LONG ISLAND LIGHTING COMPANY

OFFSITE DOSE CALCULATION MANUAL

March 1983

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1.0 INTRODUCTION

The purpose of this manual is to show the calculational methodology and parameters used to comply with the Radiological Effluent Technical Specification (RETS).

Section 2.0 establishes methods to calculate the Liquid Effluent Monitor set point and the Gaseous Effluent Monitor set point in order to comply with RETS Sections 3.3.7.11 and 3.3.7.12, respectively.

Section 3.0 establishes dose calculational methods for liquid and gaseous effluents. The liquid effluents dose calculation methods are used to show compliance with RETS Sections 3.11.1.2 and 3.11.1.3. The dilution factor of 8.85 used in calculation Method 2 is a calculated value based on a submerged, multiport diffuser with a port discharge velocity of 12 fps and a 300 ft radius mixing zone.

The gaseous effluent dose calculation methods are used to show compliance with RETS Sections 3.11.2.1, 3.11.2.2, and 3.11.2.3. The atmospheric dispersion and deposition factors used in calculation methods were calculated based on onsite meteorological data for the 2 year period October 1, 1973 - September 30, 1975.

Section 4.0 identifies the receptor locations which represent critical pathway locations, water dilution, atmospheric dispersion, and deposition factors used in calculation Method 2. Table 4-1 summarizes the above factors for the gaseous effluent pathways.

Section 5.0 indicates locations at which environmental sampling may be conducted.

Tables 3.5-11 through 3.5-15 are incorporated only for future use if there is a change in the land use census which requires considering any combination of the following pathway(s): cows' milk; goats' milk; and meat.

2.0 SET POINTS

2.1 LIQUID EFFLUENT SET POINT (Compliance with Sections 3.3.7.10 and 3.11.1.1 of the Radiological Effluent Technical Specification (RETS)

The radionuclide concentrations released into Long Island Sound via the diffuser may not exceed the concentrations specified in 10CFR20, Appendix B, Table II, Column 2 and 2.00E-04 μCi/ml for dissolved or entrained noble gases.

The alarm set point of the effluent monitors is dependent on:

1. circulating water flow rate, a once-through system (the circulating water system is composed of four pumps and circulates sea water at a rate of 574,000 gpm)
2. discharge waste sample tank flow rate,
3. isotopic composition of liquid to be discharged, and
4. the maximum permissible concentration (MPC) of the radionuclides in the effluent.

2.1.1 Liquid Radwaste Effluent Line Flow Indicator Set Point (FE-179)

A sample will be taken of the liquid to be discharged and an isotopic analysis performed.

Using the results of the isotopic analysis, calculate the following:

$$\frac{C}{MPC} = \frac{C_a}{MPC_A} + \frac{C_b}{MPC_B} + \ldots + \frac{C_n}{MPC_n}$$

where:

C_a , C_b , etc. = concentration of the individual radio nuclides identified (μCi/ml), and

MPC_A , MPC_B, etc. = maximum permissible concentration of the respective radionuclides (μCi/ml) from 10CFR20, Appendix B, Table II, Column 2. For dissolved or entrained noble gases, the MPC assumed will be 2.00E-04.

The quantity $\frac{C}{MPC}$ is numerically equivalent to the required dilution factor (i.e., circulating water flow rate/tank discharge flow rate).

Obtain the circulating water discharge flow rate from the control room.

Calculate the radwaste discharge isolation release rate as follows:

$$\text{Isolation Release Rate (gpm)} = \frac{\text{Circ. Water Flow (gpm)} * .8}{\frac{C}{MPC}}$$

This isolation release rate is the maximum discharge pump release rate which would discharge the tank contents at exactly 80 percent of the MPC permitted in 10CFR20, Appendix B, Table II, Column 2 and 2.00E-04 μCi/ml for dissolved and entrained noble gases.

2.1.1.1 Discharge Waste Sample Tanks, and Recovery Sample Tanks Discharge Radiation Monitor Setpoint (RE-013)

The function of this monitor set point is to verify that the liquid radwaste being discharged has the same activity as was analyzed to be discharged. If the activity is higher than the activity which was analyzed to be discharged, the radiation monitor will terminate the release.

A sample is taken from the discharge waste sample tanks or recovery sample tanks.

1. Discharge waste sample tanks or recovery sample tanks as applicable
2. Reactor building salt water drain tank discharge
3. Residual heat removal heat exchanger service water discharge.

Service water discharge and an isotopic analysis of each sample is performed. This analysis includes isotopic analysis for gamma emitters, alpha emitters, and specifically Sr-89, Sr-90, Fe-55, H_3. If the analysis for alpha emitters, beta emitters, and specifically Sr-89, Sr-90, Fe-55, H_3 cannot be performed at the time of discharge, then the concentrations done to comply with Technical Specification Table 4.11.1.1.1-1 will be used.

Obtain the circulating water flow rate from the control room.

The set point is calculated as follows:

Discharge waste sample tanks setpoint:

$$\text{Setpoint} = \frac{\left[\sum_{i=1}^{N} C_{Di}\, E_i\right]\left[f_D + f_R + f_H + f_S + (F_C - f_H)\right]}{\sum_{i=1}^{N}\left[\frac{f_D C_{Di} + f_R C_{Ri} + f_S C_{si} + f_H C_{Ri}}{(MPC)_i}\right]} \quad \text{(cpm)}$$

Recovery sample tanks setpoint:

$$\text{Setpoint} = \frac{\left[\sum_{i=1}^{N} C_{Si}\, E_i\right]\left[f_D + f_R + f_H + f_S + (F_C - f_H)\right]}{\sum_{i=1}^{N}\left[\frac{f_D C_{Di} + f_R C_{Ri} + f_S C_{Si} + f_H C_{Ri}}{(MPC)_i}\right]} \quad \text{(cpm)}$$

Where

C_{Di} = Discharge waste sample tank concentration of radioisotope(i) (μC_i/ml)

C_{Ri} = Recovery sample tank concentration of radioisotope(i) (μC_i/ml)

C_{Si} = Reactor building salt water drain tank concentration of radioisotope(i) (μC_i/ml)

C_{Hi} = RHR heat exchanger service water outlet concentration of radioisotope(i) (μC_i/ml)

f_D = Discharge waste sample tank discharge flow rate (gpm)

f_R = Recovery sample tank discharge flow rate (gpm)

f_S = Reactor building salt water drain tank discharge flow rate (gpm),

f_H = RHR heat exchanger service water outlet discharge flow rate (gpm),

F_C = Total circulating water flow rate (gpm) (this includes)

E_i = counting efficiency of RE-013 for radionuclide(i) (cpm/Ci/ml)

$(MPC)_i$ = maximum permissible concentration of nuclide(i)(μC_i/ml) from 10CFR20, Appendix B, Table II, Column 2. For dissolved or entrained noble gases, the MPC assumed will be 2.00 E-04.

The above calculation is made for each batch released.

2.1.2 Reactor Building Salt Water Drain Tank Discharge Monitor Set Point (RE-079)

The function of this monitor set point is to verify that the release from the reactor building salt water drain tank does not exceed the concentrations specified in 10CFR20, Appendix B, Table II, Column 2 and 2.00E-04 μC_i/ml for dissolved or entrained noble gas.

A sample will be taken from the reactor building salt water drain tank discharge along with individual samples of any of the following streams which may be in the process of being discharged:

1. Discharge waste sample tank discharge
2. Recovery sample tanks discharge
3. Residual heat removal heat exchanger service water discharge

An isotopic analysis of each sample is performed. This analysis includes isotopic analysis for gamma emitters, alpha emitters, and specifically Sr-89, Sr-90, Fe-55, H_3.

If the analysis for alpha emitters, beta emitters, and specifically Sr-89, Sr-90, FE-55, H_3 cannot be performed at the time of discharge, then the concentrations done to comply with Technical Specification Table 4.11.1.1.1-1 will be used.

Obtain the circulating water flow rate from the control room.

The set point will be calculated as follows:

$$\text{Set point} = \frac{\left[\sum_{i=1}^{N} C_{Ri}\, E_i\right]\left[f_D + f_R + f_H + f_S + (F_C - f_H)\right]}{\sum_{i=1}^{N}\left[\frac{f_D C_{Di} + f_R C_{Ri} + f_S C_{Si} + f_H C_{Ri}}{(MPC)_i}\right]} \quad \text{(cpm)}$$

Where:

E_i = counting efficiency of RE-079 for radionuclide(i) ($cpm/\mu C_i/ml$)

All other parameters are as defined in Section 2.1

When the tank operates on a batch mode, the above calculation is made for each batch to be released.

2.1.3 Residual Heat Removal Heat Exchanger Service Water Outlet Monitor Set Point (RE-023)

The function of this monitor is to detect RHR leakage into the service water. The service water is expected to contain activity only if there is RHR system leakage. Therefore, initially the set point will be based on three times the background. After operation of RHR system, and if activity is measured in the service water system, then the monitor set point will be calculated as follows.

A sample will be taken from the RHR heat exchanger service water outlet along with individual samples of any of the following streams which may be in the process of being discharged:

1. Discharge waste sample tank discharge
2. Recovery sample tanks discharge
3. Reactor building salt water drain tank discharge

An isotopic analysis of each sample is performed. This analysis includes isotopic analysis for gamma emitters, alpha emitters, and specifically Sr-89, Sr-90, Fe-55, H_3.

If the analysis for alpha emitters, beta emitters, and specifically Sr-89, Sr-90, Fe-55, H_3 cannot be performed at the

time of discharge, then the concentrations done to comply with Technical Specification Table 4.11.1.1.1-1 will be used.

Obtain the circulating water flow rate from the control room.

The set point is calculated as follows:

Set point =

$$\frac{\left[\sum_{i=1}^{N} C_{Hi}\, E_{Hi}\right]\left[f_D + f_R + f_H + f_S + (F_C - f_H)\right]}{\sum_{i=1}^{N}\left[\frac{f_D C_{Di} + f_R C_{Ri} + F_s\, C_{Si} + f_H C_{Ri}}{(MPC)_i}\right]} \quad \text{(cpm)}$$

Where:

E_i = counting efficiency of RE-023 for radionuclide (i)

All other parameters are as defined in Section 2.1.

2.2 GASEOUS EFFLUENT MONITOR SET POINT (Compliance with Section 3.3.7.12 of the RETS)

The alarm set point for the station ventilation exhaust monitor is set to the noble gas, total body, dose rate limit specified in Section 3.11.2.1 of the RETS.

Either of two methods may be used to calculate the dose rates based on the measured release rate of each isotope. The first method is the method used by the computerized radiation monitoring system, the second method is an alternate noncomputerized method.

2.2.1 Method 1: (Computerized Method)

Computerized method is under development.

2.2.2 Method 2: (Noncomputerized Method)

To calculate the set point in cpm, the following methodology is established:

1. A gaseous sample from the monitor will be taken and analyzed for isotopic composition and concentration, C_i.

2. At the time of sampling, the count rate, cpm, of the station ventilation exhaust noble gas radiation monitor will be recorded, C.R.

2.2.2.1 Gaseous Effluent Monitor Set Point Based on Noble Gases Total Body Dose Rate

1. The noble gas total body dose rate is calculated using the following equation:

Total Body Dose Rate:

$$\sum_i DR_i = 0.7E\text{-}05 * DFB_i * X/Q * C_i * V \qquad \text{(mrem/hr)}$$

where:

DR_i = predicted dose rate based on gas sample (mrem/hr),

X/Q = 7.94E-07 sec/m³, historic annual average X/Q at 366 meters NNE due to releases via the station ventilation exhaust point,

DFB_i = total body dose rate conversion factor (mrem/yr/pCi/m³), from Table 2.2-1,

C_i = sampled isotope release concentration (pCi/cc),

V = 1.70E+08 cc/sec (3.60E+05 cfm), station ventilation exhaust rate, and

.07 = dose reduction factor due to shielding provided by residential structures.

2. The isotopic release activity concentration is normalized to a total body dose rate of 500 mrem/yr by multiplying by the following normalizing factor:

$$F = 500/\sum DR$$

3. From the above, the set point based on total body dose rate can be calculated as follows:

Set point = F * C.R. (cpm)

where:

Set point = alarm set point that results in a total body dose rate of 500 mrem/yr,

F = normalization factor (unitless), and

C.R. = station ventilation exhaust noble gas radiation monitor count rate (cpm).

The above procedure and format can be used for variable set point calculation.

As an example, the expression could be used to calculate a new set point during containment purge by substituting the appropriate purge X/Q (from Table 4-1), purge V (5.70E+05 cc/sec (1200 cfm)), and purge C_i (pCi/cc).

2.2.2.2 Gaseous Effluent Monitor Set Point Based on Noble Gases Skin Dose Rate

1. The noble gases skin dose rate is calculated using the following equation:

$$\sum_i DR_i = K_{si} * X/Q * C_i * V \quad \text{(mrem/yr)}$$

where:

DR = predicted dose rate based on gas sample, (mrem/yr),

X/Q = 7.94E-07 sec/m³, historic annual average X/Q at 366 meters NNE due to releases via the station ventilation exahust point,

K_{si} = skin dose rate conversion factor (mrem/yr/pCi/m³), from Table 2.2-1,

C_i = sampled isotope release concentration (pCi/cc),

V = 1.70E+08 cc/sec (3.60E+05), station ventilation exhaust rate.

2. The isotopic release activity concentration is normalized to a skin dose rate of 3000 mrem/yr by multiplying by the following normalizing factor:

$$F_S = 3000/\sum DR$$

3. From the above, the alarm set point, based on skin dose rate, can be calculated as follows:

Set point = F * C.R. (cpm)

where:

Set point = alarm set point that results in a skin dose rate of 3000 mrem/yr (cpm),

F = normalization factor (unitless), and

C.R. = station ventilation exhaust noble gas radiation monitor count rate (cpm).

The above procedure and format can be used for variable set point calculation.

As an example, the expression could be used to calculate a new set point during containment purge by substituting the appropriate purge X/Q, (from Table 4-1), purge V (5.70E+05 cc/sec (1200 cfm)), and purge C_i (pCi/cc).

2.2.2.3 Gaseous Effluent Monitor Set Point Based on Organ Dose Rate

1. Skip Step 2 of Section 2.2.2.

2. The organ (inhalation thyroid) dose rate is calculated using the following equation:

$$\sum_i DR_i = 1.14E\text{-}04 * DFA_i * X/Q * C_i * V * R_a \quad \text{(mrem/hr)}$$

where:

DR_i = calculated inhalation dose rate to adult thyroid based on gas sample (mrem/hr),

X/Q = 7.94E-07 sec/m³, historical annual average X/Q at 336 meters NNE due to release via the station ventilation exhaust point,

DFA_i = dose factors adult thyroid only (I-131 through I-135), from Table 3.5-1, (mrem/pCi),

C_i = sampled isotope release concentration (pCi/cc),

V = 1.70E+08 cc/sec station ventilation exhaust rate, and

R_a = constant, adult breathing rate 8,000 m³/yr.

3. The isotopic release activity concentration is normalized to an organ dose rate of .17 mrem/hr by multiplying by the following normalizing factor:

$$F = .17/\sum_{DR}$$

4. From the above, the alarm set point, incremental change during one hour, based on an organ dose rate, can be calculated as follows:

   One Hour Incremental Set Point = F * C * T * S * E (cpm)

   Where:

   One Hour Incremental Set Point = alarm set point that results in an organ dose rate of .17 mrem/hr (or .17 mrem in one hour) (cpm),

   F = normalization factor (unitless),

   C = I-131 concentration in sampled release, (pCi/cc)

   T = Iodine detector efficiency for I-131, (cpm/pCi),

   S = radiation monitor sample flow rate (cc/hr), and

   E = charcoal cartridge Iodine filter efficiency.

2.2.3 Main Condenser Offgas System Effluent Monitor Set Point (RE-065)

1. A gaseous sample from the monitor will be taken and analyzed for isotopic composition and concentration, C_i.

2. At the time of sampling, the count rate, $\frac{mrem}{hr}$, of the monitor will be recorded, CR.

3. The isotopic release activity concentration, C_i, is normalized to 1 MPC at the site boundary by multiplying by the following factor:

$$F = \frac{1}{\left(\sum_{i=1}^{i=n} \frac{C_i}{(MPC)_i} \right) * V * {}^{\Psi}/_{Q}}$$

   Where; V = Main condenser offgas system ventilation flow rate (m^3/sec)

   $^{\Psi}/_{Q}$ = Site boundary annual average meteorological dispersion factor ($\frac{sec}{m^3}$)

5. From the above, the alarm set point, based on 1 MPC at the site boundary, is calculated as follows:

   Set Point = F * (CR) (mr/hr)

2.2.4 Main Condenser Air Ejector Monitor Set Point (RE-012)

1. A gaseous sample from the monitor will be taken and analyzed for noble gases isotopic composition and concentration, $\mu C_i/cc$.

2. At the time of sampling, the count rate, rpm, of the monitor will be recorded, CR.

3. The isotopic release activity concentrations, C_i, are summed and multiplied by the air ejector flow rate, V $\frac{cc}{sec}$ to obtain the noble gas release rate, $\mu C_i/sec$.

4. The release rate in step 3 is normalized to the Technical Specification Section 3.11.2.7 release limit of $244,0000 \mu C_i/sec$ by dividing by $2440000 \mu C_i/sec$.

5. From above, the alarm set point, based on a release rate of $2440000 \mu C_i/sec$ can be calculated as follows:

$$\text{Set Point} = \frac{\sum_i C_i * V * CR}{2440000}$$

2.2.5 Main Condenser Air Ejector Effuluent, Bypass Mode, Set Point (RE-012)

1. A gaseous sample from the monitor will be taken and analyzed for isotopic composition and concentration, C_i.

2. At the time of sampling, the count rate, $\frac{mrem}{hr}$, of the monitor will be recorded, CR.

3. The isotopic release activity concentration, C_i, is normalized to 1 MPC at the site boundary by multiplying by the following factor:

$$F = \frac{1}{\left(\sum_{i=1}^{i=n} \frac{C_i}{(MPC)_i}\right) * V * {}^{\Psi}/_{Q}}$$

Where; V = Main Condenser Air Ejector, bypass mode, Ventilation flow rate (m^3/sec)

Ψ/Q = Site Boundary annual average meterological dispersion factor ($\frac{sec}{m^3}$)

4. From the above, the alarm set point, based on 1 MPC at the Site Boundary, is calculated as follows:

Set Point = F * (CP) (mr/hr)

2.2.5.1 Main Condenser Air Ejector Effluent, Bypass Mode Set Point Based on Main Condenser Air Removal Pump Discharge Monitor (RE-051)

1. A gaseous sample from the monitor will be taken and analyzed for isotopic composition and concentration, C_i.

2. At the time of sampling, the count rate, $\frac{mrem}{hr}$, of the monitor will be recorded, CR.

3. The isotopic release activity concentration, C_i, is normalized to 1 MPC at the site boundary by multiplying by the following factor:

$$F = \frac{1}{\left(\sum_{i=1}^{i=n} \frac{C_i}{(MPC)_i} \right) * \left(V_1 + V_2 \right) * \Psi/Q}$$

Where; V_1 = Air removal pump discharge flow rate (m^3/sec)

V_2 = Air ejector discharge flow rate (m^3/sec)

Ψ/Q = Site boundary annual average meteorological dispersion factor ($\frac{sec}{m^3}$)

4. From the above, the high alarm set point, based on 1 MPC at the site boundary, is calculated as follows:

Set Point = F * (CR) (mrem/hr)

TABLE 2.2-1

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

Radio-nuclide	β-Air [1] (DFb_i)	β-Skin [2] (DFS_i)	γ-Air [1] (DFH_i)	γ-Body [2] (DFB_i)	Ksi [4] Skin Dose [2]
Kr-83m	2.88E-04 [3]	---	1.93E-05	7.56E-08	1.5E-05
Kr-85m	1.97E-03	1.46E-03	1.23E-03	1.17E-03	2.4E-03
Kr-85	1.95E-03	1.34E-03	1.72E-05	1.61E-05	1.4E-03
Kr-87	1.03E-02	9.73E-03	6.17E-03	5.92E-03	1.5E-02
Kr-88	2.93E-03	2.37E-03	1.52E-02	1.47E-02	1.4E-02
Kr-89	1.06E-02	1.01E-02	1.73E-02	1.66E-02	2.4E-02
Kr-90	7.83E-03	7.29E-03	1.63E-02	1.56E-02	2.0E-02
Xe-131m	1.11E-03	4.76E-04	1.56E-04	9.15E-05	6.0E-04
Xe-133m	1.48E-03	9.94E-04	3.27E-04	2.51E-04	1.2E-03
Xe-133	1.05E-03	3.06E-04	3.53E-04	2.94E-04	5.8E-04
Xe-135m	7.39E-04	7.11E-04	3.36E-03	3.12E-03	3.3E-03
Xe-135	2.46E-03	1.86E-03	1.92E-03	1.81E-03	3.4E-03
Xe-137	1.27E-02	1.22E-02	1.51E-03	1.42E-03	1.3E-02
Xe-138	4.75E-03	4.13E-03	9.21E-03	8.83E-03	1.1E-02
Ar-41	3.28E-03	2.69E-03	9.30E-03	8.84E-03	9.9E-03

[1] $\frac{\text{mrad-m}^3}{\text{pCi-yr}}$

[2] $\frac{\text{mrem-m}^3}{\text{pCi-yr}}$

[3] 2.88E-04 = 2.88×10^{-4}

[4] $Ksi = (0.7)(1.11)(DFH_i) + DFS_i$

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3.0 DOSE CALCULATION METHODS

This section presents the calculational specifics required to demonstrate compliance with the following Radiological Effluent Technical Specifications (RETS) sections:

3.11.1.2 - Liquid Effluent Dose Calculation

3.11.1.3 - Operation of Liquid Radwaste Treatment System

3.11.2.1 - Gaseous Effluent Dose Rate

3.11.2.2 - Noble Gas Air Dose

3.11.2.3 - Gaseous Effluent Dose From Radioiodines, Radioactive Materials In Particulate Form

3.11.2.5 - Operation of Ventilation Exhaust Treatment System

Calculation methods are based on the equation and calculational methods described in Regulatory Guide 1.109 "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR50, Appendix I".

Either of two methods may be used to calculate the dose rates based on the measured release rate of each isotope. The first method is the method used by the computerized radiation monitoring system, the second method is an alternate noncomputerized method.

3.1 LIQUID EFFLUENT, DOSE CALCULATION

To comply with Section 3.11.1.2 of the RETS, the liquid effluents released into Long Island Sound (see Fig. 3.1-1) shall be limited:

1. During any calendar quarter to less than or equal to 1.5 mrem to the total body and to less than or equal to 5 mrem to any organ.

2. During any calendar year to less than or equal to 3 mrem to the total body and to less than or equal to 10 mrem to any organ.

3.1.1 Method 1: (Computerized Method)

Equations A through C are to be used to calculate the offsite doses due to release of liquid radwaste. For this dose calculation the actual concentration to be discharged by isotope, the total volume of liquid to be discharged, and the number of circulating water pumps running, supplied by the operator, shall be used.

A. Ingestion of Fish

$$R_{aj} = (0.344 * U_a/K) \sum_{i=1}^{75} Q_i * B_i * D_{aij} * \exp(-L_i + 24.0)$$

where:

R_{aj} = dose to organ (j) of individuals in age group (a) due to the release (mrem),

K = Integer variable, 1 to 4, number of circulating water pumps running,

U_a = constants, child 6.9, teen 16.0, adult 21.0 kg/yr,

Q_i = variable, quantity of each isotope (i) released (curies),

B_i = constants, from Table 3.1-1 for fish,

D_{aij} = constants, from Tables 3.1-2 through 3.1-4, and

L_i = constants, from Table 3.1-5.

B. Ingestion of Seafood

Equation and parameters are identical to Equation A except for the following:

U_a = constants, child 1.7, teen 3.8, adult 5.0 kg/yr, and

B_i = constants, from Table 3.1-1 for seafood.

C. Shoreline Deposits

$$R_{aj} = (0.506 * U_a/K) * \sum_{i=1}^{80} D_{aij} * Q_i * \exp(-L_i * 1.0)/L_i * (1.0 - \exp(-L_i * 1.314E+05))$$

where:

R_{aj} = dose to organ (j) of individuals in age group (a) due to the release (mrem),

Q_i = variable, quantity of each isotope (i) released (curies),

U_a = constants, child 14.0, teen 67.0, adult 12.0 hr/yr, and

D_{aij} = constants, from Table 3.1-6.

All other terms are as defined in Equation A

3.1.2 Method 2: (Noncomputerized Method)

The dose contributions for the total release period shall be calculated for all radionuclides identified in liquid effluents released into Long Island Sound using the following expression:

$$D_\tau = \sum_{i=1}^{N}\left[A_{i\tau} \sum_{l=1}^{M} \Delta t_l \; C_{il} \; F_l\right] \qquad (3.1\text{-}1)$$

where:

D_τ = the cumulative dose or dose commitment to the total body or an organ from the liquid effluents for the total release period $\sum_{l=1}^{M} \Delta t_l$ (mrem),

Δt_l = the length of the l^{th} release period over which C_{il} and F_l are averaged for all liquid released (minutes),

C_{il} = the average concentration of radionuclide C_{il} in undiluted liquid effluent during release period Δt_l from any liquid release (μCi/cc),

$A_{i\tau}$ = the site-related ingestion dose or dose commitment factor to the total body or any organ for each identified principal gamma and beta emitter listed in Table 3.1-7 (mrem/min per μCi/cc), and

F_l = the near field average dilution factor for C_{il}, during any liquid effluent release, defined as the average undiluted liquid waste flow rate during release divided by the product of the average circulating water flow rate times 8.85. (8.85 is the near field mixing factor for the mixing of the diffuser discharge into Long Island Sound.)

If the calculated doses exceed the limit specified above consult RETS Section 3.11.1.2.

3.2 OPERATION OF LIQUID WASTE TREATMENT SUBSYSTEMS

The dose projection analysis will be performed using the methodology described in Section 3.1 with the exception that the calculated doses will be compared with the limits specified in RETS Section 3.11.1.3.

Liquid radwaste subsystems are shown on Fig. 3.2-1.

3.3 DOSE RATE DUE TO GASEOUS EFFLUENTS

To comply with Section 3.11.2.1 of RETS, the dose rate at any time in the unrestricted area for noble gas dose and for organ dose due to radioactive materials in gaseous effluents released via the station ventilation exhaust duct shall be limited to the following values:

1. The dose rate limit for noble gas shall be less than 2 mrem/hr to the total body and less than 12 mrem/hr to the skin, and

2. the dose 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 shall be less than 6 mrem/hr to any organ.

Either of the following two methods may be used to determine the dose rates:

3.3.1 Method 1: (Computerized Method)

3.3.1.1 Noble Gas Total Body and Skin Dose Rate

$$DT_S = (X/Q) * 2.22E+04 * \sum_{i=1}^{15} Q_i * DFB_i$$

$$DS_S = (X/Q) * [(2.46E+04 * \sum_{i=1}^{15} Q_i * DFH_i) + (3.17E+04 * \sum_{i=1}^{15} Q_i * DFS_i)]$$

where:

DT_s and DS_s = dose to adult total body and skin in sector(s) at site boundary, due to noble gases during the last 15 minutes (mrem),

Q_i = variable, quantity of each isotope, i, (noble gases only), released in the last 15 minutes (curies),

(X/Q) = variable, atmospheric dispersion factor for the period of release (site boundary only), (sec/m^3), and

DFB_i, DFH_i, and DFS_i = constants, from Table 2.2-1.

3.3.1.2 Organ Dose Rate (Particulate Release)

The organ dose rate will be calculated as described in Section 3.5.1.1.

3.3.2 Method 2: (Noncomputerized Method)

3.3.2.1 Noble Gas Total Body Dose Rate

$$DT_s = 1.14E\text{-}04 * X/Q_1 * \sum_i [DFB_i * (C_{i_1} * V_1 - C_{i_2} * V_2 - C_{i_3} * V_3)] * 0.70$$

$$+ 1.14E\text{-}04 * V_2 * X/Q_2 * \sum_i [DFB_i * C_{i_2}] * 0.70$$

$$+ 1.14E\text{-}04 * V_3 * X/Q_3 * \sum_i [DFB_i * C_{i_3}] * 0.70$$

During periods of no intermittent releases such as no main condenser air removal pump operation and no containment drywell purge the above formula reduces to the following:

$$DT_s = 1.14E\text{-}04 * V_1 * X/Q_1 * \sum_i [DFB_i * C_{i_1}] * 0.70$$

$$= 8.00E\text{-}05 * V_1 * X/Q_1 * \sum_i [DFB_i * C_{i_1}]$$

where:

DT_S = total body dose rate from all radionuclides releases (mrem/hr),

DFB_i = the total body dose rate factor due to gamma emissions for each identified noble gas radionuclide (mrem/yr per pCi/m³) (Table 2.2-1),

C_{i1} = the station ventilation exhaust duct release concentration of radionuclide, i, (pCi/cc) (from the isotopic analyses performed on the gaseous sample taken from the station ventilation exhaust monitor),

C_{i2} = the air removal pump ventilation exhaust duct release concentration of radionuclide, i, (pCi/cc) (from the isotopic analyses performed on the gaseous sample taken from the air removal pump discharge monitor),

C_{i3} = the containment drywell purge ventilation exhaust concentration of radionuclide, i, (pCi/cc) (from the isotopic analyses performed on the gaseous sample taken from the containment drywell filter train exhaust monitor),

V_1 = 1.70E+08 cc/sec (3.60E+05 cfm), station ventilation exhaust duct ventilation exhaust flow rate,

V_2 = 5.70E+05 cc/sec (1200 cfm), air removal pump exhaust duct ventilation exhaust flow rate,

V_3 = 5.70E+05 cc/sec (1200 cfm), containment drywell purge ventilation exhaust flow rate,

X/Q_1 = 7.94E-07 sec/m³, historic annual average X/Q at 366 meters NNE due to release via the station ventilation exhaust point,

X/Q_2 = 1.89E-06 sec/m³, historic annual average, short term X/Q at 1931 meters ESE due to air removal pump release via the station ventilation exhaust point,

X/Q_3 = 1.89E-06 sec/m³, historic annual average short term X/Q at 1931 meters ESE due to containment drywell purge via the station ventilation exhaust point,

1.14E-04 = inverse of 8,760 hr/yr, and

0.70 = shielding factor that accounts for dose reduction due to shielding from residential structures.

Substituting historic values for X/Q's and V's.

The noble gas total body dose rate (mrem/hr) is calculated by the following equation:

$$DT_s = 3.7E\text{-}05 * \sum_i [DFB_i * (298\ C_{i_1} - C_{i_2} - C_{i_3})]$$

$$+ 8.4E\text{-}05 * \sum_i [DFB_i * C_{i_2}] + 8.4E\text{-}05 * \sum_i [DFB_i * C_{i_3}]$$

Note that during periods of no intermittent releases such as no main condenser air removal pump operation and no containment drywell purge the above formula reduces to the following:

$$DT_s = 1.1E\text{-}02 * \sum [DFB_i * C_{i_1}] \quad \text{mrem/hr}$$

3.3.2.2 Noble Gas Skin Dose Rate

$$DS_s = 1.14E\text{-}04 * X/Q_1 * \sum_i [K_{si} * (C_{i_1} * V_i - C_{i_2} * V_2 - C_{i_3} * V_3)]$$

$$+ 1.14E\text{-}04 * V_2 * X/Q_2 * \sum_i [K_{si} * C_{i_2}]$$

$$+ 1.14E\text{-}04 * V_3 * X/Q_3 * \sum_i [K_{si} * C_{i_3}]$$

During periods of no intermittent releases such as no main condenser air removal pump operation and no containment drywell purge the above formula reduces to the following:

$$DS_s = 1.14E\text{-}04 * V_1 * X/Q_1 * \sum_i [K_{si} * C_{i_1}]$$

where:

DS_s = skin dose from all radionuclides released (mrem/hr),

K_{si} = the skin dose factor due to beta and gamma emissions for each identified noble gas radionuclide (mrem/yr per pCi/m³) from Table 2.2-1,

C_{i1} = the station ventilation exhaust duct release concentration of radionuclide, i, (pCi/cc) (from isotopic analyses performed on the gaseous sample taken from the station ventilation exhaust monitor),

C_{i2} = the air removal pump ventilation exhaust duct release concentration of radionuclide, i, (pCi/cc) (from the isotopic analyses performed on the gaseous sample taken from the air removal pump discharge monitor),

C_{i3} = the containment drywell purge ventilation exhaust concentration of radionuclide, i, (pCi/cc) (from the isotopic analyses performed on the gaseous sample taken from the containment drywell filter train exhaust monitor),

V_1 = 1.7E+08 cc/sec (3.60E+05 cfm), station ventilation exhaust duct ventilation exhaust flow rate,

V_2 = 5.70E+05 cc/sec (1200 cfm), air removal pump exhaust duct ventilation exhaust flow rate,

V_3 = 5.70E+05 cc/sec (1200 cfm), containment drywell purge ventilation exhaust flow rate,

X/Q_1 = 7.94E-07 sec/m^3, historic annual average X/Q at 366 meters NNE due to release via the station ventilation exhaust point,

X/Q_2 = 1.89E-06 sec/m^3, historic annual average short term X/Q at 1931 meters ESE due to air removal pump release via the station ventilation exhaust point,

X/Q_3 = 1.89E-06 sec/m^3, historic annual average short term X/Q at 1931 meters ESE due to containment drywell purge via the station ventilation exhaust point, and

1.14E-04 = inverse of 8,760 hr/yr.

3.3.2.3 Organ Dose Rate (particulate releases)

$$DS_s = 1.14E\text{-}04 * \sum_i [P_{ij} * X/Q_1 * (C_{i_1} V_1 - C_{i_2} V_2)]$$

$$- C_{i_3} V_3)] + 1.14E\text{-}04 * V_2 * \sum_i [P_{ij} * X/Q_2 * C_{i_2}]$$

$$+ 1/4E\text{-}04 * V_3 * \sum_i [P_{ij} * X/Q_3 * C_{i_3}]$$

During periods of no intermittent releases such as no main condenser air removal pump operation and no containment drywell purge the above formula reduces to the following:

$$D_s = 1.14E\text{-}04 * V_1 * \sum_i P_{ij} * X/Q_1 * C_{i_1}$$

where:

D_s = total dose rate to organ j (mrem/hr),

P_{ij} = the inhalation dose rate conversion factor for radionuclides other than noble gases, i, and organ j, (mrem/yr per $\mu Ci/m^3$) from Table 3.3-1,

C_{i1} = the station ventilation exhaust duct release concentration of radionuclide, i, ($\mu Ci/cc$) (from the isotopic analyses performed on the filter paper and charcoal cartridge taken from the station ventilation exhaust monitor),

C_{i2} = the air removal pump ventilation exhaust duct release concentration of radionuclide, i, ($\mu Ci/cc$) (from the isotopic analyses performed on the iodine and filter cartridge taken from the air removal pump discharge monitor),

C_{i3} = the containment drywell purge ventilation exhaust concentration of radionuclide, i, ($\mu Ci/cc$) (from the isotopic analyses performed on the gaseous sample taken from the containment drywell filter train exhaust monitor),

V_1 = 1.70E+08 cc/sec (3.60E+05 cfm), station ventilation exhaust duct ventilation exhaust flow rate,

V_2 = 5.70E+05 cc/sec (1200 cfm), air removal pump exhaust duct ventilation exhaust flow rate,

V_3 = 5.70E+05 cc/sec (1200 cfm), containment drywell purge ventilation exhaust flow rate,

X/Q_1 = 1.10E-07 sec/m^3, historic annual average X/Q at 1931 meters ESE due to releases via the station ventilation exhaust point,

X/Q_2 = 3.60E-07 sec/m^3, historic annual average short term X/Q at 1931 meters ESE due to condenser air removal pump release via the station ventilation exhaust point,

X/Q_3 = 3.60E-07 sec/m^3, historic annual average short term X/Q at 1931 meters ESE due to containment drywell purge via the station ventilation exhaust point,

D/Q_1 = 4.80E-09 m^{-2}, historic annual average D/Q deposition factor at 1931 meters ESE due to releases via the station ventilation exhaust point,

D/Q_2 = 1.40E-08 m^{-2}, historic annual average short term D/Q deposition factor at 1931 meters ESE due to condenser air removal pump releases via the station ventilation exhaust point,

D/Q_3 = 1.40E-08 m^{-2}, historic annual average short term D/Q deposition factor at 1931 meters ESE due to containment drywell purge via the station ventilation exhaust point, and

1.14E-04 = Inverse of 8,760 hr/yr.

Substituting constant historic values for X/Qs, D/Q's, and V.

The organ dose rate (mrem/hr) from the particulate releases is calculated by the following equation:

$$D_s = 1.14E\text{-}04 * \sum_i [(1.10E\text{-}07\ P_{ij})$$

$$* (1.70E+08\ C_{i_1} - 5.70E+05\ C_{i_2} - 5.70E+05\ C_{i_3})]$$

$$+ 6.50E+01 * \sum_i [(3.60E\text{-}07\ P_{ij} * C_{i_2}]$$

$$+ 6.50E+01 * \sum_i [(3.60E\text{-}07\ P_{ij} * C_{i_3}]$$

Note that during periods of no intermittent releases such as no main condenser air removal pump operation and no Containment Drywell purge the above formula reduces to the following:

$$D_s = 1.90E+04 * \sum_i 1.10E\text{-}07\ P_{ij} * C_{i_1}$$

3.4 GASEOUS EFFLUENTS, NOBLE GAS AIR DOSE

To comply with Section 3.11.2.2 of the RETS, the air dose in unrestricted area location due to releases via the station ventilation exhaust point shall be limited to the following:

1. During any calendar quarter to less than or equal to 5 mrad for gamma radiation and less than or equal to 10 mrad for beta radiation.

2. During any calendar year to less than or equal to 10 mrad for gamma radiation and less than or equal to 20 mrad for beta radiation.

Either of the following two methods may be used to determine the dose:

3.4.1 Method 1: (Computerized Method)

3.4.1.1 Noble Gas Gamma and Beta Air Dose

$$D_{G_S} = 3.17E+04 + (X/Q) * \sum_{i=1}^{15} Q_i * DFH_i$$

$$D_{B_S} = 3.17E+04 * (X/Q) * \sum_{i=1}^{15} Q_i * DFB_i$$

where:

D_{G_S} and D_{B_S} = dose in sector(s) at site boundary due to gamma air and beta air radiation (mrad),

Q_i = variable, quantity of each isotope, i, released in the last hour (curies),

(X/Q) = variable, atmospheric dispersion factor for the period of release (site boundary only) (sec/m³), and

DFH_i and DFB_i = constants, from Table 2.2-1.

3.4.2 Method 2: (Noncomputerized Method)

3.4.2.1 Noble Gas Gamma Air Dose

The general equation is:

$$D_{G_S} = 3.17E-08 * \sum_i \left[(M_i * X/Q_1) * (C_{i_1} V_1 t_1 - C_{i_2} V_2 t_2 - C_{i_3} V_3 t_3) \right]$$

$$+ 3.17E-08 * V_2 * t_2 * X/Q_2 * \sum_i \left[M_i * C_{i_2} \right]$$

$$+ 3.17E-08 * V_3 * t_3 * X/Q_3 * \sum_i \left[M_i * C_{i_3} \right]$$

During periods of no intermittent releases, such as no main condenser air removal pumps operation and no containment drywell purge the above formula reduces to the following:

$$D_{G_S} = 3.17E-08 * V_1 * X/Q_1 * t_1 * \sum_i \left[M_i + C_{i_1} \right]$$

where:

D_{GS} = the total gamma air dose from the releases (mrad),

3.17E-08 = the inverse of number of seconds in a year,

M_i = the air dose factor due to gamma emissions for each identified noble gas radionuclide (mrad/yr per $\mu Ci/m^3$) from Table 3.4-1,

t = release period (seconds),

C_{i1} = the station ventilation exhaust duct release concentration of radionuclide, i, ($\mu Ci/cc$) (from the isotopic analyses performed on the gaseous sample taken from the station ventilation exhaust monitor),

C_{i2} = the air removal pump ventilation exhaust duct release concentration of radionuclide, i, ($\mu Ci/cc$) (from the isotopic analyses performed on the gaseous sample taken from the air removal pump discharge monitor),

C_{i3} = the containment drywell purge ventilation exhaust concentration of radionuclide, i, ($\mu Ci/cc$) (from the isotopic analyses performed on the gaseous sample taken from the containment drywell filter train exhaust monitor),

V_1 = 1.70E+08 cc/sec (3.60E+05 cfm), station ventilation exhaust duct ventilation exhaust flow rate,

V_2 = 5.70E+05 cc/sec (1200 cfm), air removal pump exhaust duct ventilation exhaust flow rate,

V_3 = 5.70E+05 cc/sec (1200 cfm), containment drywell purge ventilation exhaust flow rate,

X/Q_1 = 8.44E-07 sec/m^3, historic annual average X/Q at 457 meters ESE due to release via the station ventilation exhaust point,

X/Q_2 = 1.83E-06 sec/m^3, historic annual average, short term X/Q at 457 meters ESE due to condenser air ESE due to condenser air removal pump release via the station ventilation exhaust point, and

X/Q_3 = 1.83-06 sec/m^3, historic annual average, short term X/Q at 457 meters ESE due to containment drywell purge release via the station ventilation exhaust release point.

Substituting historic values for X/Q's and V.

The noble gas gamma air dose is calculated by the following equation:

$$D_{G_S} = 1.60E\text{-}08 * \sum_i \left[(M_i) * (298\, C_{i_1} t_1 - C_{i_2} t_2 - C_{i_3} t_3) \right]$$

$$+ 3.30E\text{-}08 * \sum_i \left[M_i * C_{i_2} * t_2 \right] + 3.30E\text{-}08 * \sum_i \left[M_i * C_{i_3} * t_3 \right]$$

Note that during periods of no intermittent releases such as no main condenser air removal pump operation and no containment drywell purge the above formula reduces to the following:

$$D_{G_S} = 4.50E\text{-}06\ t_1 * \sum_i \left[M_i * C_{i_1} \right]$$

3.4.2.2 Noble Gas Beta Air Dose

The general equation is:

$$D_{B_S} = 3.17E\text{-}08 * X/Q_1 * \sum \left[(N_i) * (C_{i_1} V_1 t_1 - C_{i_2} V_2 t_2 - C_{i_3} V_3 t_3) \right]$$

$$+ 3.17E\text{-}08 * X/Q_2 * V_2 * t_2 * \sum_i \left[N_i + C_{i_2} \right]$$

$$+ 3.17E\text{-}08 * X/Q_3 * V_3 * t_3 * \sum_i \left[N_i * C_{i_3} \right]$$

During periods of no intermittent releases, such as no main condenser air removal pump operation and no containment drywell purge the above formula reduces to the following:

$$D_{B_S} = 3.17E\text{-}08 * X/Q_1 * V_1 * t_1 * \sum_i \left[N_i * C_{i_1} \right]$$

where:

D_{B_S} = beta air dose from all radionuclides released (mrem/yr),

N_i = the air dose factor due to beta emissions for each identified noble gas radionuclide (mrad/yr per $\mu Ci/m^3$) from Table 3.4-1,

3.17E-08 = the inverse of number of seconds in a year,

t = release period (seconds),

C_{i1} = the station ventilation exhaust duct release concentration of radionuclide, i, ($\mu Ci/cc$) (from the isotopic analyses performed on the gaseous sample taken from the station ventilation exhaust monitor),

C_{i2} = the air removal pump ventilation exhaust duct release concentration of radionuclide, i, ($\mu Ci/cc$) (from the isotopic analyses performed on the gaseous sample taken from the air removal pump discharge monitor),

C_{i3} = the containment drywell purge ventilation exhaust concentration of radionuclide, i, ($\mu Ci/cc$) (from the isotopic analysis performed on the gaseous sample taken from the containment drywell filter train exhaust monitor),

V_1 = 1.70E+08 cc/sec (3.60E+05 cfm), station ventilation exhaust duct ventilation exhaust flow rate,

V_2 = 5.70E+05 cc/sec (1200 cfm), air removal pump exhaust duct ventilation exhaust flow rate,

V_3 = 5.70E+05 cc/sec (1200 cfm), containment drywell purge ventilation exhaust flow rate,

X/Q_1 = 8.44E-07 sec/m^3, historic annual average X/Q at 457 meters ESE due to release via the station ventilation exhaust point,

X/Q_2 = 1.83E-06 sec/m^3, historic annual average short term X/Q at 457 meters ESE due to condenser air removal pump release via the station ventilation exhaust point, and

X/Q_3 = 1.83E-06 sec/m³, historic annual average short term X/Q at 457 meters ESE due to containment drywell purge release via the station ventilation exhaust point.

The noble gas beta air dose is calculated by the following equation:

Substituting historic values for X/Q's and V's the general equation reduces to:

$$D_{B_S} = 1.60E\text{-}08 * \sum_i \left[(N_i) * (298\, C_{i_1} t_1 - C_{i_2} t_2 - C_{i_3} t_3) \right]$$

$$+ 3.30E\text{-}08 * t_2 * \sum_i \left[N_i * C_{i_2} \right] + 3.30E\text{-}08 * t_3 * \sum_i \left[N_i * C_{i_3} \right]$$

Note that during periods of no intermittent releases such as no main condenser air removal pump operation and no containment drywell purge the above formula reduces to the following:

$$D_{Bs} = 3.30E\text{-}08 * t_1 * \sum_i \left[N_i * C_{i_1} \right]$$

3.5 GASEOUS EFFLUENT, DOSE DUE TO RADIOIODINES AND RADIOACTIVE MATERIALS IN PARTICULATE FORM AND RADIONUCLIDES (other than Noble Gases) with Half-Lives Greater than 8 days

To comply with Section 3.11.2.3 of the Radiological Effluent Technical Specifications, the organ dose to maximum individual in unrestricted area due to radioiodines and particulates releases via the station ventilation exhaust point shall be limited to the following:

1. During any calendar quarter to less than or equal to 7.5 mrem to any organ, and

2. During any calendar year to less than or equal to 15 mrem to any organ.

Either of the following two methods may be used to determine the dose:

3.5.1 Method 1: (Computerized Method)

3.5.1.1 Organ Doses

A. Inhalation Dose

$$D_{jasL} = 3.17E+04 * (X/Q)_L * R_a * \sum_{i=1}^{80} Q_i * DFA_i$$

where:

D_{jasl} = dose to an organ (j) of a person in age group (a) in sector(s) at location (L) during the last hour (mrem),

R_a = constants, child 3,700, teen 8,000, adult 8,000, infant 1,400 m^3/yr,

Q_i = variable, quantity of isotope (i) released in the last hour (curies),

$(X/Q)_L$ = variables, atmospheric dispersion factors at location (L) for the period of release (sec/m^3), and

DFA_i = constants, from Tables 3.5-1 through 3.5-4.

B. Dose Due to Standing on Contaminated Ground

$$D_{jsL} = 7.00E+11 * (D/Q)_L * \sum_{i=1}^{80} DFG_{ij} * Q_i / L_i$$

$$* (1.0 - \exp)(-L_i * 1.31E+05))$$

where:

D_{jsl} = dose to organ (j) of individuals in all age groups in sector (s) at location (L) due to the release (mrem),

$(D/Q)_L$ = variables, relative deposition factors at location (L) for the period of release (m^{-2}),

DFG_{ij} = constants, from Table 3.1-6,

Q_i = variable, quantity of each isotope (i) released in the last hour (curies), and

L_i = constants, from Table 3.1-5.

C. Dose Due to Eating Vegetation

For All Isotopes Except H-3 and C-14

$$D_{jas} = 1.00 * C * U_a * (D/Q) * \sum_{i=1}^{78} DFI_{ij} * Q_i$$

$$* [(R/2.0*E_i) + (B_{iv}/2.40.0*L_i)] * \exp(-L_i * 24.0)$$

For C-14

$$D_{jas} = 2.2E+07 * U_a * (X/Q) * Q_{14} * DFI_{ij}$$

For H-3

$$D_{jas} = 1.2E+07 * DFI_{ij} * U_a * (X/Q) * Q_t/H$$

where:

D_{jas} = dose to organ (j) of an individual in age group (a) in sector (s) due to the release (mrem),

C = constants, 5.50E+07 for iodines, 1.10E+08 for other isotopes,

U_a = constants, child 26.0, teen 42.0, adult 64.0 kg/yr (from Table 3.5-5),

(D/Q) = variable, relative deposition factor at the nearest garden for the period of release (m^{-2}),

DFI_{ij} = constants, from Tables 3.1-2 through 3.1-4,

Q_i = variable, quantity of each isotope (i) released in the last hour (curies),

R = constants, 1.0 for iodines, 0.2 for other isotopes,

E_i = L + 0.0021,

B_{ii} = constants, from Table 3.5-6,

L_i = constants, from Table 3.1-5,

(X/Q) = variable, atmospheric dispersion factor at the nearest garden for the period of release (sec/m^3),

Q_{14} = variable, quantity of C-14 released in the last hour (curies),

Q_t = variable, quantity of H-3 released in the last hour (curies), and

H = constants, from Table 3.5-7.

D. Dose Due to Drinking Milk

For All Isotopes Except C-14 and H-3

$$D_{jas} = Qf * U_a * (D/Q) * C * \sum_{i=1}^{78} F_{mi} * [(R/0.75*E_i) + (B_{iv}/240.0*L_i)] * DFI_{ija} * Q_i * \exp(-L_i * 48.0)$$

For C-14

$$D_{jas} = 2.20E+07 * DFI_{ija} * U_a * Q_{14} * (X/Q) * Qf * F_{mi} * \exp(-L_i * 48.00)$$

For H-3

$$D_{jas} = 1.20E+07 * DFI_{ija} * U_a * Qt * (X/Q) * Qf * F_{mi} * \exp(-L_i * 48.0)/H$$

where:

D_{jas} = dose to organ (j) of an individual in age group (a) in sector (s) at the nearest cow (mrem),

U_a = constants, child 330, teen 400, adult 310, infant 330 litres/yr,

F_{mi} = constants, from Table 3.5-6,

Qf = constants, 50 kg/day for cattle,

(X/Q) = variable, atmospheric dispersion factor at the nearest cow for the period of release (sec/m^3), and

(D/Q) = variable, relative dispersion factor at the nearest cow for the period of release (m^{-2}).

All other terms are as defined in Equation B.

3.5.2 Method 2: (Backup Method)

3.5.2.1 Organ Doses:

$$D_j = 3.17E\text{-}08 * \sum_i \left[(P_{ij} * X/Q_1 + P_{oij} * D/Q_1) * (C_{i_1} * V_1 * t_1 - C_{i_2} * V_2 * t_2 - C_{i_3} * C_3 * t_3) \right]$$

$$+ 3.17E\text{-}08 * t_2 * \sum_i \left[(P_{ij} * X/Q_2 + P_{oij} * D/Q_2) * C_{i2} \right]$$

$$+ 3.17E\text{-}08 * t_3 * \sum_i \left[(P_{ij} * X/Q_3 + P_{oij} * D/Q_3) * C_{i_3} \right]$$

(3.5.1-1)

During periods of no intermittent releases, such as no main condenser air removal pump operation and no containment drywell purge the above formula reduces to the following:

$$D_j = 3.17E\text{-}08 * t_1 * \sum_i \left[(P_{ij} * X/Q + P_{oij} * D/Q_1) * C_{i_1} \right]$$

where:

D_j = total dose to organ j (mrem/yr),

P_{ij} = the inhalation dose conversion factor for radionuclides, i, (other than noble gases), and organ j, (mrem/yr per μCi/m) from Table 3.5-8,

P_{oij} = the dose conversion factor for radionuclides, other than noble gases, i, and organ j, for the leafy vegetables, stored vegetables, and contaminated ground pathways in m^2 (mrem/yr per μCi/sec) respectively, from Table 3.5-9 the dose factors P_{ij}, P_{oij} are based on the critical individual organ for the child group, since this group is most restrictive),

t = release period (seconds),

C_{i1} = the station ventilation exhaust duct release concentration of radionuclide, i, (μCi/cc) (from the isotopic analyses performed on the iodine and filter cartridge taken from the station ventilation exhaust monitor),

C_{i2} = the air removal pump ventilation exhaust duct release concentration of radionuclide, i, (μCi/cc) (from the isotopic analyses performed on the iodine and filter cartridge taken from the air removal pump discharge monitor),

C_{i3} = the containment drywell purge ventilation exhaust concentration of radionuclide, i, (μCi/cc) (from the isotopic analyses performed on the gaseous sample taken from the containment drywell filter train exhaust monitor),

V_1 = 1.70E+08 cc/sec (3.60E+05 cfm), station ventilation exhaust duct ventilation exhaust flow rate,

V_2 = 5.70E+05 cc/sec (1200 cfm), air removal pump exhaust duct ventilation exhaust flow rate,

V_3 = 5.70E+05 cc/sec (1200 cfm), containment drywell purge ventilation exhaust flow rate,

X/Q_1 = 1.10E-07 sec/m^3, historic annual average X/Q at 1931 meters ESE due to releases via the station ventilation exhaust point,

X/Q_2 = 3.60E-07 sec/m^3, historic annual average short term X/Q at 1931 meters ESE due to condenser air removal pump release via the station ventilation exhaust point,

X/Q_3 = 3.60E-07 sec/m^3, historic annual average short term X/Q at 1931 meters ESE due to containment drywell purge via the station ventilation exhaust point,

D/Q_1 = 4.80E-09 m^{-2}, historic annual average D/Q deposition factor at 1931 meters ESE due to releases via the station ventilation exhaust point,

D/Q_2 = 1.40E-08 m^{-2}, historic annual average short term D/Q deposition factor at 1931 meters ESE due to condenser air removal pump releases via the station ventilation exhaust point,

D/Q_3 = 1.40E-08 m^{-2}, historic annual average short term D/Q deposition factor at 1931 meters ESE due to containment drywell purge exhaust via the station ventilation exhaust point.

The organ dose from the particulate releases is calculated by the following equation:

Substituting constant historic values for X/Q's, D/Q's, and V's, the general equation reduces to:

$$D_j = 3.17E\text{-}08 * \sum_i \left[(1.10E\text{-}07\ P_{ij} + 4.80E\text{-}09\ P_{oij})\right]$$

$$*(1.70E+08\ C_{i1}\ \tau_1 - 5.70E+05\ C_{i2}\ \tau_2 - 5.70E+05\ C_{i3}\ \tau_3)$$

$$+ 3.17E\text{-}08 * \sum_i \left[(3.60E\text{-}07\ P_{ij} + 1.40E\text{=}08\ P_{oij}) * C_{i2} * \tau_2\right]$$

$$+ 3.17E\text{-}08 * \sum_i \left[(3.60E\text{-}07\ P_{ij} + 1.40E\text{-}08\ P_{oij}) * C_{i3} * \tau_3\right]$$

(3.5.1-2)

Note that during periods of no intermittent releases such as no main condenser air removal pump operation and no containment drywell purge the above formula reduces to the following:

$$D_j = 3.17E\text{-}08 * t_1 * \sum_i \left[(18.7\ P_{ij} + .82\ P_{oij}) * C_{i1}\right]$$

NOTE:

If the land use census (Table 3.5-10) changes, the critical location, i.e., the location where an individual would be exposed to the highest dose, must be reevaluated using Equation 3.5.1-1 for each of the following locations:

1. nearest residence,
2. nearest vegetable garden, and
3. nearest milk cow or goat.

At each location, the following pathways must be considered and dose (dose rates) reevaluated if any actual pathway exists:

1. inhalation,

2. leafy vegetables (fresh),
3. stored vegetables,
4. goat's or cow's milk (if both exist choose the one resulting in a higher dose), and
5. deposition on ground.

Since a person will always be present, pathways 1 and 5 must always be evaluated.

Once the location of the critical individual is determined and found to be other than the one at 1931 meters ESE, the values of X/Q and D/Q in Equation 3.5.1-2 become invalid. Values for X/Q and D/Q at the updated critical location must be used.

3.6 OPERATION OF VENTILATION EXHAUST TREATMENT SYSTEM

The Ventilation Exhaust Treatment System (Fig. 3.6-1) shall be used to reduce radioactive materials in gaseous waste prior to their discharge as specified in RETS Section 3.11.2.5. The dose analysis will be performed as described in Sections 3.5.1 or 3.5.2. If the calculated doses exceed the limits specified above consult RETS Section 3.11.2.5.

TABLE 3.1-1

BIOACCUMULATION FACTORS TO BE USED IN THE ABSENCE OF SITE-SPECIFIC DATA
(pCi/kg per pCi/liter)[1]

Element	Saltwater	
	Fish	Invertebrate
H	9.0E-01	9.3E-01
C	1.8E+03	1.4E+03
Na	6.7E-02	1.9E-01
P	2.9E+04	3.0E+04
Cr	4.0E+02	2.0E+03
Mn	5.5E+02	4.0E+02
Fe	3.0E+03	2.0E+04
Co	1.0E+02	1.0E+03
Ni	1.0E+02	2.5E+02
Cu	6.7E+02	1.7E+03
Zn	2.0E+03	5.0E+04
Br	1.5E-02	3.1E+00
Rb	8.3E+00	1.7E+01
Sr	2.0E+00	2.0E+01
Y	2.5E+01	1.0E+03
Zr	2.0E+02	8.0E+01
Nb	3.0E+04	1.0E+02
Mo	1.0E+01	1.0E+01
Tc	1.0E+01	5.0E+01
Ru	3.0E+00	1.0E+03
Rh	1.0E+01	2.0E+03
Te[2]	1.0E+01	1.0E+02
I	1.0E+01	5.0E+01
Cs	4.0E+01	2.5E+01
Ba	1.0E+01	1.0E+02
La	2.5E+01	1.0E+03
Ce	1.0E+01	6.0E+02
Pr	2.5E+01	1.0E+03
Nd	2.5E+01	1.0E+03
W	3.0E+01	3.0E+01
Np	1.0E+01	1.0E+01

[1] Values in Table 3.1-1 are taken from Reference 6 of Regulatory Guide 1.109, Rev. 1, Oct. 1977 unless otherwise indicated.

[2] Data taken from Reference 8 of Regulatory Guide 1.109, Rev. 1, Oct. 1977.

TABLE 3.1-2

INGESTION DOSE FACTORS FOR ADULTS
(mrem per pCi ingested)

Radio-nuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	No Data	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
C-14	2.84E-06	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07
Na-24	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06
P-32	1.93E-04	1.20E-05	7.46E-06	No Data	No Data	No Data	2.17E-05
Cr-51	No Data	No Data	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
Mn-54	No Data	4.57E-06	8.72E-07	No Data	1.36E-06	No Data	1.40E-05
Mn-56	No Data	1.15E-07	2.04E-08	No Data	1.46E-07	No Data	3.67E-06
Fe-55	2.75E-06	1.90E-06	4.43E-07	No Data	No Data	1.06E-06	1.09E-06
Fe-59	4.34E-06	1.02E-05	3.91E-06	No Data	No Data	2.85E-06	3.40E-05
Co-58	No Data	7.45E-07	1.67E-06	No Data	No Data	No Data	1.51E-05
Co-60	No Data	2.14E-06	4.72E-06	No Data	No Data	No Data	4.02E-05
Ni-63	1.30E-04	9.01E-06	4.36E-06	No Data	No Data	No Data	1.88E-06
Ni-65	5.28E-07	6.86E-08	3.13E-08	No Data	No Data	No Data	1.74E-06
Cu-64	No Data	8.33E-08	3.91E-08	No Data	2.10E-07	No Data	7.10E-06
Zn-65	4.84E-06	1.54E-05	6.96E-06	No Data	1.03E-05	No Data	9.70E-06
Zn-69	1.03E-08	1.97E-08	1.37E-09	No Data	1.28E-08	No Data	2.96E-09
Br-83	No Data	No Data	4.02E-08	No Data	No Data	No Data	5.79E-08
Br-84	No Data	No Data	5.21E-08	No Data	No Data	No Data	4.09E-13
Br-85	No Data	No Data	2.14E-09	No Data	No Data	No Data	LT E-24
Rb-86	No Data	2.11E-05	9.83E-06	No Data	No Data	No Data	4.16E-06
Rb-88	No Data	6.05E-08	3.21E-08	No Data	No Data	No Data	8.36E-19
Rb-89	No Data	4.01E-08	2.82E-08	No Data	No Data	No Data	2.33E-21
Sr-89	3.08E-04	No Data	8.84E-06	No Data	No Data	No Data	4.94E-05
Sr-90	7.58E-03	No Data	1.86E-03	No Data	No Data	No Data	2.19E-04
Sr-91	5.67E-06	No Data	2.29E-07	No Data	No Data	No Data	2.70E-05
Sr-92	2.15E-06	No Data	9.30E-08	No Data	No Data	No Data	4.26E-05
Y-90	9.62E-09	No Data	2.58E-10	No Data	No Data	No Data	1.02E-04
Y-91m	9.09E-11	No Data	3.52E-12	No Data	No Data	No Data	2.67E-10
Y-91	1.41E-07	No Data	3.77E-09	No Data	No Data	No Data	7.76E-05
Y-92	8.45E-10	No Data	2.47E-11	No Data	No Data	No Data	1.48E-05
Y-93	2.68E-09	No Data	7.40E-11	No Data	No Data	No Data	8.50E-05
Zr-95	3.04E-08	9.75E-09	6.60E-09	No Data	1.53E-08	No Data	3.09E-05
Zr-97	1.68E-09	3.39E-10	1.55E-10	No Data	5.12E-10	No Data	1.05E-04
Nb-95	6.22E-09	3.46E-09	1.86E-09	No Data	3.42E-09	No Data	2.10E-05
Mo-99	No Data	4.31E-06	8.20E-07	No Data	9.76E-06	No Data	9.99E-06
Tc-99m	2.47E-10	6.98E-10	8.89E-09	No Data	1.06E-08	3.42E-10	4.13E-07
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-05	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

TABLE 3.1-2 (CONT'D)

Radio-nuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Te-129m	1.15E-05	4.29E-08	1.82E-06	3.95E-06	4.80E-05	No Data	5.79E-05
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-05	No Data	1.57E-06
I-132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	No Data	1.02E-07
I-133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	No Data	2.22E-06
I-134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	No Data	2.51E-10
I-135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	No Data	1.31E-06
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 3.1-3

INGESTION DOSE FACTORS FOR TEENAGER
(mrem per pCi ingested)

Radio-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	2.08E-06	6.25E-07	No Data	No Data	1.70E-06	1.16E-06
Fe-59	5.87E-06	1.37E-05	5.29E-06	No Data	No Data	4.32E-06	3.24E-05
Co-58	No Data	9.72E-07	2.24E-06	No Data	No Data	No Data	1.34E-05
Co-60	No Data	2.81E-06	6.33E-06	No Data	No Data	No Data	3.66E-05
Ni-63	1.77E-04	1.25E-05	6.00E-06	No Data	No Data	No Data	1.99E-06
Ni-65	7.49E-07	9.57E-08	4.36E-08	No Data	No Data	No Data	5.19E-06
Cu-64	No Data	1.15E-07	5.41E-08	No Data	2.71E-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	8.92E-08	4.54E-08	No Data	No Data	No Data	7.30E-15
Rb-89	No Data	5.50E-09	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	2.09E-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
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	1.01E-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
Tc-101	3.60E-10	5.12E-10	5.03E-09	No Data	9.26E-09	3.12E-10	8.75E-17
Ru-103	2.55E-07	No Data	1.09E-07	No Data	8.99E-07	No Data	2.13E-05
Ru-105	2.18E-08	No Data	8.46E-09	No Data	2.75E-07	No Data	1.76E-05
Ru-106	3.92E-06	No Data	4.94E-07	No Data	7.56E-06	No Data	1.88E-04
Ag-110m	2.05E-07	1.94E-07	1.18E-07	No Data	3.70E-07	No Data	5.45E-05
Te-125m	3.83E-06	1.38E-06	5.12E-07	1.07E-06	No Data	No Data	1.13E-05
Te-127m	9.67E-06	3.43E-06	1.15E-06	2.30E-06	3.92E-05	No Data	2.41E-05
Te-127	1.58E-07	5.60E-08	3.40E-08	1.09E-07	6.40E-07	No Data	1.22E-05

TABLE 3.1-3 (CONT'D)

Radio-nuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Te-129m	1.63E-05	6.05E-06	2.58E-06	5.26E-06	6.82E-05	No Data	6.12E-05
Te-129	4.48E-08	1.67E-08	1.09E-08	3.20E-08	1.88E-07	No Data	2.45E-07
Te-131m	2.44E-06	1.17E-06	9.76E-07	1.75E-06	1.22E-05	No Data	9.39E-05
Te-131	2.79E-08	1.15E-08	5.72E-09	2.15E-08	1.22E-07	No Data	2.29E-09
Te-132	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
Cs-134	8.37E-05	1.97E-04	9.14E-05	No Data	6.26E-05	2.39E-05	2.45E-06
Cs-136	8.59E-06	3.38E-09	2.27E-05	No Data	1.84E-05	2.90E-06	2.72E-06
Cs-137	1.12E-04	1.49E-04	5.19E-05	No Data	5.07E-05	1.97E-05	2.12E-06
Cs-138	7.76E-08	1.49E-07	7.45E-08	No Data	1.10E-07	1.28E-08	6.76E-11
Ba-139	1.39E-07	9.78E-11	4.05E-09	No Data	9.22E-11	6.74E-11	1.24E-06
Ba-140	2.84E-05	3.48E-08	1.88E-06	No Data	1.18E-08	2.34E-08	4.38E-05
Ba-141	6.71E-08	5.01E-11	2.24E-09	No Data	4.65E-11	3.43E-11	1.43E-13
Ba-142	2.99E-08	2.99E-11	1.54E-09	No Data	2.53E-11	1.99E-11	9.18E-20
La-140	3.48E-09	1.71E-09	4.55E-10	No Data	No Data	No Data	9.82E-05
La-142	1.79E-10	7.95E-11	1.98E-11	No Data	No Data	No Data	2.42E-06
Ce-141	1.33E-08	8.88E-09	1.02E-09	No Data	4.18E-98	No Data	2.54E-05
Ce-143	2.35E-09	1.71E-06	1.91E-10	No Data	7.67E-10	No Data	5.14E-05
Ce-144	6.96E-07	2.88E-07	3.74E-08	No Data	1.72E-07	No Data	1.75E-04
Pr-143	1.31E-08	5.23E-09	6.52E-10	No Data	3.04E-09	No Data	4.31E-05
Pr-144	4.30E-11	1.76E-11	2.13E-12	No Data	1.01E-11	No Data	4.74E-14
Nd-147	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
Np-239	1.76E-09	1.66E-10	9.22E-11	No Data	5.21E-10	No Data	2.67E-05

TABLE 3.1-4

INGESTION DOSE FACTORS FOR CHILD
(mrem per pCi ingested)

Radio-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	4.84E-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	1.35E-05	No Data	No Data	7.74E-06	2.78E-05
Co-58	No Data	1.80E-06	5.51E-06	No Data	No Data	No Data	1.05E-05
Co-60	No Data	5.29E-06	1.56E-05	No Data	No Data	No Data	2.93E-05
Ni-63	5.38E-04	2.88E-05	1.83E-05	No Data	No Data	No Data	1.94E-06
Ni-65	2.22E-06	2.09E-07	1.22E-07	No Data	No Data	No Data	2.56E-05
Cu-64	No Data	2.45E-07	1.48E-07	No Data	5.92E-07	No Data	1.15E-05
Zn-65	1.37E-05	3.65E-05	2.27E-05	No Data	2.30E-05	No Data	6.41E-06
Zn-69	4.38E-08	6.33E-08	5.85E-09	No Data	3.84E-08	No Data	3.99E-06
Br-83	No Data	No Data	1.71E-07	No Data	No Data	No Data	LT E-24
Br-84	No Data	No Data	1.93E-07	No Data	No Data	No Data	LT E-24
Br-85	No Data	No Data	9.12E-09	No Data	No Data	No Data	LT E-24
Rb-86	No Data	6.70E-05	4.12E-05	No Data	No Data	No Data	4.31E-06
Rb-88	No Data	1.90E-07	1.32E-07	No Data	No Data	No Data	9.32E-09
Rb-89	No Data	1.17E-07	1.04E-07	No Data	No Data	No Data	1.02E-09
Sr-89	1.32E-03	No Data	3.77E-05	No Data	No Data	No Data	5.11E-05
Sr-90	1.70E-02	No Data	4.31E-03	No Data	No Data	No Data	2.29E-04
Sr-91	2.40E-05	No Data	9.06E-07	No Data	No Data	No Data	5.30E-05
Sr-92	9.03E-06	No Data	3.62E-07	No Data	No Data	No Data	1.71E-04
Y-90	4.11E-08	No Data	1.10E-09	No Data	No Data	No Data	1.17E-04
Y-91m	3.82E-10	No Data	1.37E-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
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
Tc-101	1.07E-09	1.12E-09	1.42E-08	No Data	1.91E-08	5.92E-10	3.56E-09
Ru-103	7.31E-07	No Data	2.81E-07	No Data	1.84E-06	No Data	1.89E-05
Ru-105	6.45E-08	No Data	2.34E-08	No Data	5.67E-07	No Data	4.21E-05
Ru-106	1.17E-05	No Data	1.46E-06	No Data	1.58E-05	No Data	1.82E-04
Ag-110m	5.39E-07	3.64E-07	2.91E-07	No Data	5.78E-07	No Data	4.33E-05
Te-125m	1.14E-05	3.09E-06	1.52E-06	3.20E-06	No Data	No Data	1.10E-05
Te-127m	2.89E-05	7.78E-06	3.43E-06	6.91E-06	8.24E-05	No Data	2.34E-05
Te-127	4.71E-07	1.27E-07	1.01E-07	3.26E-07	1.34E-06	No Data	1.84E-05

TABLE 3.1-4 (CONT'D)

Radio-nuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Te-129m	4.87E-05	1.36E-05	7.56E-06	1.57E-05	1.43E-04	No Data	5.94E-05
Te-129	1.34E-07	3.74E-08	3.18E-08	9.56E-08	3.92E-07	No Data	8.34E-06
Te-131m	7.20E-06	2.49E-06	2.65E-06	5.12E-06	2.41E-05	No Data	1.01E-04
Te-131	8.30E-08	2.53E-08	2.47E-08	6.35E-08	2.51E-07	No Data	4.36E-07
Te-132	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
Cs-134	2.34E-04	3.84E-04	8.10E-05	No Data	1.19E-04	4.27E-05	2.07E-06
Cs-136	2.35E-05	6.46E-05	4.18E-05	No Data	3.44E-05	5.13E-06	2.27E-06
Cs-137	3.27E-04	3.13E-04	4.62E-05	No Data	1.02E-04	3.67E-05	1.96E-06
Cs-138	2.28E-07	3.17E-07	2.01E-07	No Data	2.23E-07	2.40E-08	1.46E-07
Ba-139	4.14E-07	2.21E-10	1.20E-08	No Data	1.93E-10	1.30E-10	2.39E-05
Ba-140	8.31E-05	7.28E-08	4.85E-06	No Data	2.37E-08	4.34E-08	4.21E-05
Ba-141	2.00E-07	1.12E-10	6.51E-09	No Data	9.69E-11	6.58E-10	1.14E-07
Ba-142	8.74E-08	6.29E-11	4.88E-09	No Data	5.09E-11	3.70E-11	1.14E-09
La-140	1.01E-08	3.53E-09	1.10E-09	No Data	No Data	No Data	9.84E-05
La-142	5.24E-10	1.67E-10	5.23E-11	No Data	No Data	No Data	3.31E-05
Ce-141	3.97E-08	1.98E-08	2.94E-09	No Data	8.68E-08	No Data	2.47E-05
Ce-143	6.99E-09	3.79E-06	5.49E-10	No Data	1.59E-09	No Data	5.55E-05
Ce-144	2.08E-06	6.52E-07	1.11E-07	No Data	3.61E-07	No Data	1.70E-04
Pr-143	3.93E-08	1.18E-08	1.95E-09	No Data	6.39E-09	No Data	4.24E-05
Pr-144	1.29E-10	3.99E-11	6.49E-12	No Data	2.11E-11	No Data	8.59E-08
Nd-147	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
Np-239	5.25E-09	3.77E-10	2.65E-10	No Data	1.09E-09	No Data	2.79E-05

TABLE 3.1-5

DECAY CONSTANTS (1/Hr)

Radio-nuclide	Constant	Radio-nuclide	Constant
H-3	6.408E-06	Ru-103	7.300E-04
C-14	1.379E-08	Ru-105	1.600E-01
Na-24	4.600E-02	Ru-106	7.800E-05
P-32	2.000E-03	Ag-110m	1.100E-04
Cr-51	1.044E-03	Te-125m	5.000E-04
Mn-54	9.252E-05	Te-127m	2.600E-04
Mn-56	2.700E-01	Te-127	7.400E-02
Fe-55	2.930E-05	Te-129m	8.600E-04
Fe-59	6.480E-04	Te-129	5.900E-01
Co-58	4.068E-04	Te-131m	2.300E-02
Co-60	1.501E-05	Te-131	1.700E+00
Ni-63	8.600E-07	Te-132	8.900E-03
Ni-65	2.700E-01	I-130	5.600E-02
Cu-64	5.400E-02	I-131	3.593E-03
Zn-65	1.184E-04	I-132	3.000E-01
Zn-69	7.296E-01	I-133	3.334E-02
Br-83	2.900E-01	I-134	7.900E-01
Br-84	1.300E+00	I-135	1.100E-01
Br-85	1.449E+01	Cs-134	3.852E-05
Rb-86	1.500E-03	Cs-136	2.203E-03
Rb-88	2.400E+00	Cs-137	2.635E-06
Rb-89	2.700E+00	Cs-138	1.300E+00
Sr-89	5.724E-04	Ba-139	5.000E-01
Sr-90	2.776E-06	Ba-140	2.257E-03
Sr-91	7.300E-02	Ba-141	2.300E+00
Sr-92	2.600E-01	Ba-142	3.900E+00
Y-90	1.100E-02	La-140	1.700E-02
Y-91m	8.300E-01	La-142	4.500E-01
Y-91	4.900E-04	Ce-141	8.892E-04
Y-92	2.00E-01	Ce-143	2.100E-02
Y-93	6.800E-02	Ce-144	1.019E-04
Zr-95	4.392E-04	Pr-143	2.100E-03
Zr-97	4.100E-02	Pr-144	2.400E+00
Nb-95	8.200E-04	Nd-147	2.600E-03
Mo-99	1.000E-02	W-187	2.900E-02
Tc-99m	1.200E-01	Np-239	1.200E-02
Tc-101	2.900E+00		

TABLE 3.1-6

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

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

TABLE 3.1-6 (CONT'D)

Element	Total Body	Skin
Te-131m	8.40E-09	9.90E-09
Te-131	2.20E-09	2.60E-06
Te-132	1.70E-09	2.00E-09
I-130	1.40E-08	1.70E-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 3.1-7

DOSE RATE CONVERSION FACTORS [1], A
FOR (FISH AND INVERTEBRATE) INGESTION PATHWAY
(mrem/min per μCi/cc)

Isotope	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	-	5.9E-03	5.9E-03	5.9E-03	5.9E-03	5.9E-03	5.9E-03
C-14	-	-	-	-	-	-	-
Na-24	3.3E-03	3.3E-03	3.3E-03	3.3E-03	3.3E-03	3.3E-03	3.3E-03
P-32	2.6E+05	1.6E+04	1.0E+04	-	-	-	3.0E+04
Cr-51	-	-	8.9E-02	5.3E-02	2.0E-02	1.2E-01	2.2E+01
Mn-54	-	1.2E+02	2.2E+01	-	3.4E+01	-	3.6E+02
Mn-56	-	4.6E-03	8.3E-04	-	5.6E-03	-	1.4E-01
Fe-55	1.9E+03	8.6E+03	2.2E+03	-	-	9.9E+03	3.3E+03
Fe-59	1.3E+03	3.1E+03	1.2E+03	-	-	8.6E+02	1.0E+04
Co-58	-	9.8E+00	2.2E+01	-	-	-	2.0E+02
Co-60	-	2.8E+01	6.2E+01	-	-	-	5.3E+02
Ni-63	8.3E+02	5.8E+01	2.7E+01	-	-	-	1.2E+01
Ni-65	4.8E-03	6.3E-04	2.8E-04	-	-	-	1.6E-02
Cu-64	-	9.6E-01	4.5E-01	-	2.4E+00	-	8.2E+01
Zn-65	2.6E+03	8.3E+03	3.8E+03	-	5.6E+03	-	5.2E+03
Zn-69m	2.8E+01	6.7E+01	6.2E-00	-	4.1E+01	-	4.1E+03
Br-83	-	-	1.2E-06	-	-	-	1.7E-06
Br-84	-	-	2.8E-17	-	-	-	2.1E-22
Br-85	-	-	-	-	-	-	-
Rb-86	-	-	-	-	-	-	-
Rb-88	-	-	-	-	-	-	-
Rb-89	-	5.3E-31	3.8E-31	-	-	-	-
Sr-89	8.2E+01	-	2.3E+00	-	-	-	1.3E+01
Sr-90	2.0E+03	-	4.9E+02	-	-	-	2.7E+01
Sr-91	2.6E-01	-	1.2E-02	-	-	-	1.3E+00
Sr-92	1.2E-03	-	5.3E-05	-	-	-	2.4E-02
Y-90	-	-	-	-	-	-	-
Y-91m	-	-	-	-	-	-	-
Y-91	1.5E+00	-	3.8E-02	-	-	-	7.9E+02
Y-92	7.9E-05	-	2.3E-06	-	-	-	1.4E+00
Y-93	5.4E-03	-	1.5E-04	-	-	-	1.7E+02
Zr-95	2.6E-01	8.3E-02	5.6E-02	-	1.3E-01	-	2.6E+02
Zr-97	5.4E-03	1.1E-03	4.9E-04	-	1.6E-03	-	3.3E+02
Nb-95	7.2E+00	4.0E+00	1.6E+00	-	3.9E+00	-	2.4E+04
Mo-99	-	1.6E+00	3.2E+01	-	3.7E+00	-	3.7E+00
Tc-99m	1.4E-05	3.8E-05	4.8E-04	-	5.7E-04	1.9E-05	2.2E-02
Tc-101	6.3E-35	9.0E-35	9.0E-34	-	1.6E-33	4.6E-35	-
Ru-103	1.7E+00	-	7.3E-01	-	6.6E+00	-	2.0E+02
Ru-105	3.5E-03	-	1.4E-03	-	4.4E-02	-	2.1E+00
Ru-106	2.6E+01	-	3.3E+00	-	5.0E+01	-	1.7E+03
Ag-110m	2.5E+01	2.4E+01	1.4E+01	-	4.5E+01	-	9.8E+03
Te-129m	1.5E+01	5.5E+00	2.4E+00	5.2E+00	6.2E+01	-	7.5E+01
Te-131m	1.3E+00	6.4E-01	5.3E-01	1.0E+00	6.4E+00	-	6.3E+01
Te-132	2.7E+01	1.8E+00	1.6E+00	1.9E+00	1.7E+01	-	8.3E+01

TABLE 3.1-7 (CONT'D)

Isotope	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
I-131	3.3E+00	4.7E+00	2.7E+00	1.5E+03	8.0E+00	-	1.2E+00
I-132	1.2E-04	3.3E-04	1.1E-04	4.3E-02	5.1E-04	-	6.1E-05
I-133	5.5E-01	9.6E-01	2.9E-01	1.8E+02	1.7E+00	-	8.5E-01
I-134	5.0E-10	1.4E-09	4.9E-10	1.8E-07	2.2E-09	-	1.2E-12
I-135	3.1E-02	8.2E-02	2.9E-02	1.1E+01	1.3E-01	-	8.9E-02
Cs-134	1.1E+02	2.7E+02	2.1E+02	-	8.6E+01	2.8E+01	4.6E+00
Cs-136	1.1E+01	4.4E+01	3.2E+01	-	2.4E+01	3.3E+00	5.0E+00
Cs-137	1.5E+02	1.9E+02	1.3E+02	-	6.7E+01	2.2E+01	3.8E+00
Cs-138	3.5E-15	7.0E-15	3.5E-15	-	5.2E-15	5.2E-16	3.0E-20
Ba-139	8.1E-07	5.7E-10	2.4E-08	-	5.4E-10	3.3E-10	1.5E-06
Ba-140	2.5E+01	3.2E-02	1.7E+00	-	1.1E-02	1.8E-02	5.3E+01
Ba-141	-	1.0E-28	4.6E-27	-	9.7E-29	5.8E-29	6.4E-35
Ba-142	8.0E-43	8.2E-46	5.1E-44	-	7.0E-46	4.6E-46	-
La-142	2.6E-08	1.2E-08	3.0E-09	-	-	-	8.9E-05
Ce-141	5.5E-02	3.7E-02	4.2E-03	-	1.7E-02	-	1.4E+02
Ce-143	5.9E-03	4.4E+00	4.9E-04	-	2.0E-03	-	1.6E+02
Ce-144	2.9E+00	1.2E+00	1.6E-01	-	7.2E-01	-	9.7E+02
Pr-143	8.8E-02	3.6E-02	4.5E-03	-	2.1E-02	-	3.9E+02
Nd-147	6.1E-02	7.0E-02	4.2E-03	-	4.1E-02	-	3.4E+02
W-187	7.5E-02	6.3E-02	2.1E-02	-	-	-	2.0E+01
Np-239	4.4E-04	6.3E-02	2.1E-02	-	-	-	2.0E+01

(1) See Section 4.0

TABLE 3.3-1

CHILD INHALATION DOSE RATE CONVERSION FACTORS, Pij
(mrem/yr per μCi/m^3)

Isotope	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cr-51	-	-	3.4E+01	2.1E+01	7.9E+00	4.9E+03	1.1E+03
Mn-54	-	1.3E+04	2.1E+03	-	3.3E+03	4.9E+05	2.6E+04
Fe-59	4.0E+03	9.3E+06	3.5E+03	-	-	3.4E+05	6.5E+04
Co-58	-	1.1E+02	2.0E+02	-	-	1.1E+06	2.7E+04
Co-60	-	7.8E+02	1.3E+03	-	-	5.2E+06	7.0E+04
Zn-65	1.1E+04	3.6E+04	1.5E+04	-	2.4E+04	2.9E+05	1.8E+04
Sr-89	3.9E+04	-	1.1E+03	-	-	1.6E+06	1.2E+05
Sr-90	1.2E+07	-	7.3E+05	-	-	1.1E+07	2.5E+05
Zr-95	1.0E+04	2.4E+03	2.2E+03	-	1.8E+04	1.6E+06	4.3E+04
Sb-124	1.1E+04	2.0E+02	4.1E+03	2.6E+01	-	8.3E+05	1.4E+05
I-131	3.3E+04	3.4E+04	2.6E+04	1.1E+07	2.1E+04	-	1.9E+03
I-133	1.3E+04	1.5E+04	6.1E+03	3.7E+06	8.7E+03	-	4.1E+04
Cs-134	4.7E+05	7.3E+05	1.7E+05	-	9.9E+04	8.8E+04	3.8E+03
Cs-136	1.3E+04	4.8E+04	3.7E+04	-	2.9E+04	4.2E+03	1.7E+03
Cs-137	6.4E+05	5.9E+05	9.1E+04	-	7.5E+04	7.3E+04	5.7E+03
Ba-140	5.3E+03	3.4E+04	3.0E+02	-	5.7E+00	1.3E+06	7.5E+03
Ce-141	2.3E+03	1.1E+03	1.7E+02	-	2.2E+03	3.7E+05	4.1E+04

TABLE 3.4-1

NOBLE GAS DOSE FACTORS

Isotope	Gamma Air Dose Factor Mi (mrad/yr per μCi/m^3)	Beta Air Dose Factor Ni (mrad/yr per μCi/m^3)
Kr - 83m	1.9E+01	2.9E+02
Kr - 85m	1.2E+03	2.0E+03
Kr - 85	1.7E+01	2.0E+03
Kr - 87	6.2E+03	1.0E+04
Kr - 88	1.5E+04	2.9E+03
Kr - 89	1.7E+04	1.1E+04
Kr - 90	1.6E+04	7.8E+03
Xe - 131m	1.6E+02	1.1E+03
Xe - 133m	3.3E+02	1.5E+03
Xe - 133	3.5E+02	1.1E+03
Xe - 135m	3.4E+03	7.4E+02
Xe - 135	1.9E+03	2.5E+03
Xe - 137	1.5E+03	1.3E+02
Xe - 138	9.2E+03	4.8E+03
Ar - 41	9.3E+03	3.3E+03

TABLE 3.5-1

INHALATION DOSE FACTORS FOR ADULTS
(mrem per pCi inhaled)

Radio-nuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	No Data	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07
C-14	2.27E-06	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07
Na-24	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06
P-32	1.65E-04	9.64E-06	6.26E-06	No Data	No Data	No Data	1.08E-05
Cr-51	No Data	No Data	1.25E-08	7.44E-09	2.85E-09	1.80E-06	4.15E-07
Mn-54	No Data	4.95E-06	7.87E-07	No Data	1.23E-06	1.75E-04	9.67E-06
Mn-56	No Data	1.55E-10	2.29E-11	No Data	1.63E-10	1.18E-06	2.53E-06
Fe-55	3.07E-06	2.12E-06	4.98E-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	3.03E-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
Y-93	1.18E-05	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

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TABLE 3.5-1 (CONT'D)

Radio-nuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
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-05	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-05	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
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	9.41E-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 3.5-2

INHALATION DOSE FACTORS FOR TEENAGER
(mrem per pCi inhaled)

Radio-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
Y-93	1.69E-08	No Data	4.65E-10	No Data	No Data	1.04E-05	7.24E-05
Zr-95	1.82E-05	5.73E-06	3.94E-06	No Data	8.42E-06	3.36E-04	1.86E-05
Zr-97	1.72E-08	3.40E-09	1.57E-09	No Data	5.15E-09	1.62E-05	7.88E-05
Nb-95	2.32E-06	1.29E-06	7.08E-07	No Data	1.25E-06	9.39E-05	1.21E-05
Mo-99	No Data	2.11E-08	4.08E-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-15
Ru-103	2.63E-07	No Data	1.12E-07	No Data	9.29E-07	9.79E-05	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

TABLE 3.5-2 (CONT'D)

Radio-nuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
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
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 3.5-3

INHALATION DOSE FACTORS FOR CHILD
(mrem per pCi inhaled)

Radio-nuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	No Data	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07
C-14	9.70E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06
Na-24	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06
P-32	7.04E-04	3.09E-05	2.67E-05	No Data	No Data	No Data	1.14E-05
Cr-51	No Data	No Data	4.17E-08	2.31E-08	6.57E-09	4.59E-06	2.93E-07
Mn-54	No Data	1.16E-05	2.57E-06	No Data	2.71E-06	4.26E-04	6.19E-06
Mn-56	No Data	4.48E-10	8.43E-11	No Data	4.52E-10	3.55E-06	3.33E-05
Fe-55	1.28E-05	6.80E-06	2.10E-06	No Data	No Data	3.00E-05	7.75E-07
Fe-59	5.59E-06	9.04E-06	4.51E-06	No Data	No Data	3.43E-04	1.91E-05
Co-58	No Data	4.79E-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-67	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
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
Tc-101	2.19E-14	2.30E-14	2.91E-13	No Data	3.92E-13	1.58E-07	4.41E-09
Ru-103	7.55E-07	No Data	2.90E-07	No Data	1.90E-06	1.79E-04	1.21E-05
Ru-105	4.13E-10	No Data	1.50E-10	No Data	3.63E-10	4.30E-06	2.69E-05
Ru-106	3.68E-05	No Data	4.57E-06	No Data	4.97E-05	3.87E-03	1.16E-04
Ag-110m	4.56E-06	3.08E-06	2.47E-06	No Data	5.74E-06	1.48E-03	2.71E-05
Te-125m	1.82E-06	6.29E-07	2.47E-07	5.20E-07	No Data	1.29E-04	9.13E-06
Te-127m	6.72E-06	2.31E-06	8.16E-07	1.64E-06	1.72E-05	4.00E-04	1.93E-05
Te-127	7.49E-10	2.57E-10	1.65E-10	5.30E-10	1.91E-09	2.71E-06	1.52E-05
Te-129m	5.19E-06	1.85E-06	8.22E-07	1.71E-06	1.36E-05	4.76E-04	4.91E-05

TABLE 3.5-3 (CONT'D)

Radio-nuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Te-129	2.64E-11	9.45E-12	6.44E-12	1.93E-11	6.94E-11	7.93E-07	6.89E-06
Te-131m	3.63E-08	1.60E-08	1.37E-08	2.64E-08	1.08E-07	5.56E-05	8.32E-05
Te-131	5.87E-12	2.28E-12	1.78E-12	4.59E-12	1.59E-11	5.55E-07	3.60E-07
Te-132	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
Cs-134	1.76E-04	2.74E-04	6.07E-05	No Data	8.93E-05	3.27E-05	1.04E-06
Cs-136	1.76E-05	4.62E-05	3.14E-05	No Data	2.58E-05	3.93E-06	1.13E-06
Cs-137	2.45E-04	2.23E-04	3.47E-05	No Data	7.63E-05	2.81E-05	9.78E-07
Cs-138	1.71E-07	2.27E-07	1.50E-07	No Data	1.68E-07	1.84E-08	7.29E-08
Ba-139	4.98E-10	2.66E-13	1.45E-11	No Data	2.33E-13	1.56E-06	1.56E-05
Ba-140	2.00E-05	1.75E-08	1.17E-06	No Data	5.71E-09	4.71E-04	2.75E-05
Ba-141	5.29E-11	2.95E-14	1.72E-12	No Data	2.56E-14	7.89E-07	7.44E-08
Ba-142	1.35E-11	9.73E-15	7.54E-13	No Data	7.87E-15	4.44E-07	7.41E-10
La-140	1.74E-07	6.08E-08	2.04E-08	No Data	No Data	4.94E-05	6.10E-05
La-142	3.50E-10	1.11E-10	3.49E-11	No Data	No Data	2.35E-06	2.05E-05
Ce-141	1.06E-05	5.28E-06	7.83E-07	No Data	2.31E-06	1.47E-04	1.53E-05
Ce-143	9.89E-08	5.37E-08	7.77E-09	No Data	2.26E-08	3.12E-05	3.44E-05
Ce-144	1.83E-03	5.72E-04	9.77E-05	No Data	3.17E-04	3.23E-03	1.05E-04
Pr-143	4.99E-06	1.50E-06	2.47E-07	No Data	8.11E-07	1.17E-04	2.63E-05
Pr-144	1.61E-11	4.99E-12	8.10E-13	No Data	2.64E-12	4.23E-07	5.32E-08
Nd-147	2.92E-06	2.36E-06	1.84E-07	No Data	1.30E-06	8.87E-05	2.22E-05
W-187	4.41E-09	2.61E-09	1.17E-09	No Data	No Data	1.11E-05	2.46E-05
Np-239	1.26E-07	9.04E-09	6.35E-09	No Data	2.63E-08	1.57E-05	1.73E-05

TABLE 3.5-4

INHALATION DOSE FACTORS FOR INFANT
(mrem per pCi inhaled)

Radio-nuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
H-3	No Data	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07
C-14	1.89E-05	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06
Na-24	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06
P-32	1.45E-03	8.03E-05	5.53E-05	No Data	No Data	No Data	1.15E-05
Cr-51	No Data	No Data	6.39E-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
Cu-64	No Data	1.34E-09	5.53E-10	No Data	2.84E-09	6.64E-06	1.07E-05
Zn-65	1.38E-05	4.47E-05	2.22E-05	No Data	2.32E-05	4.62E-04	3.67E-05
Zn-69	3.85E-11	6.91E-11	5.13E-12	No Data	2.87E-11	1.05E-06	9.44E-06
Br-83	No Data	No Data	2.72E-07	No Data	No Data	No Data	LT E-24
Br-84	No Data	No Data	2.86E-07	No Data	No Data	No Data	LT E-24
Br-85	No Data	No Data	1.46E-08	No Data	No Data	No Data	LT E-24
Rb-86	No Data	1.36E-04	6.30E-05	No Data	No Data	No Data	2.17E-06
Rb-88	No Data	3.98E-07	2.05E-07	No Data	No Data	No Data	2.42E-07
Rb-89	No Data	2.29E-07	1.47E-07	No Data	No Data	No Data	4.87E-08
Sr-89	2.84E-04	No Data	8.15E-06	No Data	No Data	1.45E-03	4.57E-05
Sr-90	2.92E-02	No Data	1.85E-03	No Data	No Data	8.03E-03	9.36E-05
Sr-91	6.83E-08	No Data	2.47E-09	No Data	No Data	3.76E-05	5.24E-05
Sr-92	7.50E-09	No Data	2.79E-10	No Data	No Data	1.70E-05	1.00E-04
Y-90	2.35E-06	No Data	6.30E-08	No Data	No Data	1.92E-04	7.43E-05
Y-91m	2.91E-10	No Data	9.90E-12	No Data	No Data	1.99E-06	1.68E-06
Y-91	4.20E-04	No Data	1.12E-05	No Data	No Data	1.75E-03	5.02E-05
Y-92	1.17E-08	No Data	3.29E-10	No Data	No Data	1.75E-05	9.04E-05
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
Tc-101	4.65E-14	5.88E-14	5.80E-13	No Data	6.99E-13	4.17E-07	6.03E-07
Ru-103	1.44E-06	No Data	4.85E-07	No Data	3.03E-06	3.94E-04	1.15E-05
Ru-105	8.74E-10	No Data	2.93E-10	No Data	6.42E-10	1.12E-05	3.46E-05
Ru-106	6.20E-05	No Data	7.77E-06	No Data	7.61E-05	8.26E-03	1.17E-04
Ag-110m	7.13E-06	5.16E-06	3.57E-06	No Data	7.80E-06	2.62E-03	2.36E-05
Te-125m	3.40E-06	1.42E-06	4.70E-07	1.16E-06	No Data	3.19E-04	9.22E-06
Te-127m	1.19E-05	4.93E-06	1.48E-06	3.48E-06	2.68E-05	9.37E-04	1.95E-05
Te-127	1.59E-09	6.81E-10	3.49E-10	1.32E-09	3.47E-09	7.39E-06	1.74E-05

TABLE 3.5-4 (CONT'D)

Radio-nuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Te-129m	1.01E-05	4.35E-06	1.59E-06	3.91E-06	2.27E-05	1.20E-03	4.93E-05
Te-129	5.63E-11	2.48E-11	1.34E-11	4.82E-11	1.25E-10	2.14E-06	1.88E-05
Te-131m	7.62E-08	3.93E-08	2.59E-08	6.38E-08	1.89E-07	1.42E-04	8.51E-05
Te-131	1.24E-11	5.87E-12	3.57E-12	1.13E-11	2.85E-11	1.47E-06	5.87E-06
Te-132	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
Cs-134	2.83E-04	5.02E-04	5.32E-05	No Data	1.36E-04	5.69E-05	9.53E-07
Cs-136	3.45E-05	9.61E-05	3.78E-05	No Data	4.03E-05	8.40E-06	1.02E-06
Cs-137	3.92E-04	4.37E-04	3.25E-05	No Data	1.23E-04	5.09E-05	9.53E-07
Cs-138	3.61E-07	5.58E-07	2.84E-07	No Data	2.93E-07	4.67E-08	6.26E-07
Ba-139	1.06E-09	7.03E-13	3.07E-11	No Data	4.23E-13	4.25E-06	3.64E-05
Ba-140	4.00E-05	4.00E-08	2.07E-06	No Data	9.59E-09	1.14E-03	2.74E-05
Ba-141	1.12E-10	7.70E-14	3.55E-12	No Data	4.64E-14	2.12E-06	3.39E-06
Ba-142	2.84E-11	2.36E-14	1.40E-12	No Data	1.36E-14	1.11E-06	4.95E-07
La-140	3.61E-07	1.43E-07	3.68E-08	No Data	No Data	1.20E-04	6.06E-05
La-142	7.36E-10	2.69E-10	6.46E-11	No Data	No Data	5.87E-06	4.25E-05
Ce-141	1.98E-05	1.19E-05	1.42E-06	No Data	3.75E-06	3.69E-04	1.54E-05
Ce-143	2.09E-07	1.38E-07	1.58E-08	No Data	4.03E-08	8.30E-05	3.55E-05
Ce-144	2.28E-03	8.65E-04	1.26E-04	No Data	3.84E-04	7.03E-03	1.06E-04
Pr-143	1.00E-05	3.74E-06	4.99E-07	No Data	1.41E-06	3.09E-04	2.66E-05
Pr-144	3.42E-11	1.32E-11	1.72E-12	No Data	4.80E-12	1.15E-06	3.06E-06
Nd-147	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
Np-239	2.65E-07	2.37E-08	1.34E-08	No Data	4.73E-08	4.25E-05	1.78E-05

TABLE 3.5-5

RECOMMENDED VALUES FOR U_{ap} TO BE USED FOR THE MAXIMUM EXPOSED INDIVIDUAL IN LIEU OF SITE-SPECIFIC DATA

Pathway	Infant	Child	Teen	Adult
Fruits, vegetables & grain (kg/yr)[1],[2]	-	520	630	520
Leafy vegetables (kg/yr)[1]	-	26	42	64
Milk (ℓ/yr)[1]	330	330	400	310
Meat & poultry (kg/yr)[1]	-	41	65	110
Fish (fresh or salt) (kg/yr)[3]	-	6.9	16	21
Other seafood (kg/yr)[1]	-	1.7	3.8	5
Drinking water (ℓ/yr)[4]	330	510	510	730
Shoreline recreation (hr/yr)[4]	-	14	67	12
Inhalation (m^3/yr)	1400[5]	3700[6]	8000[6]	8000[5]

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[1] Consumption rate obtained from Reference 19 for average individual and age-prorated and maximized using techniques contained in Reference 10 of Regulatory Guide 1.109, Rev 1, Oct. 1977.

[2] Consists of the following (on a mass basis): 22% fruit, 54% vegetables (including leafy vegetables), and 24% grain.

[3] Consumption rate for adult obtained by averaging data from References 10 and 21-24 of Regulatory Guide 1.109, Rev. 1, Oct. 1977 and age-prorated using techniques contained in Reference 10.

TABLE 3.5-5 (CONT'D)

(4) Data obtained directly from Reference 10 of Regulatory Guide 1.109, Rev. 1, Oct 1977.

(5) Data obtained directly from Reference 20 of Regulatory Guide 1.109, Rev. 1, Oct. 1977.

(6) Inhalation rate derived from data provided in Reference 20 of Regulatory Guide 1.109, Rev. 1, Oct. 1977.

TABLE 3.5-6

STABLE ELEMENT TRANSFER DATA[1]

Element	B Veg/Soil	F (Cow) Milk (d/l)	F Meat (d/kg)
H[2]	4.8E+00	1.0E-02	1.2E-02
C[2]	5.5E+00	1.2E-02	3.1E-02
Na	5.2E-02	4.0E-02[3]	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[3]	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[4]	2.9E-03
Cs	1.0E-02	1.2E-02[3]	4.0E-03
Ba	5.0E-03	4.0E-04[3]	3.2E-03
La	2.5E-03	5.0E-06	2.0E-04
Ce	2.5E-03	1.0E-04[3]	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[5]

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[1] Data presented in this table is from Reference 1 of Regulatory Guide 1.109, Rev. 1, Oct. 1977.

[2] Meat and milk coefficients are based on specific activity considerations.

[3] From Reference 15 of Regulatory Guide 1.109, Rev. 1, Oct. 1977.

[4] See text (Regulatory Guide 1.109, Rev. 1, Oct. 1977).

[5] From Reference 13 of Regulatory Guide 1.109, Rev. 1, Oct. 1977.

TABLE 3.5-7

HUMIDITY PARAMETERS AT RECEPTORS

Monthly Average Absolute Humidity (gm/m^3)	
January	3.06
February	3.09
March	3.83
April	5.71
May	8.19
June	12.62
July	15.53
August	14.62
September	11.68
October	8.11
November	5.37
December	3.73

TABLE 3.5-8

CHILD INHALATION DOSE RATE CONVERSION FACTORS, Pij
(mrem/yr per μCi/m^3)

Isotope	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cr-51	-	-	3.5E+01	2.1E+01	7.9E+00	4.9E+03	1.1E+03
Mn-54	-	1.3E+04	2.1E+03	-	3.3E+03	4.9E+05	2.6E+04
Fe-59	4.0E+03	9.3E+06	3.5E+03	-	-	3.4E+05	6.5E+04
Co-58	-	1.1E+02	2.0E+02	-	-	1.1E+06	2.7E+04
Co-60	-	7.8E+02	1.3E+03	-	-	5.2E+06	6.8E+04
Zn-65	1.1E+04	3.6E+04	1.5E+04	-	2.4E+04	2.9E+05	1.8E+04
Sr-89	3.9E+04	-	1.1E+03	-	-	1.6E+06	1.2E+05
Sr-90	1.2E+07	-	7.3E+05	-	-	1.1E+07	2.5E+05
Zr-95	1.0E+04	2.4E+03	2.2E+03	-	1.8E+04	1.6E+06	4.3E+04
Sb-124	1.1E+04	2.0E+02	4.1E+03	2.6E+01	-	8.3E+05	1.4E+05
I-131	3.3E+04	3.4E+04	2.6E+04	1.1E+07	2.1E+04	-	1.9E+03
I-133	1.3E+04	1.5E+04	5.9E+03	3.7E+06	8.7E+03	-	4.1E+04
Cs-134	4.7E+05	7.3E+05	1.7E+05	-	9.9E+04	8.8E+04	2.8E+03
Cs-136	1.3E+04	4.8E+04	3.7E+04	-	2.9E+04	4.2E+03	4.2E+03
Cs-137	6.4E+05	5.9E+05	9.1E+04	-	7.5E+04	7.3E+04	5.7E+03
Ba-140	5.3E+03	3.4E+04	3.0E+02	-	5.7E+00	1.3E+06	7.3E+03
Ce-141	2.3E+03	1.1E+03	1.7E+02	-	2.2E+03	3.7E+05	4.1E+04

TABLE 3.5-9

P_{oij}

CONTAMINATED GROUND, INGESTION OF LEAFY AND STORED VEGETABLES DOSE RATE CONVERSION FACTORS

m^2(mrem/yr/μCi/sec)

Isotope	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cr-51	4.9E+06	4.9E+06	4.9E+06	4.9E+06	4.9E+06	5.0E+06	1.5E+07
Mn-54	1.3E+09	1.6E+09	1.4E+09	1.3E+09	1.4E+09	1.3E+09	2.3E+09
Fe-59	3.9E+03	5.5E+08	3.8E+08	2.8E+08	2.7E+08	3.5E+08	1.2E+09
Co-58	3.8E+03	4.5E+08	6.1E+08	3.8E+08	3.8E+08	3.8E+08	8.3E+08
Co-60	2.2E+10	2.2E+10	2.3E+10	2.2E+10	2.2E+10	2.2E+10	2.4E+10
Zn-65	1.3E+09	2.2E+09	1.4E+09	8.4E+08	1.7E+09	8.4E+08	1.7E+09
Sr-89	4.4E+10	2.1E+04	1.2E+09	2.1E+04	2.1E+04	2.1E+04	1.6E+09
Sr-90	1.7E+12	5.3E+06	4.1E+11	5.3E+06	5.3E+06	5.3E+06	2.2E+10
Zr-95	4.9E+08	4.9E+08	4.9E+08	4.9E+08	4.9E+08	4.9E+08	1.4E+09
Sb-124	7.1E+08	6.1E+08	6.5E+08	6.1E+08	6.1E+08	6.9E+08	3.5E+09
I-131	7.6E+07	7.6E+07	1.1E+07	2.1E+10	5.1E+07	8.6E+06	1.4E+07
I-133	2.9E+06	3.3E+06	2.0E+06	5.2E+08	2.4E+06	1.2E+06	2.1E+06
Cs-134	2.5E+10	3.6E+10	1.3E+10	6.9E+09	1.1E+10	1.0E+10	7.1E+09
Cs-136	1.7E+08	2.4E+08	2.2E+08	1.5E+08	2.0E+08	1.6E+08	1.6E+08
Cs-137	3.8E+10	3.6E+10	1.4E+10	1.0E+10	1.3E+10	1.3E+10	1.0E+10
Ba-140	4.6E+08	1.7E+08	1.9E+08	1.7E+08	1.7E+08	1.7E+08	1.8E+08
Ce-141	1.5E+07	1.4E+07	1.4E+07	1.4E+07	1.4E+07	1.4E+07	4.5E+08

Original
March 1983

TABLE 3.5-10

DISTANCE FROM REACTOR CENTERLINE BY SECTOR
OUT TO 8,046 m (Meters)

Sector	Nearest Residence	Nearest Vegetable Garden	Nearest Site Boundary
N	-	-	436
NNE	381	-	365
NE	518	-	332
ENE	884	1,932	311
E	1,128	3,867	346
ESE	914	1,932	457
SE	1,097	2,091	1,105
SSE	914	1,771	876
S	610	1,771	610
SSW	518	7,080	457
SW	549	4,073	533
WSW	1,585	2,252	457
W	1,570	2,252	360
WNW	610	-	354
NW	-	-	419
NNW	-	-	436

NOTE:

There are no milk cows, milk goats, or meat animals within the 8,046 m radius of the site. The nearest milk cow and milk goat are located 8,690 m east of the site.

TABLE 3.5-11

P_{ij}

CHILD INGESTION OF COWS MILK DOSE RATE CONVERSION FACTORS

m^2(mrem/yr/μCi/sec)

Isotope	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cr-51	-	-	1.3E+04	7.7E+03	2.8E+03	1.7E+04	3.2E+06
Mn-54	-	4.2E+06	7.9E+05	-	1.2E+06	-	1.3E+07
Fe-59	1.4E+07	3.1E+07	1.2E+07	-	-	8.8E+06	1.0E+08
Co-58	-	5.3E+06	1.6E+07	-	-	-	3.2E+07
Co-60	-	2.0E+07	6.1E+07	-	-	-	1.1E+08
Zn-65	7.9E+08	2.6E+09	1.1E+09	-	1.7E+09	-	1.6E+09
Sr-89	2.9E+09	-	8.4E+07	-	-	-	1.1E+08
Sr-90	6.2E+10	-	1.5E+10	-	-	-	1.8E+08
Zr-95	1.5E+03	3.5E+02	3.1E+02	-	2.3E+02	-	3.5E+05
Sb-124	1.2E+07	2.2E+05	4.5E+06	2.9E+04	-	9.0E+06	3.2E+08
I-131	2.7E+08	2.8E+08	2.1E+07	8.9E+10	1.7E+08	-	2.4E+07
I-133	3.9E+06	4.8E+06	1.9E+06	1.9E+09	2.8E+06	-	1.9E+06
Cs-134	1.0E+10	1.7E+10	3.6E+09	-	2.2E+09	1.9E+09	9.4E+07
Cs-136	1.2E+08	4.6E+08	3.4E+08	-	2.6E+08	3.7E+07	5.4E+07
Cs-137	1.5E+10	1.5E+10	2.2E+09	-	1.9E+09	1.7E+09	9.1E+07
Ba-140	4.9E+07	4.3E+04	2.9E+06	-	5.2E+03	2.6E+04	2.5E+06
Ce-141	5.1E+04	2.7E+04	3.8E+03	-	4.0E+03	-	3.1E+07

TABLE 3.5-12

P_{oij}
CHILD INGESTION OF GOAT'S MILK DOSE RATE CONVERSION FACTORS
m²(mrem/yr/μCi/sec)

Isotope	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cr-51	-	-	1.6E+03	9.1E+02	3.4E+02	2.0E+03	3.8E+05
Mn-54	-	5.0E+05	9.5E+04	-	1.5E+05	-	1.5E+06
Fe-59	1.7E+05	4.1E+05	1.6E+05	-	-	1.1E+05	1.4E+06
Co-58	-	6.4E+05	2.0E+06	-	-	-	3.8E+06
Co-60	-	2.5E+06	7.4E+06	-	-	-	1.4E+07
Zn-65	9.7E+07	3.0E+08	1.4E+08	-	2.0E+08	-	1.9E+08
Sr-89	6.0E+09	-	1.7E+08	-	-	-	2.3E+08
Sr-90	1.2E+11	-	3.1E+10	-	-	-	1.7E+09
Zr-95	1.7E+02	4.0E+01	3.7E+01	-	2.7E+01	-	4.3E+04
Sb-124	1.4E+06	2.6E+04	5.6E+05	3.4E+03	-	1.1E+06	4.0E+07
I-131	3.2E+08	3.2E+08	2.5E+07	1.1E+11	2.0E+08	-	2.8E+07
I-133	4.7E+06	2.2E+06	2.3E+06	1.4E+09	3.4E+06	-	2.3E+06
Cs-134	3.1E+10	5.1E+10	1.1E+10	-	6.7E+09	5.8E+09	2.9E+08
Cs-136	3.7E+08	1.4E+09	1.0E+09	-	7.7E+08	1.1E+08	1.6E+08
Cs-137	4.7E+10	4.5E+10	6.7E+09	-	5.6E+09	5.2E+09	2.7E+08
Ba-140	6.0E+06	5.2E+03	3.5E+05	-	6.3E+02	3.1E+03	3.1E+05
Ce-141	6.2E+03	3.1E+03	4.7E+02	-	4.9E+02	-	3.8E+06

TABLE 3.5-13

P_{oij}
CHILD INGESTION OF MEAT DOSE RATE CONVERSION FACTORS
m^3(mrem/yr/μCi/sec)

Isotope	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cr-51	-	-	1.1E+03	6.7E+02	2.5E+02	1.5E+03	2.8E+05
Mn-54	-	1.2E+06	2.3E+05	-	3.4E+05	-	3.7E+06
Fe-59	4.2E+07	9.9E+07	3.7E+07	-	-	2.7E+07	3.2E+08
Co-58	-	7.2E+06	2.2E+07	-	-	-	4.3E+07
Co-60	-	3.3E+07	9.7E+07	-	-	-	1.9E+08
Zn-65	7.0E+07	2.3E+08	1.1E+08	-	1.5E+08	-	1.5E+08
Sr-89	2.1E+08	-	6.0E+06	-	-	-	7.8E+06
Sr-90	5.6E+09	-	1.4E+09	-	-	-	7.3E+07
Zr-95	1.0E+06	2.5E+05	2.3E+05	-	1.5E+05	-	2.5E+08
Sb-124	3.2E+06	5.8E+04	1.2E+06	7.7E+03	-	2.4E+06	9.0E+07
I-131	3.5E+06	3.5E+06	2.7E+05	1.1E+09	2.2E+06	-	3.0E+05
I-133	1.3E+01	1.6E+01	6.4E+02	3.9E+01	9.7E+02	-	6.6E+02
Cs-134	4.2E+08	7.1E+08	1.5E+08	-	8.9E+07	7.8E+07	3.8E+06
Cs-136	1.9E+06	7.4E+06	5.4E+06	-	4.3E+06	5.7E+05	8.5E+05
Cs-137	6.4E+08	6.2E+08	9.3E+07	-	7.6E+07	7.2E+07	3.7E+06
Ba-140	1.9E+07	1.7E+04	1.1E+06	-	2.0E+03	9.7E+03	9.4E+05
Ce-141	8.7E+03	4.2E+03	6.5E+02	-	6.7E+02	-	5.3E+06

TABLE 3.5-14

P_{oij}
INFANT INGESTION OF COW'S MILK DOSE CONVERSION FACTORS
m^2(mrem/yr/μCi/sec)

Isotope	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cr-51	-	-	1.3E+04	7.7E+03	2.8E+03	1.7E+04	3.2E+06
Mn-54	-	4.2E+06	7.9E+05	-	1.2E+06	-	1.3E+07
Fe-59	1.4E+07	3.1E+07	1.2E+07	-	-	8.8E+06	1.0E+08
Co-58	-	1.1E+07	2.7E+07	-	-	-	2.8E+07
Co-60	-	4.3E+07	1.0E+08	-	-	-	1.0E+08
Zn-65	7.9E+08	2.6E+09	1.1E+09	-	1.7E+09	-	1.6E+09
Sr-89	6.3E+09	-	1.8E+08	-	-	-	1.2E+08
Sr-90	8.4E+10	-	2.2E+10	-	-	-	8.4E+08
Zr-95	2.9E+03	7.4E+02	5.3E+02	-	2.3E+02	-	3.3E+05
Sb-124	1.2E+07	2.2E+05	4.5E+06	2.9E+04	-	9.0E+06	3.2E+08
I-131	5.7E+08	6.7E+08	3.8E+08	2.2E+11	1.7E+08	-	2.6E+07
I-133	8.0E+06	1.2E+07	3.6E+06	2.8E+09	2.8E+06	-	2.2E+06
Cs-134	2.1E+10	3.8E+10	3.1E+09	-	2.2E+09	4.2E+09	8.9E+07
Cs-136	1.2E+08	4.6E+08	3.4E+08	-	2.6E+08	3.7E+07	5.4E+07
Cs-137	3.2E+10	3.7E+10	2.0E+09	-	1.9E+09	4.4E+09	9.4E+07
Ba-140	1.0E+08	1.0E+05	8.4E+06	-	5.2E+03	6.5E+04	2.6E+06
Ce-141	1.1E+05	6.7E+04	7.8E+03	-	4.0E+03	-	3.3E+07

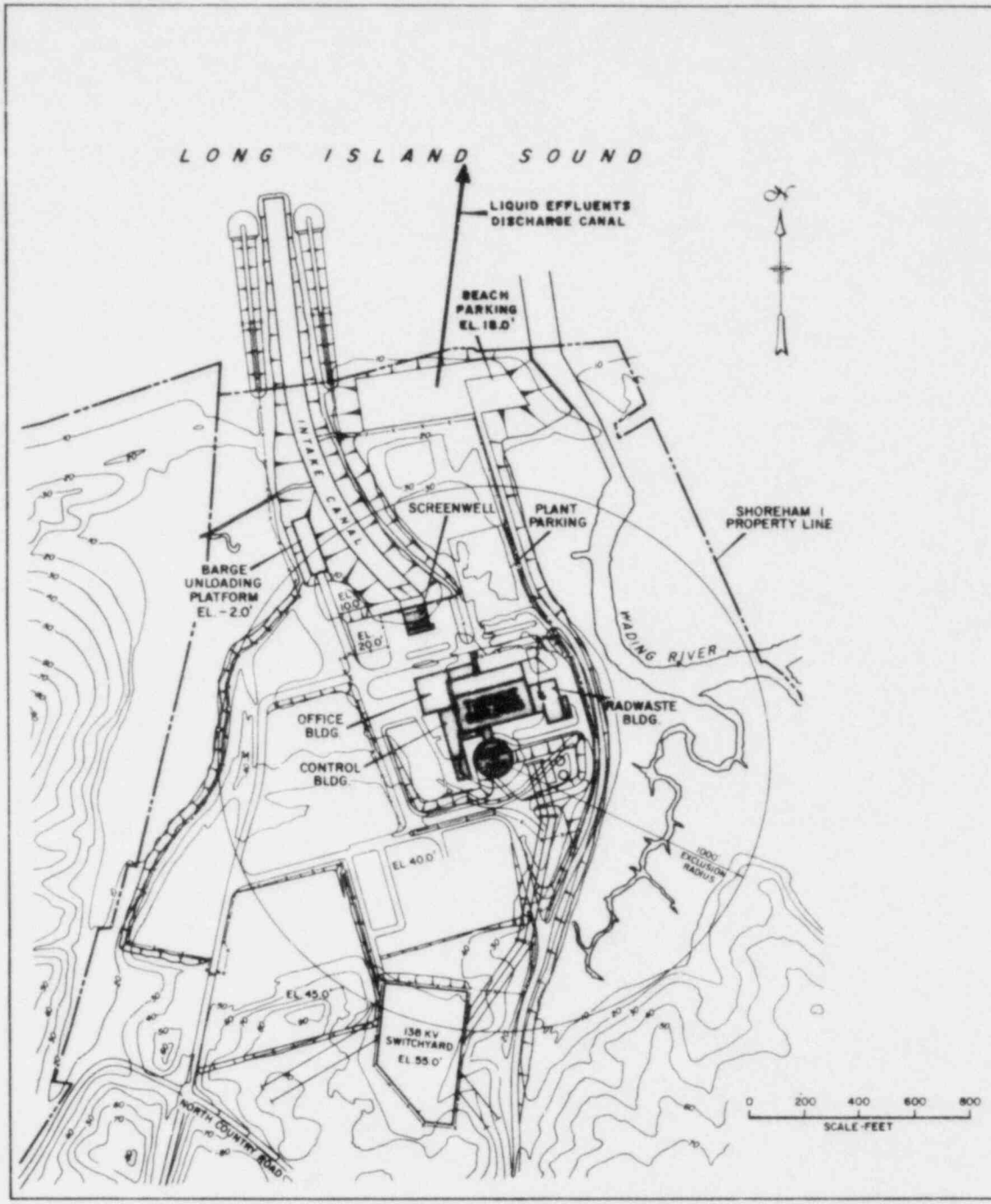
TABLE 3.5-15

P_{oij}

INFANT INGESTION OF GOAT'S MILK DOSE CONVERSION FACTORS

m^2(mrem/yr/μCi/sec)

Isotope	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Cr-51	-	-	1.6E+03	9.1E+02	3.4E+02	2.0E+03	3.8E+05
Mn-54	-	5.0E+05	9.5E+04	-	1.5E+05	-	1.5E+06
Fe-59	1.7E+05	4.1E+05	1.6E+05	-	-	1.1E+05	1.4E+06
Co-58	-	1.3E+06	3.2E+06	-	-	-	3.4E+06
Co-60	-	5.1E+06	1.2E+07	-	-	-	1.3E+07
Zn-65	9.7E+07	3.0E+08	1.4E+08	-	2.0E+08	-	1.9E+08
Sr-89	1.3E+10	-	3.6E+08	-	-	-	2.4E+08
Sr-90	1.8E+11	-	4.7E+10	-	-	-	1.7E+09
Zr-95	3.5E+02	9.0E+01	6.4E+01	-	2.7E+01	-	4.1E+04
Sb-124	1.4E+06	2.6E+05	5.6E+05	3.4E+03	-	1.1E+06	4.0E+07
I-131	6.7E+08	8.0E+10	4.8E+08	2.6E+11	2.0E+08	-	3.1E+07
I-133	9.7E+06	1.4E+07	4.3E+06	3.4E+09	3.4E+06	-	2.6E+06
Cs-134	6.2E+10	1.1E+11	9.6E+09	-	6.7E+09	1.3E+10	2.7E+05
Cs-136	3.7E+08	1.4E+09	1.0E+09	-	7.7E+08	1.1E+08	1.6E+08
Cs-137	9.8E+10	1.1E+11	6.2E+09	-	5.6E+09	1.3E+10	2.9E+08
Ba-140	1.2E+07	1.3E+04	6.5E+05	-	6.3E+02	7.7E+03	3.2E+05
Ce-141	1.3E+04	8.0E+03	9.4E+02	-	4.9E+02	-	3.8E+06



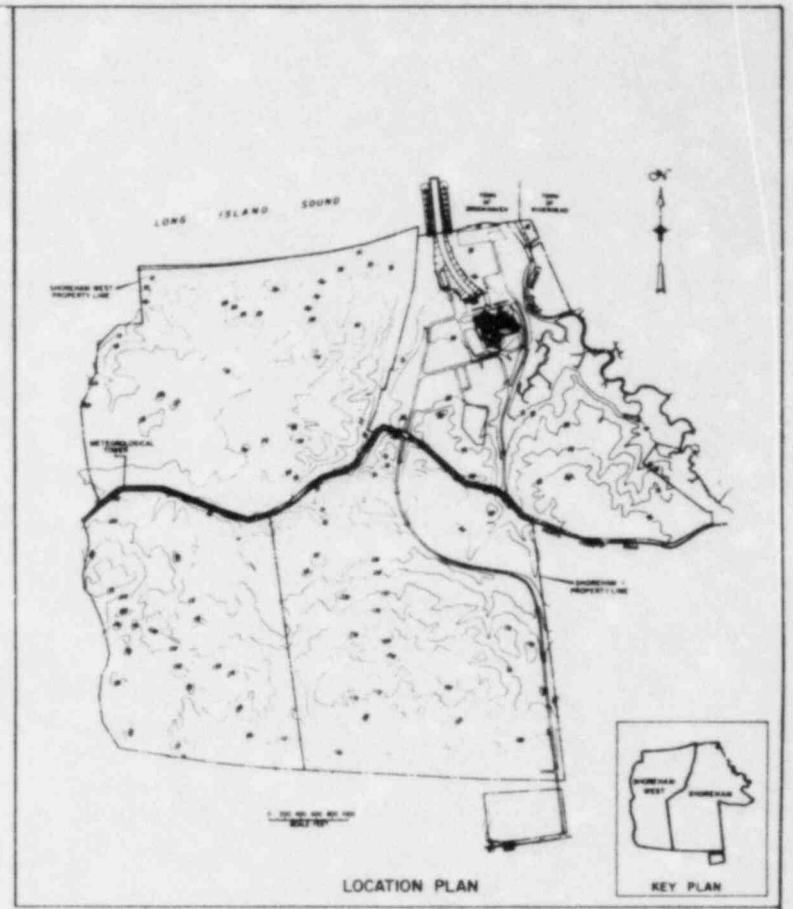


FIGURE 3.1-1
SITE BOUNDARY FOR LIQUID EFFLUENTS

ORIGINAL - MARCH 1983

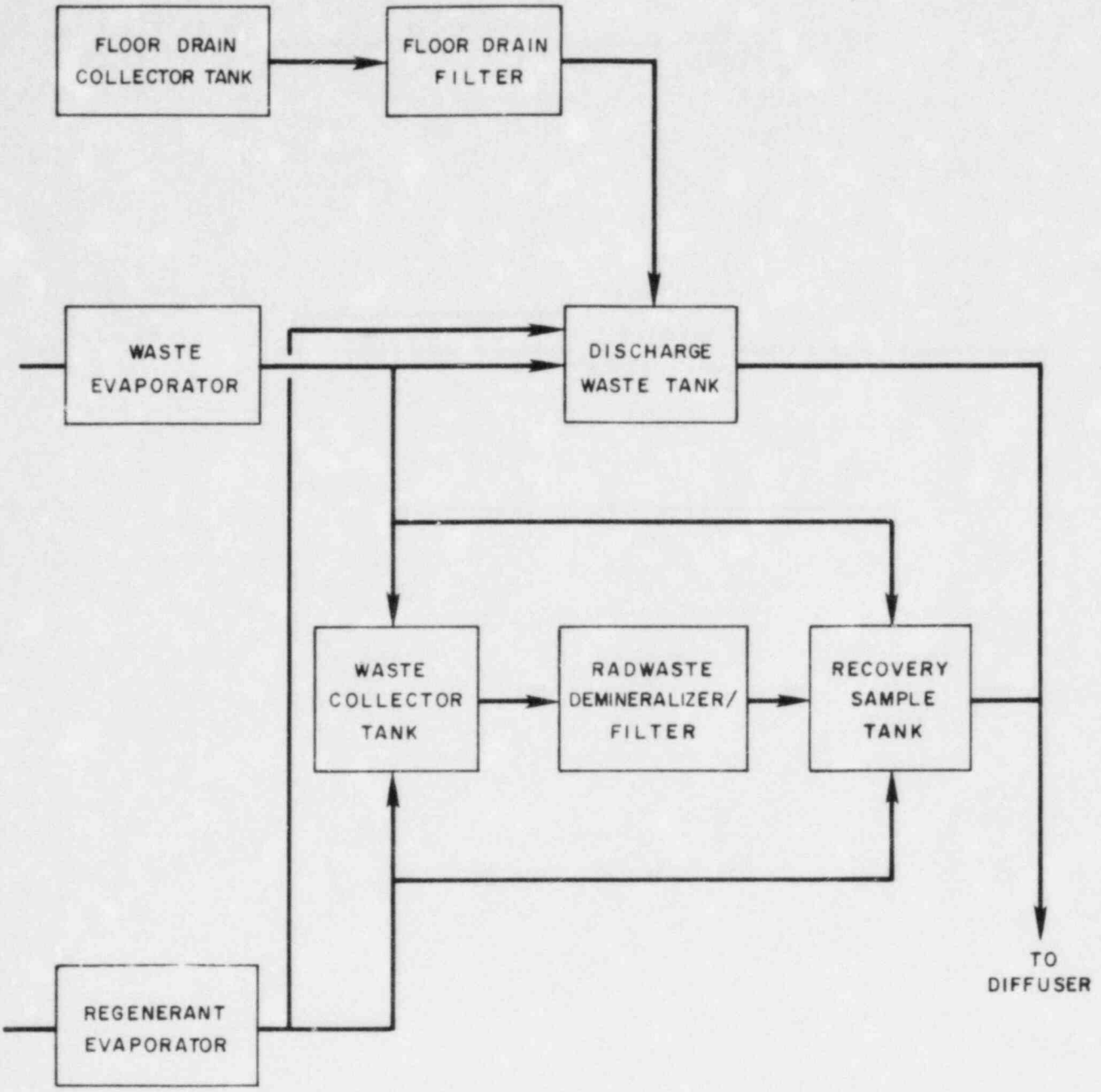


FIGURE 3.2-1
LIQUID RADWASTE
TREATMENT SYSTEM

ORIGINAL-MARCH 1983

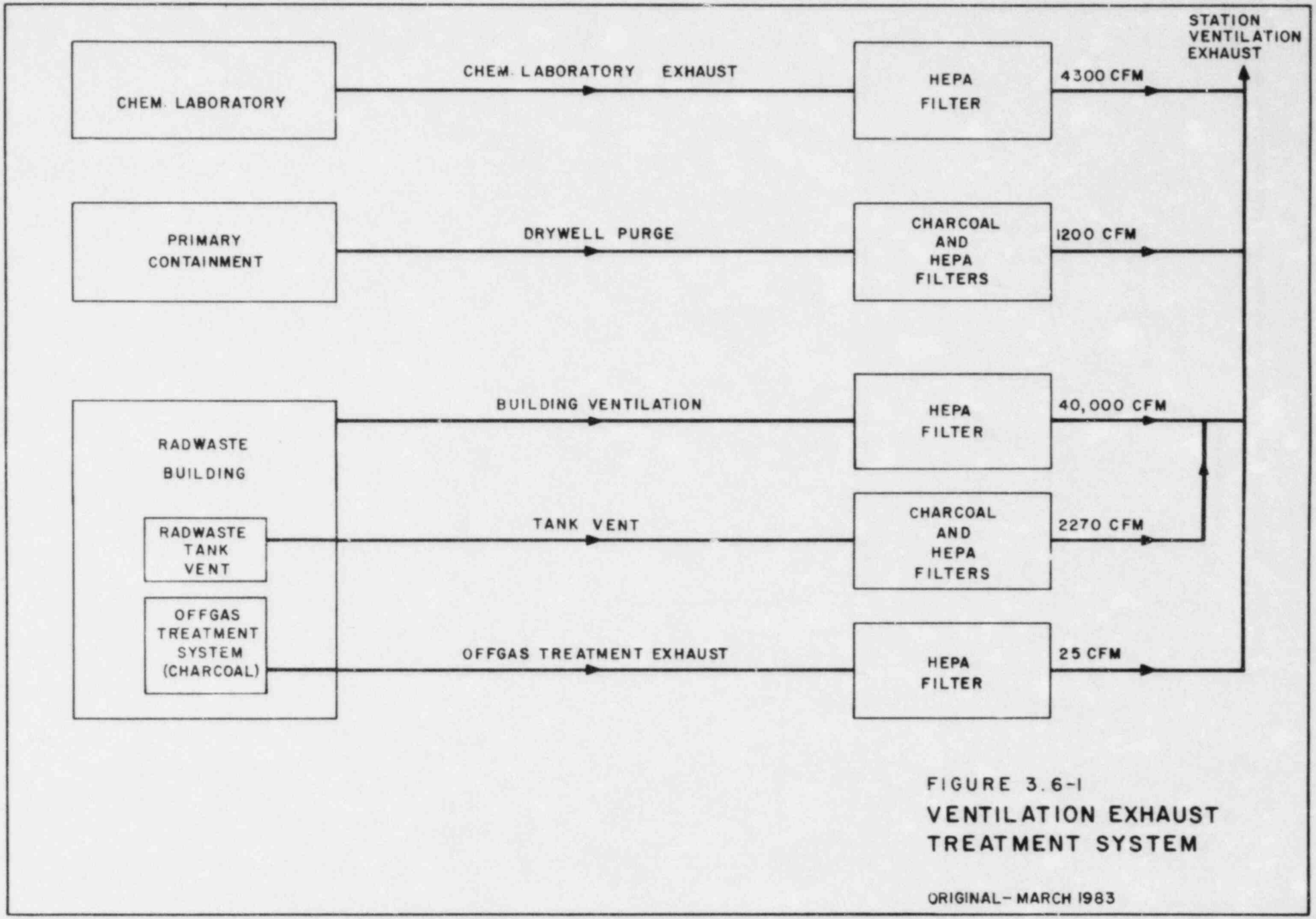


FIGURE 3.6-1
VENTILATION EXHAUST TREATMENT SYSTEM

ORIGINAL- MARCH 1983

4.0 RECEPTOR LOCATIONS, METEOROLOGY AND HYDROLOGY

The purpose of this section is to identify those receptor locations which represent critical pathway locations and to specify the dilution, dispersion, and deposition factors at these locations to be used in Calculation Method 2 when computerized radiation monitoring system is inoperable.

For liquid effluent pathways a dilution factor of 8.85 is used based on a calculation.

For gaseous effluent pathways, Table 4-1 lists the critical locations for receptors and their respective dispersion and deposition factors. The atmospheric dispersion and deposition factors were calculated based on onsite meteorological data for the 2 year period October 1, 1973 - September 30, 1975.

Regulatory Guide 1.109 methodology and parameters, except as noted above, were used in the noncomputerized method dose rate conversion factors.

TABLE 4-1

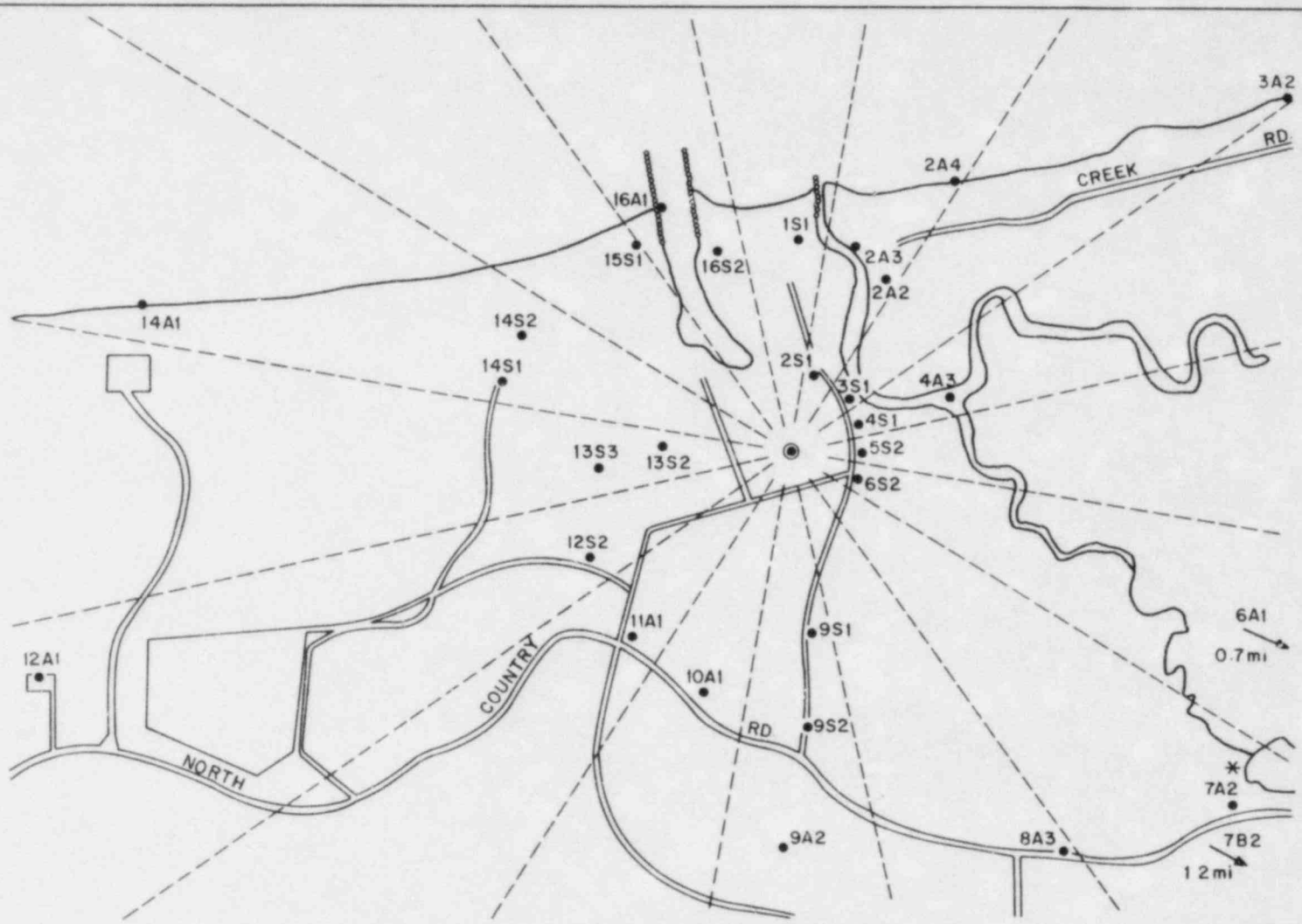
CRITICAL RECEPTOR LOCATIONS FOR GASEOUS EFFLUENT CALCULATIONS

Technical Specification Section	3.11.2.1	3.11.2.2	3.11.2.3	3.11.2.5
Sections in this Manual	3.3	3.4	3.5	3.6
Limiting Criteria	Instantaneous Dose Rate to Whole Body and Skin due to Noble Gas and Dose to any organ due To radionuclides other than Noble Gas	Quarterly and Annual Air Doses due to Gamma and Beta radiation	Quarterly and Annual Dose due to radionuclides other than Noble Gas	Dose to any organ due to radionuclides other than Noble Gas for 31 day period
Distance and Direction of Receptor from the Plant	1) Noble Gas: 366 meters, NNE 2) Organ: 1931 meters, ESE	457 meters, ESE	1931 meters, ESE	1931 meters, ESE
Description of Location	Location of highest Dose Rate	Location of highest Dose	Location of highest Dose	Location of highest Dose
Long Term Atmospheric Dispersion Factor for Station Ventilation Exhaust X/Q_1	1) 7.94E-07 sec/m³ 2) 1.10E-07 sec/m³	8.44E-07 sec/m³	1.10E-07 sec/m³	1.10E-07 sec/m³
Short Term Atmospheric Dispersion Factor for Air Removal Pump X/Q_2	1) 1.89E-06 sec/m³ 2) 3.60E-07 sec/m³	1.83E-06 sec/m³	3.60E-07 sec/m³	3.60E-07 sec/m³
Short Term Atmospheric Dispersion Factor for Containment Drywell Purge X/Q_3	1) 1.89E-06 sec/m³ 2) 3.60E-07 sec/m³	1.83E-06 sec/m³	3.60E-07 sec/m³	3.60E-07 sec/m³
Long Term Relative Deposition Factor for Station Ventilation Exhaust D/Q_1	1) NA 2) 4.80E-09 m^{-2}	NA	4.80E-09 m^{-2}	4.80E-09m^{-2}
Short Term Relative Deposition Factor for Air Removal Pump D/Q_2	1) NA 2) 1.40E-08 m^{-2}	NA	1.40E-08 m^{-2}	1.40E-08 m^{-2}
Short Term Relative Deposition Factor for Containment Drywell Purge D/Q_3	1) NA 2) 1.40E-08 m^{-2}	NA	1.40E-08 m^{-2}	1.40E-08 m^{-2}

5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLING LOCATIONS

The purpose of this section is to identify those sampling locations from which the radiological environmental monitoring samples shall be collected pursuant to Technical Specification 3/4.12.

Sampling locations for on site and off site locations are shown on Figures 5-1 and 5-2 respectively. The number and frequency for sampling at these locations is given in Technical Specification Table 3.12-1.



* SCHEDULED FOR INSTALLATION EARLY 1982

0 0.25 0.50

SCALE — MILES

FIGURE 5-1

ON SITE SAMPLING LOCATIONS
RADIOLOGICAL ENVIRONMENTAL
MONITORING PROGRAM

ORIGINAL - MARCH 1983

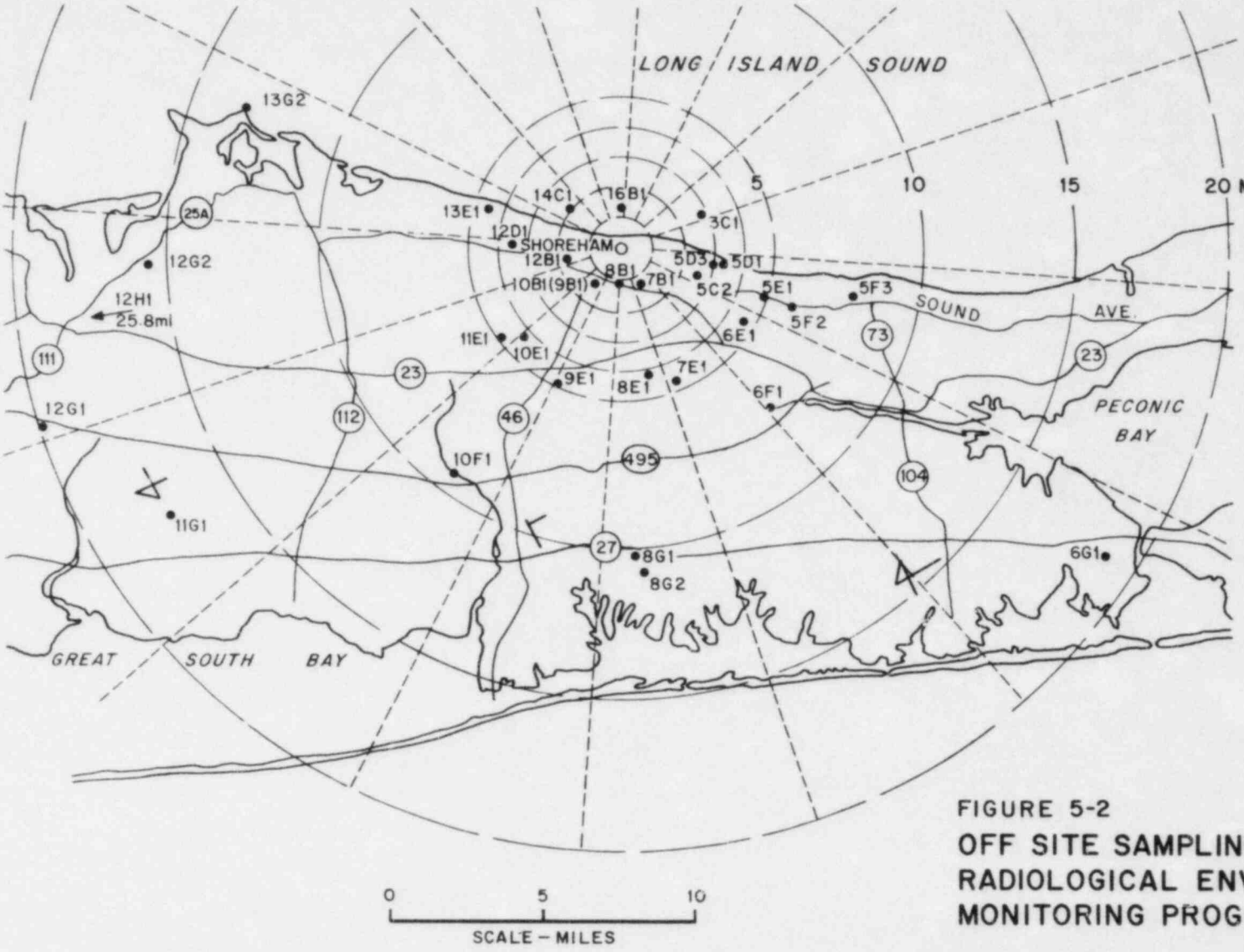


FIGURE 5-2

OFF SITE SAMPLING LOCATIONS
RADIOLOGICAL ENVIRONMENTAL
MONITORING PROGRAM

ORIGINAL - MARCH 1983