

OFFSITE DOSE CALCULATION MANUAL

FOR

OCONEE NUCLEAR STATION

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INTRODUCTION

The Offsite Dose Calculation Manual provides the methodology and parameters to be used in the calculation of off-site doses due to radioactive liquid and gaseous effluents to assure compliance with the dose limitations of the Technical Specifications. These dose limitations assure that:

- 1) the concentration of radioactive liquid effluents from the site to the unrestricted area will be limited to the concentration levels of 10CFR20, Appendix B, Table II;
- 2) the exposures to any individual from radioactive liquid effluents will not result in doses greater than the design objectives of 10CFR50, Appendix I;
- 3) the dose rate at any time at the site boundary from radioactive gaseous effluents will be limited to the annual dose limits of 10CFR20 for unrestricted areas; and
- 4) the exposure to any individual from radioactive gaseous effluents will not result in doses greater than the design objectives of 10CFR50, Appendix I.

The methodology used to assure compliance with the dose limitations described above shall also be used to prepare the radioactive liquid and gaseous effluent reports required by the Technical Specifications. To assure compliance with 40CFR190 when twice the design objectives of 10CFR50, Appendix I are exceeded, the methodology and parameters to be used in calculating the off-site dose to any individual resulting from the entire fuel cycle except mining and waste management facilities are provided in this Manual.

The Manual also provides the methodology and parameters to be used in the calculation of radioactive liquid and gaseous effluent monitoring instrumentation alarm/trip setpoints to assure compliance with the concentration and dose rate limitations of the Technical Specifications. Changes to the methodology and parameters used in this Manual shall be reviewed by a qualified reviewer(s) and approved by the Station Manager and Nuclear Safety Review Board prior to implementation. Changes to this Manual shall be submitted to the Nuclear Regulatory Commission within 90 days of the date the change was made effective by inclusion in the Monthly Operating Report to comply with Specification 6.7.

This Manual does not replace any station implementing procedures.

1.0 RELEASE RATE CALCULATIONS

1.1 LIQUID EFFLUENTS

To comply with Specification 3.9.1 and to assure that the concentration of radioactive liquid effluents from the site to the unrestricted area is limited to the concentrations of 10CFR20, Appendix B, Table II, Column 2, the following release rate calculation shall be performed:

$$f \leq F \div \left(c \sum_{i=1}^n \frac{C_i}{MPC_i} \right)$$

where:

C_i = The concentration of radionuclide, 'i', in undiluted liquid effluent, in $\mu\text{Ci/ml}$.

MPC_i = the concentration of radionuclide, 'i', from 10CFR20, Appendix B, Table II, Column 2, in $\mu\text{Ci/ml}$.

f = the undiluted effluent flow from the tank, in gpm.

F = the dilution flow from the site discharge structure to unrestricted area receiving waters, in gpm.

c = recirculation factor at equilibrium, 1.0.

The above calculation is the release rate for a single release point. There are two potential release points at Oconee, the liquid radwaste effluent line to the Keowee Hydroelectric Unit tailrace and the oil collection basin effluent line to the Keowee River.

1.1.1 Liquid Radwaste Effluent Line

To simplify calculations for the liquid radwaste effluent line, it is assumed that no activity above background is present in the oil collection basin effluent. This assumption shall be confirmed by radiation monitoring measurements on the turbine building sumps and by periodic analysis of the composite sample collected at the oil collection basin. For the liquid radwaste effluent line, one of the following calculations shall be performed for discharge flow, in gpm, depending on hydroelectric unit operation:

$$f_1 \leq 1.8E+4 \div \sum_{i=1}^n \frac{C_i}{MPC_i}$$

$$f_2 \leq 2.9E+6 \div \sum_{i=1}^n \frac{C_i}{MPC_i}$$

where:

C_i = the concentration of radionuclide, 'i', in undiluted effluent as determined by laboratory analyses, in $\mu\text{Ci/ml}$.

MPC_i = the concentration of radionuclide, 'i', from 10CFR20, Appendix B, Table II, Column 2. If radionuclide, 'i', is a dissolved noble gas, the MPC_i , = $2\text{E}-4\mu\text{Ci/ml}$.

F = the dilution flow available depending on hydroelectric unit operation, in gpm:

F_1 = $1.8\text{E}+4$ gpm

F_2 = $2.9\text{E}+6$ gpm

c = the recirculation factor at equilibrium is 1.0.

1.1.2 Oil Collection Basin Effluent Line

The oil collection basin effluent is normally considered nonradioactive; that is, it is unlikely the effluent will contain measurable activity above background. It is assumed that no activity is present in the effluent until indicated by radiation monitoring measurements on the turbine building sumps and by periodic analyses of the composite sample collected at the oil collection basin. Radiation monitoring alarm/trip setpoints assure that Specification 3.9.1 is not exceeded. See ODCM Section 3.1.2 for radiation monitoring alarm/trip setpoints.

1.2 GASEOUS EFFLUENTS

In order to comply with the Specification 3.10.1 to assure that the dose rate, at any time, in the unrestricted area due to radioactive materials released in gaseous effluents from the site is limited to ≤ 500 mrem/yr to the total body and ≤ 3000 mrem/yr to the skin for the noble gases and is limited to ≤ 1500 mrem/yr to any organ for all radioiodine and for all radioactive materials in particulate form and radionuclides other than noble gases with half lives greater than 8 days, the following release rate calculations shall be performed solving for 'f':

1.2.1 Release Rate Limit for Noble Gases

$$\sum_i K_i \times [(\overline{X/Q})Q_i] < 500 \text{ mrem/yr, and}$$

$$\sum_i (L_i + 1.1 M_i) [(\overline{X/Q})Q_i] < 3000 \text{ mrem/yr}$$

where the terms are defined below.

1.2.2 Release Rate Limit for All Radioiodines and Radioactive Materials in Particulate Form and Radionuclides other than Noble Gases

$$\sum_i P_i [W Q_i] < 1500 \text{ mrem/yr}$$

where:

- K_i = The total body dose factor due to gamma emissions for each identified noble gas radionuclide, in mrem/yr per $\mu\text{Ci}/\text{m}^3$ from Table 1.2-1.
- L_i = The skin dose factor due to beta emissions for each identified noble gas radionuclide, in mrem/yr per $\mu\text{Ci}/\text{m}^3$ from Table 1.2-1.
- M_i = The air dose factor due to gamma emissions for each identified noble gas radionuclide, in mrad/yr per $\mu\text{Ci}/\text{m}^3$ from Table 1.2-1 (unit conversion constant of 1.1 mrem/mrad converts air dose to skin dose).

P_i = The dose parameter for radionuclides other than noble gases for the inhalation pathway, in mrem/yr per $\mu\text{Ci}/\text{m}^3$ and for the food and ground plane pathways in m^2 (mrem/yr) per $\mu\text{Ci}/\text{sec}$ from Table 1.2-2. The dose factors are based on the critical individual organ and most restrictive age group (child or infant).

Q_i = The release rate of radionuclides, 'i', in gaseous effluent from all release points at the site, in $\mu\text{Ci}/\text{sec}$.

$(\bar{x}/Q) = 4.1\text{E}-7 \text{ sec}/\text{m}^3$. The highest calculated annual average relative concentration for any area at or beyond the unrestricted area boundary.

W = The highest calculated annual average dispersion parameter for estimating the dose to an individual at the controlling location:

$W = 4.5\text{E}-9 \text{ sec}/\text{m}^3$, for the inhalation pathway. The location is the unrestricted area in the S sector.

$W = 2.4\text{E}-9 \text{ meter}^{-2}$, for the food and ground plane pathways. The location is the unrestricted area boundary in the SSW sector (nearest residence, cow, and vegetable garden)

$$Q_i = k_1 C_i F \div K_2 = 4.72\text{E}+2 C_i f$$

where:

C_i = the concentration of radionuclide, 'i', in undiluted gaseous effluent, in $\mu\text{Ci}/\text{ml}$.

f = the undiluted effluent flow, in cfm.

k_1 = conversion factor, $2.83\text{E}4 \text{ ml}/\text{ft}^3$.

k_2 = conversion factor, $6\text{E}1 \text{ sec}/\text{min}$.

The above calculations, when solved for flowrate, are the release rates for noble gases and for radioiodines, particulates and other radionuclides with half-lives greater than 8 days. The most conservative of release rates calculated in Sections 1.2.1 and 1.2.2 shall control the release rate for a single release point.

The unit vent is the release point for waste gas decay tanks, containment building purges, the condenser air ejector, and auxiliary building ventilation. The ventilation exhaust from the interim radwaste building may contain radioactive effluent but is normally considered non-radioactive as is the condenser air ejector; that is, it is unlikely the effluent will contain measureable activity above background. It is assumed that no activity is present in the effluent until indicated by radiation monitoring measurements and by analyses of periodic samples collected on that line. Radiation monitoring alarm/trip setpoints in conjunction with administrative controls assure that Specification 3.10.1 is not exceeded. See Section 3.2 of this manual for radiation monitoring setpoints.

TABLE 1.2-1

DOSE FACTORS FOR NOBLE GASES AND DAUGHTERS*

Radionuclide	Total Body Dose Factor K_i (mrem/yr per $\mu\text{Ci}/\text{m}^3$)	Skin Dose Factor L_i (mrem/yr per $\mu\text{Ci}/\text{m}^3$)	Gamma Air Dose Factor M_i (mrad/yr per $\mu\text{Ci}/\text{m}^3$)	Beta Air Dose Factor N_i (mrad/yr per $\mu\text{Ci}/\text{m}^3$)
Kr-83m	7.56E-02**	---	1.93E+01	2.66E+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

*The listed dose factors are for radionuclides that may be detected in gaseous effluents.

**7.56E-02 = 7.56×10^{-2} .

TABLE 1.2-2

DOSE PARAMETERS FOR RADIOIODINES AND RADIOACTIVE
PARTICULATE, GASEOUS EFFLUENTS*

Radio- nuclide	P_i	P_i	Radio- nuclide	P_i	P_i
	Inhalation Pathway (mrem/yr per $\mu\text{Ci}/\text{m}^3$)	Food & Ground Pathways (m^2 . mrem/yr per $\mu\text{Ci}/\text{sec}$)		Inhalation Pathway (mrem/yr per $\mu\text{Ci}/\text{m}^3$)	Food & Ground Pathways (m^2 . mrem/yr per $\mu\text{Ci}/\text{sec}$)
H-3	6.5E+02	2.4E+03	Cd-115m	7.0E+04	5.2E+07
Mn-54	2.5E+04	1.1E+09	Sn-123	2.9E+05	3.7E+09
Fe-59	2.4E+04	7.2E+09	Sn-126	1.2E+06	1.1E+10
Co-58	1.1E+04	5.8E+08	Sb-124	5.9E+04	1.4E+09
Co-60	3.2E+04	4.6E+09	SB-125	1.5E+04	9.1E+09
Zn-65	6.3E+04	1.8E+10	Te-127m	3.8E+04	1.3E+09
Rb-86	1.9E+05	2.1E+10	Te-129m	3.2E+04	1.3E+09
Sr-89	4.0E+05	1.1E+10	Cs-134	7.0E+05	5.0E+10
Sr-90	4.1E+07	1.0E+11	Cs-136	1.3E+05	5.7E+09
Y-91	7.0E+04	5.9E+06	Cs-137	6.1E+05	5.0E+10
Zr-95	2.2E+04	3.5E+08	Ba-140	5.6E+04	2.6E+08
Nb-95	1.3E+04	3.8E+08	Ce-141	2.2E+04	3.2E+07
Ru-103	1.6E+04	1.6E+08	Ce-144	1.5E+05	1.6E+08
Ru-106	1.6E+05	3.0E+08	I-131	1.5E+07	1.0E+12
Ag-110m	3.3E+04	1.5E+10	I-133	3.6E+06	9.6E+09
			Unidentified**	4.1E+07	1.0E+11

*The listed dose parameters are for radionuclides that may be detected in gaseous effluents.

2.0 DOSE CALCULATIONS

2.1 LIQUID EFFLUENTS

Cumulative dose contributions resulting from liquid radioactive effluent releases shall be calculated for the maximum exposed individual; the maximum exposed individual is an adult who drinks water from a downstream water supply and who consumes fish caught in the discharge area. Dose calculations¹ shall be based on:

$$D_{\tau} = \sum_i [A_i \sum_{\ell=1}^m \Delta t_{\ell} C_{i\ell} F_{\ell}]$$

where:

D_{τ} = the cumulative dose commitment to the total body or any organ, τ , from the liquid effluent for the total time period $\sum_{\ell=1}^m \Delta t_{\ell}$, in mrem.

Δt_{ℓ} = the length of the ℓ th time period over which $C_{i\ell}$ and F_{ℓ} are averaged for all liquid releases, in hours.

$C_{i\ell}$ = the average concentration of radionuclide, 'i', in undiluted liquid effluent during time period Δt_{ℓ} from any liquid release, in $\mu\text{Ci/ml}$.

F_{ℓ} = the near field average dilution factor for $C_{i\ell}$ during any liquid effluent release where:

$$F_{\ell} = \frac{f}{F \times k}$$

where:

f = liquid radwaste flow, in gpm.

F = dilution flow, in gpm.

k = 2 when hydroelectric unit not operating; k = 1 when hydroelectric unit operating.

¹Calculated in accordance with Regulatory Guide 1.109 (Rev.1)

A_{it} = the site related ingestion dose commitment factor to the total body or any organ, 't', for each identified principal gamma and beta emitter, mrem/hr per $\mu\text{Ci/ml}$:

$$A_{it} = 1.14E5 (730/D_w + 21BF_i)DF_i$$

where:

D_w = Dilution factor from the near field area to the potable water intake for adult water consumption, $1.7E-4$.

BF_i = Bioaccumulation factor for radionuclide, 'i', in fish, pCi/kg , per pCi/l , from Table 2.1-1.

DF_i = Dose conversion factor for radionuclide, 'i', for adults in pre-selected organ, 't', in mrem/pCi , from Table 2.1-2.

730 = Adult, water consumption, in kg/yr .

21 = Adult, fish consumption, in kg/yr .

2.1.1 Quarterly Dose Calculations

To comply with Specification 6.1.4, quarterly cumulative dose contributions resulting from liquid radioactive effluent releases shall be calculated quarterly using the calculations listed in Section 2.1.

2.1.2 31 Day Dose Calculations

To comply with Specification 3.9.1, cumulative dose contributions shall be determined every 31 days. Based on the dose calculations performed, using source terms used, to evaluate Appendix I to 10 CFR50 compliance. The calculations to determine 31 days dose contributions may be simplified from those presented in Section 2.1. Based on these calculations, it is assumed that the maximum exposed individual is an adult who consumes fish caught in the discharge area and that 90% of the dose is from cesium-134 and cesium-137. The simplified calculation to determine the whole body dose of an adult is:

$$D_{WB} = 6.88E5 \sum_{\ell=1}^m F_{\ell} D_w t_{\ell} (Cs_{134} + 0.59 Cs_{137})$$

where:

Cs_{134} = the average concentration of Cs-134 in undiluted liquid effluent during time period Δt_{ℓ} , in $\mu\text{Ci/ml}$.

Cs_{137} = the average concentration of Cs-137 in undiluted liquid effluent during time period Δt_{ℓ} , in $\mu\text{Ci/ml}$.

F_{ℓ} , Δt_{ℓ} , D_w - defined in section 2.1.

BF_{Cs} = $2E3$ pCi/kg per pCi/l from Table 2.1-1.

DF_{134} = $1.21 E-4$ mrem/pCi from Table 2.1-2.

DF_{137} = $7.13 E-5$ mrem/pCi from Table 2.1-2.

TABLE 2.1-1*

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

<u>ELEMENT</u>	<u>FRESHWATER</u>	
	<u>FISH</u>	<u>INVERTEBRATE</u>
H	9.0E-01	9.0E-01
C	4.6E-03	9.1E-03
Na	1.0E-02	2.0E 02
P	1.0E 05	2.0E 04
Cr	2.0E 02	2.0E 03
Mn	4.0E 02	9.0E 04
Fe	1.0E 02	3.2E 03
Co	5.0E 01	2.0E 02
Ni	1.0E 02	1.0E 02
Cu	5.0E 01	4.0E 02
Zn	2.0E 03	1.0E 04
Br	4.2E 02	3.3E 02
Rb	2.0E 03	1.0E 03
Sr	3.0E 01	1.0E 02
Y	2.5E 01	1.0E 03
Zr	3.3E 00	6.7E 00
Nb	3.0E 04	1.0E 02
Mo	1.0E 01	1.0E 01
Tc	1.5E 01	5.0E 00
Ru	1.0E 01	3.0E 02
Rh	1.0E 01	3.0E 02
Te	4.0E 02	6.1E 03
I	1.5E 01	5.0E 00
Cs	2.0E 03	1.0E 03
Ba	4.0E 00	2.0E 02
La	2.5E 01	1.0E 03
Ce	1.0E 00	1.0E 03
Pr	2.5E 01	1.0E 03
Nd	2.5E 01	1.0E 03
W	1.2E 03	1.0E 01
Np	1.0E 01	4.0E 02

* Table taken from Regulatory Guide 1.109 (Rev.1)

TABLE 2.1-2*

INGESTION DOSE FACTORS FOR ADULTS
(MREM PER PCI INGESTED)

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

*Taken from Regulatory Guide 1.109

TABLE 2.1-2

INGESTION DOSE FACTORS FOR ADULTS
(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
TE 129	3.14E-08	1.18E-08	7.65E-09	2.41E-08	1.32E-07	NO DATA	2.37E-08
TE 131M	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	NO DATA	8.40E-05
TE 131	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	NO DATA	2.79E-09
TE 132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	NO DATA	7.71E-05
I 130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	NO DATA	1.92E-06
I 131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-04	NO DATA	1.57E-06
I 132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	NO DATA	1.02E-07
I 133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	NO DATA	2.22E-06
I 134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	NO DATA	2.51E-10
I 135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	NO DATA	1.31E-06
CS 134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06
CS 136	6.51E-06	2.57E-05	1.85E-05	NO DATA	1.43E-05	1.96E-06	2.92E-06
CS 137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06
CS 138	5.52E-08	1.09E-07	5.40E-08	NO DATA	8.01E-08	7.91E-09	4.65E-13
BA 139	9.70E-08	6.91E-11	2.84E-09	NO DATA	6.46E-11	3.92E-11	1.72E-07
BA 140	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.46E-08	4.18E-05
BA 141	4.71E-08	3.56E-11	1.59E-09	NO DATA	3.31E-11	2.02E-11	2.22E-17
BA 142	2.13E-08	2.19E-11	1.34E-09	NO DATA	1.85E-11	1.24E-11	3.00E-26
LA 140	2.50E-09	1.26E-09	3.33E-10	NO DATA	NO DATA	NO DATA	9.25E-05
LA 142	1.28E-10	5.82E-11	1.45E-11	NO DATA	NO DATA	NO DATA	4.25E-07
CE 141	9.36E-09	6.33E-09	7.18E-10	NO DATA	2.94E-09	NO DATA	2.42E-05
CE 143	1.65E-09	1.22E-06	1.35E-10	NO DATA	5.37E-10	NO DATA	4.56E-05
CE 144	4.88E-07	2.04E-07	2.62E-08	NO DATA	1.21E-07	NO DATA	1.65E-04
PR 143	9.20E-09	3.69E-09	4.56E-10	NO DATA	2.13E-09	NO DATA	4.03E-05
PR 144	3.01E-11	1.25E-11	1.53E-12	NO DATA	7.05E-12	NO DATA	4.33E-18
ND 147	6.29E-09	7.27E-09	4.35E-10	NO DATA	4.25E-09	NO DATA	3.49E-05
W 187	1.03E-07	8.61E-08	3.01E-08	NO DATA	NO DATA	NO DATA	2.82E-05
NP 239	1.19E-09	1.17E-10	6.45E-11	NO DATA	3.65E-10	NO DATA	2.40E-05

TABLE 2.1-2

INGESTION DOSE FACTORS FOR ADULTS
(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
NB 95	6.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-05
MO 99	NO DATA	4.31E-06	8.20E-07	NO DATA	9.76E-06	NO DATA	9.99E-06
TC 99M	2.47E-10	6.98E-10	8.89E-09	NO DATA	1.06E-08	3.42E-10	4.13E-07
TC 101	2.54E-10	3.66E-10	3.59E-09	NO DATA	6.59E-09	1.87E-10	1.10E-21
RU 103	1.85E-07	NO DATA	7.97E-08	NO DATA	7.06E-07	NO DATA	2.16E-05
RU 105	1.54E-08	NO DATA	6.08E-09	NO DATA	1.99E-07	NO DATA	9.42E-06
RU 106	2.75E-06	NO DATA	3.48E-07	NO DATA	5.31E-06	NO DATA	1.78E-04
AG 110M	1.60E-07	1.48E-07	8.79E-08	NO DATA	2.91E-07	NO DATA	6.04E-05
TE 125M	2.68E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	NO DATA	1.07E-05
TE 127M	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-06	NO DATA	2.27E-05
TE 127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	NO DATA	8.68E-06
TE 129M	1.15E-05	4.29E-06	1.82E-06	3.95E-06	4.80E-05	NO DATA	5.79E-05

2.2 GASEOUS EFFLUENTS

2.2.1 Noble Gases

To comply with Specification 3.10.5 to assure that the air dose in unrestricted areas during any calendar quarter, due to noble gases released in gaseous effluents from the site, is limited to ≤ 15 mrad for gamma radiation and ≤ 30 mrad for beta radiation; and during any calendar year, to ≤ 30 mrad for gamma radiation and ≤ 60 mrad for beta radiation, the following air dose calculations shall be performed:

For gamma radiation:

$$D_{\gamma} = 3.17 \text{ E-8 } \sum_{i=1} M_i [(\bar{x/Q}) \tilde{Q}_i + (\bar{x/q}) \tilde{q}_i]$$

For beta radiation:

$$D_{\beta} = 3.17 \text{ E-8 } \sum_{i=1} N_i [(\bar{x/Q}) \tilde{Q}_i + (\bar{x/q}) \tilde{q}_i]$$

where:

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

M_i = The air dose factor due to gamma emissions for each identified noble gas radionuclide, in mrad/yr per $\mu\text{Ci}/\text{m}^3$ from Table 1.2-1.

N_i = The air dose factor due to beta emissions for each identified noble gas radionuclide, in mrad/yr per $\mu\text{Ci}/\text{m}^3$ from Table 1.2-1.

$(\bar{x/Q})$ = $4.1\text{E-7 sec}/\text{m}^3$. The highest calculated annual average relative concentration for any area at or beyond the unrestricted area boundary for long term releases (greater than 500 hrs/year).

$(\bar{x/q})$ = $4.2\text{E-6 sec}/\text{m}^3$. The relative concentration for any area at or beyond the unrestricted area boundary for short term releases (equal to or less than 500 hrs/yr).

\tilde{Q}_i = The release of noble gas radionuclides, 'i', in gaseous effluents, for long term releases (greater than 500 hrs/yr), in μCi .

\tilde{q}_i = The release of noble gas radionuclides, 'i', in gaseous effluents, for short term releases (equal to or less than 500 hrs/yr), in μCi .

2.2.2 Radioiodines, Particulates, and Others

To comply with Specification 3.10.5 to assure that the air dose to an individual from all radioiodines, radioactive materials in particulate form and radionuclides other than noble gases with half-lives greater than 8 days in gaseous effluents released to unrestricted areas, is limited to ≤ 22.5 mrem to any organ during any calendar quarter and to ≤ 45 mrem to any organ during any calendar year, the following calculation shall be performed:

$$D = 3.17 \text{ E-8 } \sum_i R_i [\tilde{w}Q_i + \tilde{w}q_i]$$

where:

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

\sim
 Q_i = The release of radioiodines, radioactive materials in particulate form and radionuclides other than noble gases in gaseous effluents, 'i', for long term releases (greater than 500 hrs/yr), in μCi . Releases shall be cumulative over the calendar quarter or year as appropriate.

\sim
 q_i = The release of radioiodines, radioactive materials in particulate form and radionuclides other than gases in gaseous effluents, 'i', for short term releases (equal to or less than 500 hrs/yr), in μCi . Releases shall be cumulative over the calendar quarter or year as appropriate.

W = The annual average dispersion parameter for estimating the dose to an individual at the controlling location for long term releases (greater than 500 hrs/yr):

$W = (\overline{X/Q})$ for the inhalation pathway, in sec/m^3 from Table 2.2-1.

$W = (\overline{D/Q})$ for the food and ground plane pathways, in meters^{-2} from Table 2.2-2.

w = The dispersion parameter for estimating the dose to an individual at the controlling location for short term releases (equal to or less than 500 hrs/yr):

$w = (\overline{X/q})$ for the inhalation pathway, in sec/m^3 from Table 2.2-3.

$w = (\overline{D/q})$ for the food and ground plane pathway, in meters^{-2} from Table 2.2-4.

R_i = The dose factor for each identified radionuclide, 'i', in m^2 (mrem/yr) per $\mu\text{Ci}/\text{sec}$ or mrem/yr per $\mu\text{Ci}/\text{m}^3$.

$$R_i = R_i^I [\overline{X/Q}] + R_i^G [\overline{D/Q}] + R_i^C [\overline{D/Q, X/Q}] + R_i^M [\overline{D/Q, X/Q}] + R_i^V [\overline{D/Q, X/Q}]$$

where:

Inhalation Pathway Factor, $R_i^I [\overline{X/Q}]$

$$R_i^I [\overline{X/Q}] = K' (BR)_a (DFA_i)_a (\text{mrem/yr per } \mu\text{Ci}/\text{m}^3)$$

where:

K' = a constant of unit conversion, $10^6 \text{ pCi}/\mu\text{Ci}$.

$(BR)_a$ = the breathing rate of the receptor of age group (a), in m^3/yr .

The breathing rates (BR)_a for the various age groups are tabulated below, as given in Regulatory Guide 1.109.

<u>Age Group (a)</u>	<u>Breathing Rate (m³/yr)</u>
Infant	1400
Child	3700
Teen	8000
Adult	8000

(DFA_i)_a = the maximum organ inhalation dose factor the receptor of age group (a) for the ith radionuclide, in mrem/pCi. The total body is considered as an organ in the selection of (DFA_i)_a. See Tables 2.2-5, 2.2-6, 2.2-7 and 2.2-8.

Inhalation dose factors (DFA_i)_a for the various age groups are given in Tables 2.2-5, 2.2-6, 2.2-7, and 2.2-8 (taken from Regulatory Guide 1.109 (Rev.1)).

Ground Plane Pathway Factor, R_i^G [D/Q]

$$R_i^G [D/Q] = K' K'' (SF) DFG_i [(1 - e^{-\lambda_i t}) / \lambda_i] (m^2 \cdot mrem/yr \text{ per } \mu Ci/sec)$$

where:

K' = a constant of unit conversion, 10⁶ pCi/μCi.

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

λ_i = the decay constant for the ith radionuclide, sec⁻¹.

t = the exposure time, 4.73 x 10⁸ sec (15 years).

DFG_i = the ground plane dose conversion factor for the ith radionuclide (mrem/hr per pCi/m²).

SF = the shielding factor (dimensionless), 0.7 (Regulatory Guide 1.109 (Rev. 1)).

Ground plane dose conversion factors, DFG, are found in Table 2.2-9.

Grass-Cow-Milk Pathway Factor, R_i^C [D/Q]

$$R_i^C [D/Q] = K' E \frac{Q_F (U_{ap})}{\lambda_i + \lambda_w} F_m(r) (DFL_i)_a \left[\frac{f_p f_s}{Y_p} + \frac{(1 - f_p f_s) e^{-\lambda_i t_h}}{Y_s} \right] e^{-\lambda_i t_f} \\ (m^2 \cdot mrem/yr \text{ per } \mu Ci/sec)$$

where:

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

Q_F = the cow's consumption rate, in kg/day (wet weight), 50 (Regulatory Guide 1.109 (Rev. 1)).

U_{ap} = the receptor's milk consumption rate for age (a), in liters/yr.

U_{ap} (liters/yr) - Infant	330
- Child	330
- Teen	400
- Adult	310 (Regulatory Guide 1.109 (Rev. 1))

Y_p = the agricultural productivity by unit area of pasture feed grass, in kg/m², 0.7.

Y_s = the agricultural productivity by unit area of stored feed, in kg/m², 2.0.

F_m = the stable element transfer coefficients, in days/liter, Table 2.2-13.

r = fraction of deposited activity retained on cow's feed grass, $r = 1$ for radioiodine and $r = 0.2$ for particulates (Regulatory Guide 1.109).

$(DFL_i)_a$ = the maximum organ ingestion dose factor for the i th radionuclide for the receptor in age group 'a', in mrem/pCi. See Tables 2.1-2, 2.2-10, 2.2-11, and 2.2-12.

λ_i = the decay constant for the i th radionuclide, in sec⁻¹.

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

t_f = the transport time from pasture to cow, to milk, to receptor, in sec, 1.73×10^5 (2 days).

t_h = the transport time from pasture, to harvest, to cow, to milk, to receptor, in sec, 7.78×10^6 (90 days).

f_p = fraction of the year that the cow is on pasture (dimensionless), 1.0.

f_s = fraction of the cow feed that is pasture grass while the cow is on pasture (dimensionless), 1.0.

E = an adjustment fraction which accounts for the fraction of radionuclides in elemental form which contribute dose for this pathway, $E = 0.5$ for radioiodine, $E = 1.0$ for all others.

The concentration of tritium in milk is based on the airborne concentration rather than the deposition. Therefore, the R_i^C is based on $[X/Q]$:

$$R_i^C[X/Q] = K'K''F_m Q_F U_{ap} (DFL_i)_a [0.75(0.5/H)] \text{ (mrem/yr per } \mu\text{Ci/m}^3\text{)}$$

where:

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

H = absolute humidity of the atmosphere, 8 gm/m^3 , (Regulatory Guide 1.109)

0.75 = the fraction of total feed that is water.

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

Grass-Cow-Meat Pathway Factor, $R_i^M[D/Q]$

The integrated concentration in meat follows in a similar manner to the development for the milk pathway, therefore:

$$R_i^M[D/Q] = K' \frac{Q_F(U_{ap})}{\lambda_i + \lambda_w} F_f(r)(DFL_i)_a \left[\frac{f_p f_s}{Y_p} + \frac{(1-f_p f_s)e^{-\lambda_i t_h}}{Y_s} \right] e^{-\lambda_i t_f}$$

($\text{m}^2 \cdot \text{mrem/yr per } \mu\text{Ci/sec}$)

where:

F_f = the stable element transfer coefficients, in days/kg, Table 2.2-13.

U_{ap} = the receptor's meat consumption rate for age (a), in kg/yr.

U_{ap} (kg/yr)	- Infant	0
	- Child	41
	- Teen	65
	- Adult	110

Taken from Regulatory Guide 1.109 (Rev. 1).

t_f = the transport time from pasture to receptor, in sec.

t_h = the transport time from crop field to receptor, in sec.

The concentration of tritium in meat is based on its airborne concentration rather than the deposition. Therefore, the R_i^M is based on $[X/Q]$:

$$R_i^M[X/Q] = K'K''F_f Q_F U_{ap} (DFL_i)_a [0.75(0.5/H)] \text{ (mrem/yr per } \mu\text{Ci/m}^3\text{)}$$

where all terms are defined above.

Vegetation Pathway Factor, $R_i^V[D/Q]$

The integrated concentration in vegetation consumed by man follows the expression developed in the derivation of the milk factor. Man is considered to consume two types of vegetation (fresh and stored) that differs only in the time period between harvest and consumption, therefore:

$$R_i^V[D/Q] = K' \left[\frac{(r)}{Y_v(\lambda_i + \lambda_w)} \right] (DFL_i)_a \left[U_{aL}^L e^{-\lambda_i t_L} + U_{aG}^S e^{-\lambda_i t_h} \right]$$

(m² · mrem/yr per μCi/sec)

where:

K' = a constant of unit conversion, 10⁶ pCi/μCi.

U_a^L = the consumption rate of fresh leafy vegetation by the receptor in age group (a), in kg/yr.

U_a^L = (kg/hr) - Infant 0
 - Child 26
 - Teen 42
 - Adult 64

U_a^S = the consumption rate of stored vegetation by the receptor in age group (a), in kg/yr.

U_a^S = (kg/yr) - Infant 0
 - Child 520
 - Teen 630
 - Adult 520

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

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

t_L = the average time between harvest of leafy vegetation and its consumption, in seconds, 8.6 x 10⁴ (1 day).

t_h = the average time between harvest of stored vegetation and its consumption, in seconds, 5.18 x 10⁶ (60 days).

Y_v = the vegetation area density, 2.0 kg/m².

and all other factors are previously defined.

The concentration of tritium in vegetation is based on the airborne concentration rather than the deposition. Therefore, the R_i is based on $[X/Q]$:

$$R_i^V[X/Q] = K'K'' \left[U_{aL}^L + U_{aG}^S \right] (DFL_i)_a [0.75(0.5/H)] \text{ (mrem/yr per } \mu\text{Ci/m}^3\text{)}.$$

All terms defined previously.

2.2.3 Quarterly Dose Calculations

To comply with Specification 6.1.4, quarterly cumulative dose contributions resulting from gaseous effluent releases shall be calculated using the calculations listed in Sections 2.2.1 and 2.2.2. Meteorological conditions concurrent with the releases of effluents shall be used to calculate the long and short term dispersion factors referenced in Sections 2.2.1 and 2.2.2 for these calculations.

Doses from radioiodine, radioactive materials in particulate form and radionuclides other than noble gases with half-lives greater than eight days shall be calculated using the appropriate calculations of Section 2.2.2 based on the results of the most current land use census.

2.2.4 31 Day Dose Calculations

To comply with Specification 3.10.5, cumulative dose contributions shall be determined every 31 days. The calculations to determine 31 day dose contributions may be simplified from those presented in Sections 2.2.1 and 2.2.2 based on the dose calculations performed using source terms presented to evaluate compliance with Appendix I to 10CFR50. Based on these calculations, the maximum exposed individual is an infant who consumes milk from a goat(s) grazed in the vicinity of the station and that 95% of the dose is from iodine-131. The simplified calculation to determine the thyroid dose of an infant is:

$$D = 2.11E4 w (Q + q)_{I-131}$$

where:

$w = (\overline{D/q})$ for food and ground plane pathway, in m^{-2} from Table 2.2-4 for location of nearest real cow or goat.

$(Q + q)_{I-131}$ = the release of iodine-131 in gaseous effluents, in μCi .

$2.11E4 = (1.05)(3.17E-8) R_i^C [\overline{D/Q}]$ with the appropriate substitutions in $R_i [\overline{D/Q}]$ for iodine-131. See Section 2.2.2.

The beta and gamma air doses can be approximated using the xenon-133 activity since it contributes about 45% of the dose; the simplified calculations to determine the beta and gamma air doses are:

$$D_{\gamma} = 7.71E-12 [\tilde{Q} + \tilde{q}]_{Xe-133}$$

$$D_{\beta} = 2.29E-11 [\tilde{Q} + \tilde{q}]_{Xe-133}$$

where:

$$X/Q = 4.1E-7 \text{ sec}/m^3$$

$7.71\text{E-}12$ = constant determined from factors previously presented.

$2.29\text{E-}11$ = constant determined from factors previously presented.

$[\tilde{Q} + \tilde{q}]_{\text{Xe-133}}$ = the total xenon-133 activity released in μCi .

TABLE 2.2-1

DISPERSION PARAMETER (χ/Q) FOR LONG TERM RELEASES > 500 HR/YR OR > 125 HR/QTR

Distance to the control location, in miles										
Sector 0	0-0.5*	0.5-1.0*	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0
N			6.5E-8	4.8E-8	4.7E-8	4.7E-8	4.7E-8	6.3E-8	5.9E-8	5.6E-8
NNE			1.1E-7	9.3E-8	8.7E-8	8.9E-8	9.2E-8	9.2E-8	7.2E-8	5.9E-8
NE			7.5E-8	7.2E-8	6.8E-8	5.8E-8	6.1E-8	6.4E-8	6.0E-8	5.7E-8
ENE			6.0E-8	6.4E-8	5.9E-8	6.1E-8	5.7E-8	5.7E-8	5.6E-8	5.6E-8
E			4.1E-8	3.7E-8	5.7E-8	4.8E-8	5.2E-8	4.9E-8	4.7E-8	4.5E-8
ESE			3.0E-8	4.0E-8	6.7E-8	5.8E-8	4.3E-8	5.3E-8	4.9E-8	4.7E-8
SE			2.8E-8	2.8E-8	6.0E-8	5.1E-8	4.1E-8	3.7E-8	3.8E-8	3.8E-8
SSE			2.3E-7	2.0E-7	3.2E-7	2.5E-7	3.7E-7	2.9E-7	2.7E-7	2.5E-7
S			2.6E-7	3.0E-7	2.1E-7	2.1E-7	3.6E-7	4.1E-7	3.7E-7	3.6E-7
SSW			3.2E-7	3.1E-7	2.9E-7	2.7E-7	2.0E-7	1.7E-7	1.7E-7	1.7E-7
SW			7.3E-8	7.1E-8	7.1E-8	5.9E-8	3.9E-8	4.4E-8	4.5E-8	4.5E-8
WSW			5.3E-8	5.2E-8	5.3E-8	4.2E-8	4.8E-8	4.3E-8	4.2E-8	4.2E-8
W			2.7E-8	3.2E-8	3.7E-8	3.7E-8	3.9E-8	3.9E-8	3.7E-8	3.6E-8
WNW			2.3E-8	2.5E-8	3.5E-8	3.5E-8	3.3E-8	3.2E-8	3.0E-8	2.9E-8
NW			3.2E-8	3.7E-8	3.1E-8	3.3E-8	3.0E-8	3.1E-8	2.9E-8	2.8E-8
NNW			6.8E-8	7.7E-8	8.3E-8	7.7E-8	7.8E-8	6.5E-8	6.3E-8	6.2E-8

* Inside Exclusion Area Boundary (EAB)

TABLE 2.2-2

DISPERSION PARAMETER ($\overline{D/Q}$) FOR LONG TERM RELEASES > 500 HR/YR OR > 125 HR/QTR

	Distance to the control location, in miles									
Sector 0	0-0.5*	0.5-1.0*	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0
N			2.4E-9	1.4E-9	8.7E-10	6.0E-10	4.7E-10	3.6E-10	2.8E-10	2.3E-10
NNE			4.1E-9	2.2E-9	1.4E-9	9.6E-10	7.4E-10	5.7E-10	4.4E-10	3.6E-10
NE			2.7E-9	1.5E-9	9.7E-10	6.6E-10	5.0E-10	3.9E-10	3.1E-10	2.5E-10
ENE			1.5E-9	8.4E-10	5.4E-10	3.7E-10	2.8E-10	2.2E-10	1.7E-10	1.4E-10
E			1.6E-9	8.7E-10	5.6E-10	3.9E-10	3.0E-10	2.3E-10	2.8E-10	1.5E-10
ESE			1.3E-9	7.0E-10	4.5E-10	3.0E-10	2.3E-10	1.8E-10	1.4E-10	1.1E-10
SE			8.0E-10	4.4E-10	2.9E-10	2.0E-10	1.5E-10	1.2E-10	8.9E-11	7.8E-11
SSE			2.7E-9	1.6E-9	1.1E-9	7.5E-10	6.0E-10	4.6E-10	3.6E-10	3.0E-10
S			4.5E-9	2.6E-9	1.7E-9	1.2E-10	9.0E-10	7.0E-10	5.5E-10	4.5E-10
SSW			4.3E-9	2.5E-9	1.6E-9	1.1E-10	8.5E-10	6.5E-10	5.0E-10	4.2E-10
SW			1.4E-9	8.4E-10	5.5E-10	3.9E-10	3.0E-10	2.3E-10	2.8E-10	1.5E-10
WSW			1.6E-9	9.1E-10	6.0E-10	4.1E-10	3.2E-10	2.5E-10	1.9E-10	1.6E-10
W			1.4E-9	7.9E-10	5.1E-10	3.6E-10	2.7E-10	2.1E-10	1.6E-10	1.3E-10
WNW			7.7E-10	4.4E-10	2.9E-10	2.0E-10	1.5E-10	1.2E-10	9.2E-11	7.4E-11
NW			1.1E-9	5.9E-10	3.8E-10	2.6E-10	2.0E-10	1.6E-10	1.2E-10	9.9E-11
NNW			1.9E-9	1.0E-9	6.6E-10	4.5E-10	3.5E-10	2.7E-10	2.1E-10	1.7E-10

* Inside EAB

TABLE 2.2-3

DISPERSION PARAMETER ($\overline{\chi/q}$) FOR SHORT TERM RELEASES ≥ 500 HR/YR OF ≥ 150 HR/QTR

		Distance to the control location, in miles									
Sector	0	0-0.5*	0.5-1.0*	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0
N				8.5E-7	5.2E-7	4.3E-7	4.4E-7	3.4E-7	4.2E-7	3.7E-7	3.3E-7
NNE				1.4E-6	1.0E-6	7.9E-7	8.3E-7	6.7E-7	6.1E-7	4.5E-7	3.5E-7
NE				9.8E-7	7.8E-7	6.2E-7	5.4E-7	4.5E-7	4.2E-7	3.7E-7	3.4E-7
ENE				7.9E-7	7.0E-7	5.4E-7	5.7E-7	4.2E-7	3.8E-7	3.5E-7	3.3E-7
E				5.4E-7	4.0E-7	5.2E-7	4.5E-7	3.8E-7	3.2E-7	2.9E-7	2.7E-7
ESE				3.9E-7	4.4E-7	6.1E-7	5.4E-7	3.1E-7	3.5E-7	3.0E-7	2.8E-7
SE				3.7E-7	3.1E-7	5.5E-7	4.7E-7	3.0E-7	2.4E-7	2.4E-7	2.2E-7
SSE				3.0E-6	2.2E-6	2.9E-6	2.3E-6	2.7E-6	1.9E-6	1.7E-6	1.5E-6
S				3.4E-6	3.3E-6	1.9E-6	2.0E-6	2.6E-6	2.7E-6	2.3E-6	2.1E-6
SSW				4.2E-6	3.4E-6	2.6E-6	2.5E-6	1.5E-6	1.1E-6	1.1E-6	1.0E-6
SW				9.6E-7	7.7E-7	6.5E-7	5.5E-7	2.8E-7	2.9E-7	2.8E-7	2.7E-7
WSW				6.9E-7	5.7E-7	4.8E-7	3.9E-7	3.5E-7	2.8E-7	2.6E-7	2.5E-7
W				3.5E-7	3.5E-7	3.4E-7	3.4E-7	2.8E-7	2.6E-7	2.3E-7	2.1E-7
WNW				3.0E-7	2.7E-7	3.2E-7	3.3E-7	2.4E-7	2.1E-7	1.9E-7	1.7E-7
NW				4.2E-7	4.0E-7	2.8E-7	3.1E-7	2.2E-7	2.0E-7	1.8E-7	1.7E-7
NNW				8.9E-7	8.4E-7	7.6E-7	7.2E-7	5.7E-7	4.3E-7	3.9E-7	3.7E-7

* Inside EAB

TABLE 2.2-4

DISPERSION PARAMETER ($\overline{D/q}$) FOR SHORT TERM RELEASES ≤ 500 HR/YR OR ≤ 150 HR/QTR

Distance to the control location, in miles										
Sector 0	0-0.5*	0.5-1.0*	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0
N			3.1E-8	1.5E-8	7.9E-9	5.6E-9	3.4E-9	2.4E-9	1.7E-9	1.4E-9
NNE			5.4E-8	2.4E-8	1.3E-8	8.9E-9	5.4E-9	3.8E-9	2.7E-9	2.1E-9
NE			3.5E-8	1.6E-8	8.8E-9	6.1E-9	3.7E-9	8.6E-9	1.9E-9	1.5E-9
ENE			2.0E-8	9.2E-9	4.9E-9	3.4E-9	2.0E-9	1.5E-9	1.1E-9	8.3E-10
E			2.1E-8	9.5E-9	5.1E-9	3.6E-9	2.2E-9	1.5E-9	1.7E-9	8.9E-10
ESE			1.7E-8	7.6E-9	4.1E-9	2.8E-9	1.7E-9	1.2E-9	8.7E-10	6.5E-10
SE			1.0E-8	4.8E-9	2.6E-9	1.9E-9	1.1E-9	7.9E-10	5.5E-10	4.3E-10
SSE			3.5E-8	1.7E-8	1.0E-8	7.0E-9	4.4E-9	3.0E-9	2.2E-9	1.8E-9
S			5.9E-8	2.8E-8	1.5E-8	1.1E-9	6.6E-9	4.6E-9	3.4E-9	2.7E-9
SSW			5.6E-8	2.7E-8	1.5E-8	1.0E-9	6.2E-9	4.3E-9	3.1E-9	2.5E-9
SW			1.8E-8	9.2E-9	5.0E-9	3.6E-9	2.2E-9	1.5E-9	1.7E-9	8.9E-10
WSW			2.1E-8	9.9E-9	5.5E-9	3.8E-9	2.3E-9	1.7E-9	1.2E-9	9.4E-10
W			1.8E-8	8.6E-9	4.6E-9	3.3E-9	2.0E-9	1.4E-9	9.9E-10	7.7E-10
WNW			1.0E-8	4.8E-9	2.6E-9	1.9E-9	1.1E-9	7.9E-10	5.7E-10	4.4E-10
NW			1.4E-8	6.4E-9	3.5E-9	2.4E-9	1.5E-9	1.1E-9	7.4E-10	5.8E-10
NNW			2.5E-8	1.1E-8	6.0E-9	4.2E-9	2.6E-9	1.8E-9	1.3E-9	1.0E-9

*Inside EAB

TABLE 2.2.5*
INHALATION DOSE FACTORS FOR ADULTS
(MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07
C 14	2.27E-06	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07
NA 24	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.26E-06	1.28E-06
P 32	1.65E-04	9.64E-06	6.26E-06	NO DATA	NO DATA	NO DATA	1.08E-05
CR 51	NO DATA	NO DATA	1.25E-08	7.44E-09	2.85E-09	1.80E-06	4.15E-07
MN 54	NO DATA	4.95E-06	7.87E-07	NO DATA	1.23E-06	1.75E-04	9.67E-06
MN 56	NO DATA	1.55E-10	2.29E-11	NO DATA	1.63E-10	1.18E-06	2.53E-06
FE 55	3.07E-06	2.12E-06	4.93E-07	NO DATA	NO DATA	9.01E-06	7.54E-07
FE 59	1.47E-06	3.47E-06	1.32E-06	NO DATA	NO DATA	1.27E-04	2.35E-05
CO 58	NO DATA	1.98E-07	2.59E-07	NO DATA	NO DATA	1.16E-04	1.33E-05
CO 60	NO DATA	1.44E-06	1.85E-06	NO DATA	NO DATA	7.46E-04	3.56E-05
NI 63	5.40E-05	3.93E-06	1.81E-06	NO DATA	NO DATA	2.23E-05	1.67E-06
NI 65	1.92E-10	2.62E-11	1.14E-11	NO DATA	NO DATA	7.00E-07	1.54E-06
CU 64	NO DATA	1.83E-10	7.69E-11	NO DATA	5.78E-10	8.48E-07	6.12E-06
ZN 65	4.05E-06	1.29E-05	5.82E-06	NO DATA	8.62E-06	1.08E-04	6.68E-06
ZN 69	4.23E-12	8.14E-12	5.65E-13	NO DATA	5.27E-12	1.15E-07	2.04E-09
BR 83	NO DATA	NO DATA	3.01E-08	NO DATA	NO DATA	NO DATA	2.90E-08
BR 84	NO DATA	NO DATA	3.91E-08	NO DATA	NO DATA	NO DATA	2.05E-13
BR 85	NO DATA	NO DATA	1.60E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	1.69E-05	7.37E-06	NO DATA	NO DATA	NO DATA	2.08E-06
RB 88	NO DATA	4.84E-08	2.41E-08	NO DATA	NO DATA	NO DATA	4.18E-19
RB 89	NO DATA	3.20E-08	2.12E-08	NO DATA	NO DATA	NO DATA	1.16E-21
SR 89	3.80E-05	NO DATA	1.09E-06	NO DATA	NO DATA	1.75E-04	4.37E-05
SR 90	1.24E-02	NO DATA	7.62E-04	NO DATA	NO DATA	1.20E-03	9.02E-05
SR 91	7.74E-09	NO DATA	3.13E-10	NO DATA	NO DATA	4.56E-06	2.39E-05
SR 92	8.43E-10	NO DATA	3.64E-11	NO DATA	NO DATA	2.06E-06	5.38E-06
Y 90	2.61E-07	NO DATA	7.01E-09	NO DATA	NO DATA	2.12E-05	6.32E-05
Y 91M	3.26E-11	NO DATA	1.27E-12	NO DATA	NO DATA	2.40E-07	1.66E-10
Y 91	5.78E-05	NO DATA	1.55E-06	NO DATA	NO DATA	2.13E-04	4.81E-05
Y 92	1.29E-09	NO DATA	3.77E-11	NO DATA	NO DATA	1.96E-06	9.19E-06

*Taken from Regulatory Guide 1.109 (Rev. 1)

TABLE 2.2-5 (cont'd)
 INHALATION DOSE FACTORS FOR ADULTS
 (MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y 93	1.18E-08	NO DATA	3.26E-10	NO DATA	NO DATA	6.06E-06	5.27E-05
ZR 95	1.34E-05	4.30E-06	2.91E-06	NO DATA	6.77E-06	2.21E-04	1.88E-05
ZR 97	1.21E-08	2.45E-09	1.13E-09	NO DATA	3.71E-09	9.84E-06	6.54E-05
NB 95	1.76E-06	9.77E-07	5.26E-07	NO DATA	9.67E-07	6.31E-05	1.30E-05
MO 99	NO DATA	1.51E-08	2.87E-09	NO DATA	3.64E-08	1.14E-05	3.10E-05
TC 99M	1.29E-13	3.64E-13	4.63E-12	NO DATA	5.52E-12	9.55E-08	5.20E-07
TC 101	5.22E-15	7.52E-15	7.38E-14	NO DATA	1.35E-13	4.99E-08	1.36E-21
RU 103	1.91E-07	NO DATA	8.23E-08	NO DATA	7.29E-07	6.31E-05	1.38E-05
RU 105	9.88E-11	NO DATA	3.89E-11	NO DATA	1.27E-10	1.37E-06	6.02E-06
RU 106	8.64E-06	NO DATA	1.09E-06	NO DATA	1.67E-05	1.17E-03	1.14E-04
AG 110M	1.35E-06	1.25E-06	7.43E-07	NO DATA	2.46E-06	5.79E-04	3.78E-05
TE 125M	4.27E-07	1.98E-07	5.84E-08	1.31E-07	1.55E-06	3.92E-05	8.83E-06
TE 127M	1.58E-06	7.21E-07	1.96E-07	4.11E-07	5.72E-06	1.20E-04	1.87E-05
TE 127	1.75E-10	8.03E-11	3.87E-11	1.32E-10	6.37E-10	8.14E-07	7.17E-06
TE 129M	1.22E-06	5.84E-07	1.98E-07	4.30E-07	4.57E-06	1.45E-04	4.79E-05
TE 129	6.22E-12	2.99E-12	1.55E-12	4.87E-12	2.34E-11	2.42E-07	1.96E-08
TE 131M	8.74E-09	5.45E-09	3.63E-09	6.88E-09	3.86E-08	1.82E-05	6.95E-05
TE 131	1.39E-12	7.44E-13	4.49E-13	1.17E-12	5.46E-12	1.74E-07	2.30E-09
TE 132	3.25E-08	2.69E-08	2.02E-08	2.37E-08	1.82E-07	3.60E-05	6.37E-05
I 130	5.72E-07	1.68E-06	6.60E-07	1.42E-04	2.61E-06	NO DATA	9.61E-07
I 131	3.15E-06	4.47E-06	2.56E-06	1.49E-03	7.66E-06	NO DATA	7.85E-07
I 132	1.45E-07	4.07E-07	1.45E-07	1.43E-05	6.48E-07	NO DATA	5.08E-08
I 133	1.08E-06	1.85E-06	5.65E-07	2.69E-04	3.23E-06	NO DATA	1.11E-06
I 134	8.05E-08	2.16E-07	7.69E-08	3.73E-06	3.44E-07	NO DATA	1.26E-10
I 135	3.35E-07	8.73E-07	3.21E-07	5.60E-05	1.39E-06	NO DATA	6.56E-07
CS 134	4.66E-05	1.06E-04	9.10E-05	NO DATA	3.59E-05	1.22E-05	1.30E-06
CS 136	4.88E-06	1.83E-05	1.38E-05	NO DATA	1.07E-04	1.50E-06	1.46E-06
CS 137	5.98E-05	7.76E-05	5.35E-05	NO DATA	2.78E-05	9.40E-06	1.05E-06
CS 138	4.14E-08	7.76E-08	4.05E-08	NO DATA	6.00E-08	6.07E-09	2.33E-13
BA 139	1.17E-10	8.32E-14	3.42E-12	NO DATA	7.78E-14	4.70E-07	1.12E-07

TABLE 2.2-5 (cont'd)

INHALATION DOSE FACTORS FOR ADULTS
(MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA 140	4.88E-06	6.13E-09	3.21E-07	NO DATA	2.09E-09	1.59E-04	2.73E-05
BA 141	1.25E-11	9.14E-15	4.20E-13	NO DATA	8.75E-15	2.42E-07	1.45E-17
BA 142	3.29E-12	3.38E-15	2.07E-13	NO DATA	2.86E-15	1.49E-07	1.96E-26
LA 140	4.30E-08	2.17E-08	5.73E-09	NO DATA	NO DATA	1.70E-05	5.73E-05
LA 142	8.54E-11	3.88E-11	9.65E-12	NO DATA	NO DATA	7.91E-07	2.64E-07
CE 141	2.49E-06	1.69E-06	1.91E-07	NO DATA	7.83E-07	4.52E-05	1.50E-05
CE 143	2.33E-08	1.72E-08	1.91E-09	NO DATA	7.60E-09	9.97E-06	2.83E-05
CE 144	4.29E-04	1.79E-04	2.30E-05	NO DATA	1.06E-04	9.72E-04	1.02E-04
PR 143	1.17E-06	4.69E-07	5.80E-08	NO DATA	2.70E-07	3.51E-05	2.50E-05
PR 144	3.76E-12	1.56E-12	1.91E-13	NO DATA	8.81E-13	1.27E-07	2.69E-18
ND 147	6.59E-07	7.62E-07	4.56E-08	NO DATA	4.45E-07	2.76E-05	2.16E-05
W 187	1.06E-09	8.85E-10	3.10E-10	NO DATA	NO DATA	3.63E-06	1.94E-05
NP 239	2.87E-08	2.82E-09	1.55E-09	NO DATA	8.75E-09	4.70E-06	1.49E-05

TABLE 2.2-6*

INHALATION DOSE FACTORS FOR TEENAGER
(MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07
C 14	3.25E-06	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07
NA 24	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06
P 32	2.36E-04	1.37E-05	8.95E-06	NO DATA	NO DATA	NO DATA	1.16E-05
CR 51	NO DATA	NO DATA	1.69E-08	9.37E-09	3.84E-09	2.62E-06	3.75E-07
MN 54	NO DATA	6.39E-06	1.05E-06	NO DATA	1.59E-06	2.48E-04	8.35E-06
MN 56	NO DATA	2.12E-10	3.15E-11	NO DATA	2.24E-10	1.90E-06	7.18E-06
FE 55	4.18E-06	2.98E-06	6.93E-07	NO DATA	NO DATA	1.55E-05	7.99E-07
FE 59	1.99E-06	4.62E-06	1.79E-06	NO DATA	NO DATA	1.91E-04	2.23E-05
CO 58	NO DATA	2.59E-07	3.47E-07	NO DATA	NO DATA	1.68E-04	1.19E-05
CO 60	NO DATA	1.89E-06	2.48E-06	NO DATA	NO DATA	1.09E-03	3.24E-05
NI 63	7.25E-05	5.43E-06	2.47E-06	NO DATA	NO DATA	3.84E-05	1.77E-06
NI 65	2.73E-10	3.66E-11	1.59E-11	NO DATA	NO DATA	1.17E-06	4.59E-06
CU 64	NO DATA	2.54E-10	1.06E-10	NO DATA	8.01E-10	1.39E-06	7.68E-06
ZN 65	4.82E-06	1.67E-05	7.80E-06	NO DATA	1.08E-05	1.55E-04	5.83E-06
ZN 69	6.04E-12	1.15E-11	8.07E-13	NO DATA	7.53E-12	1.98E-07	3.56E-08
BR 83	NO DATA	NO DATA	4.30E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	5.41E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	2.29E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	2.38E-05	1.05E-05	NO DATA	NO DATA	NO DATA	2.21E-06
RB 88	NO DATA	6.82E-08	3.40E-08	NO DATA	NO DATA	NO DATA	3.65E-15
RB 89	NO DATA	4.40E-08	2.91E-08	NO DATA	NO DATA	NO DATA	4.22E-17
SR 89	5.43E-05	NO DATA	1.56E-06	NO DATA	NO DATA	3.02E-04	4.64E-05
SR 90	1.35E-02	NO DATA	8.35E-04	NO DATA	NO DATA	2.06E-03	9.56E-05
SR 91	1.10E-08	NO DATA	4.39E-10	NO DATA	NO DATA	7.59E-06	3.24E-05
SR 92	1.19E-09	NO DATA	5.08E-11	NO DATA	NO DATA	3.43E-06	1.49E-05
Y 90	3.73E-07	NO DATA	1.00E-08	NO DATA	NO DATA	3.66E-05	6.99E-05
Y 91M	4.63E-11	NO DATA	1.77E-12	NO DATA	NO DATA	4.00E-07	3.77E-09
Y 91	8.26E-05	NO DATA	2.21E-06	NO DATA	NO DATA	3.67E-04	5.11E-05
Y 92	1.84E-09	NO DATA	5.36E-11	NO DATA	NO DATA	3.35E-06	2.06E-05

*Taken from Regulatory Guide 1.109 (Rev. 1)

TABLE 2.2-6 (cont'd)

INHALATION DOSE FACTORS FOR TEENAGER
(MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y 93	1.69E-08	NO DATA	4.65E-10	NO DATA	NO DATA	1.04E-05	7.24E-05
ZR 95	1.82E-05	5.73E-06	3.94E-06	NO DATA	8.43E-06	3.36E-04	1.86E-05
ZR 97	1.72E-08	3.40E-09	1.57E-09	NO DATA	5.15E-09	1.62E-05	7.88E-05
NB 95	2.32E-06	1.29E-06	7.08E-07	NO DATA	1.25E-06	9.39E-05	1.21E-05
MO 99	NO DATA	2.11E-08	4.03E-09	NO DATA	5.14E-08	1.92E-05	3.36E-05
TC 99M	1.73E-13	4.83E-13	6.24E-12	NO DATA	7.20E-12	1.44E-07	7.66E-07
TC 101	7.40E-15	1.05E-14	1.03E-13	NO DATA	1.90E-13	8.34E-08	1.09E-16
RU 103	2.63E-07	NO DATA	1.12E-07	NO DATA	9.29E-07	9.79E-07	1.36E-05
RU 105	1.40E-10	NO DATA	5.42E-11	NO DATA	1.76E-10	2.27E-06	1.13E-05
RU 106	1.23E-05	NO DATA	1.55E-06	NO DATA	2.38E-05	2.01E-03	1.20E-04
AG 110M	1.73E-06	1.64E-06	9.99E-07	NO DATA	3.13E-06	8.44E-04	3.41E-05
TE 125M	6.10E-07	2.80E-07	8.34E-08	1.75E-07	NO DATA	6.70E-05	9.38E-06
TE 127M	2.25E-06	1.02E-06	2.73E-07	5.48E-07	8.17E-06	2.07E-04	1.99E-05
TE 127	2.51E-10	1.14E-10	5.52E-11	1.77E-10	9.10E-10	1.40E-06	1.01E-05
TE 129M	1.74E-06	8.23E-07	2.81E-07	5.72E-07	6.49E-06	2.47E-04	5.06E-05
TE 129	8.87E-12	4.22E-12	2.20E-12	6.48E-12	3.32E-11	4.12E-07	2.02E-07
TE 131M	1.23E-08	7.51E-09	5.03E-09	9.06E-09	5.49E-08	2.97E-05	7.76E-05
TE 131	1.97E-12	1.04E-12	6.30E-13	1.55E-12	7.72E-12	2.92E-07	1.89E-09
TE 132	4.50E-08	3.63E-08	2.74E-08	3.07E-08	2.44E-07	5.61E-05	5.79E-05
I 130	7.80E-07	2.24E-06	8.96E-07	1.86E-04	3.44E-06	NO DATA	1.14E-06
I 131	4.43E-06	6.14E-06	3.30E-06	1.83E-03	1.05E-05	NO DATA	8.11E-07
I 132	1.99E-07	5.47E-07	1.97E-07	1.89E-05	8.65E-07	NO DATA	1.59E-07
I 133	1.52E-06	2.56E-06	7.78E-07	3.65E-04	4.49E-06	NO DATA	1.29E-06
I 134	1.11E-07	2.90E-07	1.05E-07	4.94E-06	4.58E-07	NO DATA	2.55E-09
I 135	4.62E-07	1.18E-06	4.36E-07	7.76E-05	1.86E-06	NO DATA	8.69E-07
CS 134	6.28E-05	1.41E-04	6.86E-05	NO DATA	4.69E-05	1.83E-05	1.22E-06
CS 136	6.44E-06	2.42E-05	1.71E-05	NO DATA	1.38E-05	2.22E-06	1.36E-06
CS 137	8.38E-05	1.06E-04	3.89E-05	NO DATA	3.80E-05	1.51E-05	1.06E-06
CS 138	5.82E-08	1.07E-07	5.58E-08	NO DATA	8.28E-08	9.84E-09	3.38E-11
BA 139	1.67E-10	1.18E-13	4.87E-12	NO DATA	1.11E-13	8.08E-07	8.06E-07

TABLE 2.2-6 (cont'd)

INHALATION DOSE FACTORS FOR TEENAGER
(MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA 140	6.84E-06	8.38E-09	4.40E-07	NO DATA	2.85E-09	2.54E-04	2.86E-05
BA 141	1.78E-11	1.32E-14	5.93E-13	NO DATA	1.23E-14	4.11E-07	9.33E-14
BA 142	4.62E-12	4.63E-15	2.84E-13	NO DATA	3.92E-15	2.39E-07	5.99E-20
LA 140	5.99E-08	2.95E-08	7.82E-09	NO DATA	NO DATA	2.68E-05	6.09E-05
LA 142	1.20E-10	5.31E-11	1.32E-11	NO DATA	NO DATA	1.27E-06	1.50E-06
CE 141	3.55E-06	2.37E-06	2.71E-07	NO DATA	1.11E-06	7.67E-05	1.58E-05
CE 143	3.32E-08	2.42E-08	2.70E-09	NO DATA	1.08E-08	1.63E-05	3.19E-05
CE 144	6.11E-04	2.53E-04	3.28E-05	NO DATA	1.51E-04	1.67E-03	1.08E-04
PR 143	1.67E-06	6.64E-07	8.28E-08	NO DATA	3.86E-07	6.04E-05	2.67E-05
PR 144	5.37E-12	2.20E-12	2.72E-13	NO DATA	1.26E-12	2.19E-07	2.94E-14
ND 147	9.83E-07	1.07E-06	6.41E-08	NO DATA	6.28E-07	4.65E-05	2.28E-05
W 187	1.50E-09	1.22E-09	4.29E-10	NO DATA	NO DATA	5.92E-06	2.21E-05
NP 239	4.23E-08	3.99E-09	2.21E-09	NO DATA	1.25E-08	8.11E-06	1.65E-05

TABLE 2.2-7*

INHALATION DOSE FACTORS FOR CHILD
(MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07
C 14	9.70E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06
NA 24	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-05	4.35E-06
P 32	7.04E-04	3.09E-05	2.67E-05	NO DATA	NO DATA	NO DATA	1.14E-05
CR 51	NO DATA	NO DATA	4.17E-08	2.31E-08	6.57E-09	4.59E-06	2.93E-07
MN 54	NO DATA	1.16E-05	2.57E-06	NO DATA	2.71E-06	4.26E-04	6.19E-06
MN 56	NO DATA	4.48E-10	8.43E-11	NO DATA	4.52E-10	3.55E-06	3.33E-05
FE 55	1.28E-05	6.80E-06	2.10E-06	NO DATA	NO DATA	3.00E-05	7.75E-07
FE 59	5.59E-06	9.04E-06	4.51E-06	NO DATA	NO DATA	3.43E-04	1.91E-05
CO 58	NO DATA	4.79E-07	8.55E-07	NO DATA	NO DATA	2.99E-04	9.29E-06
CO 60	NO DATA	3.55E-06	6.12E-06	NO DATA	NO DATA	1.91E-03	2.60E-05
NI 63	2.22E-04	1.25E-05	7.56E-06	NO DATA	NO DATA	7.43E-05	1.71E-06
NI 65	8.08E-10	7.99E-11	4.44E-11	NO DATA	NO DATA	2.21E-06	2.27E-05
CU 64	NO DATA	5.39E-10	2.90E-10	NO DATA	1.63E-09	2.59E-06	9.92E-06
ZN 65	1.15E-05	3.06E-05	1.90E-05	NO DATA	1.93E-05	2.69E-04	4.41E-06
ZN 69	1.81E-11	2.61E-11	2.41E-12	NO DATA	1.58E-11	3.84E-07	2.75E-06
BR 83	NO DATA	NO DATA	1.28E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	1.48E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	6.84E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	5.36E-05	3.09E-05	NO DATA	NO DATA	NO DATA	2.16E-06
RB 88	NO DATA	1.52E-07	9.90E-08	NO DATA	NO DATA	NO DATA	4.66E-09
RB 89	NO DATA	9.33E-08	7.83E-08	NO DATA	NO DATA	NO DATA	5.11E-10
SR 89	1.62E-04	NO DATA	4.66E-06	NO DATA	NO DATA	5.83E-04	4.52E-05
SR 90	2.73E-02	NO DATA	1.74E-03	NO DATA	NO DATA	3.99E-03	9.28E-05
SR 91	3.28E-08	NO DATA	1.24E-09	NO DATA	NO DATA	1.44E-05	4.70E-05
SR 92	3.54E-09	NO DATA	1.42E-10	NO DATA	NO DATA	6.49E-06	6.55E-05
Y 90	1.11E-06	NO DATA	2.99E-08	NO DATA	NO DATA	7.07E-05	7.24E-05
Y 91M	1.37E-10	NO DATA	4.98E-12	NO DATA	NO DATA	7.60E-07	4.64E-07
Y 91	2.47E-04	NO DATA	6.59E-06	NO DATA	NO DATA	7.10E-04	4.97E-05
Y 92	5.50E-09	NO DATA	1.57E-10	NO DATA	NO DATA	6.46E-06	6.46E-05

*Taken From Regulatory Guide 1.109 (Rev. 1)

TABLE 2.2-7 (cont'd)

 INHALATION DOSE FACTORS FOR CHILD
 (MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y 93	5.04E-08	NO DATA	1.38E-09	NO DATA	NO DATA	2.01E-05	1.05E-04
ZR 95	5.13E-05	1.13E-05	1.00E-05	NO DATA	1.61E-05	6.03E-04	1.65E-05
ZR 97	5.07E-08	7.34E-09	4.32E-09	NO DATA	1.05E-08	3.06E-05	9.49E-05
NB 95	6.35E-06	2.48E-06	1.77E-06	NO DATA	2.33E-06	1.66E-04	1.00E-05
MO 99	NO DATA	4.66E-08	1.15E-08	NO DATA	1.06E-07	3.66E-05	3.42E-05
TC 99M	4.81E-13	9.41E-13	1.56E-11	NO DATA	1.37E-11	2.57E-07	1.30E-06
TC101	2.19E-14	2.30E-14	2.91E-13	NO DATA	3.92E-13	1.58E-07	4.41E-09
RU103	7.55E-07	NO DATA	2.90E-07	NO DATA	1.90E-06	1.79E-04	1.21E-05
RU105	4.13E-10	NO DATA	1.50E-10	NO DATA	3.63E-10	4.30E-06	2.69E-05
RU106	3.68E-05	NO DATA	4.57E-06	NO DATA	4.97E-05	3.87E-03	1.16E-04
AG110M	4.56E-06	3.08E-06	2.47E-06	NO DATA	5.74E-06	1.48E-03	2.71E-05
TE125M	1.82E-06	6.29E-07	2.47E-07	5.20E-07	NO DATA	1.29E-04	9.13E-06
TE127M	6.72E-06	2.31E-06	8.16E-07	1.64E-06	1.72E-05	4.00E-04	1.93E-05
TE127	7.49E-10	2.57E-10	1.65E-10	5.30E-10	1.91E-09	2.71E-06	1.52E-05
TE129M	5.19E-06	1.85E-06	8.22E-07	1.71E-06	1.36E-05	4.76E-04	4.91E-05
TE129	2.64E-11	9.45E-12	6.44E-12	1.93E-11	6.94E-11	7.93E-07	6.89E-06
TE131M	3.63E-08	1.60E-08	1.37E-08	2.64E-08	1.08E-07	5.56E-05	8.32E-05
TE131	5.87E-12	2.28E-12	1.78E-12	4.59E-12	1.59E-11	5.55E-07	3.60E-07
TE132	1.30E-07	7.36E-08	7.12E-08	8.58E-08	4.79E-07	1.02E-04	3.72E-05
I 130	2.21E-06	4.43E-06	2.28E-06	4.99E-04	6.61E-06	NO DATA	1.38E-06
I 131	1.30E-05	1.30E-05	7.37E-06	4.39E-03	2.13E-05	NO DATA	7.68E-07
I 132	5.72E-07	1.10E-06	5.07E-07	5.23E-05	1.69E-06	NO DATA	8.65E-07
I 133	4.48E-06	5.49E-06	2.08E-06	1.04E-03	9.13E-06	NO DATA	1.48E-06
I 134	3.17E-07	5.84E-07	2.69E-07	1.37E-05	8.92E-07	NO DATA	2.58E-07
I 135	1.33E-06	2.36E-06	1.12E-06	2.14E-04	3.62E-06	NO DATA	1.20E-06
CS134	1.76E-04	2.74E-04	6.07E-05	NO DATA	8.93E-05	3.27E-05	1.04E-06
CS136	1.76E-05	4.62E-05	3.14E-05	NO DATA	2.58E-05	3.93E-06	1.13E-06
CS137	2.45E-04	2.23E-04	3.47E-05	NO DATA	7.63E-05	2.81E-05	9.78E-07
CS138	1.71E-07	2.27E-07	1.50E-07	NO DATA	1.68E-07	1.84E-08	7.29E-08
BA139	4.98E-10	2.66E-13	1.45E-11	NO DATA	2.33E-13	1.56E-06	1.56E-05

TABLE 2.2-7 (cont'd)

INHALATION DOSE FACTORS FOR CHILD
(MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LII
BA140	2.00E-05	1.75E-08	1.17E-06	NO DATA	5.71E-09	4.71E-04	2.75E-05
BA141	5.29E-11	2.95E-14	1.72E-12	NO DATA	2.56E-14	7.89E-07	7.44E-08
BA142	1.35E-11	9.73E-15	7.54E-13	NO DATA	7.87E-15	4.44E-07	7.41E-10
LA140	1.74E-07	6.08E-08	2.04E-08	NO DATA	NO DATA	4.94E-05	6.10E-05
LA142	3.50E-10	1.11E-10	3.49E-11	NO DATA	NO DATA	2.35E-06	2.05E-05
CE141	1.06E-05	5.28E-06	7.83E-07	NO DATA	2.31E-06	1.47E-04	1.53E-05
CE143	9.89E-08	5.37E-08	7.77E-09	NO DATA	2.26E-08	3.12E-05	3.44E-05
CE144	1.83E-03	5.72E-04	9.77E-05	NO DATA	3.17E-04	3.23E-03	1.05E-04
PR143	4.99E-06	1.50E-06	2.47E-07	NO DATA	8.11E-07	1.17E-04	2.63E-05
PR144	1.61E-11	4.99E-12	8.10E-13	NO DATA	2.64E-12	4.23E-07	5.32E-08
ND147	2.92E-06	2.36E-06	1.84E-07	NO DATA	1.30E-06	8.87E-05	2.22E-05
W 187	4.42E-09	2.61E-09	1.17E-09	NO DATA	NO DATA	1.11E-05	2.46E-05
NP239	1.26E-07	9.04E-09	6.35E-09	NO DATA	2.63E-08	1.57E-05	1.73E-05

TABLE 2.2-8*

 INHALATION DOSE FACTORS FOR INFANT
 (MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LII
H 3	NO DATA	4.62E-07	4.62E-07	3.62E-07	4.62E-07	4.62E-07	4.62E-07
C 14	1.89E-05	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06
NA 24	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06
P 32	1.45E-03	8.03E-05	5.53E-05	NO DATA	NO DATA	NO DATA	1.15E-05
CR 51	NO DATA	NO DATA	6.39E-08	4.11E-08	9.45E-09	9.17E-06	2.55E-07
MN 54	NO DATA	1.81E-05	3.56E-06	NO DATA	3.56E-06	7.14E-04	5.04E-06
MN 56	NO DATA	1.10E-09	1.58E-10	NO DATA	7.86E-10	8.95E-06	5.12E-05
FE 55	1.41E-05	8.39E-06	2.38E-06	NO DATA	NO DATA	6.21E-05	7.82E-07
FE 59	9.69E-06	1.68E-05	6.77E-06	NO DATA	NO DATA	7.25E-04	1.77E-05
CO 58	NO DATA	8.71E-07	1.30E-06	NO DATA	NO DATA	5.55E-04	7.95E-06
CO 60	NO DATA	5.73E-06	8.41E-06	NO DATA	NO DATA	3.22E-03	2.28E-05
NI 63	2.42E-04	1.46E-05	8.29E-06	NO DATA	NO DATA	1.49E-04	1.73E-06
NI 65	1.71E-09	2.03E-10	8.79E-11	NO DATA	NO DATA	5.80E-06	3.58E-05
CO 64	NO DATA	1.34E-09	5.53E-10	NO DATA	2.84E-09	6.64E-06	1.07E-05
ZN 65	1.38E-05	4.47E-05	2.22E-05	NO DATA	2.32E-05	4.62E-04	3.67E-05
ZN 69	3.85E-11	6.91E-11	5.13E-12	NO DATA	2.87E-11	1.05E-06	9.44E-06
BR 83	NO DATA	NO DATA	2.72E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	2.86E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	1.46E-08	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	1.36E-04	6.30E-05	NO DATA	NO DATA	NO DATA	2.17E-06
RB 88	NO DATA	3.98E-07	2.05E-07	NO DATA	NO DATA	NO DATA	2.42E-07
RB 89	NO DATA	2.29E-07	1.47E-07	NO DATA	NO DATA	NO DATA	4.87E-08
SR 89	2.84E-04	NO DATA	8.15E-06	NO DATA	NO DATA	1.45E-03	4.57E-05
SR 90	2.92E-02	NO DATA	1.85E-03	NO DATA	NO DATA	8.03E-03	9.36E-05
SR 91	6.83E-08	NO DATA	2.47E-09	NO DATA	NO DATA	3.76E-05	5.24E-05
SR 92	7.50E-09	NO DATA	2.79E-10	NO DATA	NO DATA	1.70E-05	1.00E-04
Y 90	2.35E-06	NO DATA	6.30E-08	NO DATA	NO DATA	1.92E-04	7.43E-05
Y 91M	2.91E-10	NO DATA	9.90E-12	NO DATA	NO DATA	1.99E-06	1.68E-06
Y 91	4.20E-04	NO DATA	1.12E-05	NO DATA	NO DATA	1.75E-03	5.02E-05
Y 92	1.17E-08	NO DATA	3.29E-10	NO DATA	NO DATA	1.75E-05	9.04E-05

*Taken from Regulatory Guide 1.109 (Rev. 1)

TABLE 2.2-8 (cont'd)

 INHALATION DOSE FACTORS FOR INFANT
 (MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LII
Y 93	1.07E-07	NO DATA	2.91E-09	NO DATA	NO DATA	5.46E-05	1.19E-04
ZR 95	8.24E-05	1.99E-05	1.45E-05	NO DATA	2.22E-05	1.25E-03	1.55E-05
ZR 97	1.07E-07	1.83E-08	8.36E-09	NO DATA	1.85E-08	7.88E-05	1.00E-04
NB 95	1.12E-05	4.59E-06	2.70E-06	NO DATA	3.37E-06	3.42E-04	9.05E-06
MO 99	NO DATA	1.18E-07	2.31E-08	NO DATA	1.89E-07	9.63E-05	3.48E-05
TC 99M	9.98E-13	2.06E-12	2.66E-11	NO DATA	2.22E-11	5.79E-07	1.45E-06
TC101	4.65E-14	5.88E-14	5.80E-13	NO DATA	6.99E-13	4.17E-07	6.03E-07
RU103	1.44E-06	NO DATA	4.85E-07	NO DATA	3.03E-06	3.94E-04	1.15E-05
RU105	8.74E-10	NO DATA	2.93E-10	NO DATA	6.42E-10	1.12E-05	3.46E-05
RU106	6.20E-05	NO DATA	7.77E-06	NO DATA	7.61E-05	8.26E-03	1.17E-04
AG110M	7.13E-06	5.16E-06	3.57E-06	NO DATA	7.80E-06	2.62E-03	2.36E-05
TE125M	3.40E-06	1.42E-06	4.70E-07	1.16E-06	NO DATA	3.19E-04	9.22E-06
TE127M	1.19E-05	4.93E-06	1.48E-06	3.48E-06	2.68E-05	9.37E-04	1.95E-05
TE127	1.59E-09	6.81E-10	3.49E-10	1.32E-09	3.47E-09	7.39E-06	1.74E-05
TE129M	1.01E-05	4.35E-06	1.59E-06	3.91E-06	2.27E-05	1.20E-03	4.93E-05
TE129	5.63E-11	2.48E-11	1.34E-11	4.82E-11	1.25E-10	2.14E-06	1.88E-05
TE131M	7.62E-08	3.93E-08	2.59E-08	6.38E-08	1.89E-07	1.42E-04	8.51E-05
TE131	1.24E-11	5.87E-12	3.57E-12	1.13E-11	2.85E-11	1.47E-06	5.87E-06
TE132	2.66E-07	1.69E-07	1.26E-07	1.99E-07	7.39E-07	2.43E-04	3.15E-05
I 130	4.54E-06	9.91E-06	3.98E-06	1.14E-03	1.09E-05	NO DATA	1.42E-06
I 131	2.71E-05	3.17E-05	1.40E-05	1.06E-02	3.70E-05	NO DATA	7.56E-07
I 132	1.21E-06	2.53E-06	8.99E-07	1.21E-04	2.82E-06	NO DATA	1.36E-06
I 133	9.46E-06	1.37E-05	4.00E-06	2.54E-03	1.60E-05	NO DATA	1.54E-06
I 134	6.58E-07	1.34E-06	4.75E-07	3.18E-05	1.49E-06	NO DATA	9.21E-07
I 135	2.76E-06	5.43E-06	1.98E-06	4.97E-04	6.05E-06	NO DATA	1.31E-06
CS134	2.83E-04	5.02E-04	5.32E-05	NO DATA	1.36E-04	5.69E-05	9.53E-07
CS136	3.45E-05	9.61E-05	3.78E-05	NO DATA	4.03E-05	8.40E-06	1.02E-06
CS137	3.92E-04	4.37E-04	3.25E-05	NO DATA	1.23E-04	5.09E-05	9.53E-07
CS138	3.61E-07	5.58E-07	2.84E-07	NO DATA	2.93E-07	4.67E-08	6.26E-07
BA139	1.06E-09	7.03E-13	3.07E-11	NO DATA	4.23E-13	4.25E-06	3.64E-05

TABLE 2.2-8 (cont'd)

INHALATION DOSE FACTORS FOR INFANT
(MREM PER PCI INHALED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LII
BA140	4.00E-05	4.00E-08	2.07E-06	NO DATA	9.59E-09	1.14E-03	2.74E-05
BA141	1.12E-10	7.70E-14	3.55E-12	NO DATA	4.64E-14	2.12E-06	3.39E-06
BA142	2.84E-11	2.36E-14	1.40E-12	NO DATA	1.36E-14	1.11E-06	4.95E-07
LA140	3.61E-07	1.43E-07	3.68E-08	NO DATA	NO DATA	1.20E-04	6.06E-05
LA142	7.36E-10	2.69E-10	6.46E-11	NO DATA	NO DATA	5.87E-06	4.25E-05
CE141	1.98E-05	1.19E-05	1.42E-06	NO DATA	3.75E-06	3.69E-04	1.54E-05
CE143	2.98E-07	1.38E-07	1.58E-08	NO DATA	4.03E-08	8.30E-05	3.55E-05
CE144	2.28E-03	8.65E-04	1.26E-04	NO DATA	3.84E-04	7.03E-03	1.06E-04
PR143	1.00E-05	3.74E-06	4.99E-07	NO DATA	1.41E-06	3.09E-04	2.66E-05
PR144	3.42E-11	1.32E-11	1.72E-12	NO DATA	4.80E-12	1.15E-06	3.06E-06
ND147	5.67E-06	5.81E-06	3.57E-07	NO DATA	2.25E-06	2.30E-04	2.23E-05
W 187	9.26E-09	6.44E-09	2.23E-09	NO DATA	NO DATA	2.83E-05	2.54E-05
NP239	2.65E-07	2.37E-08	1.34E-08	NO DATA	4.73E-08	4.25E-05	1.78E-05

TABLE 2.2-9*

EXTERNAL DOSE FACTORS FOR STANDING ON CONTAMINATED GROUND(mrem/hr per pCi/m²)

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

*Taken from Regulatory Guide 1.109 (Rev. 1)

TABLE 2.2-9 (cont'd)

EXTERNAL DOSE FACTORS FOR STANDING ON CONTAMINATED GROUND(mrem/hr per pCi/m²)

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

TABLE 2.2-10*

 INGESTION DOSE FACTORS FOR TEENAGER
 (MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07
C 14	4.06E-06	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07
NA 24	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06
P 32	2.76E-04	1.71E-05	1.07E-05	NO DATA	NO DATA	NO DATA	2.32E-05
CR 51	NO DATA	NO DATA	3.60E-09	2.00E-09	7.89E-10	5.14E-09	6.05E-07
MN 54	NO DATA	5.90E-06	1.17E-06	NO DATA	1.76E-06	NO DATA	1.21E-05
MN 56	NO DATA	1.58E-07	2.81E-08	NO DATA	2.00E-07	NO DATA	1.04E-05
FE 55	3.78E-06	2.68E-06	6.25E-07	NO DATA	NO DATA	1.70E-06	1.16E-06
FE 59	5.87E-06	1.37E-05	5.29E-06	NO DATA	NO DATA	4.32E-06	3.24E-05
CO 58	NO DATA	9.72E-07	2.24E-06	NO DATA	NO DATA	NO DATA	1.34E-05
CO 60	NO DATA	2.81E-06	6.33E-06	NO DATA	NO DATA	NO DATA	3.66E-05
NI 63	1.77E-04	1.25E-05	6.00E-06	NO DATA	NO DATA	NO DATA	1.99E-06
NI 65	7.49E-07	9.57E-08	4.36E-08	NO DATA	NO DATA	NO DATA	5.19E-07
CU 64	NO DATA	1.15E-07	5.41E-08	NO DATA	2.91E-07	NO DATA	8.92E-06
ZN 65	5.76E-06	2.00E-05	9.33E-06	NO DATA	1.28E-05	NO DATA	8.47E-06
ZN 69	1.47E-08	2.80E-08	1.96E-09	NO DATA	1.83E-08	NO DATA	5.16E-08
BR 83	NO DATA	NO DATA	5.74E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	7.22E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	3.05E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	2.98E-05	1.40E-05	NO DATA	NO DATA	NO DATA	4.41E-06
RB 88	NO DATA	8.52E-08	4.54E-08	NO DATA	NO DATA	NO DATA	7.30E-15
RB 89	NO DATA	5.50E-08	3.89E-08	NO DATA	NO DATA	NO DATA	8.43E-17
SR 89	4.40E-04	NO DATA	1.26E-05	NO DATA	NO DATA	NO DATA	5.24E-05
SR 90	8.30E-03	NO DATA	2.05E-03	NO DATA	NO DATA	NO DATA	2.33E-04
SR 91	8.07E-06	NO DATA	3.21E-07	NO DATA	NO DATA	NO DATA	3.66E-05
SR 92	3.05E-06	NO DATA	1.30E-07	NO DATA	NO DATA	NO DATA	7.77E-05
Y 90	1.37E-08	NO DATA	3.69E-10	NO DATA	NO DATA	NO DATA	1.13E-04
Y 91M	1.29E-10	NO DATA	4.93E-12	NO DATA	NO DATA	NO DATA	6.09E-09
Y 91	2.01E-07	NO DATA	5.39E-09	NO DATA	NO DATA	NO DATA	8.24E-05
Y 92	1.21E-09	NO DATA	3.50E-11	NO DATA	NO DATA	NO DATA	3.32E-05

*Taken from Regulatory Guide 1.109 (Rev. 1)

TABLE 2.2-10 (cont'd)

 INGESTION DOSE FACTORS FOR TEENAGER
 (MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y 93	3.83E-09	NO DATA	1.05E-10	NO DATA	NO DATA	NO DATA	1.17E-04
ZR 95	4.12E-08	1.30E-08	8.94E-09	NO DATA	1.91E-08	NO DATA	3.00E-05
ZR 97	2.37E-09	4.69E-10	2.16E-10	NO DATA	7.11E-10	NO DATA	1.27E-04
NB 95	8.22E-09	4.56E-09	2.51E-09	NO DATA	4.42E-09	NO DATA	1.95E-05
MO 99	NO DATA	6.03E-06	1.15E-06	NO DATA	1.38E-05	NO DATA	1.08E-05
TC 99M	3.32E-10	9.26E-10	1.20E-08	NO DATA	1.38E-08	5.14E-10	6.08E-07
TC101	3.60E-10	5.12E-10	5.03E-09	NO DATA	9.26E-09	3.12E-10	8.75E-18
RU103	2.55E-07	NO DATA	1.09E-07	NO DATA	8.99E-07	NO DATA	2.13E-05
RU105	2.18E-08	NO DATA	8.46E-09	NO DATA	2.75E-07	NO DATA	1.76E-05
RU106	3.92E-06	NO DATA	4.94E-07	NO DATA	7.56E-06	NO DATA	1.88E-04
AG110M	2.05E-07	1.94E-07	1.18E-07	NO DATA	3.70E-07	NO DATA	5.45E-05
TE125M	3.83E-06	1.38E-06	5.12E-07	1.07E-06	NO DATA	NO DATA	1.13E-05
TE127M	9.67E-06	3.43E-06	1.15E-06	2.30E-06	3.92E-05	NO DATA	2.41E-05
TE127	1.58E-07	5.60E-08	3.40E-08	1.09E-07	6.40E-07	NO DATA	1.22E-05
TE129M	1.63E-05	6.05E-06	2.58E-06	5.26E-06	6.82E-05	NO DATA	6.12E-05
TE129	4.48E-08	1.67E-08	1.09E-08	3.20E-08	1.88E-07	NO DATA	2.45E-07
TE131M	2.44E-06	1.17E-06	9.76E-07	1.76E-06	1.22E-05	NO DATA	9.39E-05
TE131	2.79E-08	1.15E-08	8.72E-09	2.15E-08	1.22E-07	NO DATA	2.29E-09
TE132	3.49E-06	2.21E-06	2.08E-06	2.33E-06	2.12E-05	NO DATA	7.00E-05
I 130	1.03E-06	2.98E-06	1.19E-06	2.43E-04	4.59E-06	NO DATA	2.29E-06
I 131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	NO DATA	1.62E-06
I 132	2.79E-07	7.30E-07	2.62E-07	2.46E-05	1.15E-06	NO DATA	3.18E-07
I 133	2.01E-06	3.41E-06	1.04E-06	4.76E-04	5.98E-06	NO DATA	2.58E-06
I 134	1.46E-07	3.87E-07	1.39E-07	6.45E-06	6.10E-07	NO DATA	5.10E-09
I 135	6.10E-07	1.57E-06	5.82E-07	1.01E-04	2.48E-06	NO DATA	1.74E-06
CS134	8.37E-05	1.97E-04	9.14E-05	NO DATA	6.26E-05	2.39E-05	2.45E-06
CS136	8.59E-06	3.38E-05	2.27E-05	NO DATA	1.84E-05	2.90E-06	2.72E-06
CS137	1.12E-04	1.49E-04	5.19E-05	NO DATA	5.07E-05	1.97E-05	2.12E-06
CS138	7.76E-08	1.49E-07	7.45E-08	NO DATA	1.10E-07	1.28E-08	6.76E-11
BA139	1.39E-07	9.78E-11	4.05E-09	NO DATA	9.22E-11	6.74E-11	1.24E-06

TABLE 2.2-10 (cont'd)

INGESTION DOSE FACTORS FOR TEENAGER
(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA140	2.84E-05	3.48E-08	1.83E-06	NO DATA	1.18E-08	2.34E-08	4.38E-05
BA141	6.71E-08	5.01E-11	2.24E-08	NO DATA	4.65E-11	3.43E-11	1.43E-13
BA142	2.99E-08	2.99E-11	1.84E-09	NO DATA	2.53E-11	1.99E-11	9.18E-20
LA140	3.48E-09	1.71E-09	4.55E-10	NO DATA	NO DATA	NO DATA	9.82E-05
LA142	1.79E-10	7.95E-11	1.98E-11	NO DATA	NO DATA	NO DATA	2.42E-06
CE141	1.33E-08	8.88E-09	1.02E-09	NO DATA	4.18E-09	NO DATA	2.54E-05
CE143	2.35E-09	1.71E-06	1.91E-10	NO DATA	7.67E-10	NO DATA	5.14E-05
CD144	6.96E-07	2.88E-07	3.74E-08	NO DATA	1.72E-07	NO DATA	1.75E-04
PR143	1.31E-08	5.23E-09	6.52E-10	NO DATA	3.04E-09	NO DATA	4.31E-05
PR144	4.30E-11	1.76E-11	2.18E-12	NO DATA	1.01E-11	NO DATA	4.74E-14
ND147	9.38E-09	1.02E-08	6.11E-10	NO DATA	5.99E-09	NO DATA	3.68E-05
W 187	1.46E-07	1.19E-07	4.17E-08	NO DATA	NO DATA	NO DATA	3.22E-05
NP239	1.76E-09	1.66E-10	9.22E-11	NO DATA	5.21E-10	NO DATA	2.67E-05

TABLE 2.2-11*

INGESTION DOSE FACTORS FOR CHILD
(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07
C 14	1.21E-05	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06
NA 24	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06
P 32	8.25E-04	3.86E-05	3.18E-05	NO DATA	NO DATA	NO DATA	2.28E-05
CR 51	NO DATA	NO DATA	8.90E-09	4.94E-09	1.35E-09	9.02E-09	4.72E-07
MN 54	NO DATA	1.07E-05	2.85E-06	NO DATA	3.00E-06	NO DATA	8.98E-06
MN 56	NO DATA	3.34E-07	7.54E-08	NO DATA	4.04E-07	NO DATA	4.84E-05
FE 55	1.15E-05	6.10E-06	1.89E-06	NO DATA	NO DATA	3.45E-06	1.13E-06
FE 59	1.65E-05	2.67E-05	1.33E-05	NO DATA	NO DATA	7.74E-06	2.78E-05
CO 58	NO DATA	1.80E-06	5.51E-06	NO DATA	NO DATA	NO DATA	1.05E-05
CP 60	NO DATA	5.29E-06	1.56E-05	NO DATA	NO DATA	NO DATA	2.93E-05
NI 63	5.38E-04	2.88E-05	1.83E-05	NO DATA	NO DATA	NO DATA	1.94E-06
NI 65	2.22E-06	2.09E-07	1.22E-07	NO DATA	NO DATA	NO DATA	2.56E-05
CU 64	NO DATA	2.45E-07	1.48E-07	NO DATA	5.92E-07	NO DATA	1.15E-05
ZN 65	1.37E-05	3.65E-05	2.27E-05	NO DATA	2.30E-05	NO DATA	6.41E-06
ZN 69	4.38E-08	6.33E-08	5.85E-09	NO DATA	3.84E-08	NO DATA	3.99E-06
BR 83	NO DATA	NO DATA	1.71E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	1.98E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	9.12E-09	NO DATA	NO DATA	NO DATA	LT E-24
BR 86	NO DATA	6.70E-05	4.12E-05	NO DATA	NO DATA	NO DATA	4.31E-06
RB 88	NO DATA	1.90E-07	1.32E-07	NO DATA	NO DATA	NO DATA	9.32E-09
RB 89	NO DATA	1.17E-07	1.04E-07	NO DATA	NO DATA	NO DATA	1.02E-09
SR 89	1.32E-03	NO DATA	3.77E-05	NO DATA	NO DATA	NO DATA	5.11E-05
SR 90	1.70E-02	NO DATA	4.31E-03	NO DATA	NO DATA	NO DATA	2.29E-04
SR 91	2.40E-05	NO DATA	9.06E-07	NO DATA	NO DATA	NO DATA	5.30E-05
SR 92	9.03E-06	NO DATA	3.62E-07	NO DATA	NO DATA	NO DATA	1.71E-04
Y 90	4.11E-08	NO DATA	1.10E-09	NO DATA	NO DATA	NO DATA	1.17E-04
Y 91M	3.82E-10	NO DATA	1.39E-11	NO DATA	NO DATA	NO DATA	7.48E-07
Y 91	6.02E-07	NO DATA	1.61E-08	NO DATA	NO DATA	NO DATA	8.02E-05
Y 92	3.60E-09	NO DATA	1.03E-10	NO DATA	NO DATA	NO DATA	1.04E-04

*Taken from Regulatory Guide 1.109 (Rev. 1).

TABLE 2.2-11 (cont'd)

 INGESTION DOSE FACTORS FOR CHILD
 (MREM PER PCI INGESTED)

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

TABLE 2.2-11 (cont'd)

INGESTION DOSE FACTORS FOR CHILD
(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA140	8.31E-05	7.28E-08	4.85E-06	NO DATA	2.37E-08	4.34E-08	4.21E-05
BA141	2.00E-07	1.12E-10	6.51E-09	NO DATA	9.69E-11	6.58E-10	1.14E-07
BA142	8.74E-08	6.29E-11	4.88E-09	NO DATA	5.09E-11	3.70E-11	1.14E-09
LA140	1.01E-08	3.53E-09	1.19E-09	NO DATA	NO DATA	NO DATA	9.84E-05
LA142	5.24E-10	1.67E-10	5.23E-11	NO DATA	NO DATA	NO DATA	3.31E-05
CE141	3.97E-08	1.98E-08	2.94E-09	NO DATA	8.68E-09	NO DATA	2.47E-05
CE143	6.99E-09	3.79E-06	5.49E-10	NO DATA	1.59E-09	NO DATA	5.55E-05
CE144	2.08E-06	6.52E-07	1.11E-07	NO DATA	3.61E-07	NO DATA	1.70E-04
PR143	3.93E-08	1.18E-08	1.95E-09	NO DATA	6.39E-09	NO DATA	4.24E-05
PR144	1.29E-10	3.99E-11	6.49E-12	NO DATA	2.11E-11	NO DATA	8.59E-08
ND147	2.79E-08	2.26E-08	1.75E-09	NO DATA	1.24E-08	NO DATA	3.58E-05
W 187	4.29E-07	2.54E-07	1.14E-07	NO DATA	NO DATA	NO DATA	3.57E-05
NP239	5.25E-09	3.77E-10	2.65E-10	NO DATA	1.09E-09	NO DATA	2.79E-05

TABLE 2.2-12*

INGESTION DOSE FACTORS FOR INFANT
(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07
C 14	2.37E-05	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06
NA 24	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05
P 32	1.70E-03	1.00E-04	6.59E-05	NO DATA	NO DATA	NO DATA	2.30E-05
CR 51	NO DATA	NO DATA	1.41E-08	9.20E-09	2.01E-09	1.79E-08	4.11E-07
MN 54	NO DATA	1.99E-05	4.51E-06	NO DATA	4.41E-06	NO DATA	7.31E-06
MN 56	NO DATA	8.18E-07	1.41E-07	NO DATA	7.03E-07	NO DATA	7.43E-05
FE 55	1.39E-05	8.98E-06	2.40E-06	NO DATA	NO DATA	4.39E-06	1.14E-06
FE 59	3.08E-05	5.38E-05	2.12E-05	NO DATA	NO DATA	1.59E-05	2.57E-05
CO 58	NO DATA	3.60E-06	8.93E-06	NO DATA	NO DATA	NO DATA	8.97E-06
CO 60	NO DATA	1.08E-05	2.55E-05	NO DATA	NO DATA	NO DATA	2.57E-05
NI 63	6.34E-04	3.92E-05	2.20E-05	NO DATA	NO DATA	NO DATA	1.95E-06
NI 65	4.70E-06	5.32E-07	2.42E-07	NO DATA	NO DATA	NO DATA	4.05E-05
CU 64	NO DATA	6.09E-07	2.82E-07	NO DATA	1.03E-06	NO DATA	1.25E-05
ZN 65	1.84E-05	6.31E-05	2.91E-05	NO DATA	3.06E-05	NO DATA	5.33E-05
ZN 69	9.33E-08	1.68E-07	1.25E-08	NO DATA	6.98E-08	NO DATA	1.37E-05
BR 83	NO DATA	NO DATA	3.63E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 84	NO DATA	NO DATA	3.82E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR 85	NO DATA	NO DATA	1.94E-08	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	1.70E-04	8.40E-05	NO DATA	NO DATA	NO DATA	4.35E-06
RB 88	NO DATA	4.98E-07	2.73E-07	NO DATA	NO DATA	NO DATA	4.85E-07
RB 89	NO DATA	2.86E-07	1.97E-07	NO DATA	NO DATA	NO DATA	9.74E-08
SR 89	2.51E-03	NO DATA	7.20E-05	NO DATA	NO DATA	NO DATA	5.16E-05
SR 90	1.85E-02	NO DATA	4.71E-03	NO DATA	NO DATA	NO DATA	2.31E-04
SR 91	5.00E-05	NO DATA	1.81E-06	NO DATA	NO DATA	NO DATA	5.92E-05
SR 92	1.92E-05	NO DATA	7.13E-07	NO DATA	NO DATA	NO DATA	2.07E-04
Y 90	8.69E-08	NO DATA	2.33E-09	NO DATA	NO DATA	NO DATA	1.20E-04
Y 91M	8.10E-10	NO DATA	2.76E-11	NO DATA	NO DATA	NO DATA	2.70E-06
Y 91	1.13E-06	NO DATA	3.01E-08	NO DATA	NO DATA	NO DATA	8.10E-05
Y 92	7.65E-09	NO DATA	2.15E-10	NO DATA	NO DATA	NO DATA	1.46E-04

*Taken from Regulatory Guide 1.109 (Rev. 1)

TABLE 2.2-12 (cont'd)

 INGESTION DOSE FACTORS FOR INFANT
 (MREM PER PCI INGESTED)

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

TABLE 2.2-12 (cont'd)

INGESTION DOSE FACTORS FOR INFANT
(MREM PER PCI INGESTED)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
BA140	1.71E-04	1.71E-07	8.81E-06	NO DATA	4.06E-08	1.05E-07	4.20E-05
BA141	4.25E-07	2.91E-10	1.34E-08	NO DATA	1.75E-10	1.77E-10	5.19E-06
BA142	1.84E-07	1.53E-10	9.06E-09	NO DATA	8.81E-11	9.26E-11	7.59E-07
LA140	2.11E-08	8.32E-09	2.14E-09	NO DATA	NO DATA	NO DATA	9.77E-05
LA142	1.10E-09	4.04E-10	9.67E-11	NO DATA	NO DATA	NO DATA	6.86E-05
CE141	7.87E-08	4.80E-08	5.65E-09	NO DATA	1.48E-08	NO DATA	2.48E-05
CE143	1.48E-08	9.82E-06	1.12E-09	NO DATA	2.86E-09	NO DATA	5.73E-05
CE144	2.98E-06	1.22E-06	1.67E-07	NO DATA	4.93E-07	NO DATA	1.71E-04
PR143	8.13E-08	3.04E-08	4.03E-09	NO DATA	1.13E-08	NO DATA	4.29E-05
PR144	2.74E-10	1.06E-10	1.38E-11	NO DATA	3.84E-11	NO DATA	4.93E-06
ND147	5.53E-08	5.68E-08	3.48E-09	NO DATA	2.19E-08	NO DATA	3.60E-05
W 187	9.03E-07	6.28E-07	2.17E-07	NO DATA	NO DATA	NO DATA	3.69E-05
NP239	1.11E-08	9.93E-10	5.61E-10	NO DATA	1.98E-09	NO DATA	2.87E-05

TABLE 2.2-13*

STABLE ELEMENT TRANSFER DATA

<u>Element</u>	B_{iv} <u>Veg/Soil</u>	F_m (Cow) <u>Milk (d/l)</u>	F_f <u>Meat (d/kg)</u>
H	4.8E 00	1.0E-02	1.2E-02
C	5.5E 00	1.2E-02	3.1E-02
Na	5.2E-02	4.0E-02	3.0E-02
P	1.1E 00	2.5E-02	4.6E-02
Cr	2.5E-04	2.2E-03	2.4E-03
Mn	2.9E-02	2.5E-04	8.0E-04
Fe	6.6E-04	1.2E-03	4.0E-02
Co	9.4E-03	1.0E-03	1.3E-02
Ni	1.9E-02	6.7E-03	5.3E-02
Cu	1.2E-01	1.4E-02	8.0E-03
Zn	4.0E-01	3.9E-02	3.0E-02
Rb	1.3E-01	3.0E-02	3.1E-02
Sr	1.7E-02	8.0E-04	6.0E-04
Y	2.6E-03	1.0E-05	4.6E-03
Zr	1.7E-04	5.0E-06	3.4E-02
Nb	9.4E-03	2.5E-03	2.8E-01
Mo	1.2E-01	7.5E-03	8.0E-03
Tc	2.5E-01	2.5E-02	4.0E-01
Ru	5.0E-02	1.0E-06	4.0E-01
Rh	1.3E 01	1.0E-02	1.5E-03
Ag	1.5E-01	5.0E-02	1.7E-02
Te	1.3E 00	1.0E-03 ⁺	7.7E-02
I	2.0E-02	6.0E-03 ⁺	2.9E-03
Cs	1.0E-02	1.2E-02	4.0E-03
Ba	5.0E-03	4.0E-04	3.2E-03
La	2.5E-03	5.0E-06	2.0E-04
Ce	2.5E-03	1.0E-04	1.2E-03
Pr	2.5E-03	5.0E-06	4.7E-03
Nd	2.4E-03	5.0E-06	3.3E-03
W	1.8E-02	5.0E-04	1.3E-03
Np	2.5E-03	5.0E-06	2.0E-04

*Taken from Regulatory Guide 1.109 (Rev. 1)

⁺ F_m for goat is 6.0E-2.

2.3 FUEL CYCLE CALCULATIONS

To comply with Specification 4.21 when the calculated doses associated with the effluent releases exceed twice the limits of any one of the Specifications 3.9.4 or 3.10.5, dose or dose commitment calculations to a real individual from all uranium fuel cycle sources shall be performed to assure that their doses are limited to ≤ 25 mrem to the total body or any organ except the thyroid, which is limited to ≤ 75 mrem, over twelve consecutive months.

The "Uranium fuel cycle" is defined in 40 CFR Part 190.02(b) as:

"Uranium fuel cycle means the operations of milling or uranium ore, chemical conversion of uranium, isotopic enrichment of uranium, fabrication of uranium fuel, generation of electricity by a light-water-cooled nuclear power plant using uranium fuel, and reprocessing of spent uranium fuel, to the extent that these directly support the production of electrical power for public use utilizing nuclear energy, but excludes mining operations, operations at waste disposal sites, transportation of any radioactive material in support of these operations, and the reuse of recovered non-uranium special nuclear and by-product materials from the cycle."

Based on this definition of the fuel cycle, Oconee Nuclear Station is the only facility to be considered in the evaluation of compliance with Specification 4.21. Dose contributions from radioactive liquid and gaseous effluents shall be calculated in accordance with Sections 2.1.1 and 2.2.3 of this manual. The dose from direct radiation, skyshine and radiation from the station storage facilities, at the Exclusion Area Boundary is estimated at 1.2 mrem/yr². This dose rate is conservatively estimated assuming no attenuation by off-site structures or terrain and assuming the dose results from radioactive material stored outside the station buildings in the refueling water storage tanks and the reactor makeup storage tanks. Summation of doses from direct radiation and from radioactive effluents determines the dose to the maximum exposed individual; doses calculated in this manner are extremely conservative for the real individual since it is highly unlikely that the real individual is maximumly exposed to all of the limiting pathways.

²Direct radiation estimates taken from Oconee Nuclear Station Final Environmental Statement, page 127.

3.0 RADIATION MONITORING SETPOINTS

Radiation monitor alarm/trip setpoints shall be calculated for the monitors listed in Tables 3.5.5-1 and 3.5.5-2 of Specification 3.5.5 to assure that the requirements of Specifications 3.9.1 and 3.10.1 are not exceeded at any or all release points to the unrestricted area. Administrative controls may be used to apportion this station limit between the various release points.

3.1 LIQUID MONITORS

The following equation shall be used to calculate liquid radiation monitor setpoints:

$$\frac{cf}{F + f} \leq C$$

where:

C = the effluent concentration limit implementing 10 CFR 20 for the site, in $\mu\text{Ci/ml}$.

c = the radioactivity concentration in $\mu\text{Ci/ml}$, in the effluent line prior to dilution and subsequent release, which may be the set point and, if so, represents a value which, if exceeded, would result in concentrations exceeding the limits of 10 CFR 20 in the unrestricted area.

f = the flow measured at the radiation monitor location in gpm.

F = the dilution water flow as measured prior to the release point in gpm.

(Note that if no dilution is provided, $c \leq C$. Also, note that when 'F' is large compared to 'f', then $F + f \cong F$.)

3.1.1 Liquid Radwaste Effluent Line

As described in Section 1.1.1 of this manual on release rate calculations for the waste liquid effluent, the release is controlled by limiting the flow rate of effluent from the station. Although the release rate is flow rate controlled, the radiation monitor setpoint shall be set to terminate the release if the effluent activity should exceed that determined by laboratory analyses and that used to calculate the release rate.

3.1.2 Turbine Building Sump Discharge Line

As described in Section 1.1.3 of this manual on release rate calculations for the turbine building sump effluent, the effluent is normally considered non-radioactive; that is, it is unlikely the effluent will contain measurable activity above background. It is assumed that no activity is present in the effluent until indicated by radiation monitoring and by routine analysis of the composite sample collected at the oil collection basin. Since the system discharges automatically, the maximum system concentration, which also is the radiation monitor setpoint, is calculated to assure compliance with Specification 3.9.1.

The monitor setpoint and maximum effluent concentration is:

$$c \leq \frac{MPC \times F}{kf} \leq 3.0E-6 \text{ } \mu\text{Ci/ml}$$

where:

c = the gross activity in undiluted effluent, in $\mu\text{Ci/ml}$.

f = the flow rate of undiluted effluent which may vary from 0-600 gpm, but is assumed to be 600 gpm.

C=MPC = $1E-7 \text{ } \mu\text{Ci/ml}$, the MPC for an unidentified mixture.

k = 1

F = the flow may vary from 40 to 6,600 cfs, but is conservatively estimated at 40 cfs ($1.8E-4 \text{ gpm}$), the minimum flow available.

3.2 GAS MONITORS

The following equation shall be used to calculate noble gas radiation monitor setpoints based on Xe-133:

$$K(\chi/Q)Q_i < 500$$

$$Q = 4.72E+2 \text{ C f (see section 1.2.1)}$$

$$C < 8.8E-3/f$$

where:

C = the gross activity in undiluted effluent, in $\mu\text{Ci/ml}$.

f = the flow from the tank or building and varies for various release sources, in cfm.

K = from Table 1.2-1 for Xe-133, $2.94E-2 \text{ mrem/yr per } \mu\text{Ci/m}^3$.

$(\chi/Q) = 4.1E-7 \text{ sec/m}^3$, the highest calculated annual average relative concentration for any area at or beyond the unrestricted area boundary for long term releases.

Three units share the station gaseous effluent release rate at Oconee. Monitor setpoints are calculated for each release point assuming that that release point is the only release point being used at that time. If more than one release is being made at one time, administrative controls may be used to assure that the station release rate is not exceeded.

3.2.1 Waste Gas Effluent Line

As described in Section 1.2.1 of this manual on release rate calculations for gaseous effluents, the release is controlled by limiting the flow rate of effluent from the station. Although the release rate is flow rate controlled, the radiation monitor setpoint shall be set to terminate the release if the effluent activity should exceed that determined by laboratory analyses and that used to calculate the release rate.

3.2.2 Containment Purge

As described in Section 1.2.1 of this manual on release rate calculations for gaseous effluents, the release is controlled by limiting the flow rate of effluent from the station. Although the release rate is flow rate controlled, the radiation monitor setpoint shall be set to terminate the release if the effluent activity should exceed that determined by laboratory analyses and that used to calculate the release rate.

3.2.3 Condenser Air Ejector

The exhaust from the condenser air ejector is normally considered non-radioactive; that is, it is possible but unlikely that the effluent will contain measurable activity above background. It is assumed that no activity is present in the effluent until indicated by radiation monitoring and confirmed by

analysis of grab samples from the line. Since the exhaust is continuous, a maximum concentration of gases in the exhaust, which also is the radiation monitor setpoint, is calculated to assure compliance with Specification 3.10.1. The monitor setpoint is:

$$C < 8.8E3/f < 3.4E-1 \mu\text{Ci/ml}$$

where:

$$f = 257 \text{ cfm}$$

3.2.4 Unit Vent

Releases as described in Sections 3.2.1, 3.2.2, and 3.2.3 of this manual are made through the unit vent, so the radiation monitor on the unit vent may be used to assure that station release limits are not exceeded. Depending on the stack flow, the radiation monitor setpoint may be:

$$C < 8.8E3/f < 9.3E-2 \mu\text{Ci/ml}$$

where:

$$f = 45,000 \text{ cfm (auxiliary building)} + 50,000 \text{ cfm (containment purge)} = 95,000 \text{ cfm}$$

or may be:

$$C < 8.8E3/f < 2.0E-1 \mu\text{Ci/ml}$$

where:

$$F = 45,000 \text{ cfm (auxiliary building ventilation)}$$

3.2.5 Interim Radwaste Building Ventilation Exhaust

Ventilation exhaust from the interim radwaste building is not released through the unit vent and is considered a separate release point. This exhaust is normally considered non-radioactive; that is, it is possible but unlikely that the effluent will contain measurable activity above background. Since the exhaust is continuous, a maximum concentration of gases in the exhaust, which also is the radiation monitor setpoint, is calculated to assure compliance with Specification 3.10.1. The monitor setpoint is:

$$C < 8.8E3/f < 6.3E-1 \mu\text{Ci/ml}$$

where:

$$f = 14,000 \text{ cfm}$$