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ALABAMA POWER COMPANY

JOSEPH M. FARLEY NUCLEAR PLANT

FNP-0-M-011

SAFETY RELATED

OFF-SITE DOSE CALCULATION MANUAL

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Technical Manager

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List of Effective Pages

Page	Rev.
i,ii,iii,iv,v,1-2,2-1 to 2-16,3-1 to 3-5,	10
3-17,3-18,3-21,3-22,3-24 to 3-30,3-50,5-2 to 5-4,6-1	10
3-19	8
1-1,3-6 to 3-16,3-20,3-23,	7
3-31 to 3-49,4-1,5-1,5-5 to 5-7,6-2 to 6-9	7
Appendix	10
ODCM-2	

CONTENTS

List of Tables

List of Figures

ODCM-TECHNICAL SPECIFICATIONS CROSS REFERENCE TABLE

Radiological Effluent Technical Specification Section	Dose Calculation Methodology	ODCM Page
3.3.3.10	Determination of Alarm Trip Setpoints For Liquid Monitors	2-4
3.3.3.11	Determination of Alarm Trip Setpoints For Gaseous Monitors	3-17
4.11.1.1.1	Liquid Effluents	2-7
4.11.1.1.2	Liquid Effluents	2-7
4.11.1.1.3	Liquid Effluents	2
4.11.1.2	Liquid Effluents	2-8
4.11.1.3.1	Liquid Effluents	2-11
4.11.2.1.1	Noble Gases	3-21
4.11.2.1.2	Gaseous Effluents	3-21
4.11.2.2	Noble Gases	3-25
4.11.2.3	Radioiodines and Radioactive Materials in Particulate Form	3-27
4.11.2.4.1	Gaseous Effluents	3-50
4.11.4	Dose Assessment for Environmental Radiation Standards	4-1
4.12.1	Radiological Environmental Monitoring	5-1
6.9.1.9	ODCM	All
6.9.1.10	ODCM	All
6.14	ODCM	All

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CHAPTER 1

INTRODUCTION

This Off-Site Dose Calculation Manual (ODCM) describes the methods used at Farley Nuclear Plant (FNP) for complying with the effluent release portions of the FNP Technical Specifications and the requirements of 10CFR20 and Appendix I of 10CFR50.

The concentration and dose limits that are required to be met and which are described in this manual are:

- For radioactive liquid effluents, the concentrations released to areas beyond the site boundary are limited to the values given in 10CFR20, Appendix B, Table II.
- For radioactive liquid effluents, the maximum dose to any member of the public will be less than the limits given in 10CFR50, Appendix I.
- For gaseous effluents, the dose rate at any location beyond the site boundary will be limited to the annual dose limits given in 10CFR20.
- For gaseous effluents, the maximum dose to any member of the public will be less than the limits given in 10CFR50, Appendix I.
- The maximum dose to any member of the public will not exceed the limits given in 40CFR190.

The equations employed are taken from NUREG-0133[1] and Regulatory Guide 1.111[2,3]. References to Regulatory Guides are give with the equation numbers in this ODCM. Dose factors are calculated or taken directly from Regulatory Guide 1.109[4].

This ODCM describes the physical configuration of release sources and release points for routine and non-routine liquid and gaseous effluents, the monitor setpoint calculations, dose, and dose rate calculations.

Units 1 and 2 have independent release points for gaseous releases, and a common release point for liquids. For gaseous releases, dose limits for the site are normally apportioned equally between the two units, independent of the operational status of either unit but may be altered to allow more dose appropriation to either unit as necessary.

CHAPTER 2

LIQUID EFFLUENTS

2.1 LIQUID RELEASE CONFIGURATIONS

Routine liquid releases for each unit are discharged through a single release point. These are normally batch releases from the controlled discharge of liquid waste tanks. A simplified diagram of the waste tanks and the discharge paths is shown in Figure 2-1. Radiation monitor RE-18 is on the discharge path.

Routine releases are normally batch or continuous releases of the waste sources listed in Table 2-1.

Table 2-1. Liquid Waste Effluent Pathways for Routine Releases

Tank	Release Type	Volume	Monitor*
Waste Monitor Tank 1	batch	5000 gal	1/2 RE18
Waste Monitor Tank 2	batch	5000 gal	1/2 RE18
Turbine Building Sump	continuous or batch	-	-
Steam Generator Blowdown	continuous	-	1/2 RE23A, 1/2 RE23B

Figure 2-2 shows the relationship of all of the routine liquid effluent pathways and the combined discharge to the river.

Other potential effluent pathways are monitored regularly, and may be treated as non-routine releases, if required. Non-routine releases are un-monitored during release. Dose calculations will be made based on estimates of the activity concentration and volume of flow released.

*1/2 stands for Unit 1 or Unit 2

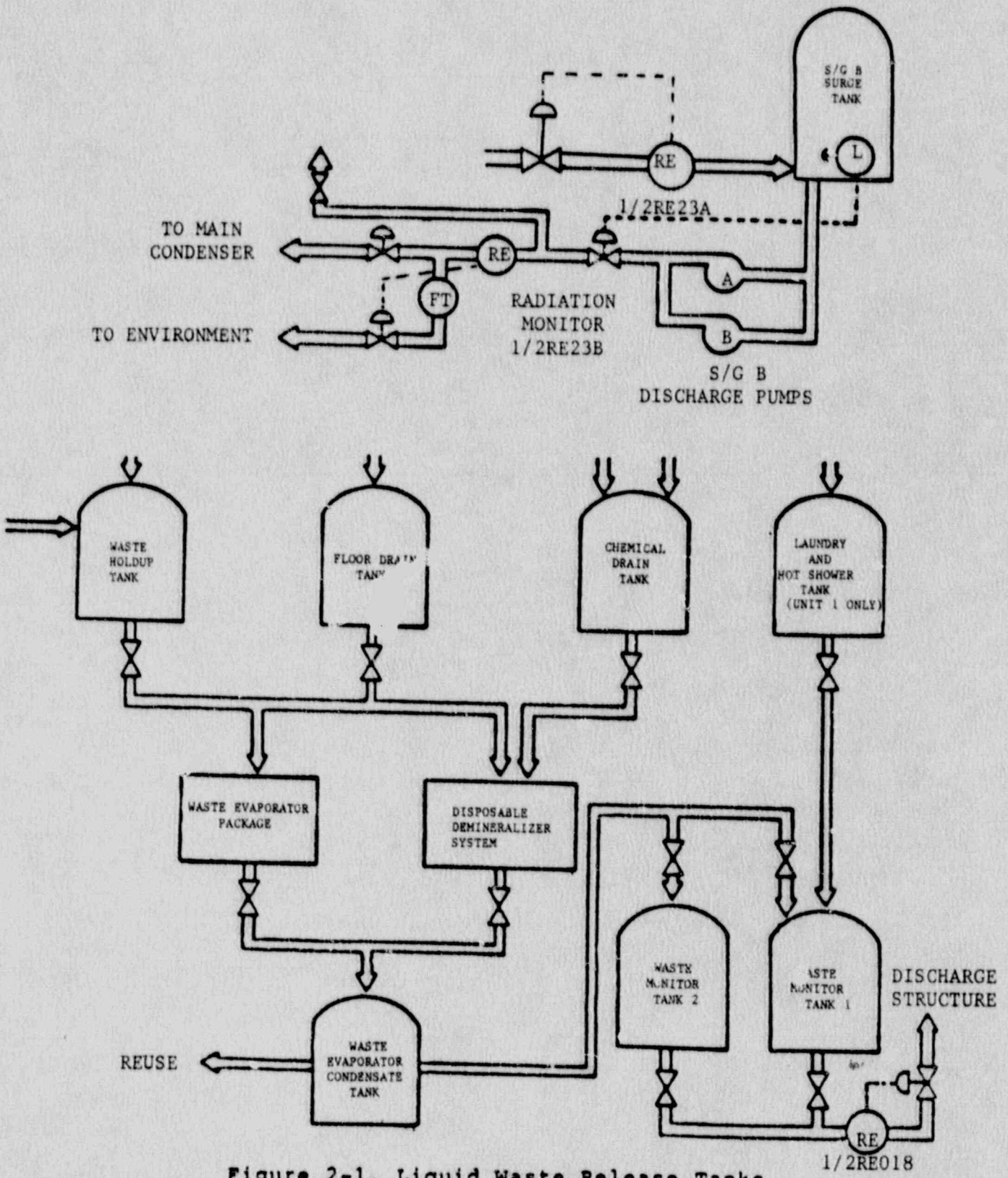


Figure 2-1. Liquid Waste Release Tanks

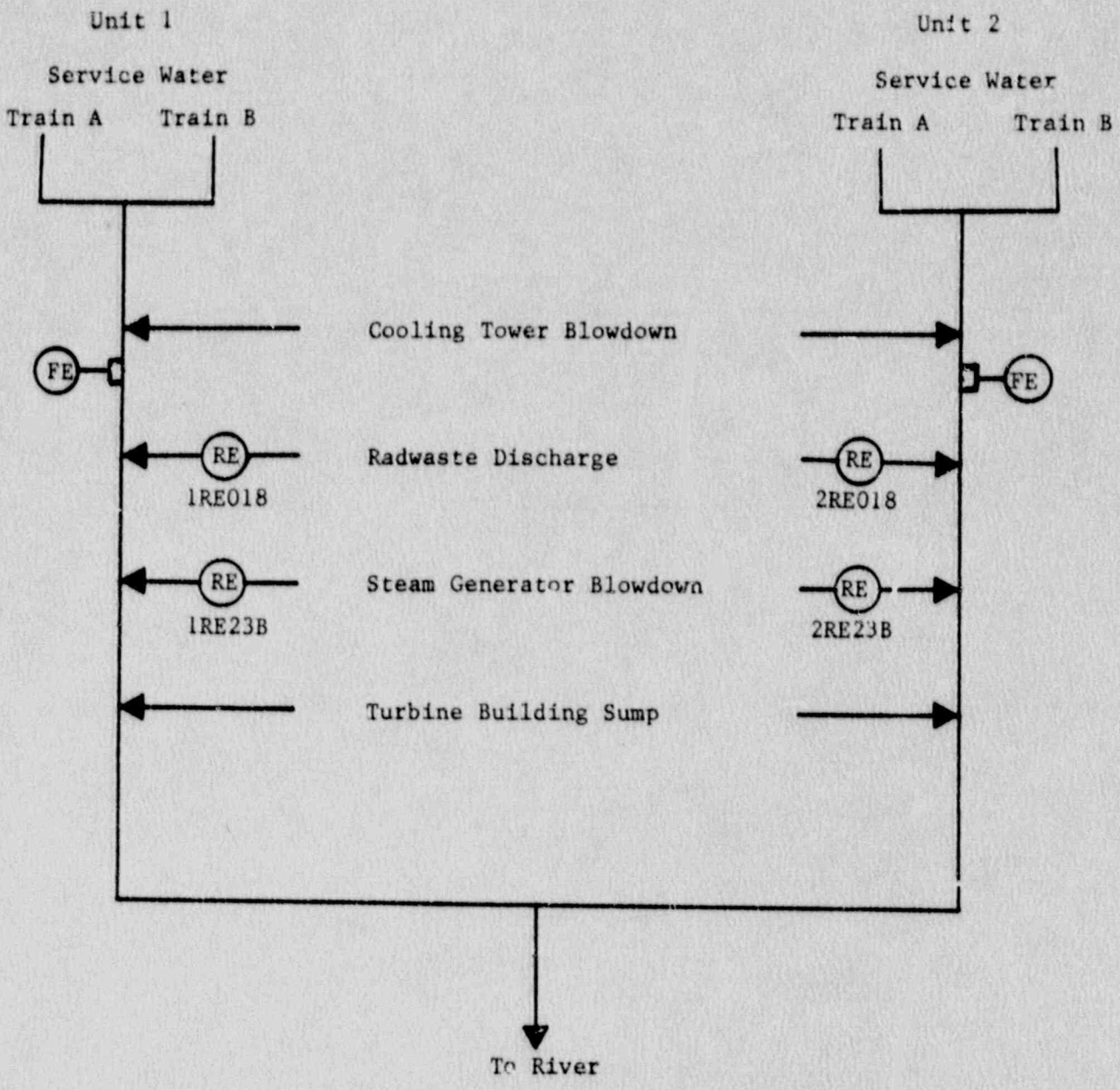


Figure 2-2. Routine Liquid Waste Effluent Pathways

2.2 SETPOINT CALCULATIONS

Calculations are made for the radiation monitors to determine the alarm/trip setpoints so that 10CFR20 compliance is met for the effluent pathway at the site boundary. These calculations use the maximum permissible concentrations (MPC) from 10CFR20 Appendix B, Table II, Column 2, and the more conservative of the soluble (S) or insoluble (I) values except for the noble gases for which a total of 2×10^{-4} μCi/ml is used.

The relationship that must be met to ensure 10CFR20 compliance is

$$\sum_i \frac{C_{i,s}}{MPC_i} \leq 1 \qquad (2.1)$$

where

$C_{i,s}$ = concentration of radionuclide i at the site boundary (discharge structure at the river) in μCi/ml.

MPC_i = 10CFR20 Appendix B, Table II, Column 2 values except for noble gases.

$\sum_i$ = Sum over all radionuclides

The concentration at the site boundary includes the contribution from all sources of both Units 1 and 2. The value of $C_{i,s}$ is a calculated value since only the concentrated input streams are measured for radionuclide content. Therefore:

$$C_{i,s} = \sum_{u=1}^{2} \frac{\sum C_{i,u,p} * f_{u,p}}{F_u} \qquad (2.2)$$

where

$C_{i,u,p}$ = concentration of radionuclide, i, in the effluent pathway, p, from Unit, u, in μCi/ml.

$f_{u,p}$ = flow rate from the effluent pathway, p, from the Unit, u, in gpm.

F_u = dilution flow (service water and cooling tower blowdown) plus $\sum_p f_{u,p}$ in gpm.

Each unit has an established and measured dilution flow so that if

$$\sum_i \frac{C_{i,u}}{MPC_i} \leq 1$$

is met for each unit then equation 2.1 will hold for the site, where $C_{i,u}$ is the concentration of radionuclide, i, in the discharge from Unit u.

Thus the unit specific 10CFR20 limit can be formulated as

$$\sum_i \frac{\sum_p \frac{C_{i,u,p} * f_{u,p}}{F_u}}{MPC_i} \leq 1 \qquad (2.3)$$

To account for multiple effluent pathways from a single unit an apportionment factor, AF_p, will be defined for each pathway such that

$$\sum_i \frac{\frac{C_{i,u,p} * f_{u,p}}{F_u}}{MPC_i} \leq AF_{u,p} \qquad (2.4)$$

with the restriction that

$$\sum_p AF_{u,p} \leq 1 \qquad (2.5)$$

Rearranging equation 2.4 and substituting $Dm_{u,p}$ for $\frac{F_u}{f_{u,p}}$ at the limit of the inequality then

$$Dm_{u,p} = \frac{1}{AF_{u,p}} \sum_i \frac{C_{i,u,p}}{MPC_i} \qquad (2.6)$$

where $Dm_{u,p}$ is the minimum dilution factor required for this effluent pathway to meet 10CFR20 limits at the site boundary (assumes all the pathways at the maximum value).

A safety factor of 2 is now applied to compensate for uncertainties in the measurements and calibrations so that the required dilution factor ($Dr_{u,p}$) is

$$Dr_{u,p} = 2 * Dm_{u,p} \qquad (2.7)$$

and can be calculated for each effluent pathway using

$$Dr_{u,p} = \frac{2}{AF_{u,p}} \sum \frac{C_{i,u,p}}{MPC_i} \qquad (2.8)$$

If the required dilution factor is less than 1, dilution is not required, but a setpoint must still be calculated.

To allow the discharge to occur without reaching the monitor setpoint the actual, or anticipated, dilution factor ($Da_{u,p}$) must be greater than the required dilution factor, $Dr_{u,p}$. This requirement will limit the effluent release point flow rate. The monitor setpoint is defined as

$$M_{u,p} = \frac{(Da_{u,p} - Dr_{H3})}{Dr_{\beta,\gamma}} \sum_i C_{ig,u,p} \qquad (2.9)$$

where

$M_{u,p}$ = setpoint in μci/ml

$\sum_i C_{ig,u,p}$ = Sum over all gamma-emitting radionuclides in the undiluted waste stream (the monitor is sensitive only to gamma-rays).

in which

$$Dr_{H3} = \frac{2}{AF_{u,p}} \frac{C_{H3,u,p}}{MPC_{H3}}$$

and

$$Dr_{\beta,\gamma} = \frac{2}{AF_{u,p}} * \sum_i \frac{C_{i,u,p}}{MPC_i}$$

*All radionuclides except H3.

$C_{H3,u,p}$ is greater than or equal to the previous monthly composite value for the waste stream.

Once the setpoint has been established the release pathway flowrate must be controlled to less than or equal to the maximum value, $F_u/Da_{u,p}$.

For the setpoint in counts per minute (cpm)

$$SPC_{u,p} = E_m * M_{u,p} + B_{u,p} \quad (2.10)$$

where

E_m = monitor calibration factor (cpm/μCi/ml)

$B_{u,p}$ = effluent monitor background in cpm

For a potential effluent pathway, e.g. the service water, that has no detectable activity, the setpoint should be set as close to background as practical to alarm if an inadvertent release were to occur but prevent spurious alarms.

The monitor setpoints determined in accordance with the methodology described above establish the upper bound for a particular monitor setpoint. Monitor setpoints may be established at lower values if desired.

2.3 10CFR20 AND TECHNICAL SPECIFICATION COMPLIANCE

2.3.1 Prior to Release

Prior to release, all tanks to be released as a batch are isolated from the source and recirculated a minimum of two volumes to ensure adequate mixing. The batch tank is then sampled after the appropriate mixing. Recirculation time to ensure adequate mixing is calculated as follows:

$$\text{minimum recirc duration (minutes)} = \frac{\text{tank content (gallons)} \times 2}{\text{recirc rate (gpm)}}$$

Prior to making a discharge the following parameters are established for the release:

a. Monitor setpont (if the pathway has a monitor).

b. Maximum effluent pathway release flow rate.

c. Anticipated dilution flow rate.

d. Assurance that the condition of equation (2.3) will be met considering all effluent pathways during the discharge.

2.3.2 During the Release

During the release the following information should be recorded:

a. Actual flow rate of the effluent release pathway.

b. Actual dilution flow rate.

c. Effluent monitor response (if there is an operable effluent monitor in the release pathway).

2.3.3 After the Release

After the release is completed, the actual effluent discharge information recorded during the release is used to verify that the condition of equation (2.3) was met during the discharge where $f_{u,p}$ and F_u are the actual flows recorded.

2.4 DOSE CALCULATIONS

A river use survey was conducted (reference 8) on the Chattahoochee River and Lake Seminole below Plant Farley. The survey encompassed drinking water, irrigation of crop and gardens, fishing, and recreational use of the river and shoreline. Only two pathways to man for the uptake of the liquid effluents were identified. These are fishing and irrigation and consumption of vegetables. Therefore, the dose calculations will consider fish and green leafy vegetables irrigated with river water consumed by an adult as the maximally exposed individual.

The dose limits specified in Technical Specification 3.11.1.2 are on a per reactor basis. Therefore the doses calculated in this subsection will be on a per reactor basis.

The dose to the maximum exposed individual due to radionuclides identified in each liquid effluent release from each unit to unrestricted areas will be calculated as follows:

$$D_\tau = \sum_i \left[A_{i\tau} \sum_1 \Delta t_1 \, C_{i1} \, F_1 \right] \qquad (2.11)$$

where:

D_τ = the cumulative dose commitment to the total body or an organ, τ, from the liquid effluents for the total time period $\sum_1 \Delta t_1$, in mrem.

$A_{i\tau}$ = site-related adult ingestion dose commitment factor to the total body or organ, τ, for each identified radionuclide in Table 2-4, in mrem/hr per μCi/ml.

Δt_1 = length of the time period over which C_{i1} and F_1 are averaged, for all liquid releases, in hours.

C_{i1} = the average concentration of radionuclide, i, in undiluted liquid effluent during time period Δt_1 from any liquid release, in μCi/ml.

F_1 = the near field average dilution factor for C_{i1} during any liquid effluent release. F_1 is defined as the ratio of the average undiluted liquid waste flow during release to the product of the average unit flow from the site discharge structure to unrestricted receiving waters times 5. (5 is the site specific applicable factor for the mixing effect of the discharge structure.)

$$F_1 = \frac{f_{u,p}}{F_u * 5} \qquad (2.12)$$

with the limitation that

$F_u * 5 \leq 448{,}800$ gpm. (1000 cfs - reference 1,

The values of $A_{i\tau}$ shown in Table 2-4 are calculated from

$$A_{i\tau} = k_o \left[U_f \, BF_i + U_v CF_{iv}\right] DF_{i\tau} \qquad (2.13)$$

where:

k_o = unit conversion factor 1.14×10^5 (year/hr).(ml/l).(pCi/uCi)

U_f = adult fish consumption, 21 kg/yr. (reference 4)

BF_i = the bioaccumulation factor (Table 2-2) in fish for each measured radionuclide i, in pCi/kg per pCi/liter (Table A-1 of Reg. Guide 1.109, Ref. 4).

U_v = adult vegetable consumption, 64 kg/yr (reference 4)

CF_{iv} = concentration factor for radionuclide i in the vegetable, pCi/kg/pCi/l

for radionuclides other than tritium

$$= M \cdot I \left[\frac{r(1-e^{-\lambda_{Ei} t_e})}{Y_v \lambda_{Ei}} + \frac{f_I B_{iv} (1-e^{-\lambda_i t_b})}{P \lambda_i} \right] e^{-\lambda_i t_h} \quad (2.14)(\text{ref. 4})$$

for tritium

$$= M \quad (2.15)(\text{ref. 4})$$

$DF_{i\tau}$ = the ingestion dose conversion factor (Table 2-3) for each organ, τ, for each nuclide, i, for adults, in mrem/pCi (Table E-11 of Reg. guide 1.109, Ref. 4).

M = additional river dilution at the point of irrigation usage (4×10^{-2} using actual river flow data for 1989 as a typical year)

I = average irrigation rate during the growing season, $1/m^2/hr$ (1.26×10^{-1} estimate based on pump capacity and garden size from reference 8 for 10% of the time).

r = fraction of deposited activity retained on leafy vegetables, 1.0 for iodines and 0.2 for others (reference 4).

Y_v = agricultural procductivity, 2.0 kg/m^2 (reference 4).

f_I = the fraction of the year that the vegetables are irrigated (0.1, estimate based on reference 8).

B_{iv} = crop to soil concentration factor, pCi/kg leaf per pCi/kg soil, Reg. Guide 1.109, Table E-1 (reference 4).

P = effective surface density for soil, 240 kg/m^2 (reference 4).

λ_i = decay constant for radionuclide i (reference 10).

λ_w = rate constant for removal of activity from a plant leaf (half-life = 14 days), 0.0021 hr^{-1} (reference 4).

$\lambda E_i = \lambda_w + \lambda_i$ (effective removal rate for radionuclide i from crops, reference 4).

t_e = period of leafy vegetable exposure during growing season, 60 days (1440 hours) (reference 4).

t_b = period of long term activity buildup in soil (nominally 15 years) 1.31×10^5 hours (reference 4).

t_h = time delay between harvest of vegetable and consumption by man, 24 hours (reference 4).

2.5 COMPOSITE ANALYSES

For radionuclides not determined in each batch or weekly composite, the dose contribution to the current calendar month or quarter cumulative summation may be approximated by assuming an average monthly or quarterly concentration based on the previous monthly or quarterly composite analyses. The nuclides determined from composite analyses are H-3, Fe-55, Sr-89, Sr-90, and gross alpha.

2.6 DOSE PROJECTIONS

Dose projections shall be made at least once in every 31 days, for all liquid effluent doses, based on the expected operating conditions. These dose projections will be compared to the projected dose limits of 0.06 mrem for the total body and 0.2 mrem for any organ. These limits are for the month.

Bioaccumulation Factors for Fresh Water fish

Element	Bioaccumulation Factor for Fresh Water Fish	
H	9.00E-01	
C	4.60E+03	
NA	1.00E+02	
P	3.00E+03	(Reference 7)
CR	2.00E+02	
MN	4.00E+02	
FE	1.00E+02	
CO	5.00E+01	
NI	1.00E+02	
CU	5.00E+01	
ZN	2.00E+03	
BR	4.20E+02	
RB	2.00E+03	
SR	3.00E+01	
Y	2.50E+01	
ZR	3.30E+00	
NB	3.00E+04	
MO	1.00E+01	
TC	1.50E+01	
RU	1.00E+01	
RH	1.00E+01	
TE	4.00E+02	
I	1.50E+01	
CS	2.00E+03	
BA	4.00E+00	
LA	2.50E+01	
CE	1.00E+00	
PR	2.50E+01	
ND	2.50E+01	
W	1.20E+03	
NP	1.00E+01	
SB	3.00E+02	(Reference 11)
AG	2.30E+00	(Reference 9)

Units are pCi/Kg per pCi/liter

Table 2-2. Bioaccumulation Factors (Ref. 4, except as indicated)

INGESTION DOSE CONVERSION FACTORS

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	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	0.00E+00	0.00E+00	0.00E+00	2.17E-05
CR-51	0.00E+00	0.00E+00	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
MN-54	0.00E+00	4.57E-06	8.72E-07	0.00E+00	1.36E-06	0.00E+00	1.40E-05
MN-56	0.00E+00	1.15E-07	2.04E-08	0.00E+00	1.46E-07	0.00E+00	3.67E-06
FE-55	2.75E-06	1.90E-06	4.43E-07	0.00E+00	0.00E+00	1.06E-06	1.09E-06
FE-59	4.34E-06	1.02E-05	3.91E-06	0.00E+00	0.00E+00	2.85E-06	3.40E-05
CO-58	0.00E+00	7.45E-07	1.67E-06	0.00E+00	0.00E+00	0.00E+00	1.51E-05
CO-60	0.00E+00	2.14E-06	4.72E-06	0.00E+00	0.00E+00	0.00E+00	4.02E-05
NI-63	1.30E-04	9.01E-06	4.36E-06	0.00E+00	0.00E+00	0.00E+00	1.88E-06
NI-65	5.28E-07	6.86E-08	3.13E-08	0.00E+00	0.00E+00	0.00E+00	1.74E-06
CU-64	0.00E+00	8.33E-08	3.91E-08	0.00E+00	2.10E-07	0.00E+00	7.10E-06
ZN-65	4.84E-06	1.54E-05	6.96E-06	0.00E+00	1.03E-05	0.00E+00	9.70E-06
ZN-69	1.03E-08	1.97E-08	1.37E-09	0.00E+00	1.28E-08	0.00E+00	2.96E-09
BR-83	0.00E+00	0.00E+00	4.02E-08	0.00E+00	0.00E+00	0.00E+00	5.79E-08
BR-84	0.00E+00	0.00E+00	5.21E-08	0.00E+00	0.00E+00	0.00E+00	4.09E-13
BR-85	0.00E+00	0.00E+00	2.14E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB-86	0.00E+00	2.11E-05	9.83E-06	0.00E+00	0.00E+00	0.00E+00	4.16E-06
RB-88	0.00E+00	6.05E-08	3.21E-08	0.00E+00	0.00E+00	0.00E+00	8.36E-19
RB-89	0.00E+00	4.01E-08	2.82E-08	0.00E+00	0.00E+00	0.00E+00	2.33E-21
SR-89	3.08E-04	0.00E+00	8.84E-06	0.00E+00	0.00E+00	0.00E+00	4.94E-05
SR-90	7.58E-03	0.00E+00	1.86E-03	0.00E+00	0.00E+00	0.00E+00	2.19E-04
SR-91	5.67E-06	0.00E+00	2.29E-07	0.00E+00	0.00E+00	0.00E+00	2.70E-05
SR-92	2.15E-06	0.00E+00	9.30E-08	0.00E+00	0.00E+00	0.00E+00	4.26E-05
Y-90	9.62E-09	0.00E+00	2.58E-10	0.00E+00	0.00E+00	0.00E+00	1.02E-04
Y-91M	9.09E-11	0.00E+00	3.52E-12	0.00E+00	0.00E+00	0.00E+00	2.67E-10
Y-91	1.41E-07	0.00E+00	3.77E-09	0.00E+00	0.00E+00	0.00E+00	7.76E-05
Y-92	8.45E-10	0.00E+00	2.47E-11	0.00E+00	0.00E+00	0.00E+00	1.48E-05
SB-124	2.81E-06	5.30E-08	1.11E-06	6.79E-09	0.00E+00	2.18E-06	7.95E-05
SB-125	2.23E-06	2.40E-08	4.48E-07	1.98E-09	0.00E+00	2.33E-04	1.97E-05

Units are mrem/pCi

Table 2-3. Ingestion Dose Conversion Factors (Ref. 4, except SB (Ref. 9))

Liquid Effluents

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
Y-93	2.68E-09	0.00E+00	7.40E-11	0.00E+00	0.00E+00	0.00E+00	8.50E-05
ZR-95	3.04E-08	9.75E-09	6.60E-09	0.00E+00	1.53E-08	0.00E+00	3.09E-05
ZR-97	1.68E-09	3.39E-10	1.55E-10	0.00E+00	5.12E-10	0.00E+00	1.05E-04
NB-95	6.22E-09	3.46E-09	1.86E-09	0.00E+00	3.42E-09	0.00E+00	2.10E-05
MO-99	0.00E+00	4.31E-06	8.20E-07	0.00E+00	9.76E-06	0.00E+00	9.99E-06
TC-99M	2.47E-10	6.98E-10	8.89E-09	0.00E+00	1.06E-08	3.42E-10	4.13E-07
TC-101	2.54E-10	3.66E-10	3.59E-09	0.00E+00	6.59E-09	1.87E-10	1.10E-21
RU-103	1.85E-07	0.00E+00	7.97E-08	0.00E+00	7.06E-07	0.00E+00	2.16E-05
RU-105	1.54E-08	0.00E+00	6.08E-09	0.00E+00	1.99E-07	0.00E+00	9.42E-06
RU-106	2.75E-06	0.00E+00	3.48E-07	0.00E+00	5.31E-06	0.00E+00	1.78E-04
AG-110M	1.60E-07	1.48E-07	8.79E-08	0.00E+00	2.91E-07	0.00E+00	6.04E-05
TE-125M	2.68E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	0.00E+00	1.07E-05
TE-127M	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	0.00E+00	2.27E-05
TE-127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	0.00E+00	8.68E-06
TE-129M	1.15E-05	4.29E-06	1.62E-06	3.95E-06	4.80E-05	0.00E+00	5.79E-05
TE-129	3.14E-08	1.18E-08	7.65E-09	2.41E-08	1.32E-07	0.00E+00	2.37E-08
TE-131M	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	0.00E+00	8.40E-05
TE-131	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	0.00E+00	2.79E-09
TE-132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	0.00E+00	7.71E-05
I-130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	0.00E+00	1.92E-06
I-131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	0.00E+00	1.57E-06
I-132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	0.00E+00	1.02E-07
I-133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	0.00E+00	2.22E-06
I-134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	0.00E+00	2.51E-10
I-135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	0.00E+00	1.31E-06
CS-134	6.22E-05	1.48E-04	1.21E-04	0.00E+00	4.79E-05	1.59E-05	2.59E-06
CS-136	6.51E-06	2.57E-05	1.85E-05	0.00E+00	1.43E-05	1.96E-06	2.92E-06
CS-137	7.97E-05	1.09E-04	7.14E-05	0.00E+00	3.70E-05	1.23E-05	2.11E-06
CS-138	5.52E-08	1.09E-07	5.40E-08	0.00E+00	8.01E-08	7.91E-09	4.65E-13
BA-139	9.70E-08	6.91E-11	2.84E-09	0.00E+00	6.46E-11	3.92E-11	1.72E-07
BA-140	2.03E-05	2.55E-08	1.33E-06	0.00E+00	8.67E-09	1.46E-08	4.18E-05
BA-141	4.71E-08	3.56E-11	1.59E-09	0.00E+00	3.31E-11	2.02E-11	2.22E-17
BA-142	2.13E-08	2.19E-11	1.34E-09	0.00E+00	1.85E-11	1.24E-11	3.00E-26
LA-140	2.50E-09	1.26E-09	3.33E-10	0.00E+00	0.00E+00	0.00E+00	9.25E-05
LA-142	1.28E-10	5.82E-11	1.45E-11	0.00E+00	0.00E+00	0.00E+00	4.25E-07
CE-141	9.36E-09	6.33E-09	7.18E-10	0.00E+00	2.94E-09	0.00E+00	2.42E-05
CE-143	1.65E-09	1.22E-06	1.35E-10	0.00E+00	5.37E-10	0.00E+00	4.56E-05
CE-144	4.88E-07	2.04E-07	2.62E-08	0.00E+00	1.21E-07	0.00E+00	1.65E-04
PR-143	9.20E-09	3.69E-09	4.56E-10	0.00E+00	2.13E-09	0.00E+00	4.03E-05
PR-144	3.01E-11	1.25E-11	1.53E-12	0.00E+00	7.05E-12	0.00E+00	4.33E-18
ND-147	6.29E-09	7.27E-09	4.35E-10	0.00E+00	4.25E-09	0.00E+00	3.49E-05
W-187	1.03E-07	8.61E-08	3.01E-08	0.00E+00	0.00E+00	0.00E+00	2.82E-05
NP-239	1.19E-09	1.17E-10	6.45E-11	0.00E+00	3.65E-10	0.00E+00	2.40E-05

Units are mrem/pCi

Table 2-3. Ingestion Dose Conversion Factors (continued)

LIQUID EFFLUENT DOSE COMMITMENT FACTORS

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	2.57E-01	2.57E-01	2.57E-01	2.57E-01	2.57E-01	2.57E-01
Na-24	4.07E+02	4.07E+02	4.07E+02	4.07E+02	4.07E+02	4.07E+02	4.07E+02
CR-51	0.00E+00	0.00E+00	1.28E+00	7.63E-01	2.81E-01	1.69E+00	3.21E+02
MN-54	0.00E+00	4.38E+03	8.36E+02	0.00E+00	1.30E+03	0.00E+00	1.34E+04
MN-56	0.00E+00	1.10E+02	1.95E+01	0.00E+00	1.40E+02	0.00E+00	3.51E+03
FE-55	6.63E+02	4.58E+02	1.07E+02	0.00E+00	0.00E+00	2.5[illegible]E+02	2.63E+02
FE-59	1.04E+03	2.46E+03	9.41E+02	0.00E+00	0.00E+00	6.86E+02	8.18E+03
CO-58	0.00E+00	9.03E+01	2.02E+02	0.00E+00	0.00E+00	0.00E+00	1.83E+03
CO-60	0.00E+00	2.60E+02	5.73E+02	0.00E+00	0.00E+00	0.00E+00	4.88E+03
NI-63	3.14E+04	2.17E+03	1.05E+03	0.00E+00	0.00E+00	0.00E+00	4.53E+02
NI-65	1.26E+02	1.64E+01	7.49E+00	0.00E+00	0.00E+00	0.00E+00	4.17E+02
CU-64	0.00E+00	9.97E+00	4.68E+00	0.00E+00	2.51E+01	0.00E+00	8.50E+02
ZN-65	2.32E+04	7.38E+04	3.33E+04	0.00E+00	4.93E+04	0.00E+00	4.65E+04
BR-83	0.00E+00	0.00E+00	4.04E+01	0.00E+00	0.00E+00	0.00E+00	5.82E+01
RB-86	0.00E+00	1.01E+05	4.71E+04	0.00E+00	0.00E+00	0.00E+00	1.99E+04
SR-89	2.25E+04	0.00E+00	6.47E+02	0.00E+00	0.00E+00	0.00E+00	3.62E+03
SR-90	5.58E+05	0.00E+00	1.37E+05	0.00E+00	0.00E+00	0.00E+00	1.61E+04
SR-91	4.07E+02	0.00E+00	1.64E+01	0.00E+00	0.00E+00	0.00E+00	1.94E+03
SR-92	1.54E+02	0.00E+00	6.68E+00	0.00E+00	0.00E+00	0.00E+00	3.06E+03
Y-90	5.78E-01	0.00E+00	1.55E-02	0.00E+00	0.00E+00	0.00E+00	6.13E+03
Y-91	8.64E+00	0.00E+00	2.31E-01	0.00E+00	0.00E+00	0.00E+00	4.75E+03
Y-92	5.06E-02	0.00E+00	1.48E-03	0.00E+00	0.00E+00	0.00E+00	8.86E+02
Y-93	1.60E-01	0.00E+00	4.43E-03	0.00E+00	0.00E+00	0.00E+00	5.09E+03
ZR-95	2.84E-01	9.09E-02	6.16E-02	0.00E+00	1.43E-01	0.00E+00	2.88E+02
ZR-97	1.33E-02	2.69E-03	1.23E-03	0.00E+00	4.06E-03	0.00E+00	8.33E+02
NB-95	4.47E+02	2.49E+02	1.34E+02	0.00E+00	2.46E+02	0.00E+00	1.51E+06
MO-99	0.00E+00	1.04E+02	1.98E+01	0.00E+00	2.36E+02	0.00E+00	2.41E+02
TC-99M	8.87E-03	2.51E-02	3.19E-01	0.00E+00	3.81E-01	1.23E-02	1.48E+01
RU-103	4.66E+00	0.00E+00	2.01E+00	0.00E+00	1.78E+01	0.00E+00	5.45E+02
RU-105	3.69E-01	0.00E+00	1.46E-01	0.00E+00	4.76E+00	0.00E+00	2.26E+02
RU-106	7.05E+01	0.00E+00	8.92E+00	0.00E+00	1.36E+02	0.00E+00	4.56E+03
AG-110M	1.15E+00	1.06E+00	6.31E-01	0.00E+00	2.09E+00	0.00E+00	4.34E+02
TE-125M	2.57E+03	9.31E+02	3.44E+02	7.73E+02	1.05E+04	0.00E+00	1.03E+04
TE-127M	6.49E+03	2.32E+03	7.91E+02	1.66E+03	2.64E+04	0.00E+00	2.18E+04

Units are mrem/hr per μCi/ml

Table 2-4. Liquid Dose Commitment Factors Ai

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
TE-127	1.05E+02	3.78E+01	2.28E+01	7.80E+01	4.29E+02	0.00E+00	8.31E+03
TE-129M	1.10E+04	4.11E+03	1.75E+03	3.79E+03	4.60E+04	0.00E+00	5.55E+04
TE-131M	1.66E+03	8.10E+02	6.75E+02	1.28E+03	8.21E+03	0.00E+00	8.04E+04
TE-132	2.41E+03	1.56E+03	1.47E+03	1.72E+03	1.50E+04	0.00E+00	7.39E+04
I-130	2.72E+01	8.03E+01	3.17E+01	6.80E+03	1.25E+02	0.00E+00	6.91E+01
I-131	1.62E+02	2.31E+02	1.33E+02	7.58E+04	3.97E+02	0.00E+00	6.10E+01
I-132	7.29E+00	1.95E+01	6.82E+00	6.82E+02	3.11E+01	0.00E+00	3.66E+00
I-133	5.13E+01	8.93E+01	2.72E+01	1.31E+04	1.56E+02	0.00E+00	8.02E+01
I-135	1.59E+01	4.17E+01	1.54E+01	2.75E+03	6.68E+01	0.00E+00	4.71E+01
CS-134	2.98E+05	7.09E+05	5.80E+05	0.00E+00	2.29E+05	7.62E+04	1.24E+04
CS-136	3.12E+04	1.23E+05	8.86E+04	0.00E+00	6.85E+04	9.39E+03	1.40E+04
CS-137	3.82E+05	5.22E+05	3.42E+05	0.00E+00	1.77E+05	5.89E+04	1.01E+04
BA-140	2.11E+02	2.65E-01	1.38E+01	0.00E+00	9.00E-02	1.51E-01	4.34E+02
LA-140	1.50E-01	7.56E-02	2.00E-02	0.00E+00	0.00E+00	0.00E+00	5.55E+03
CE-141	3.37E-02	2.28E-02	2.58E-03	0.00E+00	1.06E-02	0.00E+00	8.71E+01
CE-143	4.11E-03	3.04E+00	3.36E-04	0.00E+00	1.34E-03	0.00E+00	1.14E+02
CE-144	1.98E+00	8.28E-01	1.06E-01	0.00E+00	4.91E-01	0.00E+00	6.70E+02
PR-143	5.58E-01	2.24E-01	2.77E-02	0.00E+00	1.29E-01	0.00E+00	2.45E+03
ND-147	3.81E-01	4.40E-01	2.64E-02	0.00E+00	2.57E-01	0.00E+00	2.11E+03
W-187	2.96E+02	2.47E+02	8.65E+01	0.00E+00	0.00E+00	0.00E+00	8.10E+04
NP-239	2.87E-02	2.82E-03	1.56E-03	0.00E+00	8.81E-03	0.00E+00	5.79E+02
Sb-124	1.75E+03	3.31E+01	6.92E+02	4.24E+00	0.00E+00	1.36E+03	4.96E+04
Sb-125	1.39E+03	1.50E+01	2.80E+02	1.24E+00	0.00E+00	1.45E+05	1.23E+04

Units are mrem/hr per μCi/ml

Table 2-4. Liquid Dose Commitment Factors Ai (continued)

CHAPTER 3

GASEOUS EFFLUENTS

3.1 GASEOUS RELEASE CONFIGURATION

Gaseous releases consist of releases through three different release points:

- o Plant vent stack
- o Turbine building vent (condenser steam jet air ejector)
- o ILRT (integrated leak rate test) vent

The containment ventilation, the auxiliary building ventilation, and the waste gas decay tanks all exhaust through the plant vent stack. When a waste gas decay tank is released, this is treated as a contribution to the continuous release already occurring through the plant vent stack. All other releases through the plant vent stack are continuous. The turbine building vent is a continuous release also. The ILRT is a batch release, performed infrequently.

The plant vent stack is a mixed mode release, according to the definition in Reg. Guide 1.111. The release vent is at a comparable height to adjacent structures (the stack and containment building are both approximately 40 meters high).

All other releases are ground level releases. A schematic diagram of the routine release points and release sources and monitors is shown in Figure 3-1.

Typical flow rates (where applicable) for each release source and release point are given in Table 3-1.

Table 3-1. Gaseous Releases, Flow Rates, and Monitors

Release point	Release type	Vent flow rate	Monitor
Plant vent stack	continuous	80,000-150,000 cfm	1/2RE-14 1/2RE-22
Turbine building vent	continuous	1,060 cfm	1/2RE-15
ILRT	batch	-	-
Release sources			
Waste gas decay tank	batch	-	1/2RE-14
Containment purge	continuous	-	1/2RE-24

Release processing of the waste gas decay tank (WGDT) and containment purge releases are made through the plant vent stack.

The WGDT Curie content is tracked separately for Tech. Spec. compliance. Activities and dose from the plant vent stack are tracked to account for all activity release from containment and the auxiliary building. Containment purge activities and calculated doses are not added into the total activity and dose released since they are included in the measurements of plant vent stack activity.

WGDT activity and dose are separately calculated and tracked as batch releases. To eliminate double counting, for each plant stack release, if there was a WGDT batch release, the individual WGDT nuclide activity and dose are subtracted from the plant vent stack release for the time of the WGDT release. If any nuclide activity is negative, it is set to zero.

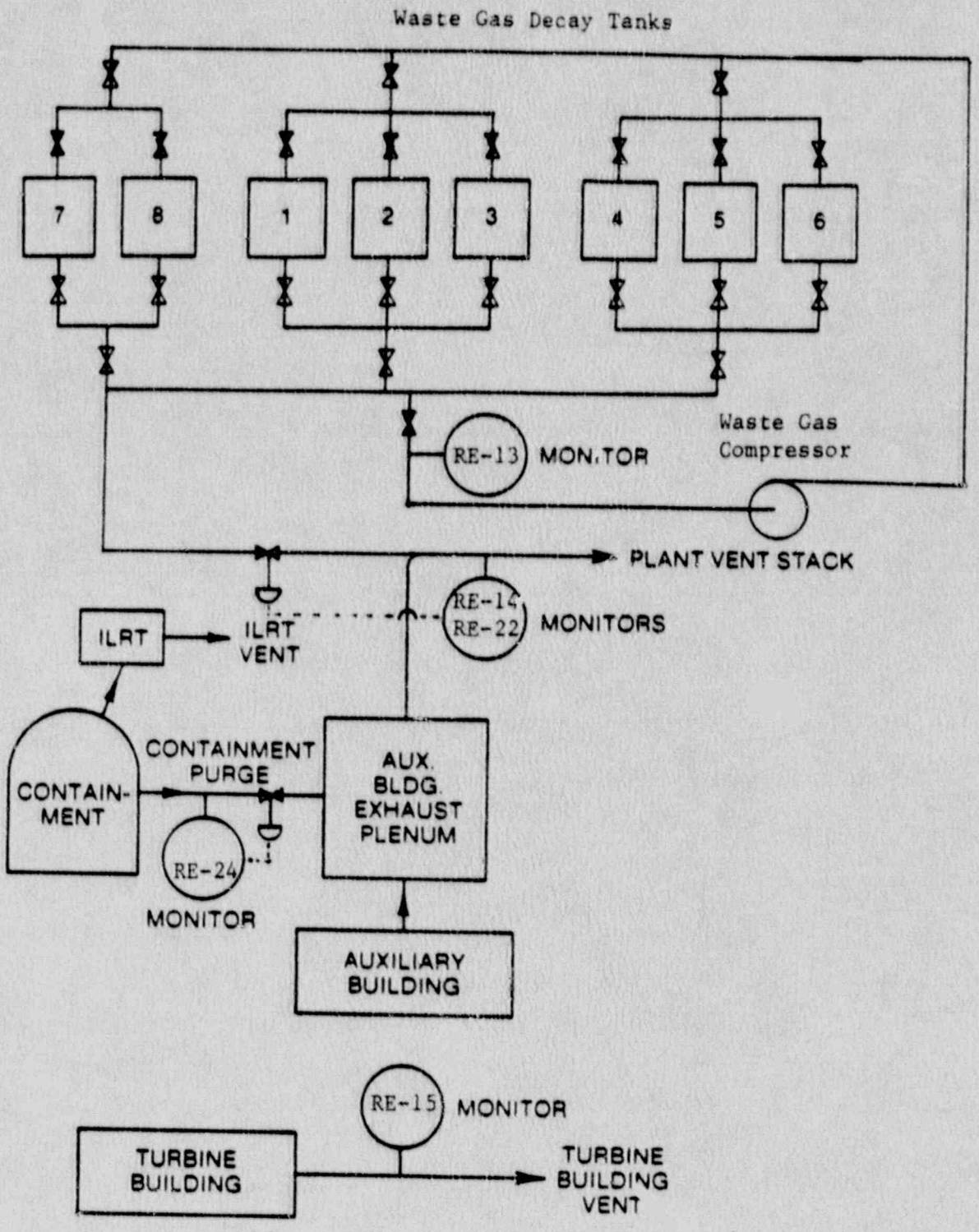


Figure 3-1. Routine Gaseous Release Sources and Release Points

3.2 CALCULATIONS OF X/Q AND D/Q VALUES

The calculations of X/Q and D/Q values are based on the constant wind speed model described in Reg. Guide 1.111, Rev. 0 (March, 1976), and Rev. 1 (July, 1977), sections C.1.c, C.2.a, C.2.b, and C.2.c. As noted in section 3.1, the plant vent stack is a mixed mode release, and the turbine building vent and ILRT are ground level releases.

A mixed mode release is handled by using portions of ground and elevated release values in combination with a factor, E, representing the degree of entrainment of the release in the building wake. If it should happen that the ground and elevated values are in different sectors, the doses and activities will be attributed to the proper sector for each of the ground and elevated releases.

Mixed Mode X/Q and D/Q

The mixed mode X/Q value is obtained from the equation

$$X/Q = [(1-E)(X/Q)_{elev} + E(X/Q)_{gnd}] \qquad (3.1)$$

where

E = fraction of effluent entrained in the building wake

$(X/Q)_{elev}$ = X/Q value for elevated release

$(X/Q)_{gnd}$ = X/Q for ground level release

Similarly for D/Q values, the mixed mode D/Q value is obtained from the equation

$$D/Q = [(1-E)(D/Q)_{elev} + E(D/Q)_{gnd}] \qquad (3.2)$$

where

E = fraction of effluent entrained in the building wake

$(D/Q)_{elev}$ = D/Q value for elevated release

$(D/Q)_{gnd}$ = D/Q for ground level release

E is determined from the following equations, depending upon the range of the value of $(W_o/\bar{u})$:

(3.3)

$E = 1$	if	$(W_o/\bar{u}) \leq 1$ or $h_s \leq h_v$
$E = 3.58-1.58\ (W_o/\bar{u})$	if	$1 < (W_o/\bar{u}) \leq 1.5$
$E = 0.3-0.06\ (W_o/\bar{u})$	if	$1.5 < (W_o/\bar{u}) \leq 5.0$
$E = 0$	if	$(W_o/\bar{u}) > 5.0$

where

W_o = effluent velocity from the stack

$\bar{u}$ = average wind speed

Ground Level X/Q

Ground level releases (turbine building vent and ILRT) use the following calculations for X/Q, which are taken from Reg.Guide 1.111.

$$(X/Q)_{j\theta v} = 2.032\ k_\theta / (\bar{u}_j\ r_\theta\ \Sigma_z) \qquad (3.4)$$

where the subscripts jθv are for hour j, sector θ, and vent v.

$$\Sigma_z = (\sigma^2_z + 0.5h^2_v/\pi)^{1/2} \qquad (3.5)$$

where Σ_z is subject to the condition

$$\Sigma_z \leq (3)^{1/2}\ \sigma_z \qquad (3.6)$$

The values of σ_z are shown in Figure 3-2 for all stability classes.

The parameters used are

2.032 = $(2/\pi)^{1/2}$ divided by width of 22.5 degree sector in radians

σ_z = the vertical standard deviation of the plume for the applicable atmospheric stability class (Pasquill category) determined at least hourly, for the distance r_θ during the time period Δt_j (Figure 3-2).

r_θ = the distance from the midpoint between the vent stacks to the receptor for each sector Θ, in meters, provided in Table 3-2.

k_θ = the recirculation factor accounting for spatial and temporal variations in air flow. For noncontinuous releases, its value is unity. For continuous releases, see Figure 3-3 for correction factor.

$\bar{u}_j$ = the average wind speed determined at least hourly, during time period Δt_j in sector Θ, at a height of 10 meters for ground level releases, in m/sec.

h_ℓ = the height of the tallest adjacent structure, which is the containment building (=40 m).

FARLEY NUCLEAR PLANT VALUES OF SECTOR DISTANCES

SECTOR	SITE BOUNDARY DISTANCE (meters)	(miles)	NEAREST RECEPTOR DISTANCE (meters)	(miles)
N	1290	0.8	4183	2.6
NNE	1450	0.9	4023	2.5
NE	1450	0.9	3862	2.4
ENE	1450	0.9	3862	2.4
E	1290	0.8	4505	2.8
ESE	1290	0.8	4505	2.8
SE	1450	0.9	5471	3.4
SSE	1610	1.0	8045	5.0
S	1610	1.0	6919	4.3
SSW	1610	1.0	4666	2.9
SW	1450	0.9	1931	1.2
WSW	1450	0.9	3862	2.4
W	1290	0.8	2092	1.3
WNW	1290	0.8	3379	2.1
NW	1450	0.9	2414	1.5
NNW	1450	0.9	3218	2.0

This table may be updated based on annual land census results as required in STS Section 3.12.2.

Table 3-2. SITE BOUNDARY AND LIMITING FOOD PATHWAY DISTANCES

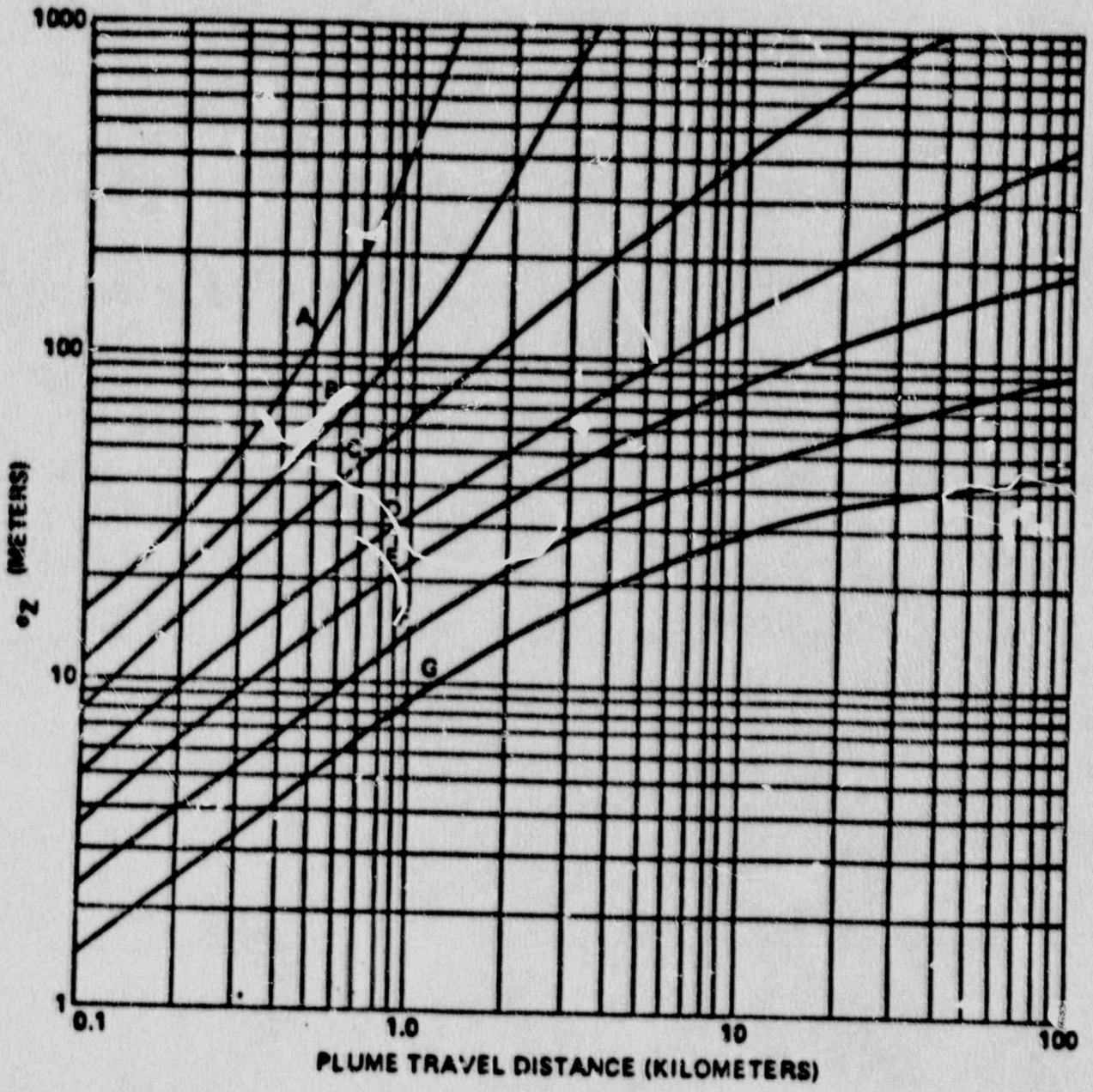


Figure 1. Vertical Standard Deviation of Material in a Plume (Letters denote Pasquill Stability Class)

Figure 3-2. Vertical Standard Deviation for the Plume (Ref. 3)

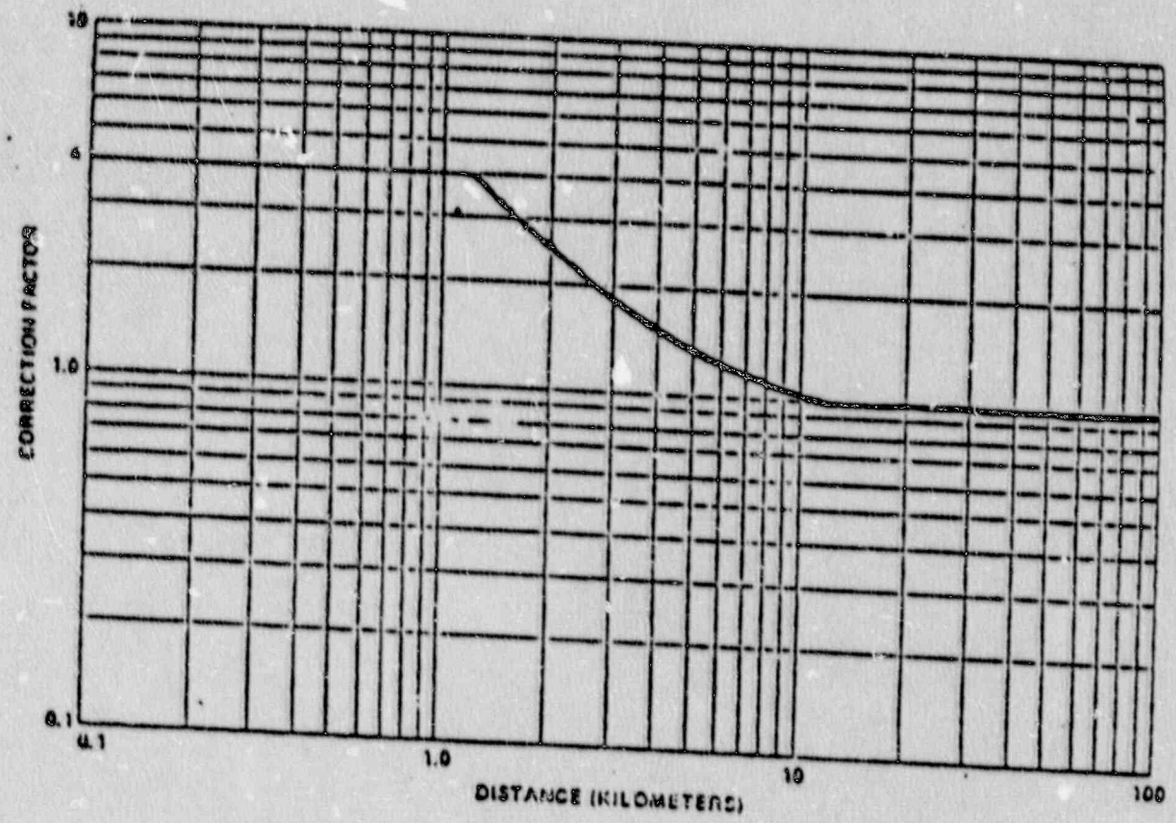


Figure 3-3. Recirculation Factor k_θ (Ref. 2)

Elevated X/Q

The elevated X/Q value is given by:

$$(X/Q)_{elev} = (2.032\ k_\theta/(\bar{u}_{elev}\ r_\theta\ \sigma_z))\ e^{-[(h_e/\sigma_z)^2/2]} \quad (3.7)$$

where

h_e = effective plume height

$$= h_s + h_{pr} = h_t - c \quad (3.8)$$

c = correction for low relative exit velocity of the plume when $W_o / \bar{u}_{elev}$ is less than 1.5.

$$= 3(1.5 - W_o/\bar{u}_{elev})d \quad (3.9)$$

d = inside diameter of stack

W_o = exit velocity of the plume

$\bar{u}_{elev}$ = average elevated wind speed

h_{pr} = plume rise

h_s = height of release point

h_t = terrain height above stack base

$$h_{pr} = 1.44\ d\ (W_o/\bar{u}_{elev})^{2/3}(r_\theta/d)^{1/3} \quad (3.10)$$

subject to

$$h_{pr} < 3(W_o/\bar{u}_{elev})d \quad (3.11)$$

$$h_{pr} < 1.5 \, (F_m / \bar{u}_{\theta j \nu})^{1/3} \, S^{-1/6} \text{ if } S > 0 \qquad (3.12)$$

where

$$F_m = (\rho_o / \rho) \, W_o^2 \, (d/2)^2 \qquad (3.13)$$

$$S = (9.8/T) \, (\Delta T / \Delta z + 9.8 \times 10^{-3}) \qquad (3.14)$$

where

ρ_o is the ambient air density

ρ is the effluent air density

S is the stability parameter with

T in degrees K

z in meters

Since the temperature of the air released is primarily that of the auxiliary building, the value of (ρ_o/ρ) will be set to unity.

Ground and Elevated D/Q

For ground level releases, the hourly $(D/Q)_{j\theta\nu}$ is given by

$$(D/Q)_{j\theta\nu} = k_\theta \, f_\theta \, \delta_{\theta\nu gj} \, / \, (0.3927 \, r_\theta) \qquad (3.15)$$

where

$j_{\theta\nu}$ = subscripts for hour j, sector θ, and vent v.

f_θ = 1 if the wind direction is into sector θ and is equal to zero otherwise.

$0.3927 \, r_\theta$ = width (arc length) of 22.5 degree sector at distance r_θ in meters.

$\delta_{\theta\nu gj}$ = ground level relative deposition rate (linear) at distance r_θ in sector θ for stability class of interest and for ground level

release in meter^{-1}. (Figure 3-4)

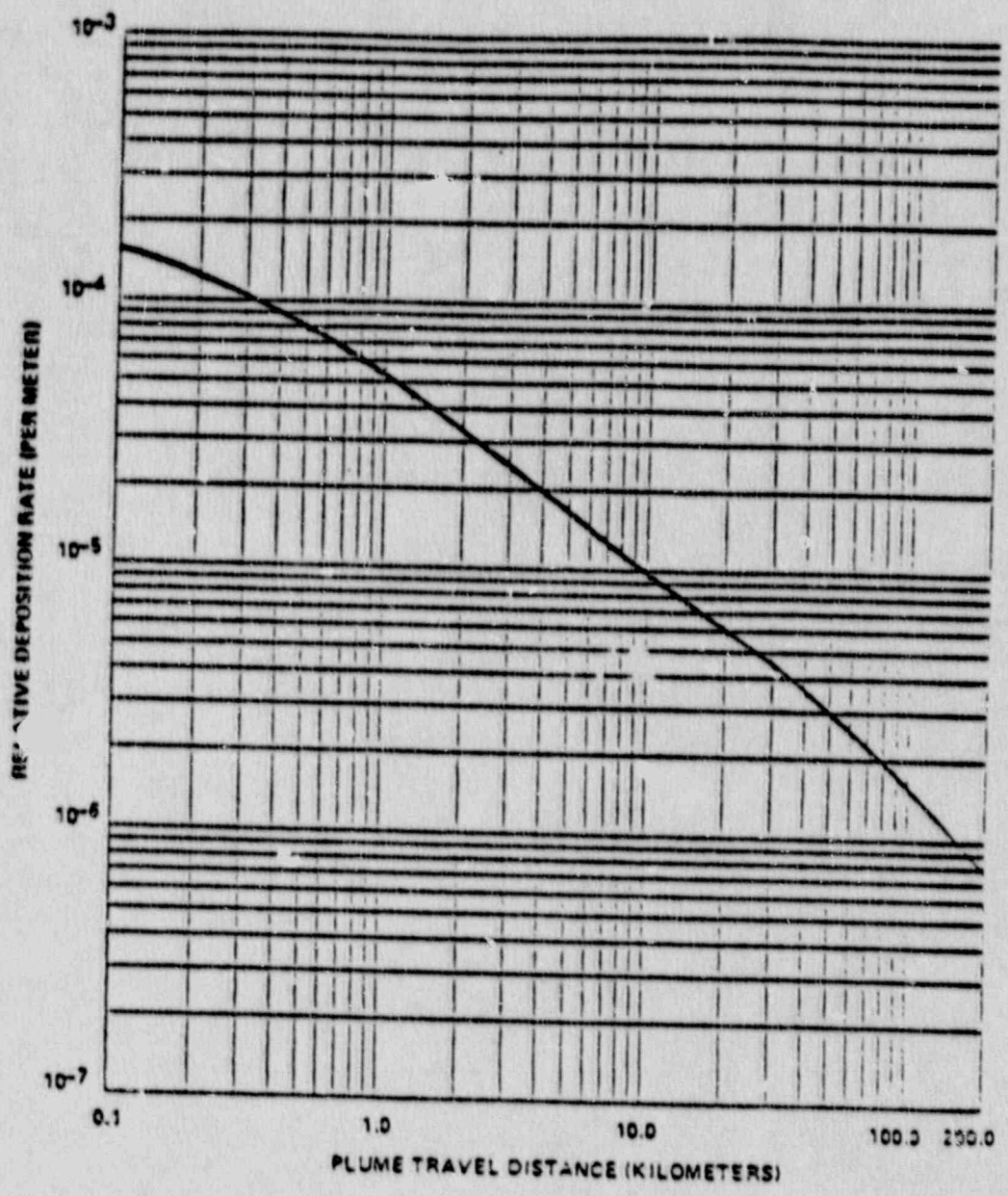
For elevated releases, $(D/Q)_{j\theta v}$ is given by

$$(D/Q)_{j\theta v} = k_\theta \; f_\theta \; \delta_{\theta v \bullet j} \; / \; (0.3927 \; r_\theta) \qquad (3.16)$$

where

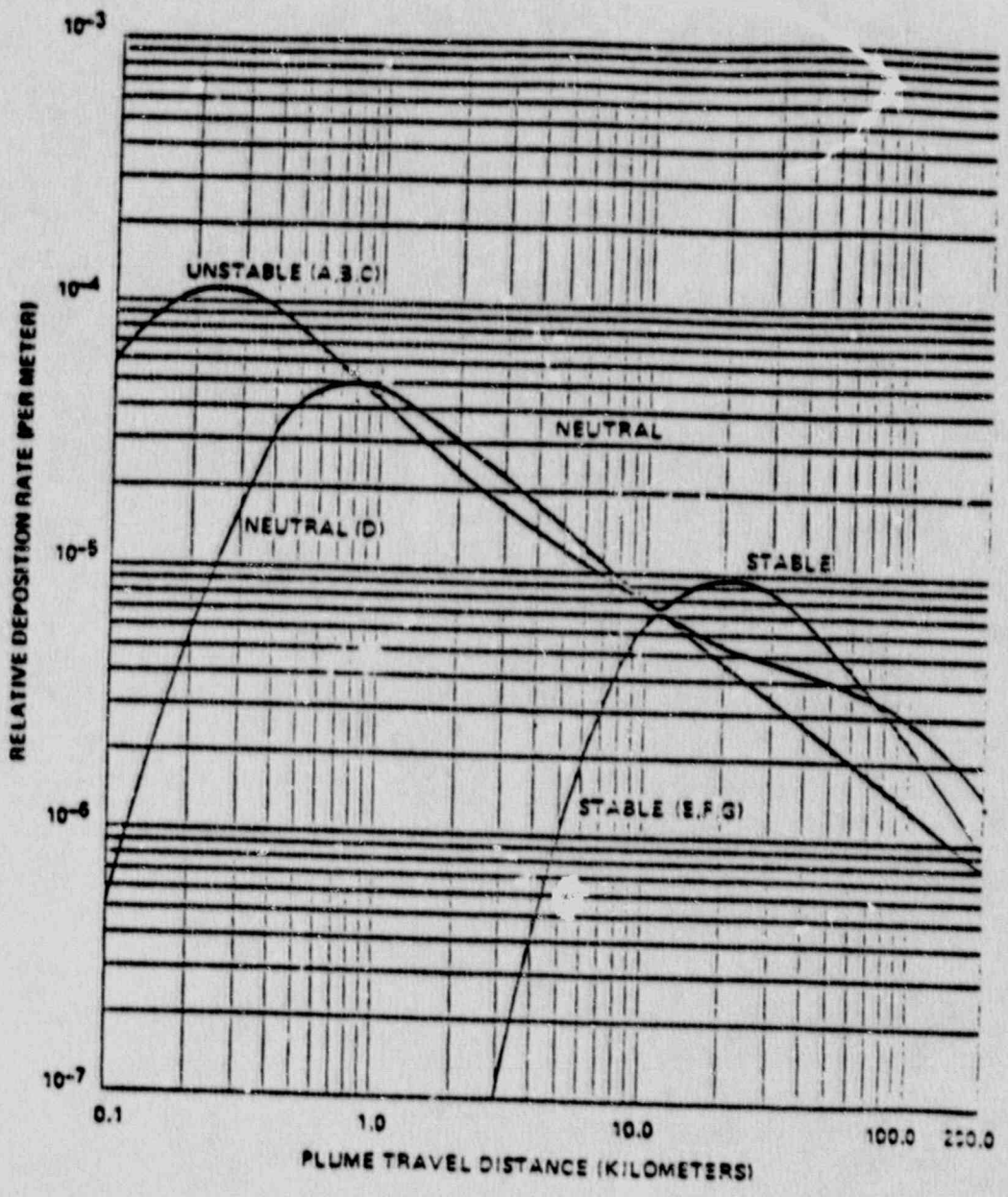
$\delta_{\theta v \bullet j}$ = elevated relative deposition rate (linear) at distance r_θ in sector Θ for stability class of interest and release height h_θ in meter^{-1}. (Figures 3-5, 3-6, and 3-7.)

and all other terms were defined earlier.



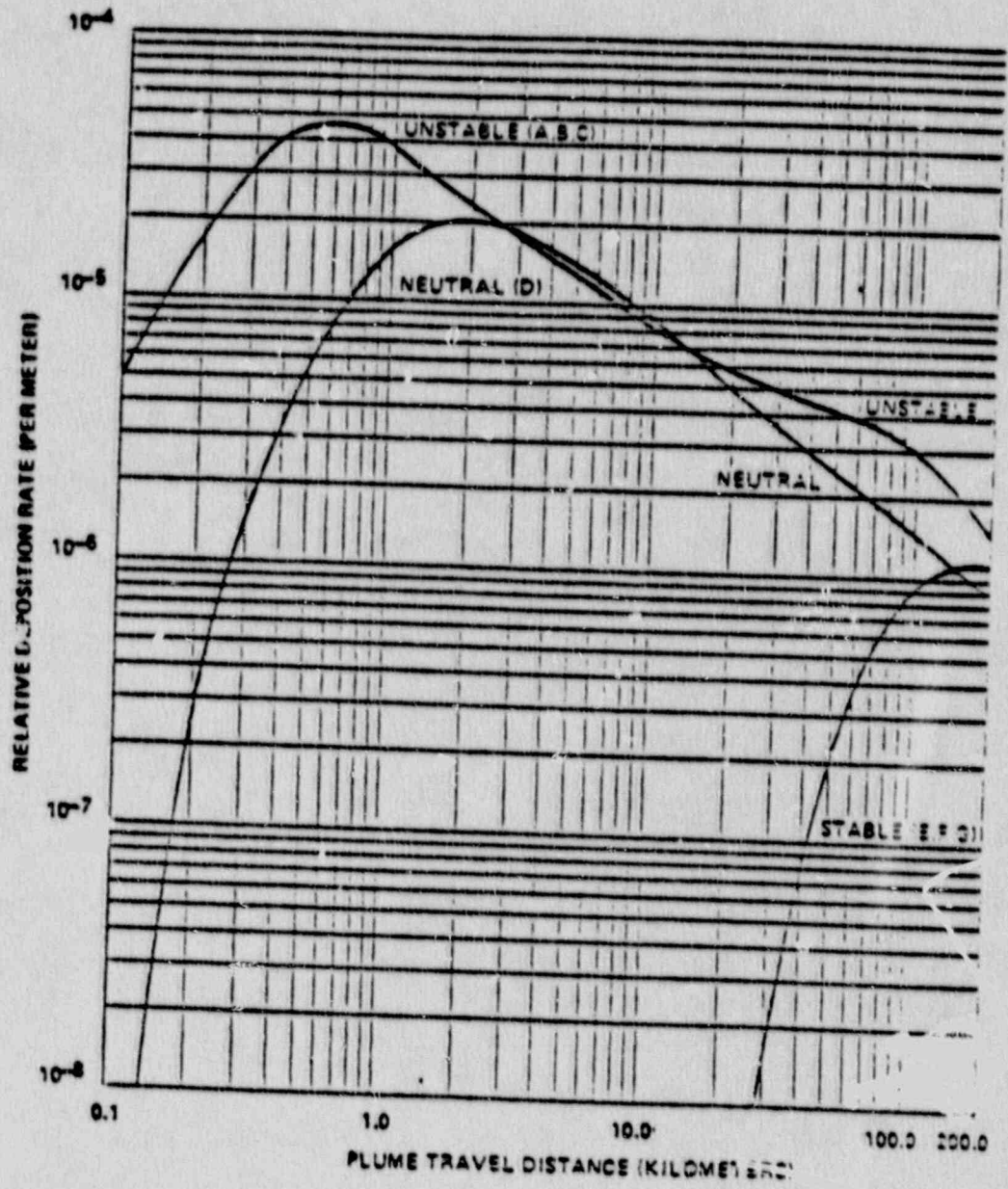
Relative Deposition for Ground Level Releases (All Atmospheric Stability Classes)

Figure 3-4. Ground Level Relative Deposition (Ref. 3)



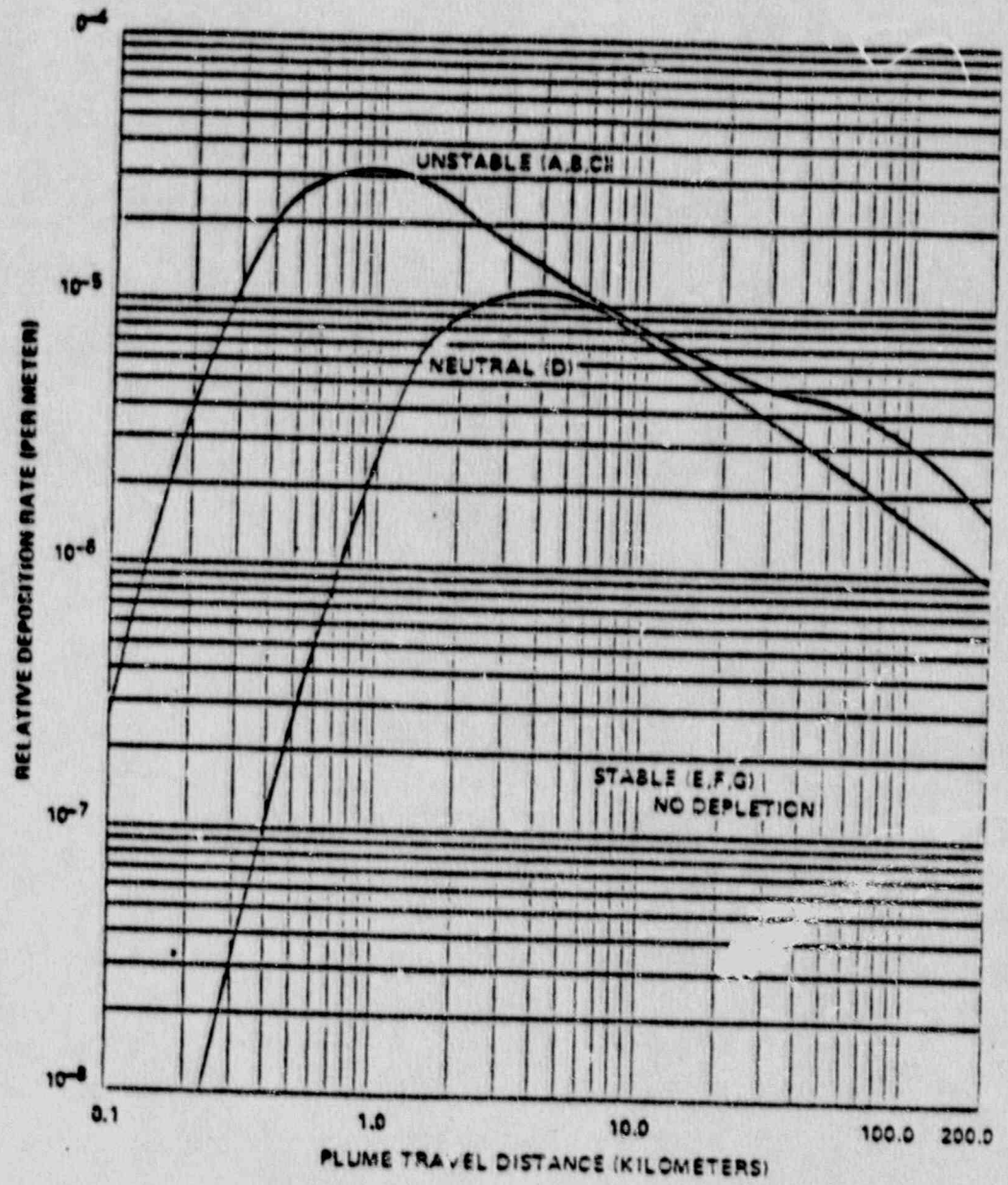
Relative Deposition for 30m Releases (Letters denote Pasquill Stability Class)

Figure 3-5. Elevated Relative Deposition - 30 m (Ref. 3)



Relative Deposition for 60m Releases (Letters denote Pasquill Stability Class)

Figure 3-6. Elevated Relative Deposition - 60 m (Ref. 3)



Relative Deposition for 100m Releases (Letters denote Pasquill Stability Class)

Figure 3-7. Elevated Relative Deposition - 100 m (Ref. 3)

3.3 SETPOINTS FOR GASEOUS MONITORS

3.3.1 Alarm setpoints for the gaseous monitors R-14, R-15, and R-22 will be calculated based on the more restrictive of the dose rate limits for noble gases for whole body and skin. These limits are expressed as

$$\sum_i K_i \, Q_{iv} < \frac{500 \text{ mrem/yr } F_v}{(X/Q)_v \times F} \qquad (3.17)$$

where

i = subscript numbering noble gases in consideration, and the sum is over all noble gases

K_i = the total body dose factor due to gamma emissions for identified noble gas isotope i (mrem/yr per uCi/m^3) from Table 3-3.

Q_{iv} = release rate of isotope i from release point v (uCi/sec)

500 = the site dose rate limit in mrem/year

v = subscript indicating release point in consideration (turbine building vent or plant vent stack)

F_v = release fraction allotted to release point in consideration. The sum of the fractions for the turbine building vent, plant vent stack, and ILRT vent will not exceed 1 for each unit.

$(\bar{X}/Q)_v$ = highest value of annual average atmospheric dispersion factor at site boundary for all sectors (sec/m^3).

$(\bar{X}/Q)_s$ = 1.08×10^{-6} sec/m^3 for the plant vent stack

$(\bar{X}/Q)_t$ = 4.87×10^{-5} sec/m^3 for the turbine building vent

F = unit apportionment factor for compliance with 10CFR20 limits for a multi-unit site. F = the number of reactor units that can be operating

simultaneously.

$$\sum_i (L_i + 1.1M_i)\, Q_{iv} < \frac{3000 \text{ mrem/yr } F_v}{(X/Q)_v \times F} \qquad (3.18)$$

where

L_i = skin dose factor due to beta emissions for identified noble gas isotope i (mrem/yr per uCi/m^3) from Table 3-3.

M_i = air dose factor due to gamma emissions for identified noble gas isotope i (mrad/yr per uCi/m^3) from Table 3-3. The factor of 1.1 mrem/mrad converts air dose to skin dose (see Ref. 1, page 22).

The actual monitor setpoints will be adjusted for a lower (thus more conservative) count rate based on the worst isotope release-dose rate Q_v as follows and need not be changed, except based on reapportioning of allotted release fraction from operating experience as mentioned above. From Table 3-3, Kr-89 would be the most restrictive isotope in either the total body or skin dose restrictions. Assuming that the total release consists of Kr-89, the whole body dose equation is more restrictive than the skin dose equation, and the release rate limit would be calculated as:

$$Q_v = \frac{500 \text{ mrem/yr } F_v}{(X/Q)_v \times F \times K_i} \qquad (3.19)$$

This yields:

$Q_s = 1.39 \times 10^4$ μCi/sec (F_s) for the stack, and

$Q_t = 3.09 \times 10^2$ μCi/sec (F_t) for the turbine building vent.

Based on maximum flow rate and conservative detector efficiency, the monitor setpoints S_v (cpm) may be calculated as follows:

$$S_v = E_m (Q_v/F_v) + b \qquad (3.20)$$

where

b = monitor background count rate (cpm)

E_m = gross monitor calibration factor (cpm per uCi/ml)

F_w = maximum effluent flow rate (ml/sec)

Setpoint calculations will be made for radiation monitors R-14, R-15, and R-22 on this basis. The limiting release rate Q_L (uCi/sec) is based on the value satisfying the relationship 3.17 for total body dose. The setpoint S_L (cpm) corresponding to this release rate may be described as

$$S_L = E_m (Q_L/F_w) + b \qquad (3.21)$$

where

F_w = maximum release flow rate (ml/sec)

3.3.2 R-24, while not a gaseous effluent monitor, monitors an effluent release source to the plant vent stack. The maximum setpoint for R-24 will be calculated based upon the monitor response curve and the alarm setpoint specified in the Technical Specifications.

$$S_L = (E_M) (A_{TS})$$

where

S_L = maximum monitor alarm setpoint in cpm

E_M = gross monitor calibration factor (cpm per μCi/cc)

A_{TS} = maximum setpoint allowed by Technical Specifications in μCi/cc

To provide early detection and termination of an abnormally high containment purge release, the R-24 setpoint may be reduced per Section 3.3.1 above.

3.3.3 R-13 monitors the supply to the waste gas decay tanks from the waste gas compressor. The alarm setpoint for R-13 is based on expected buildup in the waste gas system and the Technical Specification limit for waste gas storage.

$$S_L = (E_M) (B_{max})$$

where:

B_{max} = maximum expected buildup of radioactivity in μCi/cc

Noble Gas Nuclides and Dose Factors

Nuclide	Ki	Li	Mi	Ni
KR-83M	7.56E-02	0.00E+00	1.93E+01	2.88E+02
KR-85M	1.17E+03	1.46E+03	1.23E+03	1.97E+03
KR-85	1.61E+01	1.34E+03	1.72E+01	1.95E+03
KR-87	5.92E+03	9.73E+03	6.17E+03	1.03E+04
KR-88	1.47E+04	2.37E+03	1.52E+04	2.93E+03
KR-89	1.66E+04	1.01E+04	1.73E+04	1.06E+04
KR-90	1.56E+04	7.29E+03	1.63E+04	7.83E+03
XE-131M	9.15E+01	4.76E+02	1.56E+02	1.11E+03
XE-133M	2.51E+02	9.94E+02	3.27E+02	1.48E+03
XE-133	2.94E+02	3.06E+02	3.53E+02	1.05E+03
XE-135M	3.12E+03	7.11E+02	3.36E+03	7.39E+02
XE-135	1.81E+03	1.86E+03	1.92E+03	2.46E+03
XE-137	1.42E+03	1.22E+04	1.51E+03	1.27E+04
XE-138	8.83E+03	4.13E+03	9.21E+03	4.75E+03
AR-41	8.84E+03	2.69E+03	9.30E+03	3.28E+03

These dose factors are obtained from Regulatory Guide 1.109 (October, 1977), with uCi instead of pCi. Units are mrem/yr per uci/m^3 for Ki and Li, and mrad/yr per uci/m^3 for Mi and Ni.

Table 3-3. Dose Factors for Noble Gases and Daughters (Ref.)

3.4 GASEOUS 10CFR20 COMPLIANCE

The dose rate from each unit in unrestricted areas due to radioactive materials released in gaseous effluents from the site shall be limited to the following expressions:

(a) Release rate limit for noble gases:

$$\sum_i K_i \sum_v [(\bar{X}/Q)_v \, Q_{i,v}] < 250 \text{ mrem/yr} \qquad (3.22)$$

$$\sum_i (L_i + 1.1M_i) \sum_v [(\bar{X}/Q)_v \, Q_{i,v}] < 1500 \text{ mrem/yr} \qquad (3.23)$$

where the terms are defined below.

(b) Release rate limit for all radioiodines and for all radioactive materials in particulate form and radionuclides (other than noble gases), with half lives greater than 8 days (radioiodines, tritium, and all radionuclides in particulate form with half-lives greater than 8 days):

$$\sum_i \sum_p \sum_v [P_{i,p} \, W_{m,v} \, Q_{i,v}] < 750 \text{ mrem/yr} \qquad (3.24)$$

where:

$\sum_i$ = sum over all radionuclides

$\sum_v$ = sum over all vents

$\sum_p$ = sum over all pathways

K_i = the total body dose factor due to gamma emissions for each identified radionuclide, in mrem/yr per $\mu Ci/m^3$ (Table 3-3).

L_i = the skin dose factor due to beta emissions for each identified radionuclide, in mrem/yr per uCi/m^3 (Table 3-3).

M_i = the air dose factor due to gamma emissions for each identified radionuclide, in mrad/yr per uCi/m^3 (Table 3-3).

P_{ip} = the infant age group dose factor for the critical organ for nuclides other than noble gases for the inhalation pathway (in units of mrem/yr per uCi/m^3), and for ground plane and food pathways (in units of m^2 (mrem/yr per uCi/sec)). (Table 3-4)

W_{mv} = $(\bar{X}/Q)$ for tritium and the inhalation pathway and = $(\bar{D}/Q)$ for other nuclides and pathways.

$(\bar{X}/Q)_v$ = the highest value of the annual average atmospheric dispersion factor at the site boundary, for all sectors, in sec/m^3. The value of 1.08×10^{-6} sec/m^3 will be used for the plant vent and 4.87×10^{-5} sec/m^3 for the turbine building steam jet air ejector or the ILRT vent.

$(\bar{X}/Q)_{mv}$ = the highest value of the annual average atmospheric dispersion factor at the distance of the nearest receptor, or at 5 miles if there is no pathway at less than 5 miles, for all sectors, in sec/m^3. The value of 8.03×10^{-7} sec/m^3 will be used for the plant vent and 8.74×10^{-6} sec/m^3 for the turbine building steam jet air ejector or the ILRT vent.

$(\bar{D}/Q)_{mv}$ = the highest value of the annual average deposition factor at the distance of the nearest receptor, or at 5 miles if there is no pathway at less than 5 miles, for all sectors, in m^{-2}.

Q_{iv} = the average release rate of nuclide i in gaseous effluent from each vent release point v at the site, in uCi/sec. Noble gases may be averaged over a period of 1 hour, and any other nuclides may be averaged over a period of 1 week.

500 = site dose rate limit for whole body in mrem/year

3000 = site dose rate limit for skin in mrem/year

1500 = site dose rate limit for any organ in mrem/year

Pi VALUES FOR AN INFANT

Isotope	Inhalation	Ground Plane	Cow Milk	Goat Milk
H-3	6.47E+02	0.00E+00	2.38E+03	4.86E+03
P-32	2.03E+06	0.00E+00	1.60E+11	1.92E+11
CR-51	1.28E+04	6.65E+06	4.70E+06	5.64E+05
MN-54	1.00E+06	1.10E+09	3.90E+07	4.68E+06
FE-55	8.69E+04	0.00E+00	1.35E+08	1.76E+06
FE-59	1.02E+06	3.89E+08	3.92E+08	5.10E+06
CO-58	7.77E+05	5.26E+08	6.04E+07	7.26E+06
CO-60	4.51E+06	4.40E+09	2.10E+08	2.52E+07
NI-63	3.39E+05	0.00E+00	3.49E+10	4.19E+09
ZN-65	6.47E+05	6.88E+08	1.90E+10	2.28E+09
RB-86	1.90E+05	1.28E+07	2.23E+10	2.67E+09
SR-89	2.03E+06	3.07E+04	1.26E+10	2.64E+10
SR-90	4.09E+07	0.00E+00	1.22E+11	2.55E+11
Y-91	2.45E+06	1.51E+06	5.25E+06	6.30E+05
ZR-95	1.75E+06	3.43E+08	8.26E+05	9.91E+04
NB-95	4.79E+05	1.95E+08	2.06E+08	2.48E+07
RU-103	5.52E+05	1.54E+08	1.05E+05	1.27E+04
RU-106	1.16E+07	2.99E+08	1.45E+06	1.73E+05
AG-110M	3.67E+06	3.13E+09	1.46E+10	1.75E+09
TE-125M	1.47E+05	2.19E+06	1.51E+08	1.81E+07
TE-127M	1.31E+06	1.18E+05	1.04E+09	1.24E+08
TE-129M	1.68E+06	2.82E+07	1.39E+09	1.67E+08
I-131	1.48E+07	2.46E+07	1.05E+12	1.26E+12
I-133	3.56E+06	3.50E+06	9.61E+09	1.15E+10
I-135	6.96E+05	3.61E+06	2.00E+07	2.41E+07
CS-134	7.03E+05	2.81E+09	6.80E+10	2.04E+11
CS-136	1.35E+05	2.16E+08	5.81E+09	1.74E+10
CS-137	6.12E+05	1.15E+09	6.02E+10	1.81E+11
BA-140	1.60E+06	2.93E+07	2.41E+08	2.89E+07
CE-141	5.17E+05	1.95E+07	1.37E+07	1.64E+06
CE-144	9.84E+06	5.85E+07	1.33E+08	1.60E+07
PR-143	4.33E+05	0.00E+00	7.84E+05	9.41E+04
ND-147	3.22E+05	1.20E+07	5.74E+05	6.88E+04

Values are calculated from equation in ref. 1, with parameters from ref. 4.

Units are mrem/yr per uCi/m^3 for H-3 and the inhalation pathway and mrem/yr per uCi/sec per m^2 for the food and ground plane pathways.

Table 3-4. Infant Dose Factors

3.5 WASTE GAS STORAGE TANK

The radioactivity contained in the waste gas decay tanks will be monitored regularly to ensure that it is below the Tech. Spec. limit of 70,500 Curies per tank.

The storage limit for each tank may be verified by sampling and analysis or by use of R-13. Sample analysis results for nuclides other than Xe-133 will be converted to an equivalent Xe-133 level by normalizing with the ratio of the MPC value for that nuclide to the MPC value for Xe-133.

3.6 CUMULATIVE DOSE CALCULATIONS

Two methods of calculating cumulative doses can be employed. These are designated "Method A" and "Method B" below. Method A uses real-time input of hourly averages of meteorological data, and Method B uses highest average value of X/Q and D/Q for all releases. Method B is the "annual average" method described in NUREG-0133.

Method A or B may be selected at the discretion of the licensee.

3.6.1 Dose Calculations From Noble Gas Releases

I. Method A: Real Time Meteorological Input

The air dose in unrestricted areas due to noble gases released in gaseous effluents from each reactor at the site shall be determined by using the following expressions:

During any time period, for gamma radiation:

$$D_{\theta\gamma} = 1.14 \times 10^{-4} \sum_i M_i \sum_j \Delta t_j \sum_v (X/Q)_{j\theta v} Q_{ijv} \qquad (3.25)$$

During any time period, for beta radiation:

$$D_{\theta\beta} = 1.14 \times 10^{-4} \sum_i N_i \sum_j \Delta t_j \sum_v (X/Q)_{j\theta v} Q_{ijv} \qquad (3.26)$$

where:

1.14×10^{-4} = 1 / 8760 hours/year

$D_{\theta\beta}$ = the total beta air dose in sector θ from gaseous effluents for the total time period Δt_j, in mrad

$D_{\theta\gamma}$ = the total gamma air dose in sector θ from gaseous effluents for the total time period Δt_j, in mrad.

Δt_j = the length of the j^{th} time period over which $(X/Q)_{j\theta v}$ and Q_{ij} are averaged for all gaseous releases, in hours. For batch releases, no time period Δt_j shall be more than 1 hour; for continuous releases, no time period Δt_j shall be more than a week.

N_i = the air dose factor due to beta emissions for each identified radionuclide, in mrad/yr per $\mu Ci/m^3$ (Table 3-3).

M_i = the air dose factor due to gamma emissions for each identified radionuclide, in mrad/yr per $\mu Ci/m^3$, (Table 3-3).

$(X/Q)_{j\theta v}$ = the average atmospheric dispersion factor for the time period Δt_j in sector θ, from each vent release point at the site boundary, in sec/m^3. When Δt_j is greater than 1 hour, the average shall be based on observations of wind speed and atmospheric stability taken at least every hour during Δt_j.

Q_{ijv} = release rate for nuclide i at hour j for vent v, in uCi/sec.

II. Method B: Annual Average Meteorological Input

The dose contribution due to noble gases in gaseous effluents shall be calculated using the following expressions:

For any time period, for gamma radiation:

$$D_\gamma = 3.17 \times 10^{-8} \sum_i M_i \sum_v (\bar{X/Q})_v \, Q_{iv} \qquad (3.27)$$

and for beta radiation:

$$D_\beta = 3.17 \times 10^{-8} \sum_i N_i \sum_v (\bar{X}/Q)_v \, Q_{iv} \qquad (3.28)$$

where:

D_γ = the total gamma air dose from gaseous effluents, in mrad.

D_β = the total beta air dose from gaseous effluents, in mrad.

3.17×10^{-8} = inverse of number of seconds in a year.

$(\bar{X}/Q)_v$ = the highest value of the annual average atmospheric dispersion factor at the site boundary, for all sectors, in sec/m^3. The value of 1.08×10^{-6} sec/m^3 will be used for the plant vent and 4.87×10^{-5} sec/m^3 for the turbine building steam jet air ejector.

Q_{iv} = the release of noble gas radionuclides, i, in gaseous effluents in uCi for each vent. Releases shall be cumulative over the calendar month or quarter as appropriate.

3.6.2 Dose calculations for radioiodines and radioactive material in particulate form, and radionuclides (other than noble gases) with half lives greater than 8 days (radioiodines, tritium, and radionuclides in particulate form with half-lives greater than 8 days).

Method A: Real Time Meteorological Input

The dose to an individual from radioiodines, tritium, and radionuclides in particulate form, with half lives greater than 8 days, in gaseous effluents released from each reactor at the site to unrestricted areas (see Figure 5-1) shall be the following expression:

For any time period

$$D_{\theta\tau a} = 1.14 \times 10^{-4} \sum_i \sum_p f_{p\theta} \, R_{ip\tau a} \sum_j \Delta t_j \sum_v [W_{\theta jv} Q_{ijv}] \qquad (3.29)$$

where:

1.14×10^{-4} = 1/8760 hours/year

$D_{\theta\tau a}$ = the cumulative dose from gaseous effluents to the total body or an organ θ of an individual in age group a in sector θ for the total time period $\Sigma\Delta t_j$, in mrem.

$R_{ip\tau a}$ = the dose factor R_i for each pathway p for each organ τ for each age group a for nuclide i in sector θ, in mrem/yr per uCi/m^3 for tritium and in m^2-mrem/yr per uCi/sec for other isotopes. The R_i values for each pathway are as defined in NUREG-0133 using the default values of Regulatory Guide 1.109, and are given in Table 3-5. The dose factors are non-zero only for nuclides with half-lives greater than 8 days.

For sectors with real pathways within 5 miles from the point midway between the Unit 1 plant vent stack and the Unit 2 plant vent stack, the values of R_i are used based on these real pathways. For sectors with no real pathways within 5 miles from the point at midway between the Unit 1 plant vent stack and the Unit 2 plant vent stack, ΣR_{ip} is calculated assuming that all pathways exist at the 5-mile distance. Refer to table 3-5, calculated in accordance with NUREG-0133.

$f_{p\theta}$ = 1 for included pathways, 0 for excluded.

$W_{\theta jv}$ = dispersion parameter for calculation of food pathway dose, which is

$W_{\theta jv} = (X/Q)_{j\theta v}$ for inhalation pathway and for tritium (H-3) for all pathways.

$W_{\theta jv} = (D/Q)_{j\theta v}$ for other isotopes.

$(D/Q)_{j\theta v}$ = relative deposition (areal) for the period Δt_j, in sector θ, in meters^{-2}.

Maximum exposed individual

The maximum exposed individual is determined by selecting the age group with the largest single organ dose (reference 7).

If the ground and elevated portions of the mixed mode release are located in separate sectors, the dose obtained is apportioned between the two sectors using the entrainment factor E. The ground portion is the fraction E, and the elevated portion is (1-E).

Method B: Annual Average Methodology Input

For any time period, organ doses from radioiodines, tritium, and all radionuclides in particulate form with half-lives greater than 8 days are:

$$D_{\tau a} = 3.17 \times 10^{-8} \sum_i \sum_p R_{ip\tau a} \sum_v W_v Q_{iv} \qquad (3.30)$$

where:

3.17×10^{-8} = inverse of number of seconds in a year

$D_{\tau a}$ = the cumulative dose for age group a and organ τ from iodines and particulates with half lives greater than 8 days in gaseous effluents, in mrem.

$R_{ip\tau a}$ = the dose factor for each radionuclide i, pathway p, organ τ, and age group a, in m^2 (mrem/yr) per uCi/sec or mrem/yr per $\mu Ci/m^3$

W_v = the annual average dispersion parameter for estimating the dose to an individual at the critical location:

$(\bar{X}/Q)$ for the inhalation pathway, in sec/m^3, and for tritium in all pathways. $(\bar{D}/Q)$ for the food and ground plane pathways in $meters^3$.

Q_{iv} = the release of radioiodines, tritium, and all radioactive materials in particulate form with half lives greater than 8 days, i, in gaseous effluents for each vent,v. Releases are cumulative over the time period selected for the report.

The maximum exposed individual is determined by selecting the age group with the largest single organ dose (Reference 7).

Pathway: GROUND

Nuclide	T.Body	Skin
H-3	0.00E+00	0.00E+00
C-14	0.00E+00	0.00E+00
P-32	0.00E+00	0.00E+00
CR-51	4.66E+06	5.51E+06
MN-54	1.39E+09	1.63E+09
FE-55	0.00E+00	0.00E+00
FE-59	2.73E+08	3.21E+08
CO-58	3.79E+08	4.44E+08
CO-60	2.15E+10	2.53E+10
NI-63	0.00E+00	0.00E+00
ZN-65	7.47E+08	8.59E+08
RB-86	8.99E+06	1.03E+07
SR-89	2.16E+04	2.51E+04
SR-90	0.00E+00	0.00E+00
Y-91	1.07E+06	1.21E+06
ZR-95	2.45E+08	2.84E+08
NB-95	1.37E+08	1.61E+08
RU-103	1.08E+08	1.26E+08
RU-106	4.22E+08	5.07E+08
AG-110M	3.44E+09	4.01E+09
TE-125M	1.55E+06	2.13E+06
TE-127M	9.17E+04	1.08E+05
TE-129M	1.98E+07	2.31E+07
I-131	1.72E+07	2.09E+07
I-133	2.45E+06	2.98E+06
I-135	2.53E+06	2.95E+06
CS-134	6.86E+09	8.00E+09
CS-136	1.51E+08	1.71E+08
CS-137	1.03E+10	1.20E+10
BA-140	2.05E+07	2.35E+07
CE-141	1.37E+07	1.54E+07
CE-144	6.96E+07	8.04E+07
PR-143	0.00E+00	0.00E+00
ND-147	8.39E+06	1.01E+07

Units are m^2(mrem/yr) per uCi/sec, except for tritium, in mrem/yr per uCi/sec.

Table 3-5. Dose Factors for Particulates and Iodines

Pathway: INHALATION Age Group: ADULT

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03
C-14	1.82E+04	3.41E+03	3.41E+03	3.41E+03	3.41E+03	3.41E+03	3.41E+03
P-32	1.32E+06	7.71E+04	5.01E+04	0.00E+00	0.00E+00	0.00E+00	8.64E+04
CR-51	0.00E+00	0.00E+00	1.00E+02	5.95E+01	2.28E+01	1.44E+04	3.32E+03
MN-54	0.00E+00	3.96E+04	6.30E+03	0.00E+00	9.84E+02	1.40E+06	7.74E+04
FE-55	2.46E+04	1.70E+04	3.94E+03	0.00E+00	0.00E+00	7.21E+04	6.03E+03
FE-59	1.18E+04	2.78E+04	1.06E+04	0.00E+00	0.00E+00	1.02E+06	1.88E+05
CO-58	0.00E+00	1.58E+03	2.97E+03	0.00E+00	0.00E+00	9.28E+05	1.06E+05
CO-60	0.00E+00	1.15E+04	1.48E+04	0.00E+00	0.00E+00	5.97E+06	2.85E+05
NI-63	4.32E+05	3.14E+04	1.45E+04	0.00E+00	0.00E+00	1.78E+05	1.34E+04
ZN-65	3.24E+04	1.03E+05	4.66E+04	0.00E+00	6.90E+04	8.64E+05	5.34E+04
RB-86	0.00E+00	1.35E+05	5.90E+04	0.00E+00	0.00E+00	0.00E+00	1.66E+04
SR-89	3.04E+05	0.00E+00	8.72E+03	0.00E+00	0.00E+00	1.40E+06	3.50E+05
SR-90	9.92E+07	0.00E+00	6.10E+06	0.00E+00	0.00E+00	9.60E+06	7.22E+05
Y-91	4.62E+05	0.00E+00	1.24E+04	0.00E+00	0.00E+00	1.70E+06	3.85E+05
ZR-95	1.07E+05	3.44E+04	2.33E+04	0.00E+00	5.42E+04	1.77E+06	1.50E+05
NB-95	1.41E+04	7.82E+03	4.21E+03	0.00E+00	7.74E+03	5.05E+05	1.04E+05
RU-103	1.53E+03	0.00E+00	6.58E+02	0.00E+00	5.83E+03	5.05E+05	1.10E+05
RU-106	6.91E+04	0.00E+00	8.72E+03	0.00E+00	1.34E+05	9.36E+06	9.12E+
AG-110M	1.08E+04	1.00E+04	5.94E+03	0.00E+00	1.97E+04	4.63E+06	3.02E+
TE-125M	3.42E+03	1.58E+03	4.67E+02	1.05E+03	1.24E+04	3.14E+05	7.06E+04
TE-127M	1.26E+04	5.77E+03	1.57E+03	3.29E+03	4.58E+04	9.60E+05	1.50E+05
TE-129M	9.76E+03	4.67E+03	1.58E+03	3.44E+03	3.66E+04	1.16E+06	3.83E+05
I-131	2.52E+04	3.58E+04	2.05E+04	1.19E+07	6.13E+04	0.00E+00	6.28E+03
I-133	8.64E+03	1.48E+04	4.52E+03	2.15E+06	2.58E+04	0.00E+00	8.88E+03
I-135	2.68E+03	6.98E+03	2.57E+03	4.48E+05	1.11E+04	0.00E+00	5.25E+03
CS-134	3.73E+05	8.48E+05	7.28E+05	0.00E+00	2.87E+05	9.76E+04	1.04E+04
CS-136	3.90E+04	1.46E+05	1.10E+05	0.00E+00	8.56E+04	1.20E+04	1.17E+04
CS-137	4.78E+05	6.21E+05	4.28E+05	0.00E+00	2.22E+05	7.52E+04	8.40E+03
BA-140	3.90E+04	4.90E+01	2.57E+03	0.00E+00	1.67E+01	1.27E+06	2.18E+05
CE-141	1.99E+04	1.35E+04	1.53E+03	0.00E+00	6.26E+03	3.62E+05	1.20E+05
CE-144	3.43E+06	1.43E+06	1.84E+05	0.00E+00	8.48E+05	7.78E+06	8.16E+05
PR-143	9.36E+03	3.75E+03	4.64E+02	0.00E+00	2.16E+03	2.81E+05	2.00E+05
ND-147	5.27E+03	6.10E+03	3.65E+02	0.00E+00	3.56E+03	2.21E+05	1.73E+05

Units are m^2 (mrem/yr) per uCi/sec, except for tritium, in mrem/yr per uCi/sec.

Table 3-5. Dose Factors for Particulates and Iodines

Gaseous Effluents

Pathway: INHALATION Age Group: TEEN

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03
C-14	2.60E+04	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03	4.87E+03
P-32	1.89E+06	1.10E+05	7.16E+04	0.00E+00	0.00E+00	0.00E+00	9.28E+04
CR-51	0.00E+00	0.00E+00	1.35E+02	7.50E+01	3.07E+01	2.10E+04	3.00E+03
MN-54	0.00E+00	5.11E+04	8.40E+03	0.00E+00	1.27E+04	1.98E+06	6.68E+04
FE-55	3.34E+04	2.38E+04	5.54E+03	0.00E+00	0.00E+00	1.24E+05	6.39E+03
FE-59	1.59E+04	3.70E+04	1.43E+04	0.00E+00	0.00E+00	1.53E+06	1.78E+05
CO-58	0.00E+00	2.07E+03	2.78E+03	0.00E+00	0.00E+00	1.34E+06	9.52E+04
CO-60	0.00E+00	1.51E+04	1.98E+04	0.00E+00	0.00E+00	8.72E+06	2.59E+05
NI-63	5.80E+05	4.34E+04	1.98E+04	0.00E+00	0.00E+00	3.07E+05	1.42E+04
ZN-65	3.86E+04	1.34E+05	6.24E+04	0.00E+00	8.64E+04	1.24E+06	4.66E+04
RB-86	0.00E+00	1.90E+05	8.40E+04	0.00E+00	0.00E+00	0.00E+00	1.77E+04
SR-89	4.34E+05	0.00E+00	1.25E+04	0.00E+00	0.00E+00	2.42E+06	3.71E+05
SR-90	1.08E+08	0.00E+00	6.68E+06	0.00E+00	0.00E+00	1.65E+07	7.65E+05
Y-91	6.61E+05	0.00E+00	1.77E+04	0.00E+00	0.00E+00	2.94E+06	4.09E+05
ZR-95	1.46E+05	4.58E+04	3.15E+04	0.00E+00	6.74E+04	2.69E+06	1.49E+05
NB-95	1.86E+04	1.03E+04	5.66E+03	0.00E+00	1.00E+04	7.51E+05	9.68E+04
RU-103	2.10E+03	0.00E+00	8.96E+02	0.00E+00	7.43E+03	7.83E+05	1.09E+05
RU-106	9.84E+04	0.00E+00	1.24E+04	0.00E+00	1.90E+05	1.61E+07	9.60E+05
AG-110M	1.38E+04	1.31E+04	7.99E+03	0.00E+00	2.50E+04	6.75E+06	2.73E+05
TE-125M	4.88E+03	2.24E+03	6.67E+02	1.40E+03	0.00E+00	5.36E+05	7.50E+04
TE-127M	1.80E+04	8.16E+03	2.18E+03	4.38E+03	6.54E+04	1.60E+06	1.59E+05
TE-129M	1.39E+04	6.58E+03	2.25E+03	4.58E+03	5.19E+04	1.98E+06	4.05E+05
I-131	3.54E+04	4.91E+04	2.64E+04	1.46E+07	8.40E+04	0.00E+00	6.49E+03
I-133	1.22E+04	2.05E+04	6.22E+03	2.92E+06	3.59E+04	0.00E+00	1.03E+04
I-135	3.70E+03	9.44E+03	3.49E+03	6.[illegible]05	1.49E+04	0.00E+00	6.95E+03
CS-134	5.02E+05	1.13E+06	5.49E+05	0.00E+00	3.75E+05	1.46E+05	9.76E+03
CS-136	5.15E+04	1.94E+05	1.37E+05	0.00E+00	1.10E+05	1.78E+04	1.09E+04
CS-137	6.70E+05	8.48E+05	3.11E+05	0.00E+00	3.04E+05	1.21E+05	8.48E+03
BA-140	5.47E+04	6.70E+01	3.52E+03	0.00E+00	2.28E+01	2.03E+06	2.29E+05
CE-141	2.84E+04	1.90E+04	2.17E+03	0.00E+00	8.88E+03	6.14E+05	1.26E+05
CE-144	4.89E+06	2.02E+06	2.62E+05	0.00E+00	1.21E+06	1.34E+07	8.64E+05
PR-143	1.34E+04	5.31E+03	6.62E+02	0.00E+00	3.09E+03	4.83E+05	2.14E+05
ND-147	7.86E+03	8.56E+03	5.13E+02	0.00E+00	5.02E+03	3.72E+05	1.82E+05

Units are m^2 (mrem/yr) per uCi/sec, except for tritium, in mrem/yr per uCi/sec.

Table 3-5. Dose Factors for Particulates and Iodines

Pathway: INHALATION Age Group: CHILD

Nuclide	B[illegible]	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03
C-14	3.59E+04	6.73E+03	6.73E+03	6.73E+03	6.73E+03	6.73E+03	6.73E+03
P-32	2.60E+06	1.14E+05	9.88E+04	0.00E+00	0.00E+00	0.00E+00	4.22E+04
CR-51	0.00E+00	0.00E+00	1.54E+02	8.55E+01	2.43E+01	1.70E+04	1.08E+03
MN-54	0.00E+00	4.29E+04	9.51E+03	0.00E+00	1.00E+04	1.58E+06	2.29E+04
FE-55	4.74E+04	2.52E+04	7.77E+03	0.00E+00	0.00E+00	1.1[illegible]E+05	2.87E+03
FE-59	2.07E+04	3.34E+04	1.67E+04	0.00E+00	0.00E+00	1.27E+06	7.07E+04
CO-58	0.00E+00	1.77E+03	3.16E+03	0.00E+00	0.00E+00	1.11E+06	3.44E+04
CO-60	0.00E+00	1.31E+04	2.26E+04	0.00E+00	0.00E+00	7.07E+06	9.62E+04
NI-63	8.21E+05	4.63E+04	2.80E+04	0.00E+00	0.00E+00	2.75E+05	6.33E+03
ZN-65	4.26E+04	1.13E+05	7.03E+04	0.00E+00	7.14E+04	9.95E+05	1.63E+04
RB-86	0.00E+00	1.98E+05	1.14E+05	0.00E+00	0.00E+00	0.00E+00	7.99E+03
SR-89	5.99E+05	0.00E+00	1.72E+04	0.00E+00	0.00E+00	2.16E+06	1.67E+05
SR-90	1.01E+08	0.00E+00	6.44E+06	0.00E+00	0.00E+00	1.48E+07	3.43E+05
Y-91	9.14E+05	0.00E+00	2.44E+04	0.00E+00	0.00E+00	2.63E+06	1.84E+05
ZR-95	1.90E+05	4.18E+04	3.70E+04	0.00E+00	5.96E+04	2.23E+06	6.11E+04
NB-95	2.35E+04	9.18E+03	6.55E+03	0.00E+00	8.62E+03	6.14E+05	3.70E+04
RU-103	2.79E+03	0.00E+00	1.07E+03	0.00E+00	7.03E+03	6.62E+05	4.48E+04
RU-106	1.36E+05	0.00E+00	1.69E+04	0.00E+00	1.84E+05	1.43E+07	4.29E+05
AG-110M	1.69E+04	1.14E+04	9.14E+03	0.00E+00	2.12E+04	5.48E+06	1.00E+05
TE-125M	6.73E+03	2.33E+[illegible]	9.14E+02	1.92E+03	0.00E+00	4.77E+05	3.38E+04
TE-127M	2.49E+04	8.55E+03	3.02E+03	6.07E+03	6.36E+04	1.48E+06	7.14E+04
TE-129M	1.92E+04	6.85E+03	3.04E+03	6.33E+03	5.03E+04	1.76E+06	[illegible].82E+05
I-131	4.81E+04	4.81E+04	2.73E+04	1.62E+07	7.88E+04	0.00E+00	2.84E+03
I-133	1.66E+04	2.03E+04	7.70E+03	3.85E+06	3.38E+04	0.00E+00	5.48E+03
I-135	4.92E+03	8.73E+03	4.14E+03	7.92E+05	1.34E+04	0.00E+00	4.44E+03
CS-134	6.51E+05	1.01E+06	2.25E+05	0.00E+00	3.30E+05	1.21E+05	3.85E+03
CS-136	6.51E+04	1.71E+05	1.16E+05	0.00E+00	9.55E+04	1.45E+04	4.18E+03
CS-137	9.07E+05	8.25E+05	1.28E+05	0.00E+00	2.82E+05	1.04E+05	3.59E+03
BA-140	7.40E+04	6.48E+01	4.33E+03	0.00E+00	2.11E+01	1.74E+06	1.02E+05
CE-141	3.92E+04	1.95E+04	2.90E+03	0.00E+00	8.55E+03	5.44E+05	5.66E+04
CE-144	6.77E+06	2.12E+06	3.61E+05	0.00E+00	1.17E+06	1.20E+07	3.89E+05
PR-143	1.85E+04	5.55E+03	9.14E+02	0.00E+00	3.00E+03	4.33E+05	9.73E+04
ND-147	1.08E+04	8.73E+03	6.81E+02	0.00E+00	4.81E+03	3.28E+05	8.21E+04

Units are m^2(mrem/yr) per uCi/sec, except for tritium, in mrem/yr per uCi/sec.

Table 3-5. Dose Factors for Particulates and Iodines

Gaseous Effluents

Pathway: INHALATION Age group: INFANT

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02
C-14	2.65E+04	5.31E+03	5.31E+03	5.31E+03	5.31E+03	5.31E+03	5.31E+03
P-32	2.03E+06	1.12E+05	7.74E+04	0.00E+00	0.00E+00	0.00E+00	1.61E+04
CR-51	0.00E+00	0.00E+00	8.95E+01	5.75E+01	1.32E+01	1.28E+04	3.57E+02
MN-54	0.00E+00	2.53E+04	4.98E+03	0.00E+00	4.98E+03	1.00E+06	7.06E+03
FE-55	1.97E+04	1.17E+04	3.33E+03	0.00E+00	0.00E+00	8.69E+04	1.09E+03
FE-59	1.36E+04	2.35E+04	9.48E+03	0.00E+00	0.00E+00	1.02E+06	2.48E+04
CO-58	0.00E+00	1.22E+03	1.82E+03	0.00E+00	0.00E+00	7.77E+05	1.11E+04
CO-60	0.00E+00	8.02E+03	1.18E+04	0.00E+00	0.00E+00	4.51E+06	3.19E+04
NI-63	3.39E+05	2.04E+04	1.16E+04	0.00E+00	0.00E+00	2.09E+05	2.42E+03
ZN-65	1.93E+04	6.26E+04	3.11E+04	0.00E+00	3.25E+04	6.47E+05	5.14E+04
RB-86	0.00E+00	1.90E+05	8.82E+04	0.00E+00	0.00E+00	0.00E+00	3.04E+03
SR-89	3.98E+05	0.00E+00	1.14E+04	0.00E+00	0.00E+00	2.03E+06	6.40E+04
SR-90	4.09E+07	0.00E+00	2.39E+06	0.00E+00	0.00E+00	1.12E+07	1.31E+05
Y-91	5.88E+05	0.00E+00	1.57E+04	0.00E+00	0.00E+00	2.45E+06	7.03E+04
ZR-95	1.15E+05	2.79E+04	2.03E+04	0.00E+00	3.11E+04	1.75E+06	2.17E+04
NB-95	1.57E+04	6.43E+03	3.78E+03	0.00E+00	4.72E+03	4.79E+05	1.27E+04
RU-103	2.02E+03	0.00E+00	6.79E+02	0.00E+00	4.24E+03	5.52E+05	1.61E+04
RU-106	8.68E+04	0.00E+00	1.09E+04	0.00E+00	1.07E+05	1.16E+07	1.64E+05
AG-110M	9.98E+03	7.22E+03	5.00E+03	0.00E+00	1.09E+04	3.67E+06	3.30E+04
TE-125M	4.76E+03	1.99E+03	6.58E+02	1.62E+03	0.00E+00	4.47E+05	1.29E+04
TE-127M	1.67E+04	6.90E+03	2.07E+03	4.87E+03	3.75E+04	1.31E+06	2.73E+04
TE-129M	1.41E+04	6.09E+03	2.23E+03	5.47E+03	3.18E+04	1.68E+06	6.90E+04
I-131	3.79E+04	4.44E+04	1.96E+04	1.48E+07	5.18E+04	0.00E+00	1.06E+03
I-133	1.32E+04	1.92E+04	5.60E+03	3.56E+06	2.24E+04	0.00E+00	2.16E+03
I-135	3.86E+03	7.60E+03	2.77E+03	6.96E+05	8.47E+03	0.00E+00	1.83E+03
CS-134	3.96E+05	7.03E+05	7.45E+04	0.00E+00	1.90E+05	7.97E+04	1.33E+03
CS-136	4.83E+04	1.35E+05	5.29E+04	0.00E+00	5.64E+04	1.18E+04	1.43E+03
CS-137	5.49E+05	6.12E+05	4.55E+04	0.00E+00	1.72E+05	7.13E+04	1.33E+03
BA-140	5.60E+04	5.60E+01	2.90E+ 3	0.00E+00	1.34E+01	1.60E+06	3.84E+04
CE-141	2.77E+04	1.67E+04	1.99E+03	0.00E+00	5.25E+03	5.17E+05	2.16E+04
CE-144	3.19E+06	1.21E+06	1.76E+05	0.00E+00	5.38E+05	9.84E+06	1.48E+05
PR-143	1.40E+04	5.24E+03	6.99E+02	0.00E+00	1.97E+03	4.33E+05	3.72E+04
ND-147	7.04E+03	8.13E+03	5.00E+02	0.00E+00	3.15E+03	3.22E+05	3.12E+04

Units are mrem/yr per uCi/sec

Table 3-5. Dose Factors for Particulates and Iodines (Continued)

Pathway: COW MILK Age Group: ADULT

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	7.63E+02	7.63E+02	7.63E+02	7.63E+02	7.63E+02	7.63E+02
C-14	2.63E+08	5.27E+07	5.27E+07	5.27E+07	5.27E+07	5.27E+07	5.27E+07
P-32	1.71E+10	1.06E+09	6.61E+08	0.00E+00	0.00E+00	0.00E+00	1.92E+09
CR-51	0.00E+00	0.00E+00	2.86E+04	1.71E+04	6.30E+03	3.79E+04	7.19E+06
MN-54	0.00E+00	8.41E+06	1.61E+06	0.00E+00	2.50E+06	0.00E+00	2.58E+07
FE-55	2.51E+07	1.74E+07	4.05E+06	0.00E+00	0.00E+00	9.68E+06	9.95E+06
FE-59	2.97E+07	6.98E+07	2.68E+07	0.00E+00	0.00E+00	1.95E+07	2.33E+08
CO-58	0.00E+00	4.71E+06	1.06E+07	0.00E+00	0.00E+00	0.00E+00	9.55E+07
CO-60	0.00E+00	1.64E+07	3.62E+07	0.00E+00	0.00E+00	0.00E+00	3.08E+08
NI-63	6.73E+09	4.66E+08	2.26E+08	0.00E+00	0.00E+00	0.00E+00	9.73E+07
ZN-65	1.37E+09	4.37E+09	1.97E+09	0.00E+00	2.92E+09	0.00E+00	2.75E+09
RB-86	0.00E+00	2.60E+09	1.21E+09	0.00E+00	0.00E+00	0.00E+00	5.12E+08
SR-89	1.45E+09	0.00E+00	4.16E+07	0.00E+00	0.00E+00	0.00E+00	2.33E+08
SR-90	4.68E+10	0.00E+00	1.15E+10	0.00E+00	0.00E+00	0.00E+00	1.35E+09
Y-91	8.59E+03	0.00E+00	2.30E+02	0.00E+00	0.00E+00	0.00E+00	4.73E+06
ZR-95	9.43E+02	3.03E+02	2.05E+02	0.00E+00	4.75E+02	0.00E+00	9.59E+05
NB-95	8.26E+04	4.59E+04	2.47E+04	0.00E+00	4.54E+04	0.00E+00	2.79E+08
RU-103	1.02E+03	0.00E+00	4.39E+02	0.00E+00	3.89E+03	0.00E+00	1.19E+05
RU-106	2.04E+04	0.00E+00	2.58E+03	0.00E+00	3.94E+04	0.00E+00	1.32E+06
AG-110M	5.82E+07	5.39E+07	3.20E+07	0.00E+00	1.06E+08	0.00E+00	2.20E+10
TE-125M	1.63E+07	5.90E+06	2.18E+06	4.90E+06	6.63E+07	[illegible]	6.50E+07
TE-127M	4.58E+07	1.64E+07	5.58E+06	1.17E+07	1.86E+08	0.00E+00	1.54E+08
TE-129M	6.02E+07	2.25E+07	9.53E+06	2.07E+07	2.51E+08	0.00E+00	3.03E+08
I-131	2.96E+08	4.24E+08	2.43E+08	1.39E+11	7.26E+08	0.00E+00	1.12E+08
I-133	3.87E+06	6.38E+06	2.25E+06	9.90E+08	1.18E+07	0.00E+00	6.05E+06
I-135	1.29E+04	3.[illegible]E+04	1.24E+04	2.22E+06	5.40E+04	0.00E+00	3.80E+04
CS-134	5.65E+09	1.35E+10	1.10E+10	0.00E+00	4.35E+09	1.45E+09	2.35E+08
CS-136	2.63E+08	1.04E+09	7.48E+08	0.00E+00	5.78E+08	7.93E+07	1.18E+08
CS-137	7.38E+09	1.01E+10	6.61E+09	0.00E+00	3.43E+09	1.14E+09	1.95E+08
BA-140	2.69E+07	3.38E+04	1.76E+06	0.00E+00	1.15E+04	1.93E+04	5.54E+07
CE-141	4.84E+03	3.28E+03	3.72E+02	0.00E+00	1.52E+03	0.00E+00	1.25E+07
CE-144	3.58E+05	1.50E+05	1.92E+04	0.00E+00	8.87E+04	0.00E+00	1.21E+08
PR-143	1.58E+02	6.33E+01	7.83E+00	0.00E+00	3.66E+01	0.00E+00	6.92E+05
ND-147	9.42E+01	1.09E+02	6.51E+00	0.00E+00	6.36E+01	0.00E+00	5.22E+05

Units are m^2 (mrem/yr) per uCi/sec, except for tritium, in mrem/yr per uCi/sec.

Table 3-5. Dose Factors for Particulates and Iodines

Gaseous Effluents

Pathway: COW MILK Age Group: TEEN

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	9.94E+02	9.94E+02	9.94E+02	9.94E+02	9.94E+02	9.94E+02
C-14	4.86E+08	9.72E+07	9.72E+07	9.72E+07	9.72E+07	9.72E+07	9.72E+07
P-32	3.16E+10	1.96E+09	1.22E+09	0.00E+00	0.00E+00	0.00E+00	2.65E+09
CR-51	0.00E+00	0.00E+00	4.99E+04	2.77E+04	1.09E+04	7.13E+04	8.39E+06
MN-54	0.00E+00	1.40E+07	2.78E+06	0.00E+00	4.18E+06	0.00E+00	2.87E+07
FE-55	4.45E+07	3.16E+07	7.36E+06	0.00E+00	0.00E+00	2.00E+07	1.37E+07
FE-59	5.18E+07	1.21E+08	4.67E+07	0.00E+00	0.00E+00	3.81E+07	2.86E+08
CO-58	0.00E+00	7.94E+06	1.83E+07	0.00E+00	0.00E+00	0.00E+00	1.09E+08
CO-60	0.00E+00	2.78E+07	6.26E+07	0.00E+00	0.00E+00	0.00E+00	3.62E+08
NI-63	1.18E+10	8.35E+08	4.01E+08	0.00E+00	0.00E+00	0.00E+00	1.33E+08
ZN-65	2.11E+09	7.32E+09	3.41E+09	0.00E+00	4.68E+09	0.00E+00	3.10E+09
RB-86	0.00E+00	4.7[illegible]09	2.22E+09	0.00E+00	0.00E+00	0.00E+00	7.00E+08
SR-89	2.67E+09	0.0[illegible]	7.66E+07	0.00E+00	0.00E+00	0.00E+00	3.19E+08
SR-90	6.61E+10	0.0[illegible]	1.63E+10	.00E+00	0.00E+00	0.00E+00	1.86E+09
Y-91	1.58E+04	0.00E+00	4.24E+02	0.00E+00	0.00E+00	0.00E+00	6.48E+06
ZR-95	1.65E+03	5.21E+02	3.58E+02	0.00E+00	7.65E+02	0.00E+00	1.20E+06
NB-95	1.41E+05	7.81E+04	4.30E+04	0.00E+00	7.57E+04	0.00E+00	3.34E+08
RU-103	1.81E+03	0.00E+00	7.74E+02	0.00E+00	6.38E+03	0.00E+00	1.51E+05
RU-106	3.75E+04	0.00E+00	4.73E+03	0.00E+00	7.24E+04	0.00E+00	1.80E+06
AG-110M	9.63E+07	9.11E+07	5.50E+07	0.00E+00	1.74E+08	0.00E+00	2.56E+10
TE-125M	3.00E+07	1.08E+07	4.02E+06	8.39E+06	0.00E+00	0.00E+00	8.86E+07
TE-127M	8.44E+07	2.99E+07	1.00E+07	2.01E+07	3.42E+08	0.00E+00	2.10E+08
TE-129M	1.10E+08	4.09E+07	1.74E+07	3.55E+07	4.61E+08	0.00E+00	4.13E+08
I-131	5.37[illegible]+08	7.52E+08	4.04E+08	2.20E+11	1.30E+09	0.00E+00	1.49E+08
I-133	7.07E+06	1.20E+07	3.66E+06	1.67E+09	2.10E+07	0.00E+00	9.03E+06
I-135	2.28E+04	5.88E+04	2.18E+04	3.78E+06	9.28E+04	0.00E+00	6.51E+04
CS-134	9.82E+09	2.31E+10	1.07E+10	0.00E+00	7.34E+09	2.80E+09	2.87E+08
CS-136	4.43E+08	1.76E+09	1.18E+09	0.00E+00	9.60E+08	1.51E+08	1.42E+08
CS-137	1.34E+10	1.78E+10	6.20E+09	0.00E+00	6.06E+09	2.35E+09	2.53E+08
BA-140	4.85E+07	5.95E+04	3.13E+06	0.00E+00	2.02E+04	4.00E+04	7.48E+07
CE-141	8.88E+03	5.93E+03	6.81E+02	0.00E+00	2.79E+03	0.00E+00	1.70E+07
CE-144	6.58E+05	2.72E+05	3.54E+04	0.00E+00	1.63E+05	0.00E+00	1.66E+08
PR-143	2.90E+02	1.16E+02	1.44E+01	0.00E+00	6.73E+01	0.00E+00	9.55E+05
ND-147	1.81E+02	1.97E+02	1.18E+01	0.00E+00	1.16E+02	0.00E+00	7.11E+05

Units are m^2 (mrem/yr) per uCi/sec, except for tritium, in mrem/yr per uCi/sec.

Table 3-5. Dose Factors for Particulates and Iodines

Pathway: CCW MILK Age Group: CHILD

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.57E+03	1.57E+03	1.57E+03	1.57E+03	1.57E+03	1.57E+03
C-14	1.19E+09	2.39E+08	2.39E+08	2.39E+08	2.39E+08	2.39E+08	2.39E+08
P-32	7.78E+10	3.64E+09	3.00E+09	0.00E+00	0.00E+00	0.00E+00	2.15E+09
CR-51	0.00E+00	0.00E+00	1.02E+05	5.65E+04	1.54E+04	1.03E+05	5.40E+06
MN-54	0.00E+00	2.10E+07	5.59E+06	0.00E+00	5.88E+06	0.00E+00	1.76E+07
FE-55	1.12E+08	5.93E+07	1.84E+07	0.00E+00	0.00E+00	3.35E+07	1.10E+07
FE-59	1.20E+08	1.95E+08	9.69E+07	0.00E+00	0.00E+00	5.64E+07	2.03E+08
CO-58	0.00E+00	1.21E+07	3.71E+07	0.00E+00	0.00E+00	0.00E+00	7.07E+07
CO-60	0.00E+00	4.32E+07	1.27E+08	0.00E+00	0.00E+00	0.00E+00	2.39E+08
NI-63	2.96E+10	1.59E+09	1.01E+09	0.00E+00	0.00E+00	0.00E+00	1.07E+08
ZN-65	4.13E+09	1.10E+10	6.85E+09	0.00E+00	6.94E+09	0.00E+00	1.93E+09
RB-86	0.00E+00	8.77E+09	5.39E+09	0.00E+00	0.00E+00	0.00E+00	5.64E+08
SR-89	6.62E+09	0.00E+00	1.89E+08	0.00E+00	0.00E+00	0.00E+00	2.56E+08
SR-90	1.12E+11	0.00E+00	2.83E+10	0.00E+00	0.00E+00	0.00E+00	1.51E+09
Y-91	3.90E+04	0.00E+00	1.04E+06	0.00E+00	0.00E+00	0.00E+00	5.20E+06
ZR-95	3.83E+03	8.42E+02	7.50E+02	0.00E+00	1.21E+03	0.00E+00	8.79E+05
NB-95	3.18E+05	1.24E+05	8.84E+04	0.00E+00	1.16E+05	0.00E+00	2.29E+08
RU-103	4.28E+03	0.00E+00	1.65E+03	0.00E+00	1.08E+04	0.00E+00	1.11E+05
RU-106	9.24E+04	0.00E+00	1.15E+04	0.00E+00	1.25E+05	0.00E+00	1.44E+06
AG-110M	2.09E+08	1.41E+08	1.13E+08	0.00E+00	2.63E+08	0.00E+00	1.68E+10
TE-125M	7.38E+07	2.00E+07	9.84E+06	2.07E+07	0.00E+00	0.00E+00	7.12E+07
TE-127M	2.08E+08	5.60E+07	2.47E+07	4.97E+07	5.93E+07	0.00E+00	1.68E+08
TE-129M	2.71E+08	7.58E+07	4.21E+07	8.75E+07	7.97E+08	0.00E+00	3.31E+08
I-131	1.30E+09	1.31E+09	7.45E+08	4.33E+11	2.15E+09	0.00E+00	1.17E+08
I-133	1.72E+07	2.12E+07	8.04E+06	3.56E+09	3.54E+07	0.00E+00	8.56E+06
I-135	5.41E+04	9.73E+04	4.60E+04	8.62E+06	1.49E+05	0.00E+00	7.41E+04
CS-134	2.26E+10	3.72E+10	7.84E+09	0.00E+00	1.15E+10	4.13E+09	2.00E+08
CS-136	1.01E+09	2.78E+09	1.80E+09	0.00E+00	1.48E+09	2.21E+08	9.77E+07
CS-137	3.22E+10	3.09E+10	4.55E+09	0.00E+00	1.01E+10	3.62E+09	1.93E+08
BA-140	1.17E+08	1.03E+05	6.84E+06	0.00E+00	3.34E+04	6.12E+04	5.93E+07
CE-141	2.19E+04	1.09E+04	1.62E+03	0.00E+00	4.78E+03	0.00E+00	1.36E+07
CE-144	1.62E+06	5.09E+05	8.66E+04	0.00E+00	2.82E+05	0.00E+00	1.33E+08
PR-143	7.18E+02	2.16E+02	3.56E+01	0.00E+00	1.17E+02	0.00E+00	7.75E+05
ND-147	4.45E+02	3.60E+02	2.79E+01	0.00E+00	1.98E+02	0.00E+00	5.71E+05

Units are m^2 (mrem/yr) per uCi/sec, except for tritium, in mrem/yr per uCi/sec.

Table 3-5. Dose Factors for Particulates and Iodines

Pathway: COW MILK Age Group: INFANT

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	2.38E+03	2.38E+03	2.38E+03	2.38E+03	2.38E+03	2.38E+03
C-14	2.34E+09	5.00E+08	5.00E+08	5.00E+08	5.00E+08	5.00E+08	5.00E+08
P-32	1.60E+11	9.43E+09	6.22E+09	0.00E+00	0.00E+00	0.00E+00	2.17E+09
CR-51	0.00E+00	0.00E+00	1.61E+05	1.05E+05	2.30E+04	2.05E+05	4.70E+06
MN-54	0.00E+00	3.90E+07	8.84E+06	0.00E+00	8.64E+06	0.00E+00	1.43E+07
FE-55	1.35E+08	8.73E+07	2.33E+07	0.00E+00	0.00E+00	4.27E+07	1.11E+07
FE-59	2.24E+08	3.92E+08	1.54E+08	0.00E+00	0.00E+00	1.16E+08	1.87E+08
CO-58	0.00E+00	2.42E+07	6.05E+07	0.00E+00	0.00E+00	0.00E+00	6.04E+07
CO-60	0.00E+00	8.82E+07	2.08E+08	0.00E+00	0.00E+00	0.00E+00	2.10E+08
NI-63	3.49E+10	2.16E+09	1.21E+09	0.00E+00	0.00E+00	0.00E+00	1.07E+08
ZN-65	5.55E+09	1.90E+10	8.78E+09	0.00E+00	9.23E+09	[illegible]+00	1.61E+10
RB-86	0.00E+00	2.23E+10	1.10E+10	0.00E+00	0.00E+00	[illegible]00	5.70E+08
SR-89	1.26E+10	0.00E+00	3.61E+08	0.00E+00	0.00E+00	[illegible]+00	2.59E+08
SR-90	1.22E+11	0.00E+00	3.10E+10	0.00E+00	0.00E+00	0.00E+00	1.52E+09
Y-91	7.33E+04	0.00E+00	1.95E+03	0.00E+00	0.00E+00	0.00E+00	5.25E+06
ZR-95	6.80E+03	1.66E+03	1.18E+03	0.00E+00	1.79E+03	0.00E+00	8.26E+05
NB-95	5.93E+05	2.44E+05	1.41E+05	0.00E+00	1.75E+05	0.00E+00	2.06E+08
RU-103	8.67E+03	0.00E+00	2.90E+03	0.00E+00	1.80E+04	0.00E+00	1.05E+05
RU-106	1.90E+05	0.00E+00	2.38E+04	0.00E+00	2.25E+05	0.00E+00	1.45E+06
AG-110M	3.86E+08	2.82E+08	1.86E+08	0.00E+00	4.03E+08	0.00E+00	1.46E+10
TE-125M	1.51E+08	5.04E+07	2.04E+07	5.07E+07	0.00E+00	0.00E+00	7.18E+07
TE-127M	4.21E+08	1.40E+08	5.10E+07	1.22E+08	1.04E+09	0.00E+00	1.70E+08
TE-129M	5.57E+08	1.91E+08	8.58E+07	2.14E+08	1.39E+09	0.00E+00	3.33E+08
I-131	2.72E+09	3.21E+09	1.41E+09	1.05E+12	3.74E+09	0.00E+00	1.14E+08
I-133	3.63E+07	5.28E+07	1.55E+07	9.61E+09	6.21E+07	0.00E+00	8.94E+06
I-135	1.12E+05	2.24E+05	8.15E+04	2.00E+07	2.49E+05	0.00E+00	8.09E+04
CS-134	3.65E+10	6.80E+10	6.87E+09	0.00E+00	1.75E+10	7.18E+09	1.85E+08
CS-136	1.98E+09	5.81E+09	2.17E+09	0.00E+00	2.32E+09	4.74E+08	8.83E+07
CS-137	5.15E+10	6.02E+10	4.27E+09	0.00E+00	1.62E+10	6.55E+09	1.88E+08
BA-140	2.41E+08	2.41E+05	1.24E+07	0.00E+00	5.72E+04	1.48E+05	5.92E+07
CE-141	4.34E+04	2.64E+04	3.11E+03	0.00E+00	8.16E+03	0.00E+00	1.37E+07
CE-144	2.33E+06	9.52E+05	1.30E+05	0.00E+00	3.85E+05	0.00E+00	1.33E+08
PR-143	1.49E+03	5.55E+02	7.36E+01	0.00E+00	2.06E+02	0.00E+00	7.84E+05
ND-147	8.81E+02	9.05E+02	5.55E+01	0.00E+00	3.49E+02	0.00E+00	5.74E+05

Units are m^2(mrem/yr) per uCi/sec, except for tritium, in mrem/yr per uCi/sec.

Table 3-5. Dose Factors for Particulates and Iodines

Gaseous Effluents

Pathway: GOAT MILK Age Group: ADULT

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.56E+03	1.56E+03	1.56E+03	1.56E+03	1.56E+03	1.56E+03
C-14	2.63E+08	5.27E+07	5.27E+07	5.27E+07	5.27E+07	5.27E+07	5.27E+07
P-32	2.05E+10	1.28E+09	7.93E+08	0.00E+00	0.00E+00	0.00E+00	2.31E+09
CR-51	0.00E+00	0.00E+00	3.43E+03	2.05E+03	7.55E+02	4.55E+03	8.62E+02
MN-54	0.00E+00	1.01E+06	1.93E+05	0.00E+00	3.00E+05	0.00E+00	3.09E+06
FE-55	3.26E+05	2.26E+05	5.26E+04	0.00E+00	0.00E+00	1.26E+05	1.29E+05
FE-59	3.86E+05	9.08E+05	3.48E+05	0.00E+00	0.00E+00	2.54E+05	3.03E+06
CO-58	0.00E+00	5.66E+05	1.27E+06	0.00E+00	0.00E+00	0.00E+00	1.15E+07
CO-60	0.00E+00	1.97E+06	4.34E+06	0.00E+00	0.00E+00	0.00E+00	3.70E+07
NI-63	8.07E+08	5.60E+07	2.71E+07	0.00E+00	0.00E+00	0.00E+00	1.17E+07
ZN-65	1.65E+08	5.24E+08	2.37E+08	0.00E+00	3.50E+08	0.00E+00	3.30E+08
RB-86	0.00E+00	3.11E+08	1.45E+08	0.00E+00	0.00E+00	0.00E+00	6.14E+07
SR-89	3.05E+09	0.00E+00	8.75E+07	0.00E+00	0.00E+00	0.00E+00	4.89E+08
SR-90	9.83E+10	0.00E+00	2.41E+10	0.00E+00	0.00E+00	0.00E+00	2.84E+09
Y-91	1.03E+03	0.00E+00	2.76E+01	0.00E+00	0.00E+00	0.00E+00	5.67E+05
ZR-95	1.13E+02	3.63E+01	2.46E+01	0.00E+00	5.70E+01	0.00E+00	1.15E+05
NB-95	9.91E+03	5.51E+03	2.96E+03	0.00E+00	5.45E+03	0.00E+00	3.34E+07
RU-103	1.22E+02	0.00E+00	5.26E+01	0.00E+00	4.66E+02	0.00E+00	1.43E+04
RU-106	2.45E+03	0.00E+00	3.10E+02	0.00E+00	4.73E+03	0.00E+00	1.58E+05
AG-110M	6.99E+06	6.46E+06	3.84E+06	0.00E+00	1.27E+07	0.00E+00	2.64E+09
TE-125M	1.95E+06	7.08E+05	2.62E+05	5.88E+05	7.95E+06	0.00E+00	7.81E+06
TE-127M	5.49E+06	1.96E+06	6.69E+05	1.40E+06	2.23E+07	0.00E+00	1.84E+07
TE-129M	7.22E+06	2.70E+06	1.14E+06	2.48E+06	3.02E+07	0.00E+00	3.64E+07
I-131	3.55E+08	5.08E+08	2.91E+08	1.67E+11	8.71E+08	0.00E+00	1.34E+08
I-133	4.65E+06	8.08E+06	2.46E+06	1.19E+09	1.41E+07	0.00E+00	7.26E+06
I-135	1.54E+04	4.04E+04	1.49E+04	2.66E+06	6.48E+04	0.00E+00	4.56E+04
CS-134	1.70E+10	4.04E+10	3.30E+10	0.00E+00	1.31E+10	4.34E+09	7.06E+08
CS-136	7.90E+08	3.12E+09	2.24E+09	0.00E+00	1.74E+09	2.38E+08	3.54E+08
CS-137	2.21E+10	3.03E+10	1.98E+10	0.00E+00	1.03E+10	3.42E+09	5.86E+08
BA-140	3.23E+06	4.05E+03	2.11E+05	0.00E+00	1.38E+03	2.32E+03	6.64E+06
CE-141	5.81E+02	3.93E+02	4.46E+01	0.00E+00	1.83E+02	0.00E+00	1.50E+06
CE-144	4.29E+04	1.79E+04	2.30E+03	0.00E+00	1.06E+04	0.00E+00	1.45E+07
PR-143	1.90E+01	7.60E+00	9.39E-01	0.00E+00	4.39E+00	0.00E+00	8.30E+04
ND-147	1.13E+01	1.31E+01	7.81E-01	0.00E+00	7.64E+00	0.00E+00	6.27E+04

Units are m^2(mrem/yr) per uCi/sec, except for tritium, in mrem/yr per uCi/sec.

Table 3-5. Dose Factors for Particulates and Iodines

Gaseous Effluents

Pathway: GOAT MILK Age Group: TEEN

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	2.03E+03	2.03E+03	2.03E+03	2.03E+03	2.03E+03	2.03E+03
C-14	4.86E+08	9.72E+07	9.72E+07	9.72E+07	9.72E+07	9.72E+07	9.72E+07
P-32	3.79E+10	2.35E+09	1.47E+09	0.00E+00	0.00E+00	0.00E+00	3.18E+09
CR-51	0.00E+00	0.00E+00	5.99E+03	3.33E+03	1.31E+03	8.55E+03	1.01E+06
MN-54	0.00E+00	1.68E+06	3.34E+05	0.00E+00	5.02E+05	0.00E+00	3.45E+06
FE-55	5.79E+05	4.11E+05	9.57E+04	0.00E+00	0.00E+00	2.60E+05	1.78E+05
FE-59	6.74E+05	1.57E+06	6.07E+05	0.00E+00	0.00E+00	4.96E+05	3.72E+06
CO-58	0.00E+00	9.5[illegible]E+05	2.19E+06	0.00E+00	0.00E+00	0.00E+00	1.31E+07
CO-60	0.00E+00	3.3[illegible]E+06	7.52E+06	0.00E+00	0.00E+00	0.00E+00	4.35E+07
NI-63	1.42E+09	1.00[illegible]+08	4.81E+07	0.00E+00	0.00E+00	0.00E+00	1.59E+07
ZN-65	2.53E+08	8.78E+08	4.10E+08	0.00E+00	5.62E+08	0.00E+00	3.72E+08
RB-86	0.00E+00	5.67E+08	[illegible].67E+08	0.00E+00	0.00E+00	0.00E+00	8.40E+07
SR-89	5.62E+09	0.00E+00	1.61E+08	0.00E+00	0.00E+00	0.00E+00	6.69E+08
SR-90	1.39E+11	0.00E+00	3.43E+10	0.00E+00	0.00E+00	0.00E+00	3.90E+09
Y-91	1.90E+03	0.00E+00	5.08E+01	0.00E+00	0.00E+00	0.00E+00	7.77E+05
ZR-95	1.98E+02	6.25E+01	4.30E+01	0.00E+00	9.18E+01	0.00E+00	1.44E+05
NB-95	1.69E+04	9.37E+03	5.16E+03	0.00E+00	9.08E+03	0.00E+00	4.01E+07
RU-103	2.17E+02	0.00E+00	9.29E+01	0.00E+00	7.66E+02	0.00E+00	1.82E+04
RU-106	4.50E+03	0.00E+00	5.67E+02	0.00E+00	8.68E+03	0.00E+00	2.16E+05
AG-110M	1.16E+07	1.09E+07	6.65E+06	0.00E+00	2.08E+07	0.00E+00	3.07E+09
TE-125M	3.60E+06	1.30E+06	4.82E+05	1.01E+06	0.00E+00	0.00E+00	1.06E+07
TE-127M	1.01E+07	3.59E+06	1.20E+06	2.41E+06	4.10E+07	0.00E+00	2.52E+07
TE-129M	1.32E+07	4.90E+06	2.09E+06	4.26E+06	5.53E+07	0.00E+00	4.96E+07
I-131	6.45E+08	9.03E+08	4.85E+08	2.63E+11	1.55E+09	0.00E+00	1.79E+08
I-133	8.49E+06	1.44E+07	4.39E+06	2.01E+09	2.52E+07	0.00E+00	1.09E+07
I-135	2.74E+04	7.05E+04	2.61E+04	4.54E+06	1.11E+05	0.00E+00	7.82E+04
CS-134	2.94E+10	6.93E+10	3.22E+10	0.00E+00	2.20E+10	8.41E+09	8.62E+08
CS-136	1.34E+09	5.29E+09	3.55E+09	0.00E+00	2.88E+09	4.54E+08	4.26E+08
CS-137	4.02E+10	5.34E+10	1.86E+10	0.00E+00	1.82E+10	7.06E+09	7.60E+08
BA-140	5.82E+06	7.14E+03	3.75E+05	0.00E+00	2.42E+03	4.80E+03	8.98E+06
CE-141	1.07E+03	7.12E+02	8.18E+01	0.00E+00	3.35E+02	0.00E+00	2.04E+06
CE-144	7.90E+04	3.27E+04	4.24E+03	0.00E+00	1.95E+04	0.00E+00	1.99E+07
PR-143	3.48E+01	1.39E+01	1.73E+00	0.00E+00	8.08E+00	0.00E+00	1.15E+05
ND-147	2.17E+01	2.36E+01	1.42E+00	0.00E+00	1.39E+01	0.00E+00	8.53E+04

Units are m^2(mrem/yr) per uCi/sec, except for tritium, in mrem/yr per uCi/sec.

Table 3-5. Dose Factors for Particulates and Iodines

Gaseous Effluents

Pathway: GOAT MILK Age Group: CHILD

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	3.20E+03	3.20E+03	3.20E+03	3.20E+03	3.20E+03	3.20E+03
C-14	1.19E+09	2.39E+08	2.39E+08	2.39E+08	2.39E+08	2.39E+08	2.39E+08
P-32	9.34E+10	4.37E+09	3.60E+09	0.00E+00	0.00E+00	0.00E+00	2.58E+09
CR-51	0.00E+00	0.00E+00	1.22E+04	6.78E+03	1.85E+03	1.24E+04	6.48E+05
MN-54	0.00E+00	2.52E+06	6.70E+05	0.00E+00	7.06E+05	0.00E+00	2.11E+06
FE-55	1.45E+06	7.71E+05	2.39E+05	0.00E+00	0.00E+00	4.36E+05	1.43E+05
FE-59	1.56E+06	2.53E+06	1.26E+06	0.00E+00	0.00E+00	7.33E+05	2.63E+06
CO-58	0.00E+00	1.45E+06	4.45E+06	0.00E+00	0.00E+00	0.00E+00	8.49E+06
CO-60	0.00E+00	5.18E+06	1.53E+07	0.00E+00	0.00E+00	0.00E+00	2.87E+07
NI-63	3.56E+09	1.90E+08	1.21E+08	0.00E+00	0.00E+00	0.00E+00	1.28E+07
ZN-65	4.96E+08	1.32E+09	8.22E+08	0.00E+00	8.33E+08	0.00E+00	2.32E+08
RB-86	0.00E+00	1.05E+09	6.47E+08	0.00E+00	0.00E+00	0.00E+00	6.77E+07
SR-89	1.39E+10	0.00E+00	3.97E+08	0.00E+00	0.00E+00	0.00E+00	5.38E+08
SR-90	2.35E+11	0.00E+00	5.95E+10	0.00E+00	0.00E+00	0.00E+00	3.16E+09
Y-91	4.68E+03	0.00E+00	1.25E+02	0.00E+00	0.00E+00	0.00E+00	6.24E+05
ZR-95	4.60E+02	1.01E+02	9.00E+01	0.00E+00	1.45E+02	0.00E+00	1.05E+05
NB-95	3.81E+04	1.49E+04	1.06E+04	0.00E+00	1.40E+04	0.00E+00	2.75E+07
RU-103	5.14E+02	0.00E+00	1.98E+02	0.00E+00	1.29E+03	0.00E+00	1.33E+04
RU-106	1.11E+04	0.00E+00	1.38E+03	0.00E+00	1.50E+04	0.00E+00	1.72E+05
AG-110M	2.51E+07	1.69E+07	1.35E+07	0.00E+00	3.15E+07	0.00E+00	2.01E+09
TE-125M	8.85E+06	2.40E+06	1.18E+06	2.48E+06	0.00E+00	0.00E+00	8.54E+06
TE-127M	2.50E+07	6.72E+06	2.96E+06	5.97E+06	7.12E+07	0.00E+00	2.02E+07
TE-129M	3.26E+07	9.09E+06	5.06E+06	1.05E+07	9.56E+07	0.00E+00	3.97E+07
I-131	1.56E+09	1.57E+09	8.94E+08	5.20E+11	2.58E+09	0.00E+00	1.40E+08
I-133	2.06E+07	2.55E+07	9.65E+06	4.74E+09	4.25E+07	0.00E+00	1.03E+07
I-135	6.49E+04	1.17E+05	5.52E+04	1.03E+07	1.79E+05	0.00E+00	8.90E+04
CS-134	6.79E+10	1.11E+11	2.35E+10	0.00E+00	3.45E+10	1.24E+10	6.01E+08
CS-136	3.04E+09	8.34E+09	5.40E+09	0.00E+00	4.44E+09	6.63E+08	2.93E+08
CS-137	9.67E+10	9.26E+10	1.37E+10	0.00E+00	3.02E+10	1.09E+10	5.80E+08
BA-140	1.41E+07	1.23E+04	8.20E+05	0.00E+00	4.01E+03	7.34E+03	7.12E+06
CE-141	2.63E+03	1.31E+03	1.94E+02	0.00E+00	5.74E+02	0.00E+00	1.63E+06
CE-144	1.95E+05	6.11E+04	1.04E+04	0.00E+00	3.38E+04	0.00E+00	1.59E+07
PR-143	8.62E+01	2.59E+01	4.28E+00	0.00E+00	1.40E+01	0.00E+00	9.30E+04
ND-147	5.34E+01	4.32E+01	3.35E+00	0.00E+00	2.37E+01	0.00E+00	6.85E+04

Units are m^2(mrem/yr) per uCi/sec, except for tritium, in mrem/yr per uCi/sec.

Table 3-5. Dose Factors for Particulates and Iodines

Pathway: GOAT MILK Age group: INFANT

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	4.86E+03	4.86E+03	4.86E+03	4.86E+03	4.86E+03	4.86E+03
C-14	2.34E+09	5.00E+08	5.00E+08	5.00E+08	5.00E+08	5.00E+08	5.00E+08
P-32	1.92E+11	1.13E+10	7.46E+09	0.00E+00	0.00E+00	0.00E+00	2.60E+09
CR-51	0.00E+00	0.00E+00	1.94E+04	1.26E+04	2.76E+03	2.46E+04	5.64E+05
MN-54	0.00E+00	4.08E+06	1.06E+06	0.00E+00	1.04E+06	0.00E+00	1.72E+06
FE-55	1.76E+06	1.13E+06	3.03E+05	0.00E+00	0.00E+00	5.55E+05	1.44E+05
FE-59	2.92E+06	5.10E+06	2.01E+06	0.00E+00	0.00E+00	1.51E+06	2.43E+06
CO-58	0.00E+00	2.91E+06	7.26E+06	0.00E+00	0.00E+00	0.00E+00	7.25E+06
CO-60	0.00E+00	1.06E+07	2.50E+07	0.00E+00	0.00E+00	0.00E+00	2.52E+07
NI-63	1.19E+09	2.59E+08	1.45E+08	0.00E+00	0.00E+00	0.00E+00	1.29E+07
ZN-65	6.66E+08	2.28E+09	1.05E+09	0.00E+00	1.11E+09	0.00E+00	1.93E+09
RB-86	0.00E+00	2.67E+09	1.32E+09	0.00E+00	0.00E+00	0.00E+00	6.83E+07
SR-89	2.64E+10	0.00E+00	7.58E+08	0.00E+00	0.00E+00	0.00E+00	5.43E+08
SR-90	2.55E+11	0.00E+00	6.50E+10	0.00E+00	0.00E+00	0.00E+00	3.19E+09
Y-91	8.79E+03	0.00E+00	2.34E+02	0.00E+00	0.00E+00	0.00E+00	6.30E+05
ZR-95	8.17E+02	1.99E+02	1.41E+02	0.00E+00	2.14E+02	0.00E+00	9.91E+04
NB-95	7.12E+04	2.93E+04	1.70E+04	0.00E+00	2.10E+04	0.00E+00	2.48E+07
RU-103	1.04E+03	0.00E+00	3.48E+02	0.00E+00	2.17E+03	0.00E+00	1.27E+04
RU-106	2.28E+04	0.00E+00	2.85E+03	0.00E+00	2.70E+04	0.00E+00	1.73E+05
AG-110M	4.63E+07	3.38E+07	2.24E+07	0.00E+00	4.83E+07	0.00E+00	1.75E+09
TE-125M	1.81E+07	6.05E+06	2.45E+06	6.09E+06	0.00E+00	0.00E+00	8.62E+06
TE-127M	5.05E+07	1.68E+07	6.12E+06	1.46E+07	1.24E+08	0.00E+00	2.04E+07
TE-129M	6.69E+07	2.29E+07	1.03E+07	2.57E+07	1.67E+08	0.00E+00	3.99E+07
I-131	3.26E+09	3.85E+09	1.69E+09	1.26E+12	4.49E+09	0.00E+00	1.37E+08
I-133	4.35E+07	6.34E+07	1.86E+07	1.15E+10	7.45E+07	0.00E+00	1.07E+07
I-135	1.35E+05	2.68E+05	9.79E+04	2.41E+07	2.99E+05	0.00E+00	9.71E+04
CS-134	1.09E+11	2.04E+11	2.06E+10	0.00E+00	5.25E+10	2.15E+10	5.54E+08
CS-136	5.93E+09	1.74E+10	6.51E+09	0.00E+00	6.95E+09	1.42E+09	2.65E+08
CS-137	1.54E+11	1.81E+11	1.28E+10	0.00E+00	4.85E+10	1.96E+10	5.65E+08
BA-140	2.89E+07	2.89E+04	1.49E+06	0.00E+00	6.87E+03	1.78E+04	7.10E+06
CE-141	5.20E+03	3.17E+03	3.74E+02	0.00E+00	3.79E+02	0.00E+00	1.64E+06
CE-144	2.79E+05	1.14E+05	1.56E+04	0.00E+00	4.62E+04	0.00E+00	1.60E+07
PR-143	1.78E+02	6.67E+01	8.84E+00	0.00E+00	2.48E+01	0.00E+00	9.41E+04
ND-147	1.06E+02	1.00E+02	6.66E+00	0.00E+00	4.19E+01	0.00E+00	6.88E+04

Units are m^2(mrem/yr) per uCi/sec, except for tritium, in mrem/yr per uCi/sec.

Table 3-5. Dose Factors for Particulates and Iodines

Gaseous Effluents

Pathway: MEAT Age Group: ADULT

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	3.25E+02	3.25E+02	3.25E+02	3.25E+02	3.25E+02	3.25E+02
C-14	2.41E+08	4.83E+07	4.83E+07	4.83E+07	4.83E+07	4.83E+07	4.83E+07
P-32	4.66E+09	2.90E+08	1.80E+08	0.00E+00	0.00E+00	0.00E+00	5.24E+08
CR-51	0.00E+00	0.00E+00	7.05E+03	4.21E+03	1.55E+03	9.35E+03	1.77E+06
MN-54	0.00E+00	9.18E+06	1.75E+06	0.00E+00	2.73E+06	0.00E+00	2.81E+07
FE-55	2.93E+08	2.03E+08	4.72E+07	0.00E+00	0.00E+00	1.13E+08	1.16E+08
FE-59	2.66E+08	6.24E+08	2.39E+08	0.00E+00	0.00E+00	1.74E+08	2.08E+09
CO-58	0.00E+00	1.82E+07	4.09E+07	0.00E+00	0.00E+00	0.00E+00	3.69E+08
CO-60	0.00E+00	7.52E+07	1.66E+08	0.00E+00	0.00E+00	0.00E+00	1.41E+09
NI-63	1.89E+10	1.31E+09	6.33E+08	0.00E+00	0.00E+00	0.00E+00	2.73E+08
ZN-65	3.56E+08	1.13E+09	5.12E+08	0.00E+00	7.57E+08	0.00E+00	7.13E+08
RB-86	0.00E+00	4.87E+08	2.27E+08	0.00E+00	0.00E+00	0.00E+00	9.61E+07
SR-89	3.02E+08	0.00E+00	8.66E+06	0.00E+00	0.00E+00	0.00E+00	4.84E+07
SR-90	1.24E+10	0.00E+00	3.05E+09	0.00E+00	0.00E+00	0.00E+00	3.59E+08
Y-91	1.13E+06	0.00E+00	3.03E+04	0.00E+00	0.00E+00	0.00E+00	3.23E+08
ZR-95	1.87E+06	6.01E+05	4.07E+05	0.00E+00	9.43E+05	0.00E+00	1.90E+09
NB-95	2.30E+06	1.28E+06	6.87E+05	0.00E+00	1.26E+06	0.00E+00	7.76E+09
RU-103	1.05E+08	0.00E+00	4.53E+07	0.00E+00	4.02E+08	0.00E+00	1.23E+10
RU-106	2.80E+09	0.00E+00	3.54E+08	0.00E+00	5.40E+09	0.00E+00	1.81E+11
AG-110M	6.68E+06	6.18E+06	3.67E+06	0.00E+00	1.22E+07	0.00E+00	2.52E+09
TE-125M	3.59E+08	1.30E+08	4.81E+07	1.08E+08	1.46E+09	0.00E+00	1.43E+09
TE-127M	1.12E+09	3.99E+08	1.36E+08	2.85E+08	4.53E+09	0.00E+00	3.74E+09
TE-129M	1.13E+09	4.23E+08	1.80E+08	3.90E+08	4.73E+09	0.00E+00	5.71E+09
I-131	1.07E+07	1.54E+07	8.81E+06	5.04E+09	2.63E+07	0.00E+00	4.05E+06
I-133	3.67E-01	6.38E-01	1.94E-01	9.37E+01	1.11E+00	0.00E+00	5.73E-01
I-135	1.47E-17	1.17E-16	4.32E-17	7.73E-15	1.88E-16	0.00E+00	1.32E-16
CS-134	6.58E+08	1.56E+09	1.28E+09	0.00E+00	5.06E+08	1.68E+08	2.74E+07
CS-136	1.21E+07	4.76E+07	3.43E+07	0.00E+00	2.65E+07	3.63E+06	5.41E+06
CS-137	8.72E+08	1.19E+09	7.81E+08	0.00E+00	4.05E+08	1.35E+08	2.31E+07
BA-140	2.87E+07	3.61E+04	1.88E+06	0.00E+00	1.23E+04	2.07E+04	5.92E+07
CE-141	1.40E+04	9.50E+03	1.08E+03	0.00E+00	4.41E+03	0.00E+00	3.63E+07
CE-144	1.46E+06	6.09E+05	7.83E+04	0.00E+00	3.61E+05	0.00E+00	4.93E+08
PR-143	2.10E+04	8.41E+03	1.04E+03	0.00E+00	4.86E+03	0.00E+00	9.19E+07
ND-147	7.07E+03	8.17E+03	4.89E+02	0.00E+00	4.78E+03	0.00E+00	3.92E+07

Units are m^2 (mrem/yr) per uCi/sec, except for tritium, in mrem/yr per uCi/sec.

Table 3-5. Dose Factors for Particulates and Iodines

Gaseous Effluents

Pathway: MEAT Age Group: TEEN

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	1.94E+02	1.94E+02	1.94E+02	1.94E+02	1.94E+02	1.94E+02
C-14	2.04E+08	4.08E+07	4.08E+07	4.08E+07	4.08E+07	4.08E+07	4.08E+07
P-32	3.94E+09	2.44E+08	1.53E+08	0.00E+00	0.00E+00	0.00E+00	3.31E+08
CR-51	0.00E+00	0.00E+00	5.64E+03	3.13E+03	1.24E+03	8.05E+03	9.47E+05
MN-54	0.00E+00	7.00E+06	1.39E+06	0.00E+00	2.09E+06	0.00E+00	1.44E+07
FE-55	2.38E+08	1.69E+08	3.94E+07	0.00E+00	0.00E+00	1.07E+08	7.31E+07
FE-59	2.12E+08	4.95E+08	1.91E+08	0.00E+00	0.00E+00	1.56E+08	1.17E+09
CO-58	0.00E+00	1.41E+07	3.24E+07	0.00E+00	0.00E+00	0.00E+00	1.94E+08
CO-60	0.00E+00	5.83E+07	1.31E+08	0.00E+00	0.00E+00	0.00E+00	7.60E+08
NI-63	1.52E+10	1.07E+09	5.15E+08	0.00E+00	0.00E+00	0.00E+00	1.71E+08
ZN-65	2.50E+08	8.69E+08	4.05E+08	0.00E+00	5.56E+08	0.00E+00	3.68E+08
RB-86	0.00E+00	4.07E+08	1.91E+08	0.00E+00	0.00E+00	0.00E+00	6.02E+07
SR-89	2.55E+08	0.00E+00	7.29E+06	0.00E+00	0.00E+00	0.00E+00	3.03E+07
SR-90	8.05E+09	0.00E+00	1.99E+09	0.00E+00	0.00E+00	0.00E+00	2.26E+08
Y-91	9.54E+05	0.00E+00	2.56E+04	0.00E+00	0.00E+00	0.00E+00	3.91E+08
ZR-95	1.50E+06	4.73E+05	3.25E+05	0.00E+00	6.95E+05	0.00E+00	1.09E+09
NB-95	1.79E+06	9.95E+05	5.48E+05	0.00E+00	9.65E+05	0.00E+00	4.26E+09
RU-103	8.57E+07	0.00E+00	3.66E+07	0.00E+00	3.02E+08	0.00E+00	7.16E+09
RU-106	2.36E+09	0.00E+00	2.97E+08	0.00E+00	4.55E+09	0.00E+00	1.13E+11
AG-110M	5.06E+06	4.79E+06	2.91E+06	0.00E+00	9.13E+06	0.00E+00	1.34E+09
TE-125M	3.03E+08	1.09E+08	4.05E+07	8.47E+07	0.00E+00	0.00E+00	8.94E+08
TE-127M	9.41E+08	3.34E+08	1.12E+08	2.24E+08	3.82E+09	0.00E+00	2.35E+09
TE-129M	9.50E+08	3.53E+08	1.50E+08	3.07E+08	3.97E+09	0.00E+00	3.57E+09
I-131	8.93E+06	1.25E+07	6.71E+06	3.65E+09	2.15E+07	0.00E+00	2.47E+06
I-133	3.07E-01	5.20E-01	1.59E-01	7.26E+01	9.12E-01	0.00E+00	3.93E-01
I-135	3.64E-17	9.37E-17	3.47E-17	6.03E-15	1.48E-16	0.00E+00	1.04E-16
CS-134	5.23E+08	1.23E+09	5.71E+08	0.00E+00	3.91E+08	1.49E+08	1.53E+07
CS-136	9.40E+06	3.70E+07	2.48E+07	0.00E+00	2.01E+07	3.17E+06	2.98E+06
CS-137	7.24E+08	9.63E+08	3.36E+08	0.00E+00	3.28E+08	1.27E+08	1.37E+07
BA-140	2.38E+07	2.91E+04	1.53E+06	0.00E+00	9.87E+03	1.96E+04	3.66E+07
CE-141	1.18E+04	7.88E+03	9.05E+02	0.00E+00	3.71E+03	0.00E+00	2.25E+07
CE-144	1.23E+06	5.08E+05	6.60E+04	0.00E+00	3.04E+05	0.00E+00	3.09E+08
PR-143	1.76E+04	7.04E+03	8.78E+02	0.00E+00	4.09E+03	0.00E+00	5.81E+07
ND-147	6.23E+03	6.78E+03	4.06E+02	0.00E+00	3.98E+03	0.00E+00	2.44E+07

Units are m^2 (mrem/yr) per uCi/sec, except for tritium, in mrem/yr per uCi/sec.

Table 3-5. Dose Factors for Particulates and Iodines

Pathway: MEAT Age Group: CHILD

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	2.34E+02	2.34E+02	2.34E+02	2.34E+02	2.34E+02	2.34E+02
C-14	3.83E+08	7.67E+07	7.67E+07	7.67E+07	7.67E+07	7.67E+07	7.67E+07
P-32	7.43E+09	3.48E+08	2.86E+08	0.00E+00	0.00E+00	0.00E+00	2.05E+08
CR-51	0.00E+00	0.00E+00	8.79E+03	4.88E+03	1.33E+03	8.91E+03	4.65E+05
MN-54	0.00E+00	8.01E+06	2.13E+06	0.00E+00	2.25E+06	0.00E+00	6.72E+06
FE-55	4.57E+08	2.42E+08	7.51E+07	0.00E+00	0.00E+00	1.37E+08	4.49E+07
FE-59	3.76E+08	6.09E+08	3.03E+08	0.00E+00	0.00E+00	1.77E+08	6.34E+08
CO-58	0.00E+00	1.64E+07	5.03E+07	0.00E+00	0.00E+00	0.00E+00	9.58E+07
CO-60	0.00E+00	6.93E+07	2.04E+08	0.00E+00	0.00E+00	0.00E+00	3.84E+08
NI-63	2.91E+10	1.56E+09	9.91E+08	0.00E+00	0.00E+00	0.00E+00	1.05E+08
ZN-65	3.75E+08	1.00E+09	6.22E+08	0.00E+00	6.30E+08	0.00E+00	1.76E+08
RB-86	0.00E+00	5.77E+08	3.55E+08	0.00E+00	0.00E+00	0.00E+00	3.71E+07
SR-89	4.82E+08	0.00E+00	1.38E+07	0.00E+00	0.00E+00	0.00E+00	1.87E+07
SR-90	1.04E+10	0.00E+00	2.64E+09	0.00E+00	0.00E+00	0.00E+00	1.40E+08
Y-91	1.80E+06	0.00E+00	4.82E+04	0.00E+00	0.00E+00	0.00E+00	2.40E+08
ZR-95	2.66E+06	5.86E+05	5.21E+05	0.00E+00	8.38E+05	0.00E+00	6.11E+08
NB-95	3.10E+06	1.21E+06	8.62E+05	0.00E+00	1.13E+06	0.00E+00	2.23E+09
RU-103	1.55E+08	0.00E+00	5.96E+07	0.00E+00	3.90E+08	0.00E+00	4.01E+09
RU-106	4.44E+09	0.00E+00	5.54E+08	0.00E+00	5.99E+09	0.00E+00	6.90E+10
AG-110M	8.39E+06	5.67E+06	4.53E+06	0.00E+00	1.06E+07	0.00E+00	6.74E+08
TE-125M	5.69E+08	1.54E+08	7.59E+07	1.60E+08	0.00E+00	0.00E+00	5.49E+08
TE-127M	1.77E+09	4.78E+08	2.11E+08	4.24E+08	5.06E+09	0.00E+00	1.44E+09
TE-129M	1.79E+09	5.00E+08	2.78E+08	5.77E+08	5.26E+09	0.00E+00	2.18E+09
I-131	1.66E+07	1.67E+07	9.46E+06	5.51E+09	2.73E+07	0.00E+00	1.48E+06
I-133	5.70E-01	7.04E-01	2.66E-01	1.31E+02	1.17E+00	0.00E+00	2.84E-01
I-135	6.59E-17	1.19E-16	5.61E-17	1.05E-14	1.82E-16	0.00E+00	9.04E-17
CS-134	9.22E+08	1.51E+09	3.19E+08	0.00E+00	4.69E+08	1.68E+08	8.16E+06
CS-136	1.62E+07	4.46E+07	2.89E+07	0.00E+00	2.37E+07	3.54E+06	1.57E+06
CS-137	1.33E+09	1.28E+09	1.88E+08	0.00E+00	4.16E+08	1.50E+08	7.99E+06
BA-140	4.39E+07	3.84E+04	2.56E+06	0.00E+00	1.25E+04	2.29E+04	2.22E+07
CE-141	2.22E+04	1.11E+04	1.64E+03	0.00E+00	4.86E+03	0.00E+00	1.38E+07
CE-144	2.32E+06	7.26E+05	1.24E+05	0.00E+00	4.02E+05	0.00E+00	1.89E+08
PR-143	3.34E+04	1.00E+04	1.66E+03	0.00E+00	5.43E+03	0.00E+00	3.60E+07
ND-147	1.17E+04	9.47E+03	7.33E+02	0.00E+00	5.20E+03	0.00E+00	1.50E+07

Units are m^2(mrem/yr) per uCi/sec, except for tritium, in mrem/yr per uCi/sec.

Table 3-5. Dose Factors for Particulates and Iodines

Gaseous Effluents

Pathway: VEGETABLE Age Group: ADULT

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	2.26E+03	2.26E+03	2.26E+03	2.26E+03	2.26E+03	2.26E+03
C-14	2.28E+08	4.55E+07	4.55E+07	4.55E+07	4.55E+07	4.55E+07	4.55E+07
P-32	1.41E+09	8.74E+07	5.44E+07	0.00E+00	0.00E+00	0.00E+00	1.58E+08
CR-51	0.00E+00	0.00E+00	4.64E+04	2.78E+04	1.02E+04	6.16E+04	1.17E+07
MN-54	0.00E+00	3.13E+08	5.97E+07	0.00E+00	9.31E+07	0.00E+00	9.59E+08
FE-55	2.10E+08	1.45E+08	3.38E+07	0.00E+00	0.00E+00	3.08E+07	8.31E+07
FE-59	1.26E+08	2.96E+08	1.14E+08	0.00E+00	0.00E+00	8.28E+07	9.88E+08
CO-58	0.00E+00	3.07E+07	6.89E+07	0.00E+00	0.00E+00	0.00E+00	6.23E+08
CO-60	0.00E+00	1.57E+08	3.69E+08	0.00E+00	0.00E+00	0.00E+00	3.14E+09
NI-63	1.04E+10	7.21E+08	3.49E+08	0.00E+00	0.00E+00	0.00E+00	1.50E+08
ZN-65	3.17E+08	1.01E+09	4.56E+08	0.00E+00	6.75E+08	0.00E+00	6.36E+08
RB-86	0.00E+00	2.19E+08	1.02E+08	0.00E+00	0.00E+00	0.00E+00	4.33E+07
SR-89	9.97E+09	0.00E+00	2.86E+08	0.00E+00	0.00E+00	0.00E+00	1.60E+09
SR-90	6.05E+11	0.00E+00	1.48E+11	0.00E+00	0.00E+00	0.00E+00	1.75E+10
Y-91	5.11E+06	0.00E+00	1.37E+05	0.00E+00	0.00E+00	0.00E+00	2.81E+09
ZR-95	1.17E+06	3.77E+05	2.55E+05	0.00E+00	5.91E+05	0.00E+00	1.19E+09
NB-95	1.42E+05	7.92E+04	4.26E+04	0.00E+00	7.83E+04	0.00E+00	4.81E+08
RU-103	4.77E+06	0.00E+00	2.06E+06	0.00E+00	1.82E+07	0.00E+00	5.57E+08
RU-106	1.93E+08	0.00E+00	2.44E+07	0.00E+00	3.72E+08	0.00E+00	1.25E+10
AG-110M	1.05E+07	9.75E+06	5.79E+06	0.00E+00	1.92E+07	0.00E+00	3.98E+09
TE-125M	9.66E+07	3.50E+07	1.29E+07	2.90E+07	3.93E+08	0.00E+00	3.86E+08
TE-127M	3.49E+08	1.25E+08	4.26E+07	8.92E+07	1.42E+09	0.00E+00	1.17E+09
TE-129M	2.51E+08	9.38E+07	3.98E+07	8.64E+07	1.05E+09	0.00E+00	1.27E+09
I-131	8.08E+07	1.16E+08	6.62E+07	3.79E+10	1.98E+08	0.00E+00	3.05E+07
I-133	2.09E+06	3.63E+06	1.11E+06	5.33E+08	6.33E+06	0.00E+00	3.26E+06
I-135	3.90E+04	1.02E+05	3.77E+04	6.74E+06	1.64E+05	0.00E+00	1.15E+05
CS-134	4.67E+09	1.11E+10	9.08E+09	0.00E+00	3.59E+09	1.19E+09	1.94E+08
CS-136	4.27E+07	1.69E+08	1.21E+08	0.00E+00	9.38E+07	1.29E+07	1.91E+07
CS-137	6.36E+09	8.70E+09	5.70E+09	0.00E+00	2.95E+09	9.81E+08	1.68E+08
BA-140	1.29E+08	1.61E+05	8.42E+06	0.00E+00	5.49E+04	9.24E+04	2.65E+08
CE-141	1.97E+05	1.33E+05	1.51E+04	0.00E+00	6.19E+04	0.00E+00	5.10E+08
CE-144	3.29E+07	1.38E+07	1.77E+06	0.00E+00	8.16E+06	0.00E+00	1.11E+10
PR-143	6.26E+04	2.51E+04	3.10E+03	0.00E+00	1.45E+04	0.00E+00	2.74E+08
ND-147	3.33E+04	3.85E+04	2.31E+03	0.00E+00	2.25E+04	0.00E+00	1.85E+08

Units are m^2(mrem/yr) per uCi/sec, except for tritium, in mrem/yr per uCi/sec.

Table 3-5. Dose Factors for Particulates and Iodines

Pathway: VEGETABLE Age Group: TEEN

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	2.59E+03	2.59E+03	2.59E+03	2.59E+03	2.59E+03	2.59E+03
C-14	3.69E+08	7.38E+07	7.38E+07	7.38E+07	7.38E+07	7.38E+07	7.38E+07
P-32	1.61E+09	[illegible]09E+07	6.25E+07	0.00E+00	0.00E+00	0.00E+00	1.35E+08
CR-51	0.00E+00	0.00E+00	6.17E+04	3.43E+04	1.35E+04	8.81E+04	1.04E+07
MN-54	0.00E+00	4.54E+08	9.01E+07	0.00E+00	1.36E+08	0.00E+00	9.32E+08
FE-55	3.26E+08	2.31E+08	5.39E+07	0.00E+00	0.00E+00	1.47E+08	1.00E+08
FE-59	1.79E+09	4.19E+08	1.62E+08	0.00E+00	0.00E+00	1.32E+08	9.90E+09
CO-58	0.00E+00	4.36E+07	1.00E+08	0.00E+00	.00E+00	0.00E+00	6.01E+08
CO-60	0.00E+00	2.49E+08	5.60E+08	0.00E+00	0.00E+00	0.00E+00	3.24E+09
NI-63	1.61E+10	1.13E+09	5.45E+08	0.00E+00	0.00E+00	0.00E+00	1.81E+08
ZN-65	4.24E+08	1.47E+09	6.87E+08	0.00E+00	9.42E+08	0.00E+00	6.23E+08
RB-86	0.00E+00	2.74E+08	1.29E+08	0.00E+00	0.00E+00	0.00E+00	4.05E+07
SR-89	1.51E+10	0.00E+00	4.34E+08	0.00E+00	0.00E+00	0.00E+00	1.80E+09
SR-90	7.51E+11	0.00E+00	1.85E+11	0.00E+00	0.00E+00	0.00E+00	2.11E+10
Y-91	7.84E+06	0.00E+00	2.10E+05	0.00E+00	0.00E+00	0.00E+00	3.21E+09
ZR-95	1.72E+06	5.43E+05	3.74E+05	0.00E+00	7.98E+05	0.00E+00	1.25E+09
NB-95	1.92E+05	1.07E+05	5.87E+04	0.00E+00	1.03E+05	0.00E+00	4.56E+08
RU-103	6.82E+06	0.00E+00	2.92E+06	0.00E+00	2.41E+07	0.00E+00	5.70E+08
RU-106	3.10E+08	0.00E+00	3.90E+07	0.00E+00	5.97E+08	0.00E+00	1.48E+10
AG-110M	1.52E+07	1.43E+07	8.72E+06	0.00E+00	2.74E+07	0.00E+00	4.03E+09
TE-125M	1.48E+08	5.34E+07	1.98E+07	4.14E+07	0.00E+00	0.00E+00	4.38E+08
TE-127M	5.52E+08	1.96E+08	6.56E+07	1.31E+08	2.24E+09	0.00E+00	1.37E+09
TE-129M	3.62E+08	1.34E+08	5.73E+07	1.17E+08	1.51E+09	0.00E+00	1.36E+09
I-131	7.69E+07	1.08E+08	5.78E+07	3.14E+10	1.85E+08	0.00E+00	2.13E+07
I-133	1.94E+06	3.29E+06	1.00E+06	4.59E+08	5.77E+06	0.00E+00	2.49E+06
I-135	3.52E+04	9.07E+04	3.36E+04	5.84E+06	1.43E+05	0.00E+00	1.01E+05
CS-134	7.10E+09	1.67E+10	7.75E+09	0.00E+00	5.31E+09	2.03E+09	2.08E+08
CS-136	4.38E+07	1.72E+08	1.16E+08	0.00E+00	9.37E+07	1.48E+07	1.39E+07
CS-137	1.01E+10	1.35E+10	4.69E+09	0.00E+00	4.59E+09	1.78E+09	1.92E+08
BA-140	1.38E+08	1.69E+05	8.90E+06	0.00E+00	5.74E+04	1.14E+05	2.13E+08
CE-141	2.83E+05	1.89E+05	2.17E+04	0.00E+00	8.90E+04	0.00E+00	5.41E+08
CE-144	5.27E+07	2.18E+07	2.83E+06	0.00E+00	1.30E+07	0.00E+00	1.33E+10
PR-143	7.01E+04	2.80E+04	3.49E+03	0.00E+00	1.63E+04	0.00E+00	2.30E+08
ND-147	3.62E+04	3.94E+04	2.36E+03	0.00E+00	2.31E+04	0.00E+00	1.42E+08

Units are m^2(mrem/yr) per uCi/sec, except for tritium, in mrem/yr per uCi/sec.

Table 3-5. Dose Factors for Particulates and Iodines

Pathway: VEGETABLE Age Group: CHILD

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	0.00E+00	4.01E+03	4.01E+03	4.01E+03	4.01E+03	4.01E+03	4.01E+03
C-14	8.89E+08	1.78E+08	1.78E+08	1.78E+08	1.78E+08	1.78E+08	1.78E+08
P-32	3.30E+09	1.58E+08	1.30E+08	0.00E+00	0.00E+00	0.00E+00	9.33E+07
CR-51	0.00E+00	0.00E+00	1.17E+05	6.50E+04	1.78E+04	1.19E+05	6.21E+06
MN-54	0.00E+00	6.65E+08	1.77E+08	0.00E+00	1.86E+08	0.00E+00	5.58E+08
FE-55	8.01E+08	4.25E+08	1.32E+08	0.00E+00	0.00E+00	2.40E+08	7.87E+07
FE-59	3.98E+08	6.43E+08	3.20E+08	0.00E+00	0.00E+00	1.87E+08	6.70E+08
CO-58	0.00E+00	6.44E+07	1.97E+08	0.00E+00	0.00E+00	0.00E+00	3.76E+08
CO-60	0.00E+00	3.78E+08	1.12E+09	0.00E+00	0.00E+00	0.00E+00	2.10E+09
NI-63	3.95E+10	2.11E+09	1.34E+09	0.00E+00	0.00E+00	0.00E+00	1.42E+08
ZN-65	8.13E+08	2.17E+09	1.35E+09	0.00E+00	1.36E+09	0.00E+00	3.80E+08
RB-86	0.00E+00	4.52E+08	2.78E+08	0.00E+00	0.00E+00	0.00E+00	2.91E+07
SR-89	3.60E+10	0.00E+00	1.03E+09	0.00E+00	0.00E+00	0.00E+00	1.39E+09
SR-90	1.24E+12	0.00E+00	3.15E+11	0.00E+00	0.00E+00	0.00E+00	1.67E+10
Y-91	1.86E+07	0.00E+00	4.99E+05	0.00E+00	0.00E+00	0.00E+00	2.48E+09
ZR-95	3.86E+06	8.48E+05	7.55E+05	0.00E+00	1.21E+06	0.00E+00	8.85E+08
NB-95	4.11E+05	1.60E+05	1.14E+05	0.00E+00	1.50E+05	0.00E+00	2.96E+08
RU-103	1.03E+07	0.00E+00	5.90E+06	0.00E+00	3.86E+07	0.00E+00	3.97E+08
RU-106	7.45E+08	0.00E+00	9.30E+07	0.00E+00	1.01E+09	0.00E+00	1.16E+10
AG-110M	3.21E+07	2.17E+07	1.73E+07	0.00E+00	4.04E+07	0.00E+00	2.58E+09
TE-125M	3.51E+08	9.50E+07	4.67E+07	9.84E+07	0.00E+00	0.00E+00	3.38E+08
TE-127M	1.32E+09	3.56E+08	1.57E+08	3.16E+08	3.77E+09	0.00E+00	1.07E+09
TE-129M	8.41E+08	2.35E+08	1.31E+08	2.71E+08	2.47E+09	0.00E+00	1.03E+09
I-131	1.43E+08	1.44E+08	8.17E+07	4.76E+10	2.36E+08	0.00E+00	1.28E+07
I-133	3.53E+06	4.37E+06	1.65E+06	8.12E+08	7.28E+06	0.00E+00	1.76E+06
I-135	5.26E+04	1.13E+05	5.33E+04	9.98E+06	1.73E+05	0.00E+00	8.59E+04
CS-134	1.60E+10	2.63E+10	5.55E+09	0.00E+00	8.15E+09	2.93E+09	1.42E+08
CS-136	8.24E+07	2.27E+08	1.47E+08	0.00E+00	1.21E+08	1.80E+07	7.96E+06
CS-137	2.39E+10	2.29E+10	3.38E+09	0.00E+00	7.46E+09	2.68E+09	1.43E+08
BA-140	2.77E+08	2.42E+05	1.62E+07	0.00E+00	7.89E+04	1.45E+05	1.40E+08
CE-141	6.56E+05	3.27E+05	4.86E+04	0.00E+00	1.43E+05	0.00E+00	4.08E+08
CE-144	1.27E+08	3.98E+07	6.78E+06	0.00E+00	2.21E+07	0.00E+00	1.04E+10
PR-143	1.46E+05	4.37E+04	7.23E+03	0.00E+00	2.37E+04	0.00E+00	1.57E+08
ND-147	7.15E+04	5.79E+04	4.48E+03	0.00E+00	3.18E+04	0.00E+00	9.17E+07

Units are m^2 (mrem/yr) per uCi/sec, except for tritium, in mrem/yr per uCi/sec.

Table 3-5. Dose Factors for Particulates and Iodines

3.7 COMPOSITE ANALYSES

For radionuclides not determined in each batch or weekly composite the dose contribution to the current calendar month or quarter cumulative summation may be approximated by assuming an average monthly or quarterly concentration based on the previous monthly or quarterly composite analyses. The nuclides determined from composite analyses are H-3, Sr-89, Sr-90, and gross alpha.

3.8 DOSE PROJECTIONS

Dose projections shall be made at least once in every 31 days, based on expected operating conditions. The projected doses from noble gases and from particulates shall be compared to projected dose limits of 0.2 mrad to air for gamma radiation, 0.4 mrad to air for beta radiation, and 0.3 mrem to any organ. These are monthly dose limits.

CHAPTER 4

TOTAL DOSE

(Dose Assessment for Environmental Radiation Standards)

The Radiological Effluent Technical Specification 3.11.4 specifies in the Action that when the calculated doses associated with the effluent releases exceed twice the limits of any one of the Specifications 3.11.1.2, 3.11.2.2 or 3.11.2.3, it is required to prepare and submit a Special Report to the Commission and limit subsequent releases such that the dose or dose commitment to the critical individual from all uranium fuel cycle sources is limited to <25 mrem to the total body or any organ (except the thyroid, which is limited to <75 mrem) over 12 consecutive months.

The dose assessment which will be described in a Special Report, shall include dose contributions from direct radiation from the plant and its components. A variety of techniques is available for assessing this contribution. A simple calculation may be sufficient to demonstrate that the contribution is unimportant, or conditions may dictate more complex analyses. The most appropriate assessment technique will be determined in the course of preparing the Special Report and will be documented in the Special Report.

There are no other uranium fuel cycle sources within a 50 mile radius.

CHAPTER 5

RADIOLOGICAL ENVIRONMENTAL MONITORING LOCATIONS

Table 5-1 and Figures 5-1, 5-2, and 5-3 provide the Radiological Environmental Monitoring point locations.

RADIOLOGICAL ENVIRONMENTAL MONTIORING LOCATIONS

EXPOSURE PATHWAY AND/OR SAMPLE	SAMPLING LOCATIONS*	SAMPLE IDENTIFICATION
1. AIRBORNE		
a. Particulates	Indicator Stations:	
	[1]River Intake Structure (ESE-0.8 miles)	PI - 0501
	South Perimeter (SSE-1.0 miles)	PI - 0701
	Plant Entrance (WSW-0.9 miles)	PI - 1101
	North Perimeter (N-0.8 miles)	PI - 1601
	Control Stations:	
	Blakely, GA (NE-15 miles)	PB - 0215
	[1]Dothan, AL (W-18 miles)	PB - 1218
	[1]Neals Landing, FL (SSE-18 miles)	PB - 0718
	Community Stations:	
	Great Southern Paper Co. (SSE-3 miles)	PC - 0703
	Ashford, AL (WSW-8 miles)	PC - 1108
	Columbia, AL (N-5 miles)	PC - 1605
b. Radioiodine	Indicator Stations:	
	[1]River Intake Structure (ESE-0.8 miles)	II - 0501
	South Perimeter (SSE-1.00 miles)	II - 701
	Plant Entrance (WSW-0.9 miles)	II - 1101
	North Perimeter (N-0.8 miles)	II - 1601
	Control Stations:	
	Blakely, GA (NE-15 miles)	IB - 0215
	[1]Dothan, AL (W-18 miles)	IB - 1218
	[1]Neals Landing, FL (SSE-18 miles)	IB - 0718
	[2]Community Stations:	
	[2]Great Southern Paper Co. (SSE-3 miles)	IC - 0703
2. Direct Radiation	Indicator Stations:	
	Plant Perimeter	
	(NNE-0.9 miles)	RI - 0101
	(NE-1.0 miles)	RI - 0201
	(ENE-0.9 miles)	RI - 0301
	(E-0.8 miles)	RI - 0401
	(ESE-0.8 miles)	RI - 0501
	(SE-1.1 miles)	RI - 0601
	(SSE-1.0 miles)	RI - 0701
	(S-1.0 miles)	RI - 0801
	(SSW-1.0 miles)	RI - 0901
	(SW-0.9 miles)	RI - 1001
	(WSW-0.9 miles)	RI - 1101

*Distance as measured from the centerpoint between Unit 1 and Unit 2 plant vent stacks.

[1]Not required by Tech. Specs. Used as a spare station

[2]Not required by Tech. Specs. Use for comparison purposes with State of GA EPD.

Table 5-1. Radiological Environmental Monitoring Locations

RADIOLOGICAL ENVIRONMENTAL MONTIORING LOCATIONS

EXPOSURE PATHWAY AND/OR SAMPLE	SAMPLING LOCATIONS	SAMPLE IDENTIFICATION
	(W-0.8 miles)	RI - 1201
	(WNW-0.8 miles)	RI - 1301
	(NW-1.1 miles)	RI - 1401
	(NNW-0.9 miles)	RI - 1501
	(N-0.8 miles)	RI - 1601
	Control Stations:	
	Blakely, GA, (NE-15 miles)	RB - 0215
	Neals Landing, FL (SSE-18 miles)	RB - 0718
	Dothan, AL (W-15 miles)	RB - 1215
	Dothan, AL (W-18 miles)	RB - 1218
	Webb, AL (WNW-11 miles)	RB - 1311
	Haleburg, AL (N-12 miles)	RB - 1612
	Community Stations:	
	(NNE-4 miles)	RC - 0104
	(NE-4 miles)	RC - 0204
	(ENE-4 miles)	RC - 0304
	(E-5 miles)	RC - 0405
	(ESE-5 miles)	RC - 0505
	(SE-5 miles)	RC - 0605
	(SSE-3 miles)	RC - 0703
	(S-5 miles)	RC - 0805
	(SSW-4 miles)	RC - 0904
	(SW-1.2 miles)	RC - 1001
	(SW-5 miles)	RC - 1005
	(WSW-4 miles)	RC - 1104
	(WSW-8 miles)	RC - 1108
	(W-4 miles)	RC - 1204
	(WNW-4 miles)	RC - 1304
	(NW-4 miles)	RC - 1404
	(NNW-4 miles)	RC - 1504
	(N-5 miles)	RC - 1605
3. WATERBORNE	Indicator Station:	
a. Surface	Great Southern Paper Intake Structure (River Mile-40)	WRI
	Control Station: Andrews Lock & Dam Upper Pier (River Mile-47)	WRB
b. Ground	Indicator Station: Great Southern Paper Co. Well (SSE-4 miles)	WGI - 07
	Control Station: Whatley Well (SW-1.2 miles)	WGB - 10

Table 5-1. Radiological Environmental Monitoring Locations (con't)

RADIOLOGICAL ENVIRONMENTAL MONTIORING LOCATIONS

EXPOSURE PATHWAY AND/OR SAMPLE	SAMPLING LOCATIONS	SAMPLE IDENTIFICATION
c. Sediment	Indicator Station: Smith's Bend (River Mile-41)	RSI
	Control Station: Andrews Lock & Dam Reservoir (River Mile-47)	RSB
4. INGESTION		
a. Milk	Indicator Station: None (There are no milk animals within 5 miles per the current land use survey)	-
	Control Station: Ray Lewis Dairy Ashford, AL (WSW-14 miles)	MB-1114
b. Fish	Indicator Station: Smith Bend (River Mile-41)	
	Game Fish	FGI
	Bottom Feeding Fish	FBI
	Control Station: Andrews Lock & Dam Reservoir (River Mile-47)	
	Game Fish	FGB
	Bottom Feeding Fish	FBB
c. Forage	Indicator Stations:	
	South Southeast Perimeter (SSE-1.0 miles)	FI - 0701
	[3] North Perimeter (N-0.8 miles)	FI - 1601
	[3] South Perimeter (S-1.0 miles)	FI - 0801
	[3] Northeast Perimeter (NE-1.0 miles)	FI - 0201
	Control Station: Dothan, Alabama (W-18 miles)	FB - 1218

[3] Alternate forage plots

Table 5-1. Radiological Environmental Monitoring Locations (con't)

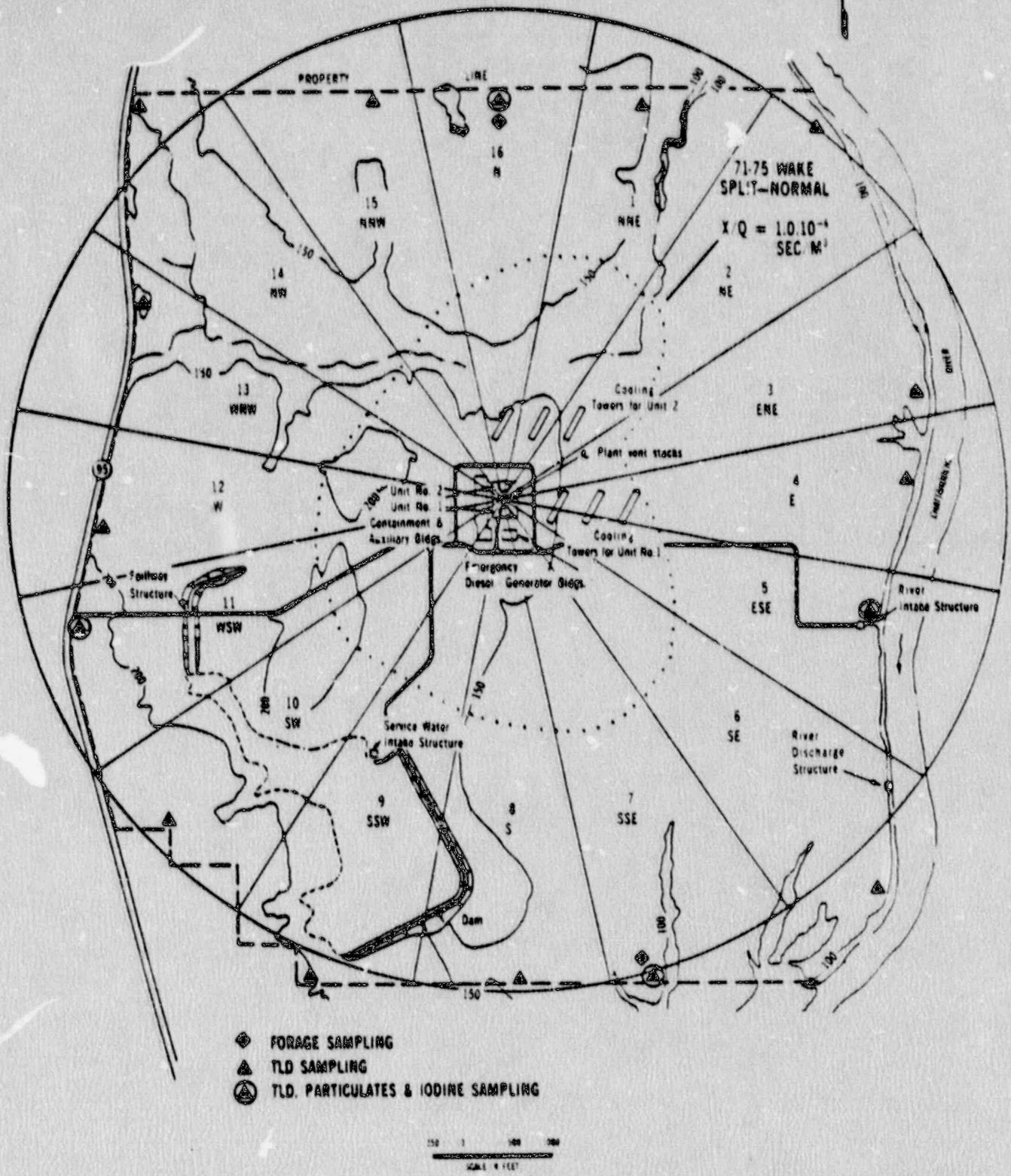


Figure 5-1. Airborne Sampling Locations at Farley Nuclear Plant, 0 - 5000 feet

RADIOLOGICAL ENVIRONMENTAL MONITORING LOCATIONS

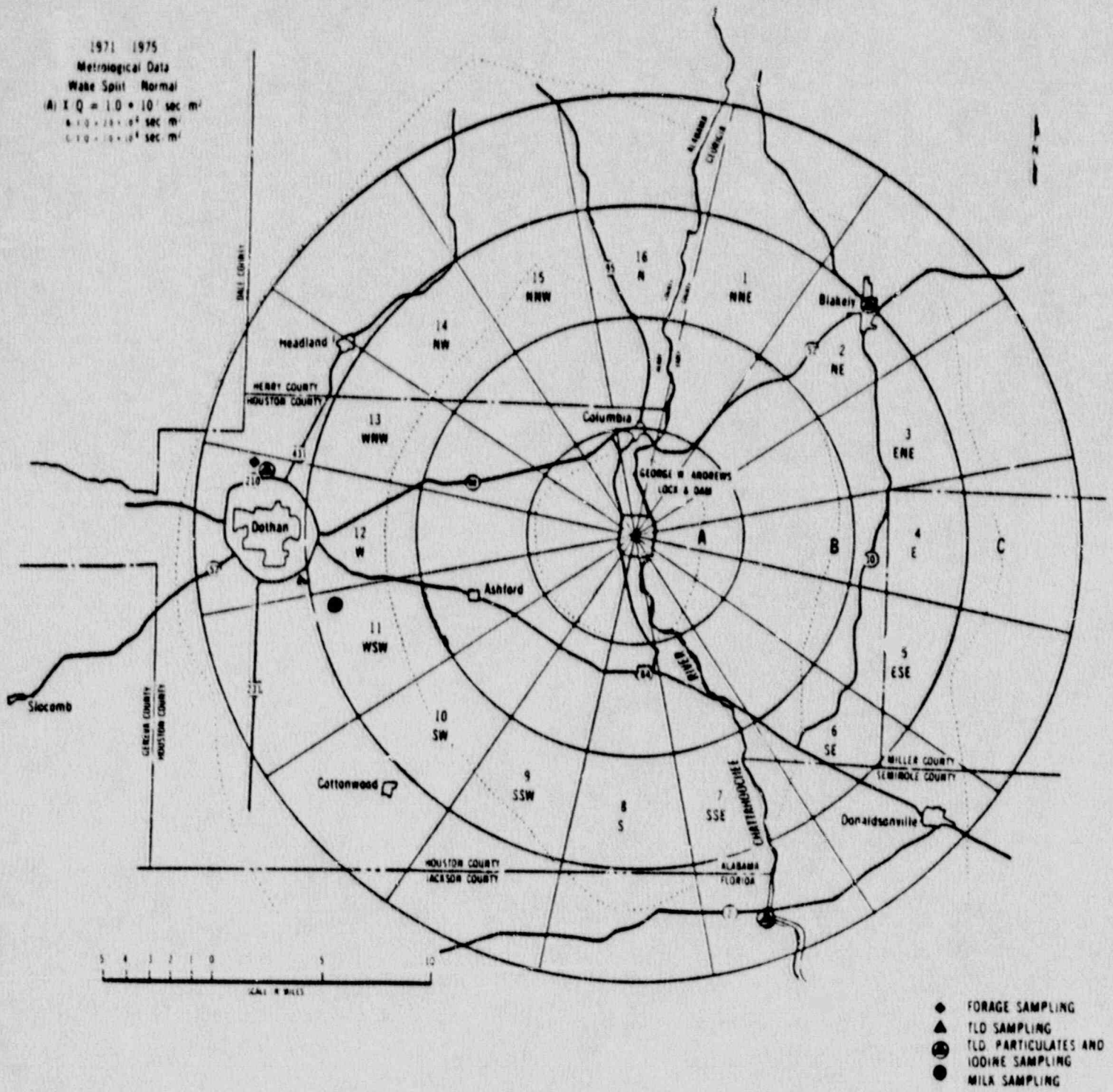


Figure 5-2. Airborne Sampling Locations at Farley Nuclear Plant, 0 - 20 miles

RADIOLOGICAL ENVIRONMENTAL MONITORING LOCATIONS

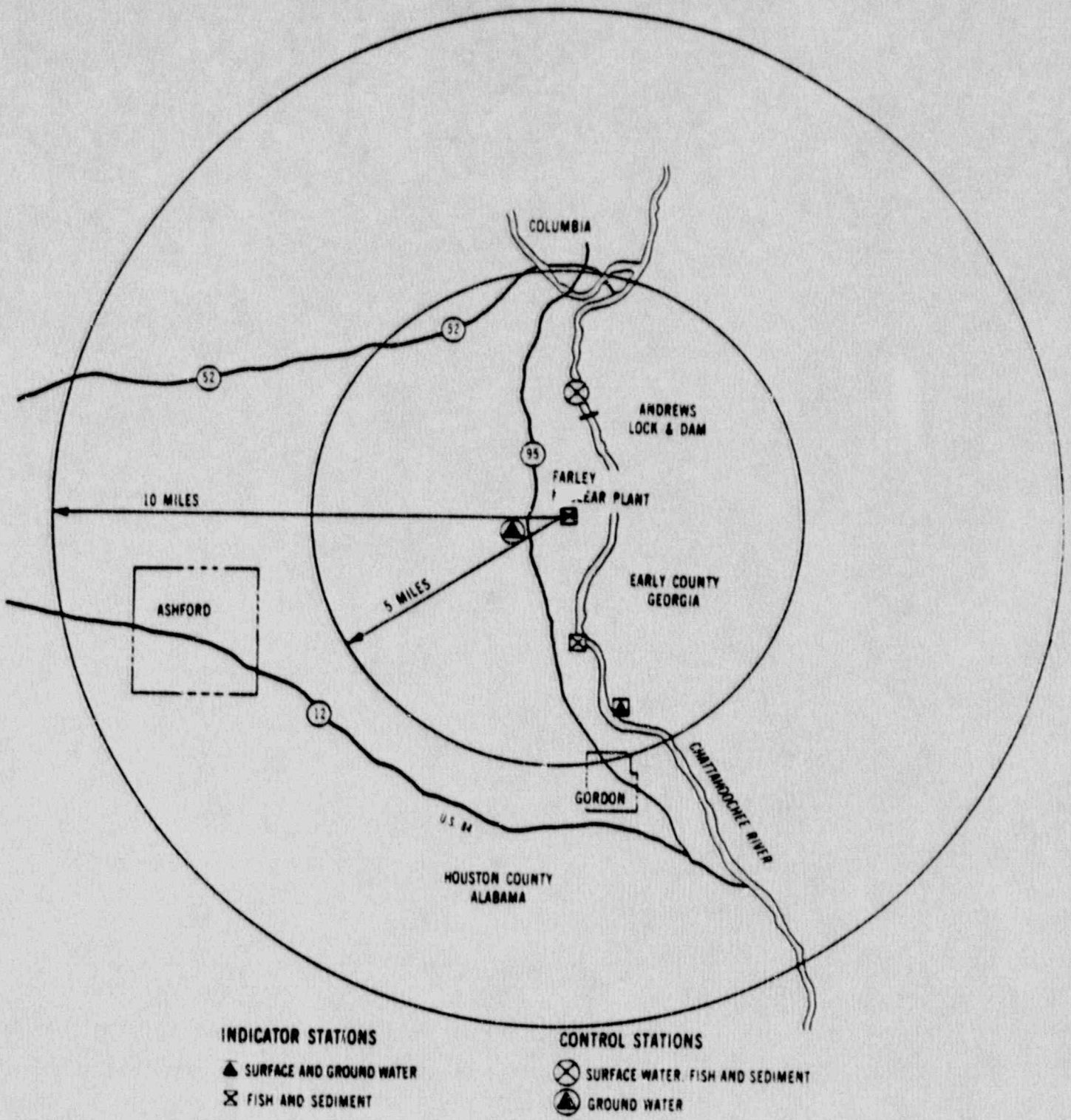


Figure 5-3. Water Sampling Locations for Farley Nuclear Plant

CHAPTER 6

METEOROLOGICAL SUMMARY

Tables 6-1 through 6-4 provide a summary of meteorological data for the years 1971 through 1975. The annual average X/Q and D/Q values for the ground level and mixed mode releases are taken from this data.

The selection of annual average value for site boundary is made by using the highest value for any sector (see Table 3-2 for site boundary and nearest receptor distances). The determination of annual average values for nearest receptor is made by comparing the X/Q and D/Q values at each near receptor, and selecting the highest of these values. Near resident locations are based on the annual land use census.

The nearest receptor is at 1.2 miles in the SW sector, and is the same for the mixed mode and ground level releases.

For the data presented in Tables 6-1 through 6-4, the annual average X/Q and D/Q values are:

Plant Stack (mixed mode)

Site boundary:

$(\bar{X}/Q)_v$ = 1.08 E-6 at SSE, 0.5 - 0.99 mile

Nearest receptor:

$(\bar{X}/Q)_{mv}$ = 8.03 E-7

$(\bar{D}/Q)_{mv}$ = 1.05 E-8

Turbine Building and ILRT (ground level)

Site boundary:

$(\bar{X}/Q)_v$ = 4.87 E-5 at S, 0.5 - 0.99 mile

Nearest receptor:

$(\bar{X}/Q)_{mv}$ = 8.74 E-6

$(\bar{D}/Q)_{mv}$ = 2.64 E-8

FARLEY NUCLEAR PLANT

DISPERSION PARAMETER X/Q FOR MIXED MODE

Distance to the control location, in miles

Sector	0.25-0.5	0.5-0.99	1.0-1.49	1.5-1.99	2.0-2.49
N	2.16E-06	9.21E-07	5.92E-07	3.83E-07	2.42E-07
NNE	2.35E-06	1.02E-06	6.18E-07	3.82E-07	2.34E-07
NE	2.23E-06	9.61E-07	6.06E-07	3.86E-07	2.40E-07
ENE	1.12E-06	5.03E-07	3.76E-07	2.65E-07	1.76E-07
E	1.20E-06	5.21E-07	3.57E-07	2.45E-07	1.60E-07
ESE	1.55E-06	6.43E-07	3.83E-07	2.44E-07	1.55E-07
SE	2.47E-06	9.69E-07	5.52E-07	3.47E-07	2.19E-07
SSE	2.77E-06	1.08E-06	6.57E-07	4.34E-07	2.81E-07
S	2.50E-06	9.37E-07	5.90E-07	4.09E-07	2.74E-07
SSW	2.02E-06	8.29E-07	6.30E-07	4.16E-07	2.66E-07
SW	2.05E-06	8.34E-07	8.03E-07	5.07E-07	3.16E-07
WSW	1.89E-06	7.41E-07	7.33E-07	4.66E-07	2.88E-07
W	1.67E-06	6.74E-07	5.81E-07	4.12E-07	2.53E-07
WNW	1.43E-06	5.97E-07	4.11E-07	3.13E-07	2.17E-07
NW	1.32E-06	5.65E-07	3.88E-07	2.68E-07	1.77E-07
NNW	1.66E-06	7.21E-07	4.85E-07	3.23E-07	2.07E-07

Note: Values are based on the joint frequency data between 1971 and 1975.

Table 6-1. X/Q Values for the Plant Stack

FARLEY NUCLEAR PLANT

DISPERSION PARAMETER X/Q FOR MIXED MODE
(Continued)

Distance to the control location, in miles

Sector	2.5-2.99	3.0-3.49	3.5-3.99	4.0-4.49	4.5-4.99
N	1.65E-07	1.24E-07	1.01E-07	9.11E-08	8.27E-08
NNE	1.55E-07	1.15E-07	9.23E-08	8.28E-08	7.48E-08
NE	1.61E-07	1.19E-07	9.62E-08	8.63E-08	7.79E-08
ENE	1.22E-07	9.28E-08	7.61E-08	6.88E-08	6.24E-08
E	1.12E-07	8.54E-08	7.09E-08	6.43E-08	5.86E-08
ESE	1.07E-07	8.13E-08	6.75E-08	6.12E-08	5.58E-08
SE	1.51E-07	1.14E-07	9.50E-08	8.61E-08	7.88E-08
SSE	1.96E-07	1.50E-07	1.26E-07	1.15E-07	1.05E-07
S	1.96E-07	1.52E-07	1.29E-07	1.18E-07	1.09E-07
SSW	1.84E-07	1.39E-07	1.22E-07	1.18E-07	1.08E-07
SW	2.13E-07	1.60E-07	1.30E-07	1.27E-07	1.15E-07
WSW	1.92E-07	1.57E-07	1.26E-07	1.13E-07	1.02E-07
W	1.68E-07	1.69E-07	1.34E-07	1.19E-07	1.08E-07
WNW	1.74E-07	1.72E-07	1.35E-07	1.21E-07	1.09E-07
NW	1.37E-07	1.24E-07	1.18E-07	1.06E-07	9.60E-08
NNW	1.42E-07	1.07E-07	1.04E-07	9.36E-08	8.50E-08

Note: Values are based on the joint frequency data between 1971 and 1975.

Table 6-1. X/Q Values for the Plant Stack (Continued)

FARLEY NUCLEAR PLANT

DISPERSION PARAMETER X/Q FOR GROUND LEVEL RELEASES

Distance to the control location, in miles

Sector	0.25-0.5	0.5-0.99	1.0-1.49	1.5-1.99	2.0-2.49
N	7.25E-05	2.38E-05	8.63E-06	4.02E-06	2.05E-06
NNE	6.16E-05	2.02E-05	7.32E-06	3.39E-06	1.73E-06
NE	5.86E-05	1.94E-05	7.04E-06	3.24E-06	1.65E-06
ENE	5.27E-05	1.74E-05	6.32E-06	2.92E-06	1.49E-06
E	6.28E-05	2.02E-05	7.27E-06	3.40E-06	1.75E-06
ESE	6.18E-05	1.97E-05	7.09E-06	3.33E-06	1.72E-06
SE	9.48E-05	3.01E-05	1.07E-05	5.06E-06	2.63E-06
SSE	1.44E-04	4.55E-05	1.61E-05	7.65E-06	3.99E-06
S	1.55E-04	4.87E-05	1.72E-05	8.20E-06	4.28E-06
SSW	9.78E-05	3.12E-05	1.11E-05	5.23E-06	2.71E-06
SW	7.40E-05	2.40E-05	8.74E-06	4.05E-06	2.07E-06
WSW	6.01E-05	1.97E-05	7.18E-06	3.31E-06	1.68E-06
W	5.76E-05	1.88E-05	6.79E-06	3.14E-06	1.60E-06
WNW	5.55E-05	1.82E-05	6.55E-06	3.03E-06	1.55E-06
NW	5.67E-05	1.86E-05	6.76E-06	3.14E-06	1.60E-06
NNW	6.60E-05	2.16E-05	7.85E-06	3.65E-06	1.87E-06

Note: Values are based on the joint frequency data between 1971 and 1975.

Table 6-2. X/Q Values for Ground Level Releases

FARLEY NUCLEAR PLANT

DISPERSION PARAMETER X/Q FOR GROUND LEVEL RELEASES
(Continued)

Distance to the control location, in miles

Sector	2.5-2.99	3.0-3.49	3.5-3.99	4.0-4.49	4.5-4.99
N	1.19E-06	8.24E-07	6.09E-07	5.35E-07	4.71E-07
NNE	1.00E-06	6.94E-07	5.13E-07	4.50E-07	3.96E-07
NE	9.47E-07	6.54E-07	4.82E-07	4.23E-07	3.71E-07
ENE	8.56E-07	5.92E-07	4.37E-07	3.82E-07	3.37E-07
E	1.02E-06	7.08E-07	5.24E-07	4.61E-07	4.06E-07
ESE	1.02E-06	6.99E-07	5.18E-07	4.56E-07	4.02E-07
SE	1.54E-06	1.07E-06	7.99E-07	7.04E-07	6.20E-07
SSE	2.34E-06	1.64E-06	1.22E-06	1.08E-06	9.49E-07
S	2.51E-06	1.76E-06	1.31E-06	1.16E-06	1.02E-06
SSW	1.58E-06	1.10E-06	8.17E-07	7.19E-07	6.33E-07
SW	1.20E-06	8.30E-07	6.12E-07	5.38E-07	4.73E-07
WSW	9.65E-07	6.67E-07	4.91E-07	4.31E-07	3.79E-07
W	9.20E-07	6.37E-07	4.71E-07	4.13E-07	3.63E-07
WNW	8.92E-07	6.18E-07	4.56E-07	4.01E-07	3.52E-07
NW	9.25E-07	6.41E-07	4.73E-07	4.16E-07	3.65E-07
NNW	1.10E-06	7.50E-07	5.54E-07	4.87E-07	4.28E-07

Note: Values are based on the joint frequency data between 1971 and 1975.

Table 6-2. X/Q Values for Ground Level Releases (Continued)

FARLEY NUCLEAR PLANT

DEPOSITION PARAMETER D/Q FOR MIXED MODE

Distance to the control location, in miles

Sector	0.25-0.5	0.5-0.99	1.0-1.49	1.5-1.99	2.0-2.49
N	3.82E-08	1.78E-08	7.53E-09	3.39E-09	1.62E-09
NNE	4.57E-08	2.08E-08	8.69E-09	3.88E-09	1.85E-09
NE	4.78E-08	2.20E-08	9.08E-09	4.03E-09	1.92E-09
ENE	2.67E-08	1.32E-08	5.63E-09	2.54E-09	1.22E-09
E	2.87E-08	1.40E-08	5.77E-09	2.55E-09	1.22E-09
ESE	3.29E-08	1.53E-08	6.17E-09	2.70E-09	1.28E-09
SE	5.30E-08	2.37E-08	9.31E-09	4.01E-09	1.90E-09
SSE	5.07E-08	2.35E-08	9.53E-09	4.19E-09	1.99E-09
S	4.86E-08	2.29E-08	9.16E-09	4.00E-09	1.90E-09
SSW	4.29E-08	2.10E-08	9.09E-09	3.97E-09	1.88E-09
SW	4.70E-08	2.28E-08	1.05E-08	4.39E-09	2.04E-09
WSW	4.46E-08	2.17E-08	9.88E-09	4.12E-09	1.92E-09
W	3.96E-08	1.94E-08	8.39E-09	3.63E-09	1.70E-09
WNW	3.22E-08	1.56E-08	6.35E-09	2.85E-09	1.37E-09
NW	2.83E-08	1.35E-08	5.55E-09	2.46E-09	1.18E-09
NNW	3.24E-08	1.55E-08	6.59E-09	2.97E-09	1.42E-09

Note: Values are based on the joint frequency data between 1971 and 1975.

Table 6-3. D/Q Values for the Plant Stack

Meteorological Summary

FARLEY NUCLEAR PLANT

DEPOSITION PARAMETER D/Q FOR MIXED MODE
(Continued)

Distance to the control location, in miles

Sector	2.5-2.99	3.0-3.49	3.5-3.99	4.0-4.49	4.5-4.99
N	8.71E-10	5.64E-10	3.10E-10	3.37E-10	2.91E-10
NNE	9.91E-10	6.43E-10	4.44E-10	3.82E-10	3.30E-10
NE	1.03E-09	6.65E-10	4.62E-10	3.98E-10	3.43E-10
ENE	6.57E-10	4.22E-10	2.96E-10	2.55E-10	2.20E-10
E	6.57E-10	4.20E-10	2.96E-10	2.55E-10	2.20E-10
ESE	6.88E-10	4.40E-10	3.09E-10	2.66E-10	2.29E-10
SE	1.01E-09	6.48E-10	4.55E-10	3.90E-10	3.36E-10
SSE	1.07E-09	6.85E-10	4.79E-10	4.12E-10	3.55E-10
S	1.02E-09	6.49E-10	4.59E-10	3.94E-10	3.40E-10
SSW	1.00E-09	6.41E-10	4.50E-10	3.86E-10	3.32E-10
SW	1.08E-09	6.90E-10	4.81E-10	4.12E-10	3.53E-10
WSW	1.02E-09	6.51E-10	4.53E-10	3.87E-10	3.32E-10
W	9.00E-10	5.92E-10	4.13E-10	3.54E-10	3.04E-10
WNW	7.33E-10	4.95E-10	3.52E-10	3.05E-10	2.65E-10
NW	6.37E-10	4.11E-10	2.91E-10	2.50E-10	2.14E-10
NNW	7.66E-10	4.95E-10	3.45E-10	2.97E-10	2.56E-10

Note: Values are based on the joint frequency data between 1971 and 1975.

Table 6-3. D/Q Values for the Plant Stack (Continued)

Meteorological Summary

FARLEY NUCLEAR PLANT

DEPOSITION PARAMETER D/Q FOR GROUND LEVEL RELEASES

Distance to the control location, in miles

Sector	0.25-0.5	0.5-0.99	1.0-1.49	1.5-1.99	2.0-2.49
N	2.50E-07	7.84E-08	2.53E-08	9.61E-09	4.28E-09
NNE	2.48E-07	7.77E-08	2.51E-08	9.53E-09	4.24E-09
NE	2.49E-07	7.80E-08	2.52E-08	9.57E-09	4.26E-09
ENE	1.69E-07	5.29E-08	1.71E-08	6.48E-09	2.88E-09
E	1.69E-07	5.28E-08	1.71E-08	6.48E-09	2.88E-09
ESE	1.80E-07	5.54E-08	1.79E-08	6.80E-09	3.02E-09
SE	2.75E-07	8.63E-08	2.79E-08	1.06E-08	4.71E-09
SSE	3.66E-07	1.15E-07	3.71E-08	1.41E-08	6.25E-09
S	3.70E-07	1.16E-07	3.75E-08	1.42E-08	6.33E-09
SSW	2.75E-07	8.62E-08	2.79E-08	1.06E-08	4.70E-09
SW	2.60E-07	8.15E-08	2.64E-08	1.00E-08	4.45E-09
WSW	2.31E-07	7.24E-08	2.34E-08	8.88E-09	3.95E-09
W	2.11E-07	6.61E-08	2.14E-08	8.11E-09	3.61E-09
WNW	1.83E-07	5.73E-08	1.85E-08	7.02E-09	3.12E-09
NW	1.74E-07	5.45E-08	1.76E-08	6.68E-09	2.97E-09
NNW	2.13E-07	6.67E-08	2.16E-08	8.19E-09	3.64E-09

Note: Values are based on the joint frequency data between 1971 and 1975.

Table 6-4. D/Q Values for Ground Level Releases

FARLEY NUCLEAR PLANT

DEPOSITION PARAMETER D/Q FOR GROUND LEVEL RELEASES
(Continued)

Distance to the control location, in miles

Sector	2.5-2.99	3.0-3.49	3.5-3.99	4.0-4.49	4.5-4.99
N	2.22E-09	1.45E-09	9.79E-10	8.27E-10	6.99E-10
NNE	2.20E-09	1.43E-09	9.71E-10	8.20E-10	6.93E-10
NE	2.21E-09	1.44E-09	9.75E-10	8.23E-10	6.96E-10
ENE	1.50E-09	9.76E-10	6.60E-10	5.58E-10	4.72E-10
E	1.50E-09	9.75E-10	6.60E-10	5.57E-10	4.71E-10
ESE	1.57E-09	1.02E-09	6.72E-10	5.85E-10	4.94E-10
SE	2.44E-09	1.59E-09	1.08E-09	9.11E-10	7.70E-10
SSE	3.25E-09	2.12E-09	1.43E-09	1.21E-09	1.02E-09
S	3.29E-09	2 14E-09	1.45E-09	1.22E-09	1.04E-09
SSW	2.44E-09	1.59E-09	1.08E-09	9.10E-10	7.69E-10
SW	2.31E-09	1.51E-09	1.02E-09	8.60E-10	7.27E-10
WSW	2.05E-09	1.34E-09	9.04E-10	7.64E-10	6.46E-10
W	1.87E-09	1.22E-09	8.25E-10	6.97E-10	5.90E-10
WNW	1.62E-09	1.06E-09	7.15E-10	6.04E-10	5.11E-10
NW	1.54E-09	1.01E-09	6.80E-10	5.75E-10	4.86E-10
NNW	1.89E-09	1.23E-09	8.34E-10	7.04E-10	5.95E-10

Note: Values are based on the joint frequency data between 1971 and 1975.

Table 6-4. D/Q Values for Ground Level Releases (Continued)

APPENDIX

ODCM EQUATIONS AND SOURCES

The equation number used in the text is indicated, along with the equation and an explanation of the origin of the equation. Terms and factors are not defined here since they are described in detail in the text.

Equation	Origin

2.1

$$\sum_{i} \frac{C_{i,s}}{MPC_i} \leq 1$$

This is the equation that must be satisfied to meet 10CFR20, Appendix B, Table II, Column 2 requirements at the discharge point of the site.

2.2

$$C_{i,s} = \sum_{u=1}^{2} \frac{\sum_{p} C_{i,u,p} * f_{u,p}}{F_u}$$

This equation is the derived concentration of radionuclide, i, at the site boundary considering all liquid pathways discharging radioactive water.

2.3

$$\sum_{i} \frac{\sum_{p} \frac{C_{i,u,p} * f_{u,p}}{F_u}}{MPC_i} \leq 1$$

This is the requirement for multiple release pathways to meet 10CFR20 concentration limits.

Equation	Origin

2.4 $$\sum_i \frac{\frac{C_{i,u,p} * f_{u,p}}{F_u}}{MPC_i} \leq AF_{u,p}$$

This defines the pathway apportionment factor with the restriction of equation 2.5.

2.5 $$\sum_p AF_{u,p} \leq 1$$

The sum of the apportionment factor shall not exceed one. Requirement to meet 10CFR20 concentration limits.

2.6 $$Dm_{u,p} = \frac{1}{AF_{u,p}} \sum_i \frac{C_{i,u,p}}{MPC_i}$$

This is the definition of the minimum dilution factor required for the pathway to meet 10CFR20 concentration limits.

2.7 $$Dr_{u,p} = 2 * Dm_{u,p}$$

This is the definition of the required dilution factor. The factor of 2 is the safety factor.

2.8 $$Dr_{u,p} = \frac{2}{AF_{u,p}} \sum_i \frac{C_{i,u,p}}{MPC_i}$$

This is the formula used to calculate the minimum required dilution factor.

2.9 $$M_{u,p} = \frac{Da_{u,p} - Dr_{H3}}{Dr_{\beta\gamma}} \sum_i C_{ig,u,p}$$

This is the definition of the monitor setpoint in the units of μCi/ml.

2.10 $$SPC_{u,p} = E_m * M_{u,p} + B_{u,p}$$

This is the derived monitor setpoint in the units of cpm.

ODCM Equations and Sources

Equation	Origin

2.11 $$D_\tau = \sum_i \left[A_{i,\tau} \sum_l \Delta t_l \; C_{il} \; F_l \right]$$

This is the definition of the dose to an organ, τ, for each liquid release. Taken from NUREG-0133, page 15.

2.12 $$F_l = \frac{f_{u,p}}{F_u * 5}$$

This is the definition of the near field average dilution factor for each release pathway. Adapted from NUREG-0133, page 16.

2.13 $$A_{i\tau} = K_o \left[U_f \; BF_i + U_v \; CF_{iv} \right] DF_{i\tau}$$

This is the organ, τ, dose commitment factor taken from NUREG-0133, page 16 with invertebrate and drinking water deleted and irrigation-vegetable consumption from Reg. Guide 1.109 adapted from equation A-13.

2.14 $$CF_{iv} = M \cdot I \left[\frac{r(1-e^{-\lambda_{Ei} t_e})}{Y_v \; \lambda_{Ei}} + \frac{f_I \; B_{iv} \; (1-e^{-\lambda_i t_b})}{P \; \lambda_i} \right] e^{-\lambda_i t_h}$$

This is the equation that defines the concentration of radionuclide, i, in vegetable, v, from the irrigation of crops with contaminated river water. Adapted from Reg. Guide 1.109 equation A-8 and A-9.

2.15 $$CF_v = M$$

Equation for tritium adapted from Reg. Guide 1.109 equations A-10 and A-9.

3.1 $$X/Q = \left[(1-E)(X/Q)_{elev} + E(X/Q)_{gnd} \right]$$

This is the algebraic equivalent of Reg. Guide 1.111 (Ref. 3) statement following equation (8):

"... elevated release $100(1-E_t)$ percent of the time and as a ground release E_t percent of the time."

3.2 This equation is the same as 3.1, but with D/Q instead of X/Q.

Equation		Origin	
3.3	$E = 1$	if	$(W_o/\bar{u}) \leq 1$
			or $h_e \leq h_v$
	$E = 2.58-1.58\ (W_o/\bar{u})$	if	$1 < (W_o/\bar{u}) \leq 1.5$
	$E = 0.3-0.06\ (W_o/\bar{u})$	if	$1.5 < (W_o/\bar{u}) \leq 5.0$
	$E = 0$	if	$(W_o/\bar{u}) > 5.0$

The equations for E are taken from Reg. Guide 1.111 equations (6), (7), and (8).

3.4 $(X/Q)_{j\theta v} = 2.032\ k_\theta\ /\ (\bar{u}_j\ r_\theta\ \Sigma_z)$

This is Reg. Guide 1.111 equation (3), with $h_e = 0$ for a ground release. Also, in this equation x has become r_θ, the index i is dropped from $\bar{u}$, and N and n_{ij} are taken care of in the sum over j, θ, and v.

k_θ is added according to the discussion following equation (3) in Reg. Guide 1.111 (March, 1976) (Ref. 2) page 1.111-9:

"(1) Sites in open terrain ... multiply by open terrain correction factor (Fig. 2)"

3.5 $\Sigma_z = (\sigma^2_z + 0.5h^2_v/\pi)^{1/2}$

This is Reg. Guide 1.111 equation (9).

3.6 $\Sigma_z \leq (3)^{1/2}\ \sigma_z$

This is Reg. Guide 1.111 equation (9), second part.

3.7 $(X/Q)_{elev} = (2.032\ k_\theta/(\bar{u}_{elev}\ r_\theta\ \sigma_z))\ e^{-[(h_e/\sigma_z)^2/2]}$

This is Reg. Guide 1.111 equation (3), with changes as noted above for equation 3.4, and σ_z instead of Σ_z according to the comment in Reg. Guide 1.111 with the definition of Σ_z.

3.8 $h_{eff} = h_- + h_{pr} - h_t - c$

This is Reg. Guide 1.111 equation (4).

Equation	Origin
3.9	$c = 3(1.5 - W_o/\bar{u}_{elev})d$
	This is Reg. Guide 1.111 equation (5).
3.10	$h_{pr} = 1.44\ d\ (W_o/\bar{u}_{elev})^{2/3}\ (r_e/d)^{1/3}$
	This is from Briggs, Plume Rise, (Ref. 5) equation 4.33, page 59.
3.11	$h_{pr} < 3\ (W_o/\bar{u}_{elev})d$
	This is from Briggs, Plume Rise, equation 5.2, page 59.
3.12	$h_{pr} < 1.5\ (F_m/\bar{u}_{elev})^{1/3}\ S^{-1/6}$ if $S > 0$
	This is from Briggs, Plume Rise, equation 4.28, page 59. However, note in the discussion following that equation that since there is no data to support the theory, the ">" sign in the equation shown in Briggs is changed to a "<" sign, using the expression as a upper limit to be conservative.
3.13	$F_m = (\rho_o/\rho)\ W^2_o\ (d/2)^2$
	This is from Briggs, Plume Rise, equation 4.19b, page 27.
3.14	$S = (9.8/T)\ (\Delta T/\Delta z + 9.8 \times 10^{-3})$
	S = stability parameter from Briggs, Plume Rise, equation 4.16, page 27.
	$S = (g/T)\ (\partial\Theta/\partial z)$
	$\partial\Theta/\partial z = \partial T/\partial z + 9.8$ deg C/Km
	This latter expression is from Meteorology and Atomic Energy (Ref. 6), page 192, in the text following equation (5.9).
	The units in equation 3.14 are Δz in m and temperature in deg K. (g = 9.8 m/sec squared)

Equation	Origin

3.15 $(D/Q)_{jev} = k_\theta \, f_\theta \, \delta_{\theta vgj} \, (0.3927 \, r_\theta)$

This is for ground releases, and is from Reg. Guide 1.111, page 12, in the section on Dry Deposition. The relative deposition rate ($\delta_{\theta vg}$) is multiplied by the fraction of the release in that sector (f_θ) and divided by the cross wind distance.

Since the sector is 22.5 degrees wide (0.3927 radians), the cross wind distance is 0.3927 r_θ at distance r_θ.

k_θ is as given in equations 3.4 and 3.7.

3.16 $(D/Q)_{jev} = k_\theta \, f_\theta \, \delta_{\theta vej} / \, (0.3927 \, r_\theta)$

This is for elevated releases, and the development is the same as for equation 3.14.

3.17 $$\Sigma_i \, K_i \, Q_{iv} < \frac{500 \text{ mrem/yr } F_v}{(X/Q)_v \times F}$$

This is derived from NUREG-0133 equation on page 22 for noble gases, whole body dose.

3.18 $$\Sigma_i \, (L_i + 1.1M_i) \, Q_{iv} < \frac{3000 \text{ mrem/yr } F_v}{(X/Q)_v \times F}$$

This is derived from NUREG-0133 equation on page 22 for noble gases, skin dose.

3.19 $$Q_v = \frac{500 \text{ mrem/yr } F_v}{(X/Q)_v \times F \times K_i}$$

This is derived from equation 3.18.

3.20 $S_w = E_m (Q_v / F_v) + b$

This is from a units conversion of Q_w in equation 3.19 to cpm, plus background.

Equation	Origin
3.21	$S_L = E_m (Q_L / F_w) + b$
	This is equation 3.20 for a specific case.
3.22	$\Sigma_i K_i \Sigma_v [(\bar{X}/Q)_v Q_{iv}] < 250$ mrem/yr
	This is NUREG-0133 organ dose equation from page 22, with $V_i = 0$, and with unit dose rate limit equal to half of site limit.
3.23	$\Sigma_i (L_i + 1.1 M_i) \Sigma_v [(\bar{X}/Q)_v Q_{iv}] < 1500$ mrem/yr
	This is NUREG-0133 organ dose equation from page 22, with $V_i = 0$, and with unit dose rate limit equal to half of site limit.
3.24	$\Sigma_i \Sigma_p \Sigma_v [P_{ip} W_{mv} Q_{iv}] < 750$ mrem/yr
	This is NUREG-0133 organ dose equation from page 22, with $W_s = 0$, and with unit dose rate limit equal to half of site limit. Also, it is summed over all pathways, as indicated in the definition of P_i.
3.25	$D_{\theta\gamma} = 1.14 \times 10^{-4} \Sigma_i M_i \Sigma_j \Delta t_j \Sigma_v (X/Q)_{j\theta v} Q_{ijv}$
3.26	$D_{\theta\beta} = 1.14 \times 10^{-4} \Sigma_i N_i \Sigma_j \Delta t_j \Sigma_v (X/Q)_{j\theta v} Q_{ijv}$
	Equations 3.25 and 3.26 are NUREG-0133, page 28, converted to hourly values. 3.17×10^{-8} 1/sec/year becomes 1.14×10^{-4} 1/hr/year. $B_i = 0$ and $b_i = 0$.

Equation	Origin
3.27	$D_\gamma = 3.17 \times 10^{-8} \sum_i M_i \sum_v (\bar{X}/Q)_v \, Q_{iv}$
3.28	$D_\beta = 3.17 \times 10^{-8} \sum_i N_i \sum_v (\bar{X}/Q)_v \, Q_{iv}$

Equations 3.27 and 3.28 are from NUREG-0133, page 28, with $B_i = 0$ and $b_i = 0$.

3.29 $D_{\theta\tau a} = 1.14 \times 10^{-4} \sum_i \sum_p f_{p\theta} R_{ip\tau a} \sum_j \Delta t_j \sum_v [W_{\theta jv} Q_{ijv}]$

This is from NUREG-0133, page 29, with time in hours, and $W_s = 0$ and $w_s = 0$.

3.30 $D_{\tau a} = 3.17 \times 10^{-3} \sum_i \sum_p R_{ip\tau a} \sum_v W_v \, Q_{iv}$

This is from NUREG-0133, page 29 again, with $W_s = 0$ and $w_s = 0$.