1-5 to 7.1-8. Choose the value of D_r closest to the release height (h_s).

For mixed mode releases, $\left(D_r\right)_v = G_t\ (D_r)_g + (1-G_t)\ (D_r)_s$.

SYMBOLS USED IN SECTION 3.2

SYMBOL	NAME	UNIT
χ/Q	Relative Effluent Concentration	(sec/m^3)
R	Range to Receptor	(m)
θ	Direction to Receptor	(degrees or sectors)
f( )	Joint Frequency Parameter	
Stab	Stability Class	
u	Wind Speed	(m/s)
S_z	Corrected Vertical Dispersion Coefficient	(m)
h_e	Effective Stack Height	(m)
h_s	Physical Stack Height	(m)
h_r	Plume Rise	(m)
h_t	Terrain Correction Factor	(m)
W_o	Exit Velocity	(m/s)
d	Stack Diameter	(m)
C	Downwash Correction Factor	(m)
F	Momentum Flux Parameter	(m^4/sec^2)
S	Stability Parameter	(sec^{-2})
H_{rs}	Terrain Height Difference	(m)
H_r	Terrain Height at Receptor Point	(m)
H_s	Terrain Height at Source	(m)
σ_z	Vertical Dispersion Coefficient	(m)
D_z	Maximum Height of Neighboring Structure	(m)
G_t	Fraction of Time the Vent Release is Considered a Ground Level Release	
D/Q	Relative Deposition Factor	(m^{-2})
D_r	Relative Deposition Rate	(m^{-1})

SYMBOL	NAME	UNIT
Q_e	Source Strength Corrected for Radioactive Decay	(μCi/sec)
Q_o	Source Strength	(μCi/sec)
λ_i	Radiological Decay Constant	(hr^{-1})
P_d	Plume Depletion Coefficient	
t	Plume Transport Time	(hr)

CONSTANTS USED IN SECTION 3.2

NUMERICAL VALUE	NAME	UNIT
3600	Conversion Constant	sec hr^{-1}
$16/2\pi$	Sector $Width^{-1}$	$Radians^{-1}$

3.3 MODELS FOR CALCULATING DOSE FROM NOBLE GASES

3.3.1 Gamma Radiation

3.3.1.1 Gamma Air Dose - Finite Cloud Model

The gamma air dose (D^{γ}) is calculated from either of the following formulae:

$$D^{\gamma}(R,\theta) = \frac{260 \times 10^{-6} \times 86400}{R \times 2\pi/16} \sum_{m} t_r^m \sum_{u} \frac{1}{u} \sum_{i} \sum_{stab} f(u,\theta,stab) Q_i \mu_{ai} \bar{E}_{\gamma i} (\bar{I}_1 + K \bar{I}_2)_i \quad (3.20)$$

$$D^{\gamma}(R,\theta) = \frac{260 \times 10^{-6}}{R\ 2\pi/16} \sum_{u} \frac{1}{u} \sum_{i} \sum_{stab} f(u,\theta,stab) \times A_i \mu_{ai} \bar{E}_{\gamma i} (\bar{I}_1 + K\bar{I}_2)_i \quad (3.21)$$

D^{γ}	Gamma Dose (mrad)
m	Index For Release Period
260	Conversion Constant ($\left[\text{mrad-radians-m}^3\text{-disintegration}\right] / \left[\text{sec-MeV-Ci}\right]$)
10^{-6}	Conversion Constant (Ci/μCi)
86400	Conversion Constant (sec/day)
$2\pi/16$	Sector Width (radians)
t_r^m	Length of Release (days)
i	Index for Summation of Nuclides

Q_i — Release Rate Corrected for Radioactive Decay in Transport (μCi/sec)

A_i — Release Corrected for Radioactive Decay (μCi)

μ_{ai} — Air Energy Absorption Coefficient (m^{-1}) (Table 7.1-9)

$\bar{E}_{\gamma i}$ — Average Energy per Disintegration (MeV/disintegration) (Table 7.1-9)

$(\bar{I}_1 + K\bar{I}_2)$ — Dimensionless Numerical Integration Constant defined in Section 7.5 of Reference 6.7. (For K values, see Table 7.1-9)

The basic form of the above equation was taken from Meteorology and Atomic Energy (Eq. 7.63) and is equivalent to Equation 6 in Regulatory Guide 1.109. The summation over the index m, represents the summing of the doses from all sources at the station (i.e., elevated releases and vent releases).

Equation 3.20 was then used to compute the gamma air dose factors S_i (for stack releases), V_i (for vent releases), and G_i (for ground level releases), mrad/yr per μCi/sec. Site-specific values of S_i, V_i and G_i using historical meteorological data are given in Appendix 7.2.

3.3.1.2 Whole Body Dose Factors

The whole body dose, calculated for preselected ranges in each downwind sector, is given by the equation that follows:

$$D^T(R,\theta) = 1.11\ SF^{\gamma} \sum_i D_i^{\gamma}(R,\theta)\ \exp(-5(\mu_t)_i) \qquad (3.22)$$

D^T	Whole Body Dose	(mrem)
1.11	Conversion Constant	(mrem/mrad)
SF^γ	Shielding and Occupancy Factor for Gamma Radiation	
μ_t	Tissue Energy Absorption Coefficient (Table 7.1-9)	(cm^2/g)

For this calculation, the shielding factor SF^γ is set to 0.7 and dose is computed at a depth of 5 cm in the tissue. The factor 1.11 is the ratio of tissue to air energy absorption coefficients. The whole body dose factors, $\bar{S}i$ (for stack releases) and $\bar{V}_i$ (for vent releases) and $\bar{G}_i$ (for ground level releases) in mrem/yr per μCi/sec, computed from $D^T(R,\theta) \div (1.11\ SF^\gamma\ 3.17 \times 10^{-8})$, are given in Appendix 7.2.

3.3.2 Beta Radiation

3.3.2.1 Beta Particle Air and Skin Dose Factors

The beta particle air dose factor L_i, (mrad/yr per $\mu Ci/m^3$) and skin dose factor, $\bar{L}_i$, mrem/yr per $\mu Ci/m^3$ are given in Reference 6.5 and included in Table 7.1-13.

SYMBOLS USED IN SECTION 3.3

SYMBOL	NAME	UNIT
D^{γ}	Gamma Dose	(mrad)
R	Range to Receptor	(m)
θ	Direction to Reception	(degrees or sector)
m	Release Period Index	
t_r^m	Length of Release	(days)
u	Wind Speed	(m/s)
i	Nuclide Index	
Stab	Stability Class	
f( )	Joint Frequency parameter	
Q_i	Release Rate Corrected for Radioactive Decay in Transport	(μCi/sec)
μ_{ai}	Air Energy Absorption Coefficient	(m^{-1})
$\overline{E}_{\gamma i}$	Average Energy per Disintegration	(MeV/disintegration)
$(\bar{I}_1+K\bar{I}_2)$	Dimensionless Numerical Integration Constant	
SF^{γ}	Shielding and Occupancy Factor for Gamma Radiation	
A_i	Release Corrected for Radioactive Decay in Transport	(μCi)
$e^{-\lambda_i R/3600u}$	Correction for Radioactive Decay in Transport	

CONSTANTS USED IN SECTION 3.3

NUMERICAL VALUE	NAME	UNIT
260	Conversion Constant	([mrad-radians-m^3-disintegration]/[sec-MeV-Ci])
10^{-6}	Conversion Constant	(Ci/μCi)
86400	Conversion Constant	(sec/day)
$2\pi/16$	Sector Width	(radians)

3.4 MODELS FOR CALCULATING DOSE FROM RADIOIODINES, "PARTICULATES", AND OTHER RADIONUCLIDES

The general model used to calculate the dose from the non-noble gas airborne effluents is given in Subsection 2.1.2.1.1.

4.0 AQUATIC TRANSPORT AND DOSE MODELS

4.1 AQUATIC TRANSPORT

Dose via the aquatic pathway is discussed in Section 2.2. Two dilution factors are considered; F, the average flow of the receiving body of water; and 1/M, an additional dilution factor.

4.1.1 River Model

For purposes of calculating dose from liquid effluents discharged into a river of flow (F), it is assumed that total mixing of the discharge in the river occurs prior to consumption as potable water or fish. No additional dilution is assumed to occur; thus 1/M equals 1.0. The river flow is taken as the long-term (generally 10 years) average.

4.1.2 Lake Michigan Model

For purposes of calculating dose from liquid effluents discharged to Lake Michigan, it is assumed that the concentration of radioactivity is diluted initially in the condenser cooling water of flow (F) and then by an additional factor 1/M of 60 prior to consumption. The dilution factor of 60 is the product of the initial entrainment dilution (factor of 10), the plume dilution (factor of 3 over approximately 1 mile), and the current direction frequency (annual average factor of 2).

For the fish ingestion pathway only, it is assumed the radioactivity is diluted fully in a hypothetical river of 5 miles width, 50 foot depth and flow rate of 0.2 miles per hour. This "river" is roughly equivalent to the passage of near shore lake currents. Neither lake recirculation nor fish migration is assumed.

4.2 AQUATIC DOSE MODEL

The general model used to calculate the dose from radioactive material released in liquid waste is given in Subsection 2.2.1.

5.0 SUMMARY

5.1 AIRBORNE EFFLUENTS

5.1.1 10 CFR 50 Appendix I Dose Limits

The 10 CFR 50 Appendix I technical specification limits for the nuclear stations are summarized in Table 5.1-1. To demonstrate compliance with the Appendix I limits the dose for each time period of the quarter will be calculated using the dose equations noted in Table 5.1-1. The current quarter dose is the summation of the dose contribution from every effluent release during the quarter. The station will calculate the doses weekly, depending on the work schedule of the station personnel and the availability of effluent release data. Each time the station evaluates the dose equations, the new contribution is added to the current total for the quarter, and the new total is compared with the limit. Next, the new total for the quarter is combined with the totals for the previous three quarters to determine the annual dose.

The results of each calculational run will be summarized in a format similar to that shown in Table 5.1-1. The maximum dose is printed with the associated wind direction. The values calculated for each wind direction and range must be stored for calculation of the maximum period, quarter, and annual dose. For the organ dose, the computer will calculate doses to seven organs for up to 73 radionuclides, and select the maximum period, quarter, and annual organ doses.

For each dose type and maximum value, the compliance status is calculated where the status (%) = 100 x maximum dose ÷ dose limit.

TABLE 5.1-1

(Name) Station

MAXIMUM DOSES RESULTING FROM AIRBORNE RELEASES

(PERIOD OF RELEASE FROM (DATE) TO (DATE). DATE OF CALCULATION (DATE))

TYPE	CURRENT PERIOD	CURRENT QUARTER*	THIRD QUARTER	SECOND QUARTER	FIRST QUARTER	ANNUAL
Gamma Air (mrad)	Eq.2.1 Δ	dose (dir.) -	NOTE: This format should appear in all 30 entries.			
Beta Air (mrad)	Eq.2.3					
Whole Body (mrem)	Eq.2.5					
Skin (mrem)	Eq.2.7					
Organ (mrem)	Eq.2.11					

Last period of release from (date) to (date), calculated (date).

COMPLIANCE STATUS

TYPE	10 CFR 50 APP. I QUARTERLY LIMIT	% OF APP. I	10 CFR 50 APP. I YEARLY LIMIT	% OF APP. I
Gamma Air (mrad)	5 x N**		10 x N	
Beta Air (mrad)	10 x N		20 x N	
Whole Body (mrem)	2.5 x N		5 x N	
Skin (mrem)	7.5 x N		15 x N	
Organ (mrem)	7.5 x N	***	15 x N	****

Δ The equation number of the model used to compute the dose for the period is listed here for information only.

* Cummulative dose for the quarter including the current period.

** N is the number of reactor units.

*** The critical organ is (Name). **** The critical organ is (Name).

5.1.2 10 CFR 20 Release Rate Limits

The compliance status with respect to the 10 CFR 20 limits is determined in the following manner and reported in the format of Table 5.1-2 for periods of unusually high release rate Q.

$$C.S._{WB} = \frac{\text{(dose rate from Eq. 2.9) x 100}}{\text{500 mrem/yr}} \quad (\%) \quad \text{whole body} \qquad (5.1)$$

$$C.S._{S} = \frac{\text{(dose rate from Eq. 2.10) x 100}}{\text{3000 mrem/yr}} \quad (\%) \quad \text{skin} \qquad (5.2)$$

$$C.S._{O} = \frac{\text{(dose rate from Eq. 2.18) x 100}}{\text{1500 mrem/yr}} \quad (\%) \quad \text{organ} \qquad (5.3)$$

The value of C.S. must not exceed 100%. If it does, the station's release rate is too high and corrective action to reduce the release rate must be taken immediately.

TABLE 5.1-2

(Name) Station

MAXIMUM INSTANTANEOUS RELEASE RATES

(PERIOD OF RELEASE FROM (DATE/TIME) TO (DATE/TIME).
DATE OF CALCULATION (DATE))

ORGAN	DOSE RATE, mrem/year	10 CFR 20 LIMIT, mrem/year	COMPLIANCE STATUS*
Whole Body		500	Eq. 5.1
Skin		3000	Eq. 5.2
(Name) Organ$^{\Delta}$		1500	Eq. 5.3

Δ The organ with the maximum dose should be named.

* See text for definition. If C.S. $\geq$ 100, add this or similar footnote to the table:

"Corrective action must be taken immediately to reduce the release rate". Also, perhaps at the bottom of this table or on a separate sheet, the radionuclides and their release rate should be listed.

5.2 LIQUID RELEASES

5.2.1 10 CFR 50 Appendix I Dose Limits

The total quarterly and annual whole body or organ doses due to radioactivity discharged in liquid wastes are computed in a manner similar to that for airborne effluents. The results, based on doses computed with Eq. 2.22, are summarized in the manner of Table 5.2-1.

5.2.2 10 CFR 20 Maximum Permissible Concentrations

The concentrations of non-noble gas radioactive material released from the site to unrestricted areas (C_i) shall be limited to the concentrations specified in 10 CFR 20, Appendix B, Table II, Column 2 (MPC_i). The concentrations of dissolved or entrained noble gases shall be limited to the concentrations specified in Table 7.1-10. The sum of the fractional limits ($C_i \div MPC_i$) must not exceed 1.0 for each release.

Hence:

$$100 \times \sum_i \frac{C_i}{MPC_i} \leq 100\% \qquad (5.4)$$

TABLE 5.2-1

(Name) Station

MAXIMUM DOSES RESULTING FROM LIQUID EFFLUENTS

(PERIOD OF RELEASE FROM (DATE) TO (DATE). DATE OF CALCULATION (DATE))

TYPE	CURRENT PERIOD	CURRENT QUARTER*	THIRD QUARTER	SECOND QUARTER	FIRST QUARTER	ANNUAL
Whole Body (mrem)		dose - NOTE: This format should appear in all 12 entries				
Organ (mrem)		dose				
Critical Organ During Period		name				

Last period of release from (date) to (date), calculated (date).

COMPLIANCE STATUS

TYPE	10 CFR 50 QUARTERLY LIMIT	% of APP. I	10 CFR 50, APP. I YEARLY LIMIT	% OF APP. I
Whole Body (mrem)	1.5 x N**		3 x N	
Organ (mrem)	5 x N	***	10 x N	****

* Cummulative dose in quarter to date

** N is the number of reactor units

*** The critical organ is (name)

**** The critical organ is (name)

5.3 URANIUM FUEL CYCLE

The methods for demonstrating compliance with the requirements of 40 CFR 190 will be determined at a later date pending guidance from the U.S. Nuclear Regulatory Commission. The effective date of the 40 CFR 190 standards is December 1, 1979.

6.0 REFERENCES

6.1 G. A. Briggs, "Plume Rise", U.S. Atomic Energy Commission, 1969.

6.2 J. F. Fletcher and W. L. Dotson, "HERMES. A Digital Computer Code for Estimating Regional Radiological Effects from Nuclear Power Industry," USAEC Report HEDL - TME - 71-168, Hanford Engineering Development Laboratory, 1971.

6.3 "Radiological Health Handbook," U.S. Dept. of Health, Education, and Welfare, Public Health Service, Rockville, Maryland, 1970.

6.4 Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors", U.S. Nuclear Regulatory Commission, Washington D.C., Revision 1, July 1977.

6.5 Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I", U.S. Nuclear Regulatory Commission, Washington D.C., Revision 1, Oct. 1977.

6.6 J. F. Sagendorf, "A Program for Evaluating Atmospheric Dispersion from a Nuclear Power Station, U.S. Dept. of Commerce, Report No. NOAA TM ERL ARL-42, Air Resources Laboratory, Idaho Falls, Idaho, 1974.

6.7 D. H. Slade, "Meteorology and Atomic Energy 1968", U.S. Atomic Energy Commission, 1968.

6.8 D. C. Kocher, ed., "Nuclear Decay Data for Radionuclides Occurring in Routine Releases from Nuclear Fuel Cycle Facilities,"ORNL/NUREG/TM-102, August 1977.

6.9 R. L. Heath, "Gamma-Ray Spectrum Catalog", Aerojet Nuclear Co., ANCR-1000-2, third or subsequent edition.

6.10 NUREG-0172, "Age-Specific Radiation Dose Commitment Factors For A One-Year Chronic Intake", Battelle Pacific Northwest Laboratories, 1977.

6.11 D. B. Turner, "Workbook of Atmospheric Dispersion Estimates," U.S. Environmental Protection Agency, Office of Air Programs, Publication No. AP-26, revised, 1970.

7.0 APPENDICES

APPENDIX - 7.1 DATA COMMON TO ALL NUCLEAR STATIONS

APPENDIX - 7.2 DATA SPECIFIC TO EACH NUCLEAR STATION

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7.1-E-14	Ingestion Dose Factors for Infants
7.1-2	Miscellaneous Dose Assessment Factors - Adult
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7.1-8	Relative Deposition for 100 m Releases

Table 7.1-1

Dose Commitment Factors

Pathway	Infant	Adult
Inhalation	7.1-E-10	7.1-E-7
Ingestion	7.1-E-14	7.1-E-11

E Tables from Reg Guide 1.109, Rev. 1, October 1977. Each table contains seven organ dose factors for 73 radionuclides. E tables follow. For radionuclides not found in these tables dose factors will be derived from ICRP 2 (1959) or NUREG-0172. (ref. 6.10)

TABLE 7.1-E-7

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	2.27E-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	[illegible]ATA	NO DATA	1.16E-04	1.33E-05
CO 60	NO DATA	1.49E-06	1.85E-06	[illegible]DATA	NO DATA	7.46E-04	3.56E-05
NI 63	5.40E-05	3.93E-06	1.81E-0[illegible]	[illegible] 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	1.09E-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	5.77E-11	NO DATA	NO DATA	1.96E-06	9.19E-06

TABLE 7.1-E-7 - Cont'd

INHALATION DOSE FACTORS FOR ADULTS
(MREM PER PCI INHALED)

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	1.38E-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	1.03E-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	1.99E-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	1.35E-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	4.98E-06	1.83E-05	1.39E-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	4.03E-08	NO DATA	6.00E-08	6.07E-09	2.33E-13
BA139	1.17E-10	6.32E-14	3.42E-12	NO DATA	7.78E-14	4.70E-07	1.12E-07

TABLE 7.1-E-7 - Cont'd

INHALATION DOSE FACTORS FOR ADULTS
(MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA140	4.98E-06	6.13E-09	3.21E-07	NO DATA	2.64E-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	2.56E-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-0	2.83E-05
CE144	4.29E-04	1.79E-04	2.30E-05	NO DATA	1.06E-04	9.72E-0	1.02E-04
PR143	1.17E-06	4.69E-07	5.90E-08	NO DATA	2.70E-07	3.51E-05	2.50E-05
PR144	3.76E-12	1.56E-12	1.91E-13	NO DATA	8.91E-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 7.1-E-10

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	6.32E-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	5.12E-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

TABLE 7.1-E-10 - 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	1.79E-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	1.95E-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	9.78E-13	2.06E-12	2.65E-11	NO DATA	2.22E-11	5.79E-07	1.45E-06
TC101	4.65E-14	5.99E-14	5.80E-13	NO DATA	6.77E-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	1.49E-06	3.48E-06	2.69E-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	1.98E-05
TE131M	7.62E-08	3.73E-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	1.49E-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	2.42E-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	1.99E-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	7.61E-05	3.79E-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	7.93E-13	3.07E-11	NO DATA	4.23E-13	4.25E-06	3.64E-05

TABLE 7.1-E-10 - 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	4.65E-08	NO DATA	NO DATA	1.20E-04	6.06E-05
LA142	7.36E-10	2.69E-10	6.40E-11	NO DATA	NO DATA	5.87E-06	4.25E-05
CE141	1.98E-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	4.99E-07	NO DATA	1.41E-06	3.09E-04	2.66E-05
PR144	3.42E-11	1.32E-11	1.72E-12	NO DATA	4.90E-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-09	NO DATA	4.73E-08	4.25E-05	1.78E-05

TABLE 7.1-E-11

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	1.37E-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

TABLE 7.1-E-11 - 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	9.76E-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
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	2.69E-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	9.63E-08	NO DATA	2.79E-09
TE132	2.52E-06	1.63E-06	1.55E-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	4.29E-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 7.1-E-11 - 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	1.95E-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	7.19E-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

TABLE 7.1-E-14

INGESTION DOSE FACTORS FOR INFANT
(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07
C 14	2.37E-05	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06
NA 24	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05
P 32	1.70E-03	1.60E-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	8.78E-06	2.40E-06	NO DATA	NO DATA	4.39E-06	1.14E-06
FE 59	3.08E-05	5.38E-05	2.12E-05	NO DATA	NO DATA	1.59E-05	2.57E-05
CO 58	NO DATA	3.60E-06	8.93E-06	NO DATA	NO DATA	NO DATA	8.97E-06
CO 60	NO DATA	1.08E-05	2.55E-05	NO DATA	NO DATA	NO DATA	2.57E-05
NI 63	6.34E-04	3.92E-05	2.20E-05	NO DATA	NO DATA	NO DATA	1.95E-06
NI 65	4.70E-06	5.32E-07	2.42E-07	NO DATA	NO DATA	NO DATA	4.05E-05
CU 64	NO DATA	6.09E-07	2.82E-07	NO DATA	1.03E-06	NO DATA	1.25E-05
ZN 65	1.34E-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	1.04E-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	2.75E-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	2.35E-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

TABLE 7.1-E-14 - 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	. 50E-05
ZR 97	1.48E-08	2.54E-09	1.16E-09	NO DATA	2.56E-09	NO DATA	1.62E-04
NB 95	4.20E-08	1.73E-08	1.00E-08	NO DATA	1.24E-08	NO DATA	1.46E-05
MO 99	NO DATA	3.40E-05	6.63E-06	NO DATA	5.08E-05	NO DATA	1.12E-05
TC 99M	1.92E-09	3.96E-09	5.10E-09	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	4.53E-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	9.07E-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 7.1-E-14 - 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	8.91E-11	9.26E-11	7.59E-07
LA140	2.11E-08	8.32E-09	2.14E-09	NO DATA	NO DATA	NO DATA	9.77E-05
LA142	1.10E-09	4.04E-10	9.67E-11	NO DATA	NO DATA	NO DATA	6.86E-05
CE141	7.87E-08	4.80E-08	5.65E-09	NO DATA	1.48E-08	NO DATA	2.48E-05
CE143	1.48E-08	9.82E-06	1.12E-09	NO DATA	2.86E-09	NO DATA	5.73E-05
CE144	2.98E-06	1.22E-06	1.67E-07	NO DATA	4.93E-07	NO DATA	1.71E-04
PR143	8.13E-08	3.04E-08	4.01E-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	3.40E-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 7.1-2

Miscellaneous Dose Assessment Factors - Adult

U_a^M = 310 liters/yr

R_a = 8000 m^3/yr

U_a^P = 520 kg/yr

U_a^V = 64 kg/yr

U_a^F = 110 kg/yr

f_P = .76

f_V = 1.0

t_h = 0 for pasture grass (milk and meat pathways)

t_h = 24 hr (1 day for leafy vegetables)

t_h = 1440 hr (60 days for produce)

t_e = 720 hr (30 days for milk and meat)

t_e = 1440 hr (60 days for produce or leafy vegetables)

f_f = 1.0 May-Oct.

f_f = 0.0 Nov-April

f_g = 0.5

λ_w = .0021 yr^{-1}

Y_v = 2.0 kg/m2 for leafy vegetables and produce pathways

Table 7.1-2

Miscellaneous Dose Assessment Factors - Adult - Cont'd

Y_v = 0.7 kg/m^2 for milk and meat pathways

t_s = 20 days

r = 0.5 (iodines)
0.2 (others)

Table 7.1-3

Miscellaneous Dose Assessment Factors - Infant

U_a^M = 330 liters/yr

U_a^P, U_a^V, U_a^F = 0

Ra = 1400 m3/yr

Q_f = 50 kg/day

r = 0.5 (iodines)*
0.2 (others

t_M = 2 days

λ_w = 0.0021 hr^{-1}

Y_v = 0.7 kg/m^2

t_e = 720 hours

*The r = 0.5 provides for the non-deposition on grass of the organic forms of iodine.

TABLE 7.1-4

STABLE ELEMENT TRANSFER DATA*

Element	F_F Meat (d/kg)	F_M(Cow) Milk (d/ℓ)
H	1.2E-02	1.0E-02
C	3.1E-02	1.2E-02
Na	3.0E-02	4.0E-02
P	4.6E-02	2.5E-02
Cr	2.4E-03	2.2E-03
Mn	8.0E-04	2.5E-04
Fe	4.0E-02	1.2E-03
Co	1.3E-02	1.0E-03
Ni	5.3E-02	6.7E-03
Cu	8.0E-03	1.4E-02
Zn	3.0E-02	3.9E-02
Rb	3.1E-02	3.0E-02
Sr	6.0E-04	8.0E-04
Y	4.6E-03	1.0E-05
Zr	3.4E-02	5.0E-06
Nb	2.8E-01	2.5E-03
Mo	8.0E-03	7.5E-03
Tc	4.0E-01	2.5E-02
Ru	4.0E-01	1.0E-06
Rh	1.5E-03	1.0E-02
Ag	1.7E-02	5.0E-02
Te	7.7E-02	1.0E-03
I	2.9E-03	6.0E-03+
Cs	4.0E-03	1.2E-02
Ba	3.2E-03	4.0E-04
La	2.0E-04	5.0E-06
Ce	1.2E-03	1.0E-04
Pr	4.7E-03	5.0E-06
Nd	3.3E-03	5.0E-06
W	1.3E-03	5.0E-04
Np	2.0E-04++	5.0E-06

*Data presented in this table are from NRC Reg Guide 1.109, Revision 1, Oct. 77, (ref. 6.5).

Table 7.1-5

Atmospheric Stability Classes

Description	Pasquill Stability Class	Temperature Interval (Degrees C/100 M)
Extremely Stable	G	$\Delta t \geq 4.0$
Moderately Stable	F	$4.0 > \Delta t \geq 1.5$
Slightly Stable	E	$1.5 > \Delta t \geq -0.5$
Neutral	D	$-0.5 > \Delta t \geq -1.5$
Slightly Unstable	C	$-1.5 > \Delta t \geq -1.7$
Moderately Unstable	B	$-1.7 > \Delta t \geq -1.9$
Extremely Unstable	A	$-1.9 > \Delta t$

Table 7.1-6

Wind Sensor Threshold

Location	Anemometer Wind Speed (mph)	Vane Wind Direction (mph)
Dresden	0.8	0.9
Quad Cities	0.6	0.8
Zion	0.6	0.6
LaSalle	0.5	0.7
Braidwood	0.8	0.8
Byron	0.8	0.8
Carroll County	0.5	0.7

Table 7.1-7 Vertical Dispersion Parameters
(Based on Reference 6.11)

The vertical dispersion parameters are given in the following:

The general form of the exponential functions is

$$\sigma_i = (C) \quad (X)^P \qquad \text{(meters)}$$

The coefficients and exponents vary with stability.
In the case of σ_z these values also vary with range (x).

Vertical Plume Width (σ_z)

Stability Class	Range (meters) From	To	Coefficient (C)	Exponent (p)
A	100	300	0.0800	1.12
	300	450	0.0095	1.49
	450	1,397	0.0002	2.13
B	100	280	0.1271	0.96
	280	540	0.1012	1.00
	540	7,393	0.0555	1.10
C	100	215	0.1055	0.92
	215	400	0.1287	0.89
	400	5,000	0.1009	0.93
	5,000	21,392	0.1267	0.90
D	100	210	0.0893	0.86
	210	500	0.0979	0.84
	500	900	0.1596	0.76
	900	2,000	0.2799	0.68
	2,000	15,000	0.4730	0.61
	15,000	35,000	0.8368	0.55
	35,000	-	1.6314	0.49
E	100	190	0.0650	0.87
	190	300	0.0737	0.84
	300	700	0.1279	0.74
	700	1,400	0.1571	0.71
	1,400	3,200	0.3740	0.59
	3,200	13,000	0.7146	0.51
	13,000	30,000	1.3970	0.44
	30,000	54,000	4.2480	0.33
	54,000	-	9.7058	0.26

Table 7.1-7 - Continued

Vertical Plume Width (σ_z) (continued)

Stability Class	Range (meters) From	To	Coefficient (C)	Exponent (p)
F	100	210	0.0548	0.81
	210	400	0.0606	0.79
	400	600	0.0564	0.80
	600	1,000	0.0980	0.72
	1,000	2,000	0.1947	0.62
	2,000	4,000	0.4847	0.50
	4,000	10,000	0.6706	0.46
	10,000	20,000	1.5723	0.37
	20,000	68,000	3.7561	0.28
	68,000	-	3.9068	0.28
G	100	210	0.0329	0.81
	210	400	0.0364	0.79
	400	600	0.0338	0.80
	600	1,000	0.0590	0.72
	1,000	2,000	0.1168	0.62
	2,000	4,000	0.2908	0.50
	4,000	10,000	0.4024	0.46
	10,000	20,000	0.9434	0.37
	20,000	68,000	2.2537	0.28
	68,000	-	2.3441	0.28

Note: For stability classes A, B and C σ_z is limited to 1 km.

Table 7.1-8 Wind Speed and Wind Direction Classes

Wind Direction Classes

WIND DIRECTION CLASS	(DEG)	N	WIND DIRECTION	GT	348.75	AND	LE	11.25
WIND DIRECTION CLASS	(DEG)	NNE	WIND DIRECTION	GT	11.25	AND	LE	33.75
WIND DIRECTION CLASS	(DEG)	NE	WIND DIRECTION	GT	33.75	AND	LE	56.25
WIND DIRECTION CLASS	(DEG)	ENE	WIND DIRECTION	GT	56.25	AND	LE	78.75
WIND DIRECTION CLASS	(DEG	E	WIND DIRECTION	GT	78.75	AND	LE	101.25
WIND DIRECTION CLASS	(DEG)	ESE	WIND DIRECTION	GT	101.25	AND	LE	123.75
WIND DIRECTION CLASS	(DEG)	SE	WIND DIRECTION	GT	123.75	AND	LE	146.25
WIND DIRECTION CLASS	(DEG)	SSE	WIND DIRECTION	GT	146.25	AND	LE	168.75
WIND DIRECTION CLASS	(DEG)	S	WIND DIRECTION	GT	168.75	AND	LE	191.25
WIND DIRECTION CLASS	(DEG)	SSW	WIND DIRECTION	GT	191.25	AND	LE	213.7'
WIND DIRECTION CLASS	(DEG)	SW	WIND DIRECTION	GT	213.75	AND	LE	236.25
WIND DIRECTION CLASS	(DEG)	WSW	WIND DIRECTION	GT	236.25	AND	LE	258.75
WIND DIRECTION CLASS	(DEG)	W	WIND DIRECTION	GT	258.75	AND	LE	281.25
WIND DIRECTION CLASS	(DEG)	WNW	WIND DIRECTION	GT	281.25	AND	LE	303.75
WIND DIRECTION CLASS	(DEG)	NW	WIND DIRECTION	GT	303.75	AND	LE	326.25
WIND DIRECTION CLASS	(DEG)	NNW	WIND DIRECTION	GT	326.25	AND	LE	348.75

Wind Speed Classes

WIND SPEED CLASS	(MPH)	1	WIND SPEED	GE	0.0	AND	LT	ST*
WIND SPEED CLASS	(MPH)	2	WIND SPEED	GE	ST	AND	LE	3.5
WIND SPEED CLASS	(MPH)	3	WIND SPEED	GT	3.5	AND	LE	7.5
WIND SPEED CLASS	(MPH)	4	WIND SPEED	GT	7.5	AND	LE	12.5
WIND SPEED CLASS	(MPH)	5	WIND SPEED	GT	12.5	AND	LE	18.5
WIND SPEED CLASS	(MPH)	6	WIND SPEED	GT	18.5	AND	LE	24.5
WIND SPEED CLASS	(MPH)	7	WIND SPEED	GT	24.5	AND	LE	31.5
WIND SPEED CLASS	(MPH)	8	WIND SPEED	GT	31.5	AND	LE	38.5
WIND SPEED CLASS	(MPH)	9	WIND SPEED	GT	38.5	AND	LE	46.5
WIND SPEED CLASS	(MPH)	10	WIND SPEED	GT	46.5	AND	LE	99.8

* ST: Speed Threshold Value

Table 7.1-9 Airborne Isotope Data

Isotope	Decay Constant (1/hr)	Average Energy per disintegration (Mev/dis) $\bar{E}_G$	$\bar{E}_B$	Linear Energy Absorption u_a (1/meter)	Linear Attenuation u (1/meter)	K	Tissue Energy Absorption Coeff. u_t (cm^2/g)
kR-83m	3.71E-1	2.48E-3	3.71E-2	37	37	0	4.87
KR-85	7.34E-6	2.2E-3	2.5E-1	50	50	0	4.87
KR-85m	1.57E-1	1.59E-1	2.53E-1	0.0033	0.017	4.15	0.0279
KR-87	5.47E-1	7.93E-1	1.32	0.0037	0.0092	1.49	0.0318
KR-88	2.47E-1	1.95	3.77E-1	0.0031	0.0058	0.87	0.0259
KR-89	1.31E+1	2.22	1.37	0.0029	0.0054	0.86	0.0251
KR-90	7.56E+1	2.10	1.01	0.003	0.0056	0.87	0.0254
Xe-131m	2.45E-3	2.01E-2	1.43E-1	0.065	0.098	0.51	0.533
Xe-133	5.47E-3	4.54E-2	1.35E-1	0.0066	0.028	3.24	0.0566
Xe-133m	1.28E-2	4.2E-2	1.9E-1	0.0076	0.03	2.95	0.0674
Xe-135	7.60E-2	2.47E-1	3.17E-1	0.0036	0.015	3.17	0.0305
Xe-135m	2.66E-0	4.32E-1	9.5E-2	0.0038	0.012	2.16	0.0326
Xe-137	1.07E+1	1.94E-1	1.64	0.0035	0.016	3.57	0.0293
Xe-138	2.38E-0	1.18	6.11E-1	0.0035	0.0075	1.14	0.0301
AR-41	2.27E+1	1.3	0.40	0.0034	0.0072	1.12	0.030

- The Constants (u_t) were obtained from Radiation Dosemetry, Vol. I, Attix and Roesch, editors, 1968, Academic Press (Table XXII).
- Other values from Radiological Health Handbook, Revised Edition, January 1970.

Table 7.1-10

Maximum Permissible Concentration of
Dissolved or Entrained Noble Gases
Released From the Site to Unrestricted Areas
in Liquid Waste

Nuclide	MPC(μCi/ml)
Kr 85 m	4×10^{-5}
85	1×10^{-4}
87	1×10^{-5}
88	1×10^{-5}
Ar 41	1×10^{-5}
Xe 131 m	1×10^{-4}
133 m	1×10^{-4}
133	1×10^{-4}
135 m	4×10^{-5}
135	4×10^{-5}

Table 7.1-11

Partial Listing of Radiological Decay Constants and Halflives▲

Isotope	Decay Constant λ_i (hrs^{-1})	Halflife T_i (days)
H - 3	6.402E-06	4.511E+03
NA - 24	4.621E-02	6.250E-01
CR - 51	1.043E-03	2.770E+01
MN - 54	9.242E-05	3.125E+02
MN - 56	2.689E-01	1.074E-01
FE - 59	6.476E-04	4.460E+01
CO - 58	4.079E-04	7.080E+01
CO - 60	1.500E-05	1.925E+03
CU - 64	5.458E-02	5.292E-01
ZN - 65	1.183E-04	2.441E+02
SR - 85	4.454E-04	6.485E+01
SR - 89	5.719E-04	5.050E+01
SR - 90	2.774E-06	1.041E+04
SR - 91	7.168E-02	4.029E-01
SR - 92	2.558E-01	1.129E-01
ZR - 95	4.471E-04	6.460E+01
NB - 95	8.228E-04	3.510E+01
MO - 99	1.050E-02	2.750E+00
TC - 99M	1.152E-01	2.508E-01
RU - 103	7.340E-04	3.935E+01
AG - 110M	1.152E-04	2.508E+02
I - 131	3.592E-03	8.040E+00
I - 132	3.014E-01	9.583E-02
I - 133	3.347E-01	8.667E-01
I - 134	7.906E-01	3.653E-02
CS - 134	3.838E-05	7.526E+02
CS - 136	2.205E-03	1.310E+01
CS - 137	2.638E-06	1.095E+04
BA - 140	2.256E-03	1.280E+01
LA - 140	1.723E-02	1.676E+00
CE - 141	8.887E-04	3.250E+01
CE - 144	1.016E-04	2.844E+02
W - 187	2.900E-02	9.958E-01
NP - 239	1.226E-02	2.355E+00
AS - 76	2.633E-02	1.097E+00
Y - 91M	8.318E-01	3.472E-02
SB - 124	4.798E-04	6.020E+01

▲ For unlisted nuclides, see References 6.8 and 6.9.

Table 7.1-12

BIOACCUMULATION FACTORS TO BE USED IN THE ABSENCE OF SITE-SPECIFIC DATA
(pCi/kg per pCi/liter)*

ELEMENT	FRESHWATER	
	FISH	INVERTEBRATE
H	9.0E-01	9.0E-01
C	4.6E 03	9.1E 03
NA	1.0E 02	2.0E 02
P	1.0E 05	2.0E 04
CR	2.0E 02	2.0E 03
MN	4.0E 02	9.0E 04
FE	1.0E 02	3.2E 03
CO	5.0E 01	2.0E 02
NI	1.0E 02	1.0E 02
CU	5.0E 01	4.0E 02
ZN	2.0E 03	1.0E 04
BR	4.2E 02	3.3E 02
RB	2.0E 03	1.0E 03
SR	3.0E 01	1.0E 02
Y	2.5E 01	1.0E 03
ZR	3.3E 00	6.7E 00
NB	3.0E 04	1.0E 02
MO	1.0E 01	1.0E 01
TC	1.5E 01	5.0E 00
RU	1.0E 01	3.0E 02
RH	1.0E 01	3.0E 02
TE	4.0E 02	6.1E 03
I	1.5E 01	5.0E 00
CS	2.0E 03	1.0E 03
BA	4.0E 00	2.0E 02
LA	2.5E 01	1.0E 03
CE	1.0E 00	1.0E 03
PR	2.5E 01	1.0E 03
ND	2.5E 01	1.0E 03
W	1.2E 03	1.0E 01
NP	1.0E 01	4.0E 02

*Values in Table 7.1-12 are taken from NRC Reg. Guide 1.109, Revision 1, Oct. 77, Table A-1, unless otherwise indicated.

Table 7.1-13

Beta Dose Factors for
Noble Gases

Radionuclide	Skin Dose Factor $\bar{L}_i$ (mrem/yr per μCi/m³)	Beta Air Dose Factor L_i (mrad/yr per μCi/m³)
Kr-83m	---	2.88E+02 *
Kr-85m	1.46E+03	1.97E+03
Kr-85	1.34E+03	1.95E+03
Kr-87	9.73E+03	1.03E+04
Kr-88	2.37E+03	2.93E+03
Kr-89	1.01E+04	1.06E+04
Kr-90	7.29E+03	7.83E+03
Xe-131m	4.76E+02	1.11E+03
Xe-133m	9.94E+02	1.48E+03
Xe-133	3.06E+02	1.05E+03
Xe-135m	7.11E+02	7.39E+02
Xe-135	1.86E+03	2.46E+03
Xe-137	1.22E+04	1.27E+04
Xe-138	4.13E+03	4.75E+03
Ar-41	2.69E+03	3.28E+03

* 2.88 E+02 = 2.88 X 10^{+2}

Figure 7.1-1 Plume Depletion Effect for Ground-Level Releases (All Atmospheric Stability Classes)

(Regulatory Guide 1.111- Figure 2)

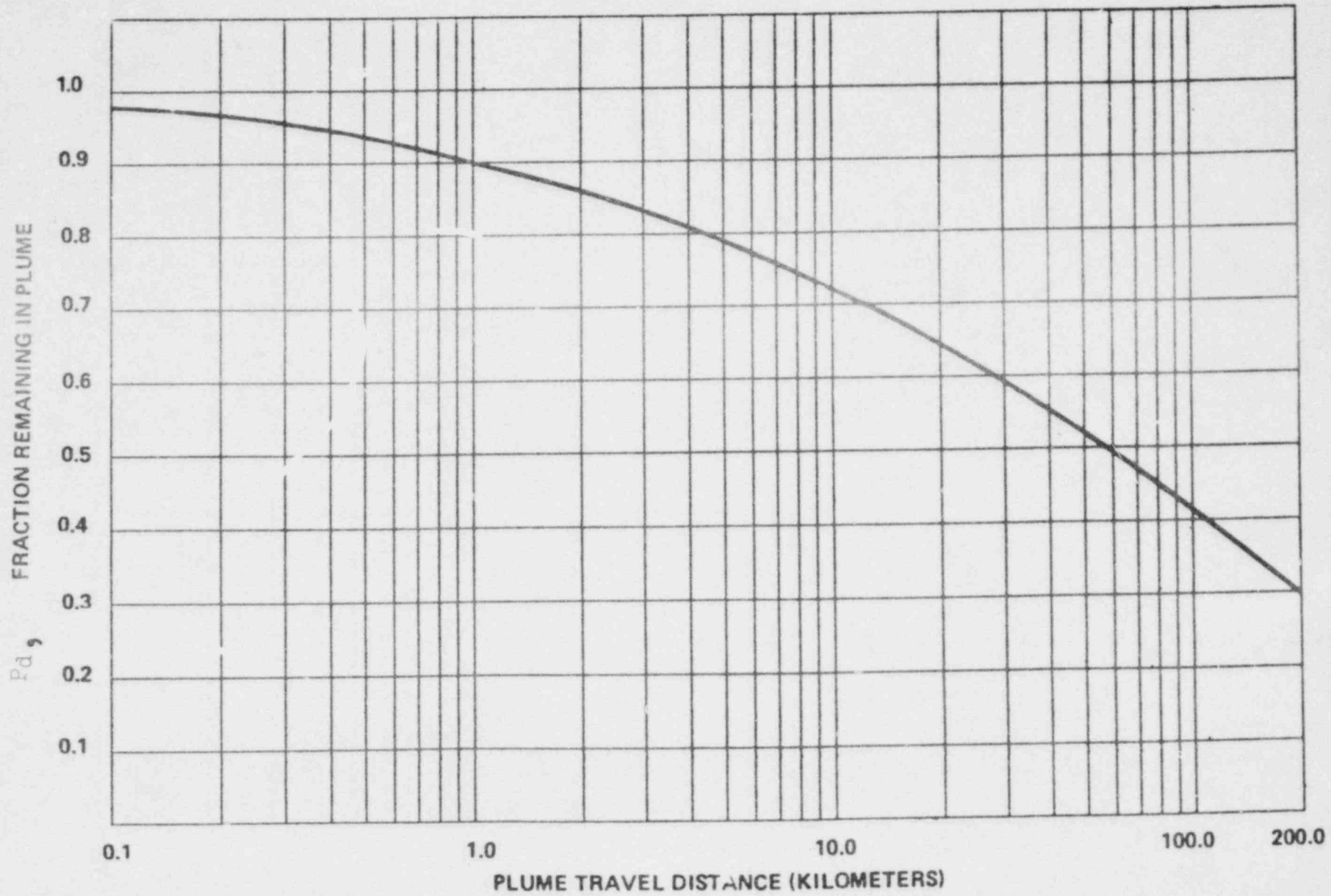


Figure 7.1-2Plume Depletion Effect for 30m Releases (Letters denote Pasquill Stability Class)

(Regulatory Guide 1.111- Figure 3)

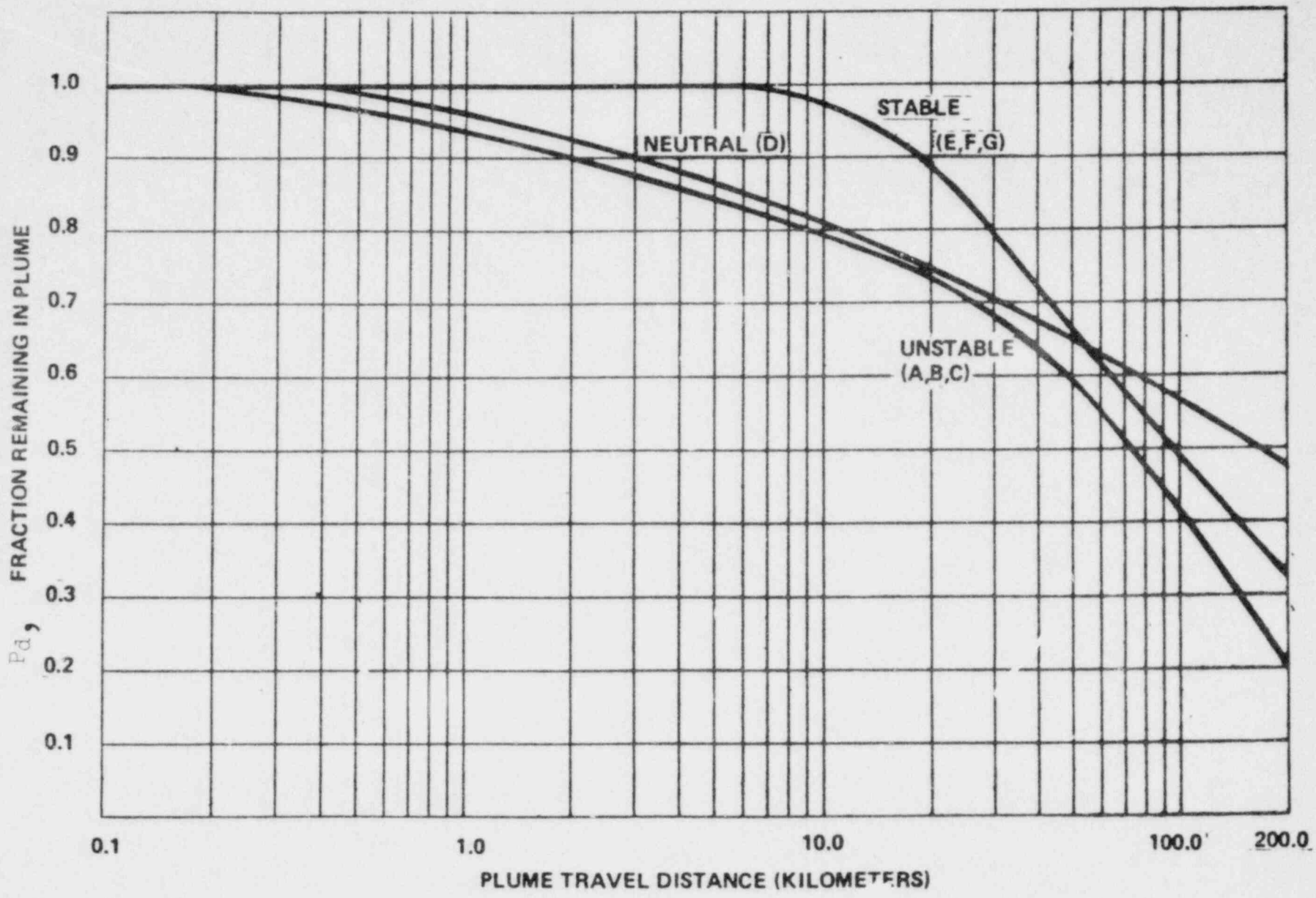


Figure 7.1-3 Plume Depletion Effect for 60-m Releases (Letters denote Pasquill Stability Class)

(Regulatory Guide 1.111- Figure 4)

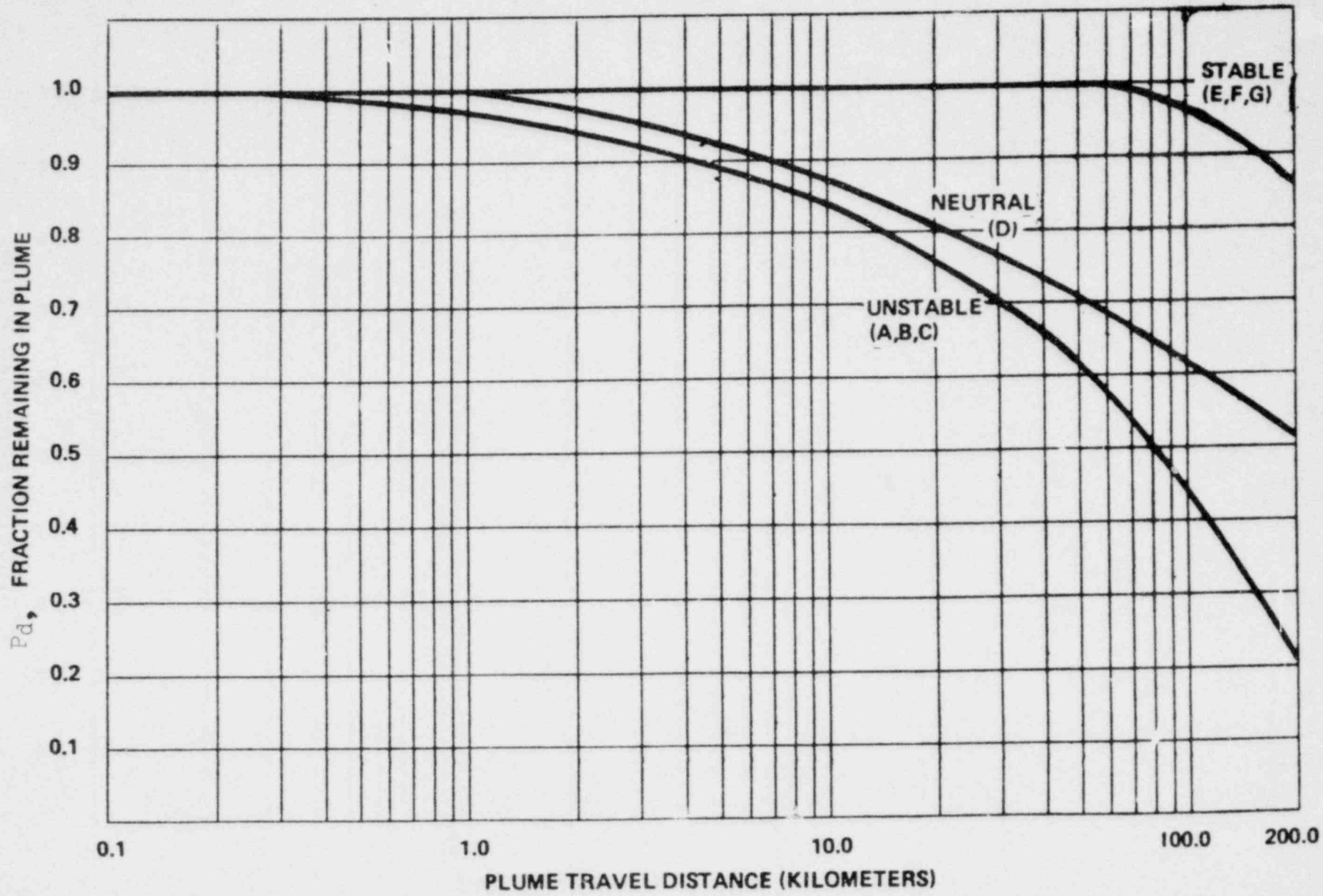
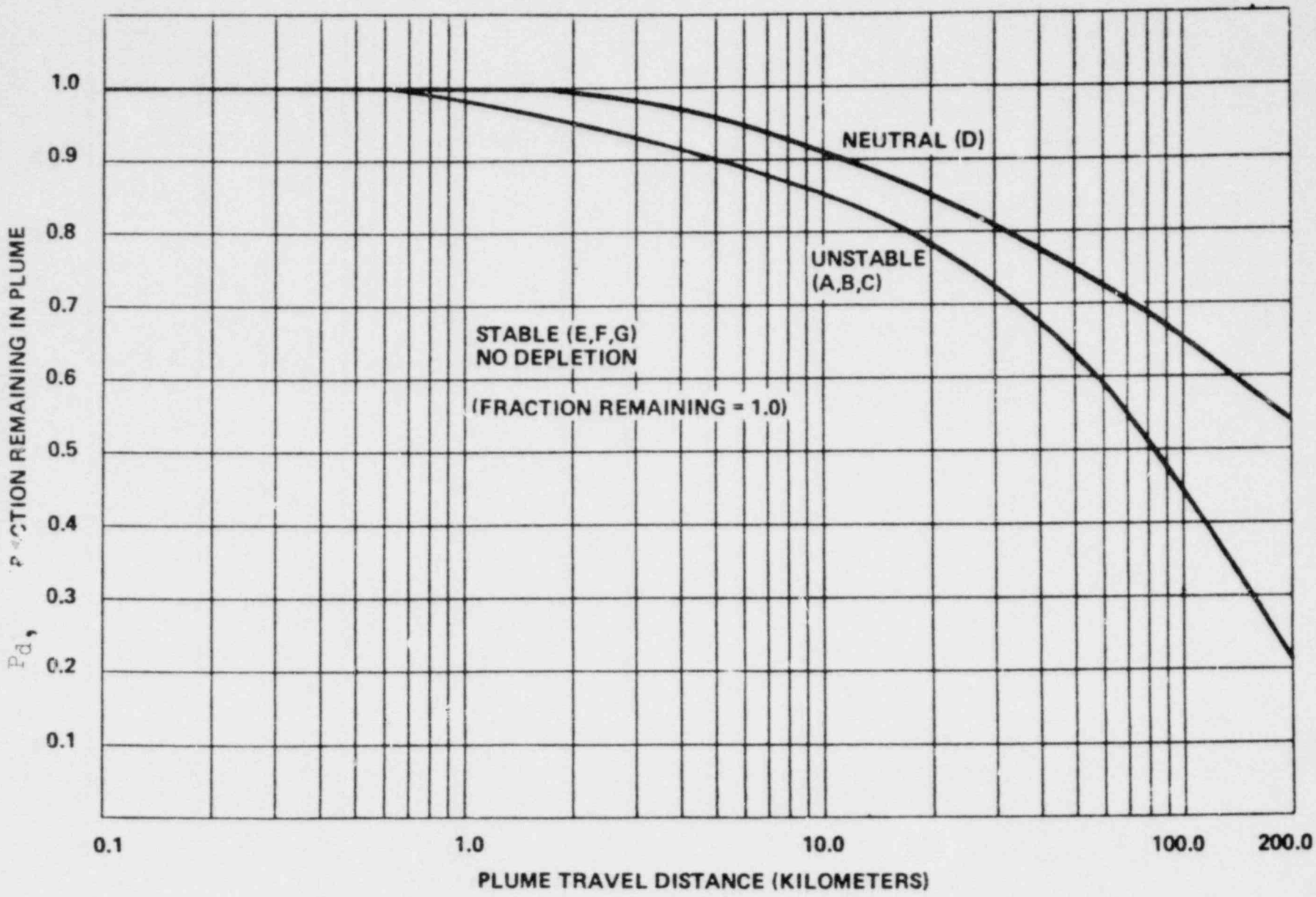


Figure 7.1-4 Plume Depletion Effect for 100-m Releases (Letters denote Pasquill Stability Class)

(Regulatory Guide 1.111- Figure 5)



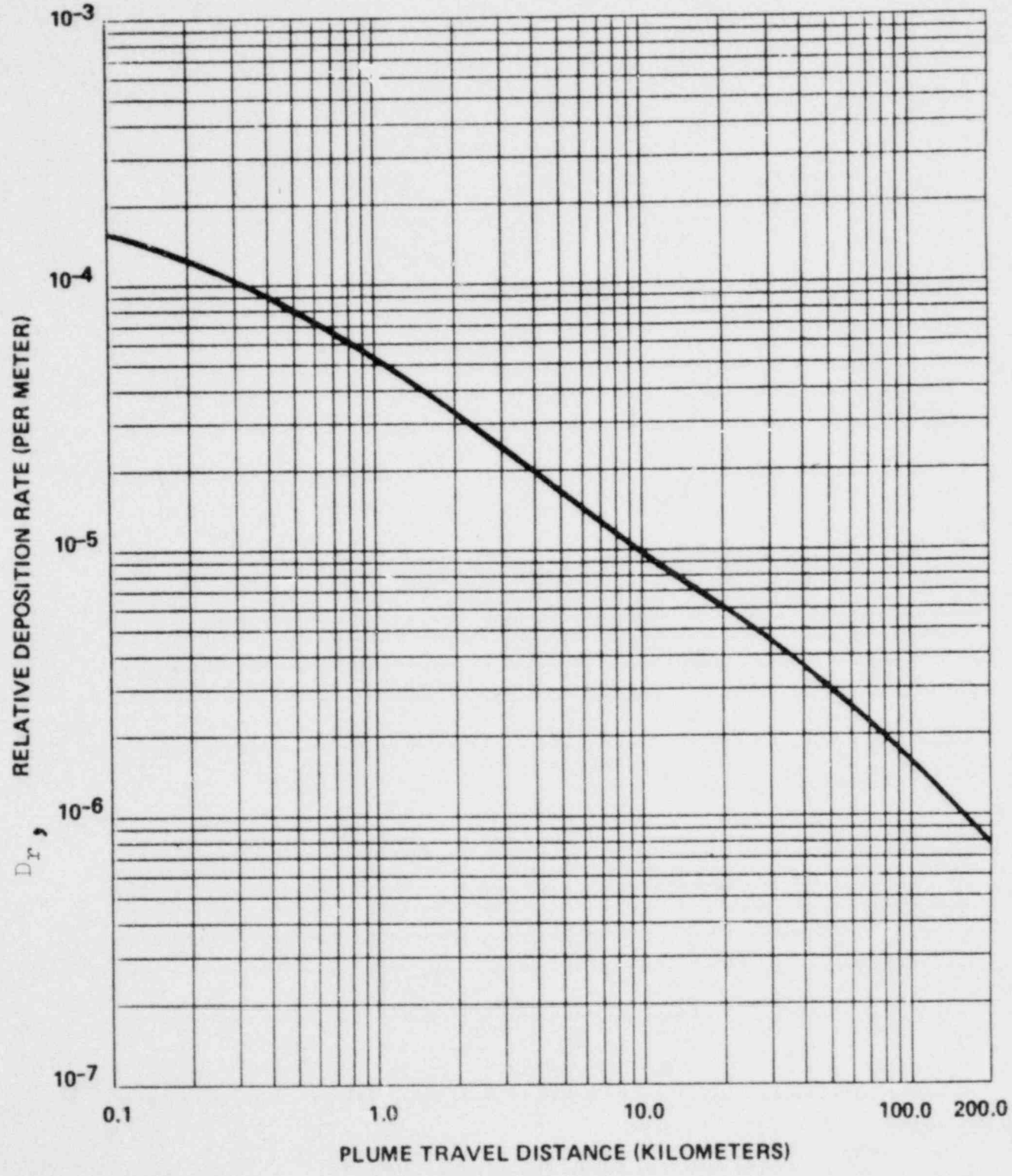


Figure 7.1-5 Relative Deposition for Ground-Level Releases (All Atmospheric Stability Classes)

(Regulatory Guide 1.111- Figure 6)

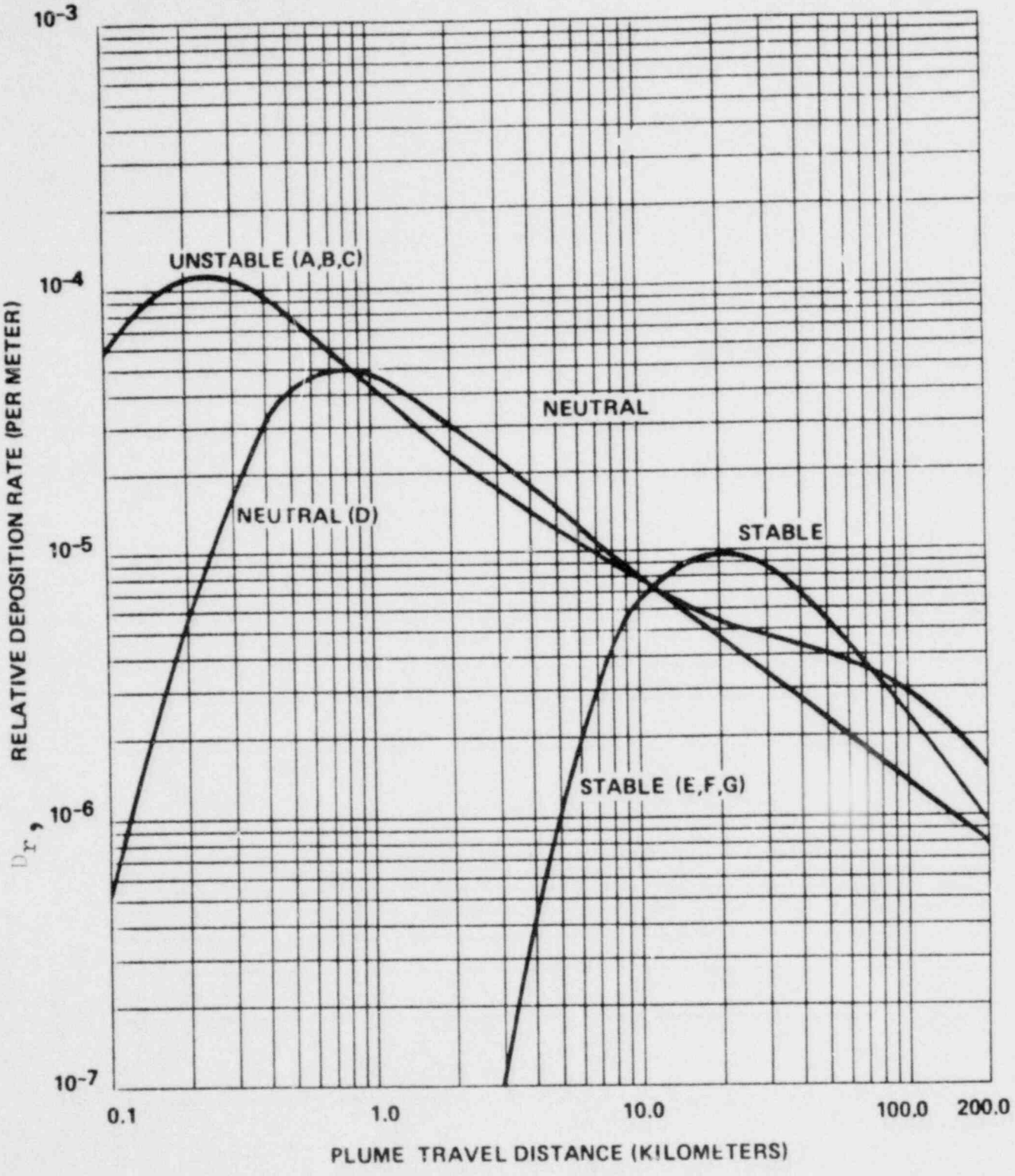


Figure 7.1-6 Relative Deposition for 30-m Releases (Letters denote Pasquill Stability Class)

(Regulatory Guide 1.111- Figure 7)

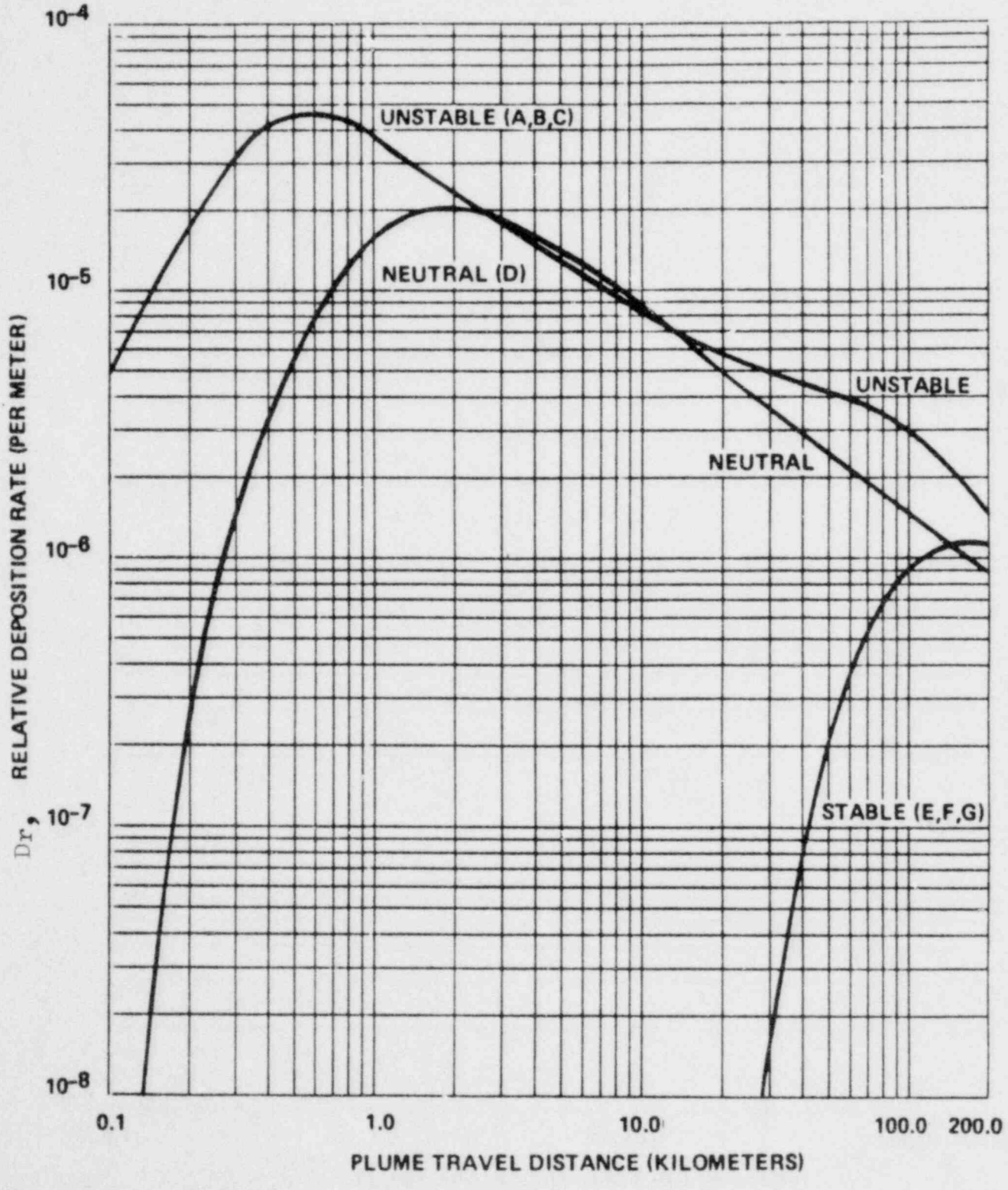


Figure 7.1-7 Relative Deposition for 60-m Releases (Letters denote Pasquill Stability Class)

(Regulatory Guide 1.111- Figure 8)

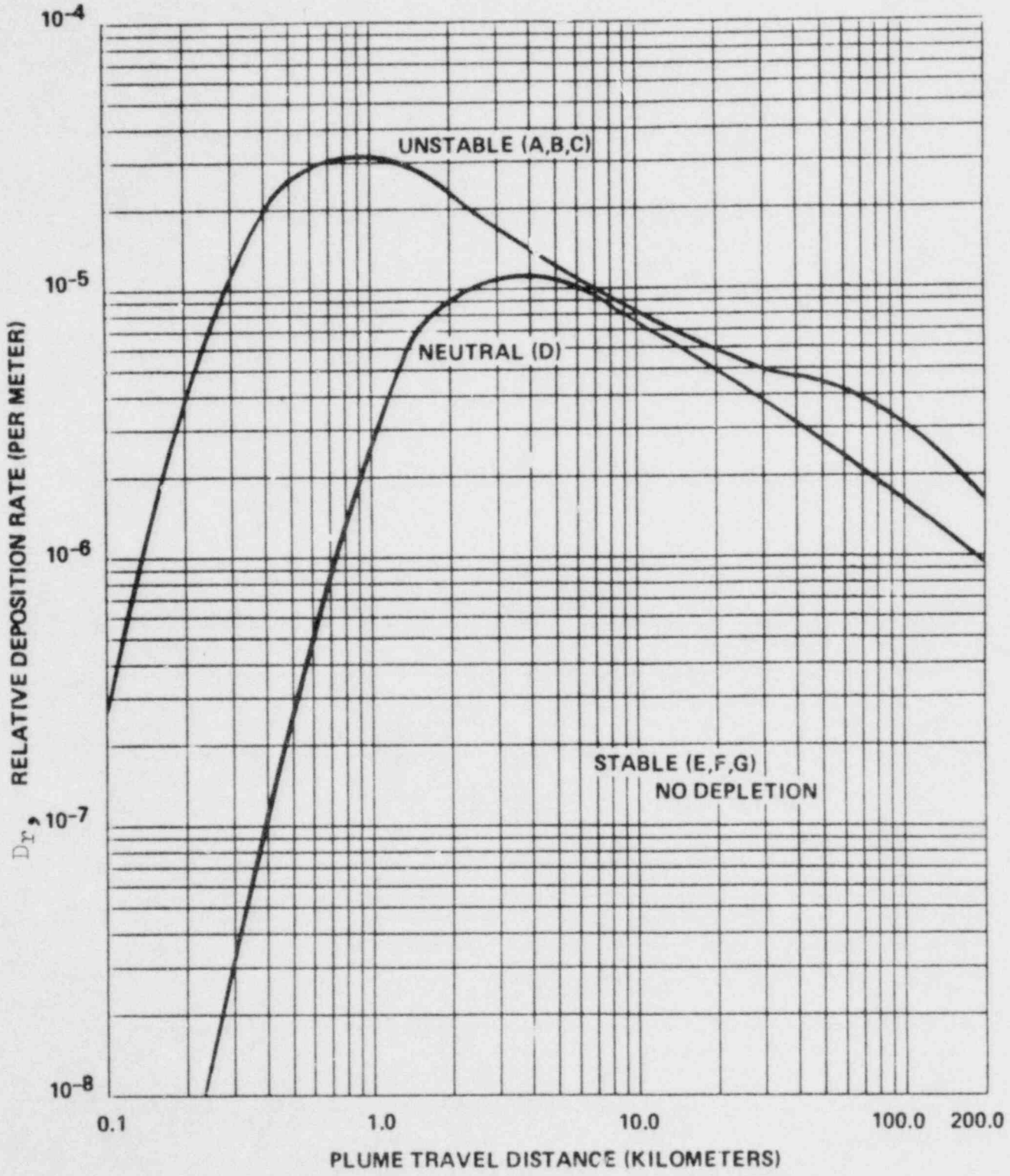


Figure 7.1-8 Relative Deposition for 100-m Releases (Letters denote Pasquill Stability Class)

(Regulatory Guide 1.111- Figure 9)

APPENDIX 7.2

Data for Zion Nuclear Power Station

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Table 7.2-7	D/Q At the Nearest Milk Cow and Meat Animal Locations
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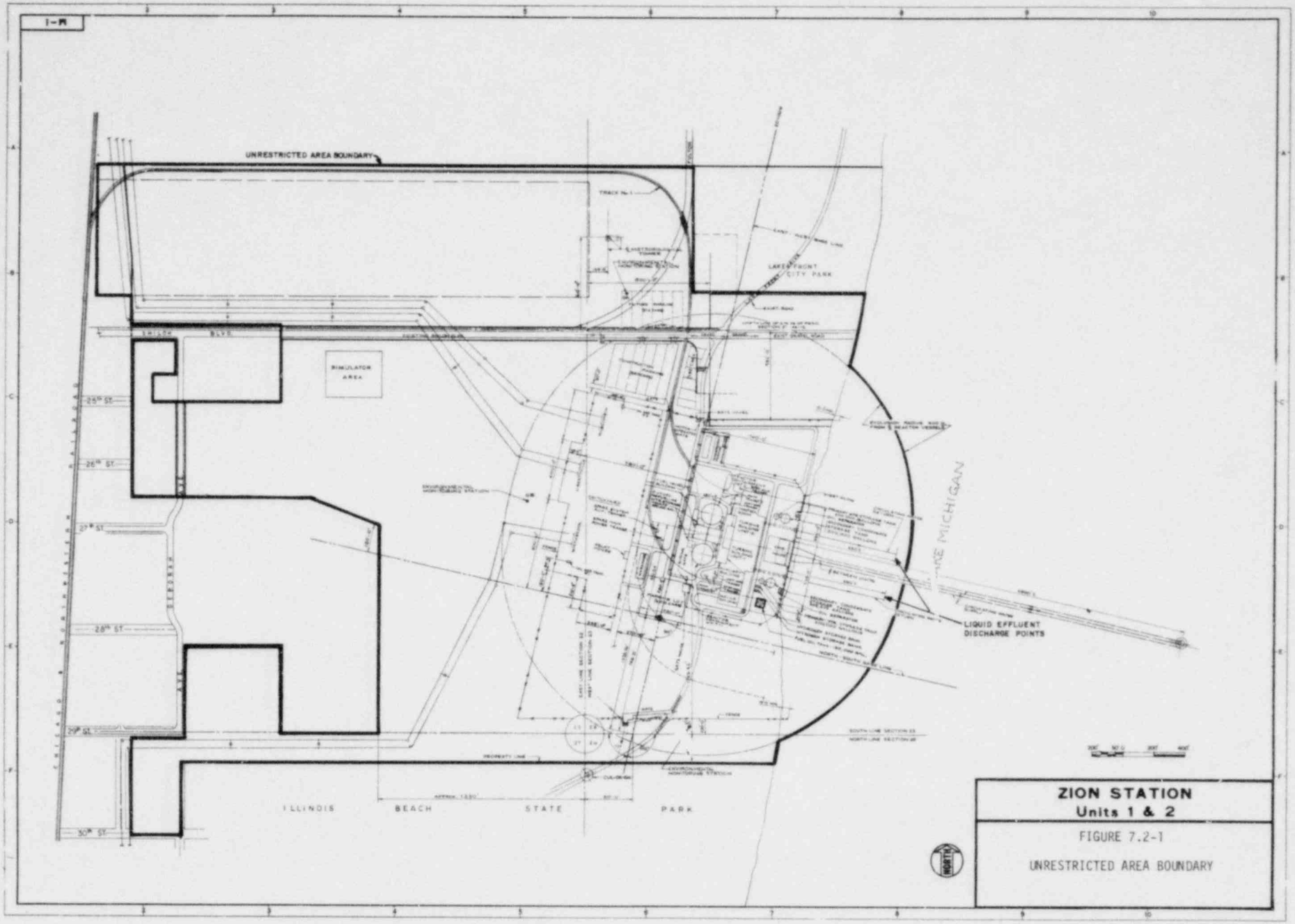

ZION STATION
Units 1 & 2

FIGURE 7.2-1

UNRESTRICTED AREA BOUNDARY

Table 7.2-1

Aquatic Environment Dose Parameters

Parameter	Zion
U^w, water usage, liters/hr	0.042
U^f, fish consumption, kg/hr	2.4×10^{-3}
$1/M^w$	60 Δ
F, ft^3/sec	$\overline{F}^w$ ** Δ
t^f, hr***	24
t^w, hr ⊙	5.5

B_i - Reg. Guide 1.109, Rev. 1, Oct. 77, Table A-1, col. 2 for freshwater fish. See Table 7.1-12

Δ At Zion, for the fish ingestion pathway only, $1/M^f = 1$ and F^f (ft^3/sec) = 4.0×10^5 based on the simplified assumption that the near shore current constitutes a "river of 5 miles width, 50 foot depth and flow of 0.2 miles per hour."

** $\overline{F}^w$ is the average flow of the condenser cooling water during the period of discharge (either Unit 1 or 2)

*** t^f (hr) = 24 hr (all stations) for the fish ingestion pathway

⊙ t^w(hr) = 5.5 hr (distance to Lake County intake is 1.1 mile; flow rate of 0.2 m.p.h)

Table 7.2-2 Annual Dose Limits Set by 10 CFR 50 Appendix 1 for Zion Station*

Type of Dose	Annual Limit
Airborne Releases	
Gamma Air Dose	20 mrad
Beta Air Dose	40 mrad
Whole Body Dose	10 mrem
Skin Dose	30 mrem
Infant Thyroid Dose	30 mrem
Liquid Releases	
Whole Body Dose	6 mrem
Thyroid Dose	20 mrem
Bone Dose	20 mrem
Skin Dose	20 mrem

* N = 2 units

Table 7.2-3

STATION: Zion Nuclear Power Station

LOCATION: Zion, Illinois

CHARACTERISTICS OF ELEVATED RELEASE POINT (NA)

1) Release Height = _____ m 2) Diameter = _____ m

2) Exit Speed = _____ ms^{-1} 4) Heat Content = _____ $KCal\ s^{-1}$

CHARACTERISTICS OF VENT STACK RELEASE POINT (NA)

1) Release Height = 55.5 m 2) Diameter = 2.4 m

3) Exit Speed = 15.2 ms^{-1}

CHARACTERISTICS OF GROUND LEVEL RELEASE

1) Release Height = 0 m

2) Building Factor (D) = 63 m

METEOROLOGICAL DATA

A 250 ft. Tower is Located 700 m NNW of elevated release point

Tower Data Used in Calculations

Release Point	Wind Speed and Direction	Differential Temperature
Elevated	(NA)	(NA)
Vent	125	125-35
Ground	35	125-35

Table 7.2-4 Critical Ranges

Zion Station

Direction	Site Boundary (m)	Nearest Resident (m)	Nearest Dairy Farm Range** (m)
N	469	2414	
NNE	475	*	
NE	*	*	
ENE	*	*	
E	*	*	
ESE	*	*	
SE	*	*	
SSE	*	*	
S	433	1609	
SSW	439	3219	
SW	518	3219	
WSW	671	3219	
W	658	1609	
WNW	893	1609	
NW	847	2012	
NNW	725	2012	

* Lake Michigan
**Within 5 miles

Table 7.2-5

Terrain Correction Factors (h_t)* - Zion Station
(h_t = 0 to Stated Range, Then h_t = Given Value)

Direction	Range	h_t
N	3 mi	3 m
NNE	-	0
NE	-	0
ENE	-	0
E	-	0
ESE	-	0
SE	-	0
SSE	-	0
S	-	0
SSW	4 mi	37 m
SW	5 mi	42 m
WSW	4 mi	50 m
W	3.5 mi	58 m
WNW	3.5 mi	67 m
NW	4.5 mi	45 m
NNW	3.0 mi	33 m

*Within 10 miles

Table 7.2-6

χ/Q and D/Q Maxima [a], Zion 1/2

Downward Direction	Elevated (Stack) Release				Mixed Mode (Vent) Release			Ground Level Release		
	Radius (Meters)	χ/Q (Sec/m^3)	Radius (Meters)	D/Q (1/m^2)	Radius (Meters)	χ/Q (Sec/m^3)	D/Q (1/m^2)	Radius (Meters)	χ/Q (Sec/m^3)	D/Q (1/m^2)
N	2800.	2.72-08	469.	7.50-10	469.	4.37-07	5.84-09	469.	9.37-06	3.70-08
NNE	2200.	4.54-08	475.	2.41-09	475.	4.21-07	8.69-09	475.	9.15-06	3.23-08
NE	400.	7.75-08	400.	4.57-09	400.	6.60-07	1.47-08	400.	1.23-05	5.55-08
ENE	400.	9.10-08	400.	4.39-09	400.	5.59-07	1.27-08	400.	1.11-05	5.43-08
E	400.	6.37-08	400.	2.89-09	400.	4.50-07	9.27-09	400.	1.10-05	5.14-08
ESE	400.	5.59-08	400.	2.38-09	400.	3.74-07	6.83-09	400.	1.03-05	3.79-08
SE	400.	4.45-08	400.	2.11-09	400.	3.96-07	6.85-09	400.	1.03-05	4.02-08
SSE	2200.	3.49-08	400.	1.14-09	400.	3.09-07	5.69-09	400.	6.99-06	3.21-08
S	1800.	4.55-08	433.	3.07-09	433.	3.68-07	9.68-09	433.	4.51-06	2.77-08
SSW	439.	7.45-08	439.	4.00-09	439.	3.11-07	8.77-09	439.	3.83-06	3.55-08
SW	1800.	3.36-08	518.	1.74-09	518.	1.61-07	4.32-09	518.	2.26-06	1.72-08
WSW	2200.	2.74-08	671.	1.03-09	671.	9.76-08	2.45-09	671.	1.20-06	9.05-09
W	2000	2.71-08	658.	1.08-09	658.	1.17-07	2.66-09	658.	1.26-06	9.78-09
WNW	2200	2.47-08	893.	9.44-10	893.	6.96-08	1.69-09	893.	8.64-07	5.42-09
NW	2000.	2.64-08	847.	1.48-09	847.	1.12-07	2.71-09	847.	1.26-06	6.95-09
NNW	2400.	4.04-08	725.	1.24-09	725.	1.93-07	3.48-07	725.	1.88-06	1.15-08

[a] Maxima at or beyond the unrestricted area boundary

Table 7.2-7

D/A At the Nearest Milk Cow (within 5 miles) and Meat Animal Locations, Zion 1/2

Downwind Direction	Nearest Milk Cow D/Q (m^{-2})				Nearest Meat Animal D/Q (m^{-2})			
	Radius (Meters)	Elevated Release	Mixed Release	Ground Release	Radius (Meters)	Elevated Release	Mixed Release	Ground Release
N	-	-	-	-	-	-	-	-
NNE	-	-	-	-	-	-	-	-
NE	-	-	-	-	-	-	-	-
ENE	-	-	-	-	-	-	-	-
E	-	-	-	-	-	-	-	-
ESE	-	-	-	-	-	-	-	-
SE	-	-	-	-	-	-	-	-
SSE	-	-	-	-	-	-	-	-
S	-	-	-	-	-	-	-	-
SSW	-	-	-	-	-	-	-	-
SW	-	-	-	-	-	-	-	-
WSW	-	-	-	-	-	-	-	-
W	-	-	-	-	4828.	1.40-10	1.73-10	3.27-10
WNW	-	-	-	-	-	-	-	-
NW	-	-	-	-	6437.	1.17-10	1.44-10	2.08-10
NNW	-	-	-	-	-	-	-	-

TABLE 7.2-8

ZION 1&2

FINITE PLUME GAMMA DOSE FACTORS AT THE EXCLUSION AREA BOUNDARY FOR KR 83M

DOWNWIND DIRECTION	RESTRICTED AREA BOUND (METERS)	ELEVATED(STACK) RELEASE RADIUS (METERS)	S (MRAD/YR)/(UCI/SEC)	SBAR	MIXED MODE(VENT) RELEASE RADIUS (METERS)	V (MRAD/YR)/(UCI/SEC)	VBAR	GROUND LEVEL RELEASE RADIUS (METERS)	G (MRAD/YR)/(UCI/SEC)	GBAR
N	469.	2800.	3.137-06	2.833-07	469.	4.908-05	4.432-06	469.	9.422-04	8.508-05
NNE	475.	2200.	5.243-06	4.735-07	475.	5.446-05	4.918-06	475.	9.052-04	8.183-05
NE	400.	400.	1.415-05	1.278-06	400.	8.170-05	7.378-06	400.	1.182-03	1.067-04
ENE	400.	400.	1.432-05	1.293-06	400.	6.781-05	6.123-06	400.	1.085-03	9.797-05
E	400.	400.	1.097-05	9.907-07	400.	5.750-05	5.192-06	400.	1.085-03	9.795-05
ESE	400.	400.	9.610-06	8.678-07	400.	4.500-05	4.064-06	400.	9.962-04	9.014-05
SE	400.	400.	8.836-06	7.979-07	400.	4.776-05	4.313-06	400.	1.043-03	9.420-05
SSE	400.	2200.	3.905-06	3.526-07	400.	3.863-05	3.489-06	400.	7.157-04	6.463-05
S	433.	1800.	5.192-06	4.6[illegible]-07	433.	4.956-05	4.475-06	433.	4.723-04	4.265-05
SSW	439.	439.	1.146-05	1.035-06	439.	4.492-05	4.056-06	439.	4.351-04	3.929-05
SW	518.	1800.	3.779-06	3.412-07	518.	2.282-05	2.060-06	518.	2.528-04	2.282-05
WSW	671.	2200.	2.897-06	2.616-07	671.	1.473-05	1.330-06	671.	1.339-04	1.209-05
W	658.	2000.	3.076-06	2.778-07	658.	1.593-05	1.439-06	658.	1.367-04	1.234-05
WNW	893.	2200.	2.707-06	2.445-07	893.	9.640-06	8.705-07	893.	9.309-05	8.406-06
NW	847.	2000.	4.174-06	3.770-07	847.	1.464-05	1.322-06	847.	1.349-04	1.218-05
NNW	725.	2400.	4.511-06	4.073-07	725.	2.505-05	2.262-06	725.	2.041-04	1.843-05

TABLE 7.2-8

ZION 1&2

FINITE PLUME GAMMA DOSE FACTORS AT THE EXCLUSION AREA BOUNDARY FOR KR 85M

DOWNWIND DIRECTION	RESTRICTED AREA BOUND (METERS)	ELEVATED(STACK) RELEASE RADIUS (METERS)	S (MRAD/YR)/(UCI/SEC)	SBAR	MIXED MODE(VENT) RELEASE RADIUS (METERS)	V (MRAD/YR)/(UCI/SEC)	VBAR	GROUND LEVEL RELEASE RADIUS (METERS)	G (MRAD/YR)/(UCI/SEC)	GBAR
N	469.	2800.	6.697-05	3.546-05	469.	5.038-04	2.640-04	469.	4.235-03	2.158-03
NNE	475.	2200.	1.004-04	5.313-05	475.	5.927-04	3.110-04	475.	3.923-03	1.995-03
NE	400.	400.	6.447-04	3.433-04	400.	8.724-04	4.576-04	400.	5.085-03	2.586-03
ENE	400.	400.	5.747-04	3.059-04	400.	7.564-04	3.970-04	400.	4.800-03	2.444-03
E	400.	400.	4.971-04	2.647-04	400.	6.555-04	3.442-04	400.	4.808-03	2.449-03
ESE	400.	400.	4.602-04	2.451-04	400.	5.818-04	3.062-04	400.	4.433-03	2.258-03
SE	400.	400.	4.788-04	2.552-04	400.	6.115-04	3.216-04	400.	4.752-03	2.423-03
SSE	400.	2200.	7.239-05	3.828-05	400.	4.755-04	2.501-04	400.	3.232-03	1.648-03
S	433.	1800.	9.828-05	5.199-05	433.	5.342-04	2.802-04	433.	2.201-03	1.124-03
SSW	439.	439.	3.947-04	2.099-04	439.	5.127-04	2.692-04	439.	2.172-03	1.113-03
SW	518.	1800.	7.297-05	3.860-05	518.	3.092-04	1.628-04	518.	1.319-03	6.766-04
WSW	671.	2200.	5.160-05	2.727-05	671.	2.023-04	1.066-04	671.	7.460-04	3.837-04
W	658.	2000.	5.831-05	3.084-05	658.	2.159-04	1.137-04	658.	7.593-04	3.905-04
WNW	893.	2200.	4.976-05	2.631-05	893.	1.433-04	7.558-05	893.	5.480-04	2.824-04
NW	847.	2000.	7.867-05	4.161-05	847.	2.185-04	1.152-04	847.	7.790-04	4.011-04
NNW	725.	2400.	9.080-05	4.805-05	725.	3.526-04	1.858-04	725.	1.125-03	5.782-04

TABLE 7.2-8

ZION 1&2

FINITE PLUME GAMMA DOSE FACTORS AT THE EXCLUSION AREA BOUNDARY FOR KR 85

DOWNWIND DIRECTION	RESTRICTED AREA BOUND (METERS)	ELEVATED(STACK) RELEASE RADIUS (METERS)	S (MRAD/YR)/(UCI/SEC)	SBAR	MIXED MODE(VENT) RELEASE RADIUS (METERS)	V (MRAD/YR)/(UCI/SEC)	VBAR	GROUND LEVEL RELEASE RADIUS (METERS)	G (MRAD/YR)/(UCI/SEC)	GBAR
N	469.	2800.	8.160-07	5.051-07	469.	5.897-06	3.650-06	469.	4.584-05	2.838-05
NNE	475.	2200.	1.208-06	7.475-07	475.	6.924-06	4.286-06	475.	4.242-05	2.626-05
NE	400.	400.	7.880-06	4.878-06	400.	1.018-05	6.302-06	400.	5.483-05	3.394-05
ENE	400.	400.	7.042-06	4.359-06	400.	8.878-06	5.496-06	400.	5.181-05	3.207-05
E	400.	400.	6.108-06	3.781-06	400.	7.707-06	4.770-06	400.	5.192-05	3.214-05
ESE	400.	400.	5.668-06	3.509-06	400.	6.898-06	4.270-06	400.	4.799-05	2.971-05
SE	400.	400.	5.902-06	3.653-06	400.	7.243-06	4.484-06	400.	5.146-05	3.185-05
SSE	400.	2200.	8.789-07	5.440-07	400.	5.620-06	3.479-06	400.	3.491-05	2.161-05
S	433.	1800.	1.182-06	7.315-07	433.	6.233-06	3.858-06	433.	2.378-05	1.472-05
SSW	439.	439.	4.849-06	3.002-06	439.	6.039-06	3.738-06	439.	2.354-05	1.457-05
SW	518.	1800.	8.923-07	5.523-07	518.	3.683-06	2.280-06	518.	1.434-05	8.877-06
WSW	671.	2200.	6.375-07	3.946-07	671.	2.418-06	1.497-06	671.	8.208-06	5.081-06
W	658.	2000.	7.158-07	4.431-07	658.	2.576-06	1.595-06	658.	8.342-06	5.164-06
WNW	893.	2200.	6.117-07	3.786-07	893.	1.715-06	1.062-06	893.	6.095-06	3.773-06
NW	847.	2000.	9.532-07	5.962-07	847.	2.614-06	1.618-06	847.	8.645-06	5.351-06
NNW	725.	2400.	1.117-06	6.913-07	725.	4.203-06	2.602-06	725.	1.239-05	7.672-06

TABLE 7.2-8

ZION :32

FINITE PLUME GAMMA DOSE FACTORS AT THE EXCLUSION AREA BOUNDARY FOR KR 37

DOWNWIND DIRECTION	RESTRICTED AREA BOUND (METERS)	ELEVATED(STACK) RELEASE RADIUS (METERS)	S (MRAD/YR)/(UCI/SEC)	SBAR	MIXED MODE(VENT) RELEASE RADIUS (METERS)	V (MRAD/YR)/(UCI/SEC)	VBAR	GROUND LEVEL RELEASE RADIUS (METERS)	G (MRAD/YR)/(UCI/SEC)	GBAR
N	469.	2800.	2.380-04	1.730-04	469.	1.844-03	1.339-03	469.	1.293-02	9.333-03
NNE	475.	2200.	3.627-04	2.637-04	475.	2.164-03	1.571-03	475.	1.189-02	8.580-03
NE	400.	400.	2.546-03	1.853-03	400.	3.189-03	2.315-03	400.	1.557-02	1.124-02
ENE	400.	400.	2.274-03	1.655-03	400.	2.787-03	2.024-03	400.	1.476-02	1.065-02
E	400.	400.	1.976-03	1.439-03	400.	2.422-03	1.759-03	400.	1.476-02	1.065-02
ESE	400.	400.	1.839-03	1.339-03	400.	2.181-03	1.585-03	400.	1.354-02	9.772-03
SE	400.	400.	1.916-03	1.395-03	400.	2.290-03	1.664-03	400.	1.453-02	1.048-02
SSE	400.	2200.	2.583-04	1.879-04	400.	1.769-03	1.286-03	400.	9.900-03	7.144-03
S	433.	1800.	3.567-04	2.594-04	433.	1.947-03	1.413-03	433.	6.769-03	4.885-03
SSW	439.	439.	1.566-03	1.140-03	439.	1.897-03	1.378-03	439.	6.772-03	4.889-03
SW	518.	1800.	2.654-04	1.931-04	518.	1.161-03	8.437-04	518.	4.076-03	2.943-03
WSW	671.	2200.	1.836-04	1.336-04	671.	7.553-04	5.491-04	671.	2.291-03	1.655-03
W	658.	2000.	2.092-04	1.522-04	658.	8.034-04	5.840-04	658.	2.344-03	1.693-03
WNW	893.	2200.	1.785-04	1.299-04	893.	5.325-04	3.872-04	893.	1.656-03	1.196-03
NW	847.	2000.	2.845-04	2.070-04	847.	8.131-04	5.913-04	847.	2.357-03	1.702-03
NNW	725.	2400.	3.247-04	2.362-04	725.	1.312-03	9.537-04	725.	3.442-03	2.486-03

TABLE 7.2-8

ZION 1&2

FINITE PLUME GAMMA DOSE FACTORS AT THE EXCLUSION AREA BOUNDARY FOR KR 88

DOWNWIND DIRECTION	RESTRICTED AREA BOUND (METERS)	ELEVATED(STACK) RELEASE RADIUS (METERS)	S (MRAD/YR)/(UCI/SEC)	SBAR	MIXED MODE(VENT) RELEASE RADIUS (METERS)	V (MRAD/YR)/(UCI/SEC)	VBAR	GROUND LEVEL RELEASE RADIUS (METERS)	G (MRAD/YR)/(UCI/SEC)	GBAR
N	469.	2800.	5.958-04	4.578-04	469.	4.380-03	3.357-03	469.	3.058-02	2.322-02
NNE	475.	2200.	8.966-04	6.888-04	475.	5.135-03	3.937-03	475.	2.818-02	2.138-02
NE	400.	400.	6.100-03	4.695-03	400.	7.560-03	5.795-03	400.	3.666-02	2.781-02
ENE	400.	400.	5.458-03	4.201-03	400.	6.623-03	5.078-03	400.	3.471-02	2.635-02
E	400.	400.	4.743-03	3.651-03	400.	5.757-03	4.415-03	400.	3.476-02	2.638-02
ESE	400.	400.	4.420-03	3.403-03	400.	5.198-03	3.989-03	400.	3.202-02	2.431-02
SE	400.	400.	4.605-03	3.546-03	400.	5.456-03	4.187-03	400.	3.435-02	2.607-02
SSE	400.	2200.	6.469-04	4.970-04	400.	4.217-03	3.236-03	400.	2.333-02	1.771-02
S	433.	1800.	8.805-04	6.765-04	433.	4.620-03	3.542-03	433.	1.593-02	1.209-02
SSW	439.	439.	3.765-03	2.898-03	439.	4.515-03	3.463-03	439.	1.588-02	1.207-02
SW	518.	1800.	6.644-04	5.107-04	518.	2.786-03	2.139-03	518.	9.651-03	7.339-03
WSW	671.	2200.	4.671-04	3.590-04	671.	1.824-03	1.401-03	671.	5.480-03	4.169-03
W	658.	2000.	5.283-04	4.060-04	658.	1.939-03	1.488-03	658.	5.590-03	4.254-03
WNW	893.	2200.	4.511-04	3.467-04	893.	1.292-03	9.925-04	893.	4.033-03	3.071-03
NW	847.	2000.	7.148-04	5.494-04	847.	1.972-03	1.514-03	847.	5.713-03	4.349-03
NNW	725.	2400.	8.198-04	6.301-04	725.	3.162-03	2.427-03	725.	8.247-03	6.274-03

TABLE 7.2-8

ZION 1&2

FINITE PLUME GAMMA DOSE FACTORS AT THE EXCLUSION AREA BOUNDARY FOR KR 89

DOWNWIND DIRECTION	RESTRICTED AREA BOUND (METERS)	ELEVATED(STACK) RELEASE RADIUS (METERS)	S (MRAD/YR)/(UCI/SEC)	SBAR	MIXED MODE(VENT) RELEASE RADIUS (METERS)	V (MRAD/YR)/(UCI/SEC)	VBAR	GROUND LEVEL RELEASE RADIUS (METERS)	G (MRAD/YR)/(UCI/SEC)	GBAR
N	469.	2800.	9.439-05	6.919-05	469.	2.839-03	2.078-03	469.	1.126-02	8.197-03
NNE	475.	2200.	2.131-04	1.562-04	475.	3.385-03	2.478-03	475.	9.691-03	7.054-03
NE	400.	400.	4.082-03	2.997-03	400.	5.222-03	3.823-03	400.	1.565-02	1.139-02
ENE	400.	400.	3.524-03	2.587-03	400.	4.431-03	3.244-03	400.	1.520-02	1.106-02
E	400.	400.	3.078-03	2.260-03	400.	3.861-03	2.827-03	400.	1.466-02	1.067-02
ESE	400.	400.	2.818-03	2.070-03	400.	3.397-03	2.489-03	400.	1.150-02	8.371-03
SE	400.	400.	2.945-03	2.163-03	400.	3.578-03	2.622-03	400.	1.234-02	8.980-03
SSE	400.	2200.	1.299-04	9.521-05	400.	2.717-03	1.990-03	400.	9.447-03	6.877-03
S	433.	1800.	2.543-04	1.864-04	433.	3.081-03	2.255-03	433.	7.012-03	5.104-03
SSW	439.	439.	2.339-03	1.718-03	439.	2.923-03	2.140-03	439.	7.942-03	5.783-03
SW	518.	1800.	1.501-04	1.100-04	518.	1.577-03	1.155-03	518.	3.803-03	2.770-03
WSW	671.	2200.	8.278-05	6.066-05	671.	8.976-04	6.574-04	671.	1.716-03	1.250-03
W	658.	2000.	1.069-04	7.837-05	658.	9.624-04	7.048-04	658.	1.878-03	1.368-03
WNW	893.	2200.	7.953-05	5.830-05	893.	5.510-04	4.036-04	893.	8.409-04	6.128-04
NW	847.	2000.	1.416-04	1.038-04	847.	8.650-04	6.337-04	847.	1.204-03	8.775-04
NNW	725.	2400.	1.300-04	9.529-05	725.	1.550-03	1.135-03	725.	2.316-03	1.687-03

TABLE 7.2-8

ZION 1&2

FINITE PLUME GAMMA DOSE FACTORS AT THE EXCLUSION AREA BOUNDARY FOR KR 90

DOWNWIND DIRECTION	RESTRICTED AREA BOUND (METERS)	ELEVATED(STACK) RELEASE RADIUS (METERS)	S (MRAD/YR)/(UCI/SEC)	SBAR	MIXED MODE(VENT) RELEASE RADIUS (METERS)	V (MRAD/YR)/(UCI/SEC)	VBAR	GROUND LEVEL RELEASE RADIUS (METERS)	G (MRAD/YR)/(UCI/SEC)	GBAR
N	469.	2800.	5.861-07	4.167-07	469.	1.053-03	7.464-04	469.	1.129-03	7.955-04
NNE	475.	2200.	3.643-06	2.590-06	475.	1.322-03	9.379-04	475.	1.138-03	8.024-04
NE	400.	400.	1.787-03	1.273-03	400.	2.444-03	1.734-03	400.	3.016-03	2.126-03
ENE	400.	400.	1.459-03	1.040-03	400.	1.979-03	1.404-03	400.	2.674-03	1.886-03
E	400.	400.	1.221-03	8.701-04	400.	1.651-03	1.171-03	400.	2.431-03	1.714-03
ESE	400.	400.	9.904-04	7.063-04	400.	1.248-03	8.869-04	400.	1.417-03	9.993-04
SE	400.	400.	1.043-03	7.440-04	400.	1.329-03	9.442-04	400.	1.360-03	9.590-04
SSE	400.	2200.	1.587-06	1.128-06	400.	1.105-03	7.846-04	400.	1.453-03	1.024-03
S	433.	1800.	1.048-05	7.447-06	433.	1.393-03	9.872-04	433.	1.350-03	9.517-04
SSW	439.	439.	8.474-04	6.037-04	439.	1.189-03	8.429-04	439.	1.777-03	1.254-03
SW	518.	1800.	5.447-06	3.871-06	518.	4.954-04	3.512-04	518.	5.835-04	4.116-04
WSW	671.	2200.	2.174-06	1.545-06	671.	2.260-04	1.601-04	671.	2.055-04	1.450-04
W	658.	2000.	2.964-06	2.107-06	658.	2.349-04	1.665-04	658.	2.251-04	1.588-04
WNW	893.	2200.	1.399-06	9.941-07	893.	7.838-05	5.555-05	893.	4.333-05	3.059-05
NW	847.	2000.	2.798-06	1.989-06	847.	1.272-04	9.021-05	847.	3.833-05	2.705-05
NNW	725.	2400.	1.280-06	9.099-07	725.	2.863-04	2.030-04	725.	1.396-04	9.845-05

TABLE 7.2-8

ZION 1&2

FINITE PLUME GAMMA DOSE FACTORS AT THE EXCLUSION AREA BOUNDARY FOR AR 41

DOWNWIND DIRECTION	RESTRICTED AREA BOUND (METERS)	ELEVATED(STACK) RELEASE RADIUS (METERS)	S (MRAD/YR)/(UCI/S	SBAR)	MIXED MODE(VENT) RELEASE RADIUS (METERS)	V (MRAD/YR)/(UCI/SEC)	VBAR	GROUND LEVEL RELEASE RADIUS (METERS)	G (MRAD/YR)/(UCI/SEC)	GBAR
N	469.	2600.	3.662-04	2.58 -04	469.	2.775-03	1.957-03	469.	2.005-02	1.414-02
NNE	475.	2200.	5.547-04	3.911-04	475.	3.256-03	2.295-03	475.	1.849-02	1.303-02
NE	400.	400.	3.798-03	2.678-03	400.	4.797-03	3.382-03	400.	2.411-02	1.700-02
ENE	400.	400.	3.395-03	2.393-03	400.	4.192-03	2.955-03	400.	2.282-02	1.609-02
E	400.	400.	2.948-03	2.078-03	400.	3.642-03	2.568-03	400.	2.284-02	1.610-02
ESE	400.	400.	2.744-03	1.935-03	400.	3.277-03	2.310-03	400.	2.101-02	1.481-02
SE	400.	400.	2.858-03	2.015-03	400.	3.440-03	2.425-03	400.	2.252-02	1.588-02
SSE	400.	2200.	3.974-04	2.802-04	400.	2.661-03	1.876-03	[illegible]	1.533-02	1.081-02
S	433.	1800.	5.436-04	3.832-04	433.	2.932-03	2.067-03	433.	1.046-02	7.377-03
SSW	439.	439.	2.341-03	1.651-03	439.	2.855-03	2.012-03	439.	1.043-02	7.350-03
SW	518.	1800.	4.061-04	2.863-04	518.	1.749-03	1.233-03	518.	6.292-03	4.436-03
WSW	671.	2200.	2.837-04	2.000-04	671.	1.138-03	8.023-04	671.	3.547-03	2.501-03
W	658.	2000.	3.219-04	2.269-04	658.	1.211-03	8.537-04	658.	3.621-03	2.553-03
WNW	893.	2200.	2.748-04	1.937-04	893.	8.054-04	5.678-04	893.	2.587-03	1.824-03
NW	847.	2000.	4.363-04	3.076-04	847.	1.229-03	8.665-04	847.	3.676-03	2.592-03
NNW	725.	2400.	4.998-04	3.524-04	725.	1.980-03	1.396-03	725.	5.342-03	3.766-03

@ADD.P OPERATIONS*UTILITY.XEROX-ONLY2

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@XQT OPERATIONS*UTILITY.MICRO-FICHE/CHECKER

TABLE 7.2-8

ZION 1&2

FINITE PLUME GAMMA DOSE FACTORS AT THE EXCLUSION AREA BOUNDARY FOR XE131M

DOWNWIND DIRECTION	RESTRICTED AREA BOUND (METERS)	ELEVATED(STACK) RELEASE RADIUS (METERS)	S (MRAD/YR)/(UCI/SEC)	SBAR	MIXED MODE(VENT) RELEASE RADIUS (METERS)	V (MRAD/YR)/(UCI/SEC)	VBAR	GROUND LEVEL RELEASE RADIUS (METERS)	G (MRAD/YR)/(UCI/SEC)	GBAR
N	469.	2800.	4.029-06	1.005-06	469.	4.874-05	9.047-06	469.	8.410-04	1.141-04
NNE	475.	2200.	6.384-06	1.529-06	475.	5.480-05	1.042-05	475.	8.087-04	1.083-04
NE	400.	400.	2.467-05	8.286-06	400.	8.177-05	1.543-05	400.	1.046-03	1.400-04
ENE	400.	400.	2.335-05	7.508-06	400.	6.859-05	1.318-05	400.	9.617-04	1.299-04
E	400.	400.	1.908-05	6.397-06	400.	5.846-05	1.134-05	400.	9.627-04	1.301-04
ESE	400.	400.	1.724-05	5.885-06	400.	4.725-05	9.658-06	400.	8.906-04	1.203-04
SE	400.	400.	1.704-05	6.044-06	400.	5.001-05	1.018-05	400.	9.330-04	1.270-04
SSE	400.	2200.	4.738-06	1.119-06	400.	4.004-05	8.020-06	400.	6.372-04	8.659-05
S	433.	1800.	6.269-06	1.497-06	433.	4.972-05	9.420-06	433.	4.212-04	5.783-05
SSW	439.	439.	1.729-05	5.268-06	439.	4.569-05	8.866-06	439.	3.893-04	5.474-05
SW	518.	1800.	4.636-06	1.114-06	518.	2.429-05	5.068-06	518.	2.296-04	3.269-05
WSW	671.	2200.	3.522-06	8.138-07	671.	1.578-05	3.312-06	671.	1.240-04	1.803-05
W	658.	2000.	3.785-06	9.003-07	658.	1.702-05	3.549-06	658.	1.260-04	1.831-05
WNW	893.	2200.	3.310-06	7.755-07	893.	1.061-05	2.299-06	893.	8.869-05	1.308-05
NW	847.	2000.	5.116-06	1.213-06	847.	1.613-05	3.501-06	847.	1.275-04	1.870-05
NNW	725.	2400.	5.698-06	1.386-06	725.	2.706-05	5.732-06	725.	1.894-04	2.740-05

TABLE 7.2-8

ZION 1&2

FINITE PLUME GAMMA DOSE FACTORS AT THE EXCLUSION AREA BOUNDARY FOR XE133M

DOWNWIND DIRECTION	RESTRICTED AREA BOUND (METERS)	ELEVATED(STACK) RELEASE RADIUS (METERS)	S (MRAD/YR)/(UCI/SEC)	SBAR	MIXED MODE(VENT) RELEASE RADIUS (METERS)	V (MRAD/YR)/(UCI/SEC)	VBAR	GROUND LEVEL RELEASE RADIUS (METERS)	G (MRAD/YR)/(UCI/SEC)	GBAR
N	469.	2800.	1.227-05	5.368-06	469.	1.094-04	4.080-05	[illegible].	1.355-03	3.759-04
NNE	475.	2200.	1.866-05	8.021-06	475.	1.261-04	4.782-05	475.	1.285-03	3.506-04
NE	400.	400.	1.022-04	4.956-05	400.	1.867-04	7.043-05	400.	1.662-03	4.531-04
ENE	400.	400.	9.249-05	4.430-05	400.	1.596-04	6.093-05	400.	1.543-03	4.258-04
E	400.	400.	7.888-05	3.824-05	400.	1.373-04	5.273-05	400.	1.545-03	4.266-04
ESE	400.	400.	7.261-05	3.537-05	400.	1.173-04	4.648-05	400.	1.429-03	3.942-04
SE	400.	400.	7.464-05	3.674-05	400.	1.236-04	4.888-05	400.	1.510-03	4.211-04
SSE	400.	2200.	1.364-05	5.824-06	400.	9.728-05	3.811-05	400.	1.029-03	2.862-04
S	433.	1800.	1.826-05	7.842-06	433.	1.140-04	4.312-05	433.	6.878-04	1.939-04
SSW	439.	439.	6.480-05	3.053-05	439.	1.074-04	4.125-05	439.	6.520-04	1.892-04
SW	518.	1800.	1.359-05	5.852-06	518.	6.157-05	2.470-05	518.	3.896-04	1.148-04
WSW	671.	2200.	9.905-06	4.188-06	671.	4.024-05	1.619-05	671.	2.150-04	6.480-05
W	658.	2000.	1.097-05	4.702-06	658.	4.311-05	1.729-05	658.	2.185-04	6.585-05
WNW	893.	2200.	9.445-06	4.020-06	893.	2.797-05	1.145-05	893.	1.560-04	4.777-05
NW	847.	2000.	1.479-05	6.328-06	847.	4.258-05	1.745-05	847.	2.230-04	6.790-05
NNW	725.	2400.	1.690-05	7.313-06	725.	6.966-05	2.817-05	725.	3.267-04	9.796-05

TABLE 7.2-8

ZION 1&2

FINITE PLUME GAMMA DOSE FACTORS AT THE EXCLUSION AREA BOUNDARY FOR XE133

DOWNWIND DIRECTION	RESTRICTED AREA BOUND (METERS)	ELEVATED(STACK) RELEASE RADIUS (METERS)	S (MRAD/YR)/(UCI/SEC)	SBAR	MIXED MODE(VENT) RELEASE RADIUS (METERS)	V (MRAD/YR)/(UCI/SEC)	VBAR	GROUND LEVEL RELEASE RADIUS (METERS)	G (MRAD/YR)/(UCI/SEC)	GBAR
N	469.	2800.	1.354-05	4.861-06	469.	1.199-04	3.885-05	469.	1.466-03	3.973-04
NNE	475.	2200.	2.049-05	7.269-06	475.	1.396-04	4.581-05	475.	1.384-03	3.703-04
NE	400.	400.	1.140-04	4.385-05	400.	2.056-04	6.720-05	400.	1.787-03	4.779-04
ENE	400.	400.	1.026-04	3.914-05	400.	1.755-04	5.776-05	400.	1.665-03	4.491-04
E	400.	400.	8.756-05	3.365-05	400.	1.511-04	4.989-05	400.	1.669-03	4.504-04
ESE	400.	400.	8.014-05	3.090-05	400.	1.287-04	4.334-05	400.	1.542-03	4.159-04
SE	400.	400.	8.256-05	3.205-05	400.	1.357-04	4.563-05	400.	1.637-03	4.452-04
SSE	400.	2 [illegible]	1.487-05	5.247-06	400.	1.071-04	3.582-05	400.	1.115-03	3.028-04
S	433.	1800.	2.012-05	7.135-06	433.	1.262-04	4.134-05	433.	7.490-04	2.054-04
SSW	439.	439.	7.195-05	2.713-05	439.	1.186-04	3.921-05	439.	7.163-04	2.005-04
SW	518.	1800.	1.494-05	5.304-06	518.	6.800-05	2.310-05	518.	4.295-04	1.214-04
WSW	671.	2200.	1.080-05	3.783-06	671.	4.440-05	1.511-05	671.	2.391-04	6.869-05
W	658.	2000.	1.200-05	4.244-06	658.	4.766-05	1.619-05	658.	2.427-04	6.971-05
WNW	893.	2200.	1.032-05	3.634-06	893.	3.106-05	1.070-05	893.	1.760-04	5.048-05
NW	847.	2000.	1.619-05	5.721-06	847.	4.728-05	1.629-05	847.	2.486-04	7.191-05
NNW	725.	2400.	1.853-05	6.600-06	725.	7.705-05	2.632-05	725.	3.626-04	1.038-04

TABLE 7.2-8

ZION 1&2

FINITE PLUME GAMMA DOSE FACTORS AT THE EXCLUSION AREA BOUNDARY FOR XE135M

DOWNWIND DIRECTION	RESTRICTED AREA BOUND (METERS)	ELEVATED(STACK) RELEASE RADIUS (METERS)	S (MRAD/YR)/(UCI/SEC)	SBAR	MIXED MODE(VENT) RELEASE RADIUS (METERS)	V (MRAD/YR)/(UCI/SEC)	VBAR	GROUND LEVEL RELEASE RADIUS (METERS)	G (MRAD/YR)/(UCI/SEC)	GBAR
N	469.	2800.	9.932-05	6.126-05	469.	1.055-03	6.483-04	469.	7.088-03	4.309-03
NNE	475.	2200.	1.648-04	1.016-04	475.	1.242-03	7.637-04	475.	6.419-03	3.900-03
NE	400.	400.	1.411-03	8.721-04	400.	1.847-03	1.135-03	400.	8.802-03	5.348-03
ENE	400.	400.	1.248-03	7.714-04	400.	1.596-03	9.812-04	400.	8.383-03	5.096-03
E	400.	400.	1.086-03	6.711-04	400.	1.388-03	8.534-04	400.	8.325-03	5.061-03
ESE	400.	400.	1.005-03	6.209-04	400.	1.235-03	7.599-04	400.	7.405-03	4.501-03
SE	400.	400.	1.047-03	6.470-04	400.	1.298-03	7.988-04	400.	7.947-03	4.833-03
SSE	400.	2200.	1.112-04	6.851-05	400.	9.997-04	6.151-04	400.	5.538-03	3.368-03
S	433.	1800.	1.660-04	1.023-04	433.	1.119-03	6.876-04	433.	3.832-03	2.331-03
SSW	439.	439.	8.538-04	5.274-04	439.	1.078-03	6.631-04	439.	3.923-03	2.390-03
SW	518.	1800.	1.148-04	7.077-05	518.	6.331-04	3.897-04	518.	2.227-03	1.357-03
WSW	671.	2200.	7.361-05	4.536-05	671.	3.982-04	2.451-04	671.	1.172-03	7.149-04
W	658.	2000.	8.710-05	5.368-05	658.	4.249-04	2.615-04	658.	1.222-03	7.458-04
WNW	893.	2200.	7.332-05	4.519-05	893.	2.725-04	1.678-04	893.	7.571-04	4.622-04
NW	847.	2000.	1.204-04	7.424-05	847.	4.182-04	2.575-04	847.	1.102-03	6.726-04
NNW	725.	2400.	1.321-04	8.146-05	725.	6.965-04	4.288-04	725.	1.733-03	1.057-03

TABLE 7.2-8

ZION 1&2

FINITE PLUME GAMMA DOSE FACTORS AT THE EXCLUSION AREA BOUNDARY FOR XE135

DOWNWIND DIRECTION	RESTRICTED AREA BOUND (METERS)	ELEVATED(STACK) RELEASE RADIUS (METERS)	S (MRAD/YR)/(UCI/SEC)	SBAR	MIXED MODE(VENT) RELEASE RADIUS (METERS)	V (MRAD/YR)/(UCI/SEC)	VBAR	GROUND LEVEL RELEASE RADIUS (METERS)	G (MRAD/YR)/(UCI/SEC)	GBAR
N	469.	2800.	9.377-05	5.061-05	469.	6.894-04	3.713-04	469.	5.649-03	3.023-03
NNE	475.	2200.	1.399-04	7.549-05	475.	8.117-04	4.373-04	475.	5.226-03	2.795-03
NE	400.	400.	8.973-04	4.850-04	400.	1.194-03	6.432-04	400.	6.763-03	3.617-03
ENE	400.	400.	7.998-04	4.322-04	400.	1.037-03	5.585-04	400.	6.390-03	3.419-03
E	400.	400.	6.923-04	3.742-04	400.	8.988-04	4.843-04	400.	6.404-03	3.426-03
ESE	400.	400.	6.411-04	3.466-04	400.	7.998-04	4.312-04	400.	5.910-03	3.162-03
SE	400.	400.	6.674-04	3.608-04	400.	8.404-04	4.531-04	400.	6.343-03	3.395-03
SSE	400.	2200.	1.012-04	5.458-05	400.	6.532-04	3.521-04	400.	4.309-03	2.306-03
S	433.	1800.	1.368-04	7.383-05	433.	7.314-04	3.940-04	433.	2.937-03	1.572-03
SSW	439.	439.	5.491-04	2.967-04	439.	7.032-04	3.789-04	439.	2.905-03	1.556-03
SW	518.	1800.	1.020-04	5.504-05	518.	4.259-04	2.296-04	518.	1.770-03	9.485-04
WSW	671.	2200.	7.238-05	3.906-05	671.	2.792-04	1.505-04	671.	1.007-03	5.398-04
W	658.	2000.	8.167-05	4.407-05	658.	2.977-04	1.605-04	658.	1.024-03	5.489-04
WNW	893.	2200.	6.969-05	3.761-05	893.	1.981-04	1.069-04	893.	7.441-04	3.991-04
NW	847.	2000.	1.100-04	5.938-05	847.	3.020-04	1.629-04	847.	1.056-03	5.664-04
NNW	725.	2400.	1.273-04	6.872-05	725.	4.865-04	2.623-04	725.	1.518-03	8.139-04

TABLE 7.2-8

ZION 1&2

FINITE PLUME GAMMA DOSE FACTORS AT THE EXCLUSION AREA BOUNDARY FOR XE137

DOWNWIND DIRECTION	RESTRICTED AREA BOUND (METERS)	ELEVATED(STACK) RELEASE RADIUS (METERS)	S (MRAD/YR)/(UCI/SEC)	SBAR	MIXED MODE(VENT) RELEASE RADIUS (METERS)	V (MRAD/YR)/(UCI/SEC)	VBAR	GROUND LEVEL RELEASE RADIUS (METERS)	G (MRAD/YR)/(UCI/SEC)	GBAR
N	469.	2800.	1.604-05	1.035-05	469.	3.968-04	2.558-04	469.	1.799-03	1.156-03
NNE	475.	2200.	3.408-05	2.200-05	475.	4.721-04	3.044-04	475.	1.559-03	1.002-03
NE	400.	400.	5.512-04	3.560-04	400.	7.222-04	4.657-04	400.	2.443-03	1.570-03
ENE	400.	400.	4.775-04	3.084-04	400.	6.137-04	3.957-04	400.	2.366-03	1.520-03
E	400.	400.	4.168-04	2.692-04	400.	5.344-04	3.446-04	400.	2.294-03	1.475-03
ESE	400.	400.	3.817-04	2.466-04	400.	4.693-04	3.028-04	400.	1.843-03	1.185-03
SE	400.	400.	3.985-04	2.575-04	400.	4.944-04	3.189-04	400.	1.979-03	1.272-03
SSE	400.	2200.	2.118-05	1.367-05	400.	3.769-04	2.431-04	400.	1.488-03	9.563-04
S	433.	1800.	3.915-05	2.527-05	433.	4.288-04	2.764-04	433.	1.088-03	6.990-04
SSW	439.	439.	3.190-04	2.061-04	439.	4.069-04	2.624-04	439.	1.208-03	7.767-04
SW	518.	1800.	2.365-05	1.523-05	518.	2.219-04	1.432-04	518.	5.943-04	3.821-04
WSW	671.	2200.	1.338-05	8.635-06	671.	1.289-04	8.315-05	671.	2.738-04	1.760-04
W	658.	2000.	1.706-05	1.101-05	658.	1.381-04	8.906-05	658.	2.982-04	1.917-04
WNW	893.	2200.	1.302-05	8.403-06	893.	8.084-05	5.215-05	893.	1.401-04	9.010-05
NW	847.	2000.	2.284-05	1.475-05	847.	1.262-04	8.141-05	847.	2.033-04	1.307-04
NNW	725.	2400.	2.177-05	1.405-05	725.	2.235-04	1.442-04	725.	3.784-04	2.433-04

TABLE 7.2-8

ZION 1&2

FINITE PLUME GAMMA DOSE FACTORS AT THE EXCLUSION AREA BOUNDARY FOR XE138

DOWNWIND DIRECTION	RESTRICTED AREA BOUND (METERS)	ELEVATED(STACK) RELEASE RADIUS (METERS)	S (MRAD/YR)/(UCI/SEC)	SBAR	MIXED MODE(VENT) RELEASE RADIUS (METERS)	V (MRAD/YR)/(UCI/SEC)	VBAR	GROUND LEVEL RELEASE RADIUS (METERS)	G (MRAD/YR)/(UCI/SEC)	GBAR
N	469.	2800.	2.228-04	1.610-04	469.	2.379-03	1.716-03	469.	1.471-02	1.051-02
NNE	475.	2200.	3.737-04	2.700-04	475.	2.801-03	2.020-03	475.	1.328-02	9.482-03
NE	400.	400.	3.298-03	2.389-03	400.	4.169-03	3.006-03	400.	1.829-02	1.306-02
ENE	400.	400.	2.920-03	2.115-03	400.	3.614-03	2.607-03	400.	1.746-02	1.247-02
E	400.	400.	2.543-03	1.842-03	400.	3.146-03	2.270-03	400.	1.732-02	1.238-02
ESE	400.	400.	2.359-03	1.710-03	400.	2.819-03	2.036-03	400.	1.537-02	1.098-02
SE	400.	400.	2.460-03	1.783-03	400.	2.962-03	2.139-03	400.	1.651-02	1.179-02
SSE	400.	2200.	2.512-04	1.815-04	400.	2.273-03	1.640-03	400.	1.152-02	8.227-03
S	433.	1800.	3.782-04	2.733-04	433.	2.521-03	1.817-03	433.	7.988-03	5.707-03
SSW	439.	439.	1.999-03	1.448-03	439.	2.446-03	1.765-03	439.	8.236-03	5.888-03
SW	518.	1800.	2.614-04	1.890-04	518.	1.448-03	1.046-03	518.	4.667-03	3.338-03
WSW	671.	2200.	1.661-04	1.200-04	671.	9.074-04	6.554-04	671.	2.44[illegible]-03	1.750-03
W	658.	2000.	1.975-04	1.428-04	658.	9.665-04	6.980-04	658.	2.5 -03	1.830-03
WNW	893.	2200.	1.659-04	1.200-04	893.	6.210-04	4.486-04	893.	1.573-03	1.126-03
NW	847.	2000.	2.737-04	1.979-04	847.	9.541-04	6.893-04	847.	2.285-03	1.635-03
NNW	725.	2400.	2.975-04	2.151-04	725.	1.585-03	1.145-03	725.	3.608-03	2.581-03

ATTACHMENT 3

BASES OF AND EXCEPTIONS TO NRC GUIDELINES FOR THE OFFSITE DOSE CALCULATION MANUAL

The Commonwealth Edison Offsite Dose Calculation Manual (ODCM) was developed from the NRC guidance in:

1. NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," October 1978;

2. Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50 Appendix I," October 1977; and

3. Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," July 1977.

Except for the principal differences described below, the environmental transport and dose models, and parameters used therein, came from these documents. However, in certain cases, the models, or to be more specific, the parameters used in the models were adjusted to either simplify some pathway calculations where the more sophisticated model (notably for atmospheric releases of tritium and carbon-14) did not affect the magnitude of the calculated dose to an individual, or to bring realism into the dose calculation by introducing site specific information.

Comparison of principal differences between NUREG-0133 and Commonwealth Edison Company's ODCM:

NUREG-0133	CECo. ODCM	Comment
1.1	1.0	No Significant Differences (NSD)
1.2	-	Not Applicable (NA)
2.1	-	NA

NUREG-0133	CECo. ODCM	Comment
2.2	-	(1) Any industrial, commercial, institutional or recreation facilities contained within the restricted area are controlled for the purpose of radiation protection and any person entering therein is considered an occupational worker, as defined in 10 CFR 20. (2) If in the FSAR a portion of the restricted or exclusion area extended over a water body for the purpose of licensure, then that same area is considered restricted area for purposes of implementing 10 CFR 50 Appendix I.
3.1	2.1 & 2.2	For multi-unit sites the site limit is the product of the unit limit by the number of units at the site, whether or not waste management systems are shared. This is in accord with the purpose of the NRC Commissioners when they wrote the limits on a per unit basis instead of establishing a fixed site limit, irrespective of the number of units. (Except that each nuclear station is committed to meeting the EPA promulgated regulation 40 CFR 190).
3.2	-	NA
3.3	3.1	"Short term" meteorological data are not provided because batch releases of air-borne effluents, if any, are randomly distributed throughout the year, i.e. the releases are not dependent solely on atmospheric conditions or the time of day.

NUREG-0133	CECo. ODCM	Comment
3.4	-	The 40 CFR 141 regulations do not apply to the Commonwealth Edison Company but to the operator of a water supply system. Hence, they are not addressed in either the Tech. Specs. or the ODCM. Furthermore, any special report on the impact on the water system would be redundant to the regular reporting of dose via the aquatic pathway since this dose calculation considers water consumption at the water supply nearest to the nuclear station's point of discharge.
3.5	-	NA
3.6	-	The ODCM is provided in accord with this NUREG requirement.
3.7	-	NA
3.8	2.3 & 5.3	NSD
4.1 & 4.1.1	8.0	Section 8.0 - Models for setting Gaseous and Liquid Effluent Monitor Alarm and Trip Setpoints will be submitted at a later date.
4.2	2.2.2	Rather than use a single value of $2X10^{-4}$ uCi/ml for all dissolved or entrained noble gases, Commonwealth Edison has derived individual MPCS for 10 noble gases using the NRC techniques.
4.3	4.1	(1) At sites where a river is the receiving body of water, total mixing is assumed rather than just near field mixing because the effluents, once in the river, are fully mixed during passage over a dam(s) prior to entering the surface water intake(s). Near field conditions are used where applicable, such as at Zion Station in Lake Michigan.

NUREG-0133	CECo. ODCM	Comment
		(2) A special model was developed for estimating the dose via the fish pathway in Lake Michigan. The special model postulates a "river" in the lake formed by the lake currents with the fish's movements restricted to this river.
4.3.1	2.2 & 4.0	NSD
4.3.2	5.2	NSD
4.4	2.2.3	This section will be described at a later date.
4.5	-	The Tech. Specs. will contain a specification discussing the treatment of radioactive material prior to release. However, the dose limits established for this purpose are not those specified by the NRC but were derived by taking one-twelfth of the site's Appendix I annual limits.
5.1 & 5.11	8.0	See comment concerning NUREG Sections 4.1 and 4.1.1.
5.2 & 5.2.1	Fig. 7.2-1	NSD
5.2.1	2.1	(1) For noble gases released in gaseous effluents, a finite plume model was used in all cases.
		(2) For radioiodines, "Particulates," and other non-noble gas radionuclides, no dairy pathway is considered during the winter when pastures do not exist and stored feed is consumed.

NUREG-0133	CECo. /CM	Comment
		(3) No special dose model is given for tritium in the ODCM because its contribution to individual dose is negligible whether a special model is used or not.
5.2.1.1	2.1.2	NSD
5.2.1.2	-	The ground plane pathway was not considered in the ODCM because it is a secondary pathway to those involving food.
5.2.1.3	2.1.2	(1) Only 50% of the radioiodines (those in elemental and particulate form) are assumed to deposit on the ground and enter food chain pathways. (2) See comment (3) for NUREG Section 5.2.1.
5.3	Fig. 7.2-1	NSD
5.3.1	2.1.1.1 and 2.1.2.1	(1) See comment under NUREG Section 3.1 (2) No age group census will be performed around the site because an infant or an adult will be assumed present at the various critical locations.
5.3.1.1	2.1.2.1	NSD
5.3.1.2	-	See comments on NUREG Section 5.2.1.2.
5.3.1.3 through 5.3.1.5	2.1.2	NSD, but see comments under NUREG Section 5.2.1.3.
5.4	-	See comment under NUREG Section 4.5
5.5	-	NA
5.6	-	NA

NUREG-0133	CECo. ODCM	Comment
5.6.1	-	NA - will be addressed in Tech. Specs.
5.6.2 & 5.6.3	-	Will be addressed in Tech. Specs., if applicable.