BRUNSWICK STEAM ELECTRIC PLANT

OFF-SITE DOSE CALCULATION MANUAL

(ODCM)

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3.0 GASEOUS EFFLUENTS

3.1 MONITOR ALARM SETPOINT DETERMINATION

This procedure determines the monitor alarm setpoint that indicates if the dose rate in the unrestricted areas due to noble gas radionuclides in the gaseous effluent released from the site to areas at and beyond the site boundary exceeds 500 mrem/year to the whole body or exceeds 3000 mrem/year to the skin.

3.1.1 Setpoint Based on Conservative Radionuclide Mix (Ground and Mixed Mode Releases)

The following method applies to gaseous releases via the Units 1 and 2 Turbine Building Vents and via the Units 1 and 2 Reactor Building Vents when determining the high alarm setpoint for the Turbine Building Vent Gas Monitors and Reactor Building Vent Gas Monitors.

3.1.1.1 Determine the "mix" (noble gas radionuclide composition) of the gaseous effluent (the "mix" can be determined from actual data or by using GALE code results of Table 3.1-1):

a. Determine the gaseous source terms that are representative of the "mix" of the gaseous effluent. Gaseous source terms are the noble gas activities in the effluent.

Gaseous source terms can be obtained from:
Table 3.1-1; Turbine Building Vent Release
Table 3.1-1; Reactor Building Vent Release
Actual release data

b. Determine S_i (the fraction of the total noble gas radioactivity in the gaseous effluent comprised by noble gas radionuclide i) for each individual noble gas radionuclide in the gaseous effluent.

$$S_i = \frac{A_i}{\sum_i A_i} \qquad (3.1\text{-}1)$$

A_i = The radioactivity of noble gas radionuclide i in the gaseous effluent from Table 3.1-1, Turbine Building Vent Release; Table 3.1-1, Reactor Building Vent Release; or from analysis of gaseous effluent.

3.1.1.2 Determine the Q_t (the maximum acceptable total release rate of all noble gas radionuclides in the gaseous effluent, μCi/sec) based upon the whole body exposure limit.

$$Q_t = \frac{500}{(\chi/Q) \sum_i (K_i S_i)} \qquad (3.1\text{-}2)$$

$(\overline{\chi/Q})_{tb}$ = The highest calculated annual average relative concentration of effluents released via the Turbine Building Vent for any area at or beyond the site boundary for all sectors (sec/m³) from Table A-1, Appendix A
= 7.50 E-6 sec/m³

$(\overline{\chi/Q})_{rb}$ = The highest calculated annual average relative concentration of effluents released via the Reactor Building Vent for any area at or beyond the site boundary for all sectors (sec/m³) from Table A-7, Appendix A
= 2.0 E-7 sec/m³

NOTE: Use the χ/Q that applies to the monitor for which the alarm setpoint is being calculated.

K_i = The total whole body dose factor due to gamma emissions from noble gas radionuclide i (mrem/year/μCi/m³) from Table 3.1-2.

3.1.1.3 Determine Q_t based upon the skin exposure limit.

$$Q_t = \frac{3000}{(\chi/Q) \sum_i [(L_i + 1.1 M_i) S_i]} \qquad (3.1\text{-}3)$$

$L_i + 1.1M_i$ = The total skin dose factor due to emissions from noble gas radionuclide i (mrem/year/μCi/m³) from Table 3.1-2.

NOTE: The Turbine Building radiation monitors are designed to input the monitor high alarm setpoint in μCi/sec or μCi/cc. The monitor setpoint in μCi/sec can be obtained by multiplying the lowest Q_t value (obtained from Sections 3.1.1.2 and 3.1.1.3) by the T_m value found in Section 3.1.1.5.b. The μCi/cc setpoint can be obtained by dividing the μCi/sec setpoint by the design flow rate in cc/sec. The equations for calculating the setpoint in cpm are included for completeness and may be used if desired.

3.1.1.4 Determine C_t (the maximum acceptable total radioactivity concentration of all noble gas radionuclides in the gaseous effluent, μCi/sec/cfm).

$$C_t = \frac{Q_t}{f} \qquad (3.1\text{-}4)$$

NOTE: Use the lower of the Q_t values obtained in Sections 3.1.1.2 and 3.1.1.3.

f = The maximum acceptable effluent flow rate at the point of release (cfm) based on design flow rates

= 15,000 cfm (Turbine Building Vent)

= 172,800 cfm (Reactor Building Vent)

3.1.1.5 Determine the monitor high alarm setpoint above background:

a. Determine CR (the calculated monitor count rate above background attributed to the noble gas radionuclides, net cpm).

$$CR = \frac{C_t}{E_m} \qquad (3.1\text{-}5)$$

E_m = The detection efficiency of the monitor for the "mix" of noble gas radionuclides in the gaseous effluent (μCi/sec/cfm•cpm) from E&RC files

b. Determine HSP (the monitor high alarm setpoint with background, cpm).

$$HSP = T_m\ CR + Bkg \qquad (3.1\text{-}6)$$

T_m = Fraction of the radioactivity from the site that may be released via the monitored pathway to ensure that the site boundary limit is not exceeded during simultaneous releases from several pathways

= 0.10 for the Unit 1 Turbine Building Vent Gas Monitor

= 0.10 for the Unit 2 Turbine Building Vent Gas Monitor

= 0.20 for the Unit 1 Reactor Building Vent Gas Monitor

= 0.20 for the Unit 2 Reactor Building Vent Gas Monitor

Bkg = The background count rate (cpm) due to internal contamination and the radiation levels in the area in which the monitor is installed when the detector sample chamber is filled with uncontaminated air

c. The monitor high alarm setpoint including background (cpm) shall be set at or below the HSP value determined above.

3.1.2 <u>Setpoint Based on Conservative Radionuclide Mix (Long-Term Elevated Release</u>

The following method applies to gaseous releases via the stack when determining the high-high alarm setpoint for the Stack Monitor during continuous release via the stack.

3.1.2.1 Determine the "mix" (noble gases and composition) of the gaseous effluent:

a. Determine the gaseous source terms that are representative of the "mix" of the gaseous effluent. Gaseous source terms are the noble gases radionuclide activity concentrations in the effluent.

b. Determine S_i (the fraction of the total radioactivity in the gaseous effluent comprised by noble gas radionuclide i) for each individual noble gas radionuclide in the gaseous effluent.

$$S_i = \frac{A_i}{\sum_i A_i} \qquad (3.1\text{-}7)$$

A_i = The radioactivity of noble gas radionuclide i in the gaseous effluent from Table 3.1-1, Stack Release, or from analysis of gaseous effluent.

3.1.2.2 Determine Q_t (the maximum acceptable total release rate of all noble gas radionuclides in the gaseous effluent, μCi/sec) based upon the whole body exposure limit.

$$Q_t = \frac{500}{\sum_i [V_i S_i]}$$

V_i = The constant for noble gas radionuclide i accounting for the gamma radiation from the elevated finite plume (mrem/year/µCi/sec) from Table 3.1-2

3.1.2.3 Determine Q_t based upon the skin exposure limit.

$$Q_t = \frac{3000}{\sum_i [(L_i \overline{(\chi/Q)}_s + 1.1B_i)S_i]} \quad (3.1\text{-}9)$$

$L_i\overline{(\chi/Q)}_s + 1.1B_i$ = The total skin dose constant for long-term releases (greater than 500 hours/year) due to emissions from noble gas radionuclide i (mrem/year/µCi/sec) from Table 3.1-2).

NOTE: The stack radiation monitor is designed to input the monitor high-high alarm setpoint in µCi/sec or µCi/cc. The monitor setpoint in µCi/sec can be obtained by multiplying the lowest Q_t value (obtained from Sections 3.1.2.2 and 3.1.2.3) by the T_m value found in Section 3.1.2.5.b. The µCi/cc setpoint can be obtained by dividing the µCi/sec setpoint by the design flow rate in cc/sec. The equations for calculating the setpoint in cps are included for completeness and may be used if desired.

3.1.2.4 Determine C_t (the total maximum acceptable radioactivity concentration of noble gas radionuclides in the gaseous effluent, µCi/sec/cfm).

$$C_t = \frac{Q_t}{f} \qquad (3.1\text{-}10)$$

<u>NOTE</u>: Use the <u>lowest</u> of the Q_t values obtained in Sections 3.1.2.2 and 3.1.2.3.

f = The maximum acceptable effuent flow rate at the point of release (cfm) based on design flow rates

= 86,000 cfm (stack)

3.1.2.5 Determine the monitor high-high alarm setpoint above background:

a. Determine the CR (the calculated monitor count rate above background attributed to the noble gas radionuclides, net cps).

$$CR = \frac{C_t}{E_m} \qquad (3.1\text{-}11)$$

E_m = The detection efficiency of the monitor for the "mix" of noble gas radionuclides in the gaseous effluent (μCi/sec/cfm•cps) from E&RC files

b. Determine HHSP (the monitor high-high alarm setpoint with background, cps).

$$HHSP = T_m\, CR + Bkg \qquad (3.1\text{-}12)$$

T_m = Fraction of the radioactivity from the site that may be released via the monitored pathway to ensure that the site boundary limit is not exceeded during simultaneous releases from several pathways

= 0.40 for the Stack Monitor

Bkg = The background count rate (cps) due to internal contamination and the radiation levels in the area in which the monitor is installed when the detector sample chamber is filled with uncontaminated air

c. The monitor high-high alarm setpoint including background (cps) shall be set at or below the HHSP value determined above.

3.1.3 Condenser Air Ejector Monitor Alarm Setpoint

This procedure determines the alarm setpoint for the Condenser Air Ejector Monitor that will provide reasonable assurance that the total body exposure to an individual at the exclusion area boundary will not exceed a small fraction of the limits of 10CFR100 in the event of an inadvertent release via the condenser air ejector.

3.1.3.1 The following method applies to gaseous releases via the Units 1 and 2 condenser air ejectors when determining the maximum allowable alarm setpoint for the Condenser Off-gas Radiation Monitors.

a. Determine Q, the allowable release rate (µCi/sec) at the air ejector for the noble gas radionuclides.

Specification 3.11.2.7 limits the gross radioactivity rate of noble gases measured at the main condenser air ejector to less than or equal to 243,600 µCi/sec (after 30 minutes' decay). Assume that the noble gas concentrations at the air ejector (t = 0) are representative of the GALE code. Since the holdup time between the air ejector and the stack (down the 30-minute holdup line) can vary due to operational conditions, the mix of the noble gases at the stack should be determined based on the actual decay time not to exceed 30 minutes. This mix can then

be applied to the 243,600 μCi/sec limit and then back-calculated to determine the allowable release rate at the air ejector, Q. As an example, assume that the holdup time is 30 minutes. The mix of the noble gases after 30 minutes' decay (t = 30 minutes) can be determined by the following table.

Nuclide	GALE Code Steam (μCi/gm) t = 0 (for 3400 MWt)	Steam (μCi/gm) t = 0 (for 2436 MWt)	μCi/sec* t = 0	$e^{-\lambda t}$ t = 30m	μCi/sec t = 30m	Fraction of Mix t = 30m
Kr-83m	9.1E-4	6.5E-4	8.58E+2	8.3E-1	7.1E+2	2.9E-2
Kr-85m	1.6E-3	1.1E-3	1.45E+3	9.2E-1	1.3E+3	5.3E-2
Kr-85	5.0E-6	3.6E-6	4.75E+0	1.0E+0	4.8E+0	2.0E-4
Kr-87	5.5E-3	3.9E-3	5.15E+3	7.6E-1	3.9E+3	1.6E-1
Kr-88	5.5E-3	3.9E-3	5.15E+3	8.8E-1	4.5E+3	1.8E-1
Kr-89	3.4E-2	2.4E-2	3.17E+4	1.5E-3	4.7E+1	1.9E-3
Kr-90	7.5E-2	5.4E-2	7.13E+4	3.8E-17	2.7E-12	1.1E-16
Xe-131m	3.9E-6	2.8E-6	3.70E+0	1.0E+0	3.7E+0	1.5E-4
Xe-133m	7.5E-5	5.4E-5	7.13E+1	9.9E-1	7.0E+1	2.8E-3
Xe-133	2.1E-3	1.5E-3	1.98E+3	1.0E+0	2.0E+3	8.1E-2
Xe-135m	7.0E-3	5.0E-3	6.60E+3	2.6E-1	1.7E+3	6.9E-2
Xe-135	6.0E-3	4.3E-3	5.68E+3	9.6E-1	5.4E+3	2.2E-1
Xe-137	3.9E-2	2.8E-2	3.70E+4	4.2E-3	1.6E+2	6.5E-3
Xe-138	2.3E-2	1.6E-2	2.11E+4	2.3E-1	4.8E+3	2.0E-1
				TOTAL	2.46E+4	1.0E+0

*Steam Flow = (10,470,524 lbs/hr) $\frac{(0.1260 \text{ gm/sec})}{\text{lbs/hr}}$ = 1.32E+6 gm/sec

Applying this mix to 243,600 μCi/sec (after 30 minutes' delay) and back calculating to t = 0 will yield the allowable μCi/sec per noble gases at the air ejectors; i.e.:

Nuclide	Fraction of Mix t = 30 min	Tech Spec (μCi/sec) t = 30 min	$e^{-\lambda t}$ t = 30 min	Tech Spec (μCi/sec) t = 0
Kr-83m	2.9E-2	7.06E+3	8.3E-1	8.51E+3
Kr-85m	5.3E-2	1.29E+4	9.2E-1	1.40E+4
Kr-85	2.0E-4	4.87E+1	1.0E+0	4.87E+1
Kr-87	1.6E-1	3.90E+4	7.6E-1	5.13E+4
Kr-88	1.8E-1	4.38E+4	8.8E-1	4.98E+4
Kr-89	1.9E-3	4.63E+2	1.5E-3	3.09E+5
Kr-90	1.1E-16	2.68E-11	3.8E-17	7.05E+5
Xe-131m	1.5E-4	3.65E+1	1.0E+0	3.65E+1
Xe-133m	2.8E-3	6.82E+2	9.9E-1	6.89E+2
Xe-133	8.1E-2	1.97E+4	1.0E+0	1.97E+4
Xe-135m	6.9E-2	1.68E+4	2.6E-1	6.46E+4
Xe-135	2.2E-1	5.36E+4	9.6E-1	5.58E+4
Xe-137	6.5E-3	1.58E+3	4.2E-3	3.76E+5
Xe-138	2.0E-1	4.87E+4	2.3E-1	2.12E+5
TOTALS	1.0E+0	2.44E+5		1.87E+6

Therefore:

Q = 1.87E+6 μCi/sec (for 30 minutes' holdup)

b. Determine C_m (the total radioactivity concentration of noble gases) in the condenser air ejector gas (μCi/sec/scfm).

$$C_m = Q/f \qquad (3.1\text{-}13)$$

Q = The allowable release rate (μCi/sec) at the air ejector for noble gases

f = The main condenser air inleakage rate plus the radiolytic gas flow rate

c. Determine the monitor high-high alarm setpoint above background.

(1) Determine MR (the calculated monitor response attributed to the noble gas radionuclides, mR/hr).

$$MR = \frac{C_m}{E_m} \quad (3.1\text{-}14)$$

E_m = The detection efficiency of the monitor for the "mix" of noble gas radionuclides in the gaseous stream [(μCi/sec)/(mR/hr•cfm)] from E&RC files

(2) The monitor high-high alarm setpoint (mR/hr) should be set at or below the MR value determined above.

3.1.4 Condenser Off-Gas Treatment System (AOG) Monitor Alarm Setpoint Determination

This method determines the monitor alarm setpoint that includes sufficient noble gas activity to cause an alarm at the stack effluent noble gas monitor.

3.1.4.1 Determine Q_t (the maximum acceptable total release rate of all noble gas radionuclides in the gaseous effluent, μCi/sec) based upon the whole body exposure (see Equation 3.1-8) and skin exposure (see Equation 3.1-9).

NOTE: Use the lowest of the Q_t values obtained.

3.1.4.2 Determine Q_s (the site adjusted maximum release rate, μCi/sec, for effluent releases via the stack).

$$Q_s = Q_t \times T_m \quad (3.1\text{-}15)$$

T_m = Fraction of radioactivity from the site that may be released via the stack to ensure that the site boundary limit is not exceeded during simultaneous releases from several pathways

= 0.4 for the stack monitor

3.1.4.3 Determine HSP (high alarm setpoint in µCi/cc).

$$HSP = Q_s \div f \qquad (3.1\text{-}16)$$

f = Maximum design flow rate of the AOG System

= 70,800 cc/sec (150 cfm)

3.1.4.4 The monitor high alarm setpoint shall be set at or below the HSP value determined above.

TABLE 3.1-2

DOSE FACTORS AND CONSTANTS

Radio nuclide	Total Whole Body Dose Factor (K_i) (mrem/yr/µCi/m³)	Total Skin Dose Factor ($L_i + 1.1M_i$) (mrem/yr/µCi/m³)	Total Body Dose Constant For Long-Term Releases (V_i) (mrem/yr/µCi/sec)	Total Skin Dose Constant for Long-Term Releases ($L_i(\chi/Q)_s + 1.1B_i$) (mrem/yr/µCi/sec)
Kr-83m	7.56E-2	2.12E+1	1.66E-9	1.54E-7
Kr-85m	1.17E+3	2.81E+3	9.18E-5	1.60E-4
Kr-85	1.61E+1	1.36E+3	1.36E-6	1.19E-5
Kr-87	5.92E+3	1.65E+4	4.17E-4	7.60E-5
Kr-88	1.47E+4	1.91E+4	1.08E-3	1.80E-3
Kr-89	1.66E+4	2.91E+4	6.55E-4	1.16E-3
Xe-131m	9.15E+1	6.48E+2	2.17E-5	4.09E-5
Xe-133m	2.51E+2	1.35E+3	1.64E-5	3.64E-5
Xe-133	2.94E+2	6.94E+2	1.72E-5	3.16E-5
Xe-135m	3.12E+3	4.41E+3	2.17E-4	3.67E-4
Xe-135	1.81E+3	3.97E+3	1.47E-4	2.56E-4
Xe-137	1.42E+3	1.39E+4	5.64E-4	1.82E-4
Xe-138	8.83E+3	1.43E+4	6.61E-4	1.12E-3
Ar-41	8.84E+3	1.29E+4	7.86E-4	1.32E-3

3.2 COMPLIANCE WITH 10CFR20 (GASEOUS)

3.2.1 Noble Gases

The gaseous effluent monitors' setpoints are utilized to show compliance with 10CFR20 for noble gases. However, because they are based upon a conservative mix of radionuclides, the possibility exists that the setpoints could be exceeded and yet 10CFR20 limits may not be exceeded. Therefore, the following methodology has been provided in the event that if the alarm/trip setpoints are exceeded, a determination may be made as to whether the actual releases have exceeded 10CFR20.

The dose rate in unrestricted areas resulting from noble gas effluents is limited to 500 mrem/year to the total body and 3000 mrem/year to the skin. Based upon NUREG 0133, the following are used to show compliance with 10CFR20.

$$\Sigma_i \left[V_i \dot{Q}_{i_s} + K_i (\overline{X/Q})_v \dot{Q}_{i_v} \right] \leq 500 \text{ mrem/yr} \qquad (3.2\text{-}1)$$

$$\Sigma_i \left\{ \left[L_i (\overline{X/Q})_s + 1.1 B_i \right] \dot{Q}_{i_s} + (L_i + 1.1 M_i)(\overline{X/Q})_v \dot{Q}_{i_v} \right\} \leq 300 \text{ mrem/yr} \qquad (3.2\text{-}2)$$

where:

K_i = The total body dose factor due to gamma emissions for noble gas radionuclide i, mrem/year per $\mu Ci/m^3$

L_i = The skin dose factor due to beta emissions for noble gas radionuclide i, mrem/year per $\mu Ci/m^3$

M_i = The air dose factor due to gamma emissions for noble gas radionuclide i, mrad/year per $\mu Ci/m^3$

V_i = The constant for each identified noble gas radionuclide i accounting for the gamma radiation from the elevated finite plume mrem/year per $\mu Ci/sec$

B_i = The constant for long-term releases (greater than 500 hours/year) for each identified noble gas radionuclide i accounting for the gamma radiation from the elevated finite plume in mrad/year per μCi/sec

1.1 = The ratio of the tissue to air absorption coefficients over the energy range of the photon of interest, mrem/mrad

$\dot{Q}_{i_s}$ = The release rate of noble gas radionuclide i in gaseous effluents from free-standing stack, μCi/sec

$\dot{Q}_{i_v}$ = The release rate of noble gas radionuclide i in gaseous effluents from all vent releases, μCi/sec

At the Brunswick Steam Electric Plant (BSEP), gaseous releases may occur from:

1. The Turbine Building vent
2. The Reactor Building vent
3. The stack

Releases from the Turbine Building are ground level. The sources of these releases are steam leakage through valve stems, pump seals, and flanged connections. Releases from the Reactor Building are considered mixed mode in nature, and the source is also leakage through valve stems, pump seals, and flanged connections. Releases from the stack are considered elevated. Their sources are the main condenser's steam jet air ejectors, Radwaste Building and AOG Building ventilation system exhausts, mechanical vacuum pump exhausts during startup, and gland seal off-gases.

Noble gas releases may occur from all three points. To show compliance with 10CFR20, Expressions 3.2-1 and 3.2-2 are now in terms of the actual release points for BSEP.

For the total body dose:

$$\Sigma_i V_i \dot{Q}_{i_s} + \Sigma_i K_i \left[(\overline{X/Q})_{rb} \dot{Q}_{i_{rb}} + (\overline{X/Q})_{tb} \dot{Q}_{i_{tb}} \right] \leq 500 \text{ mrem/yr} \qquad (3.2\text{-}3)$$

For the skin dose:

$$\Sigma_i \left[L_i(\overline{\chi/Q})_s + 1.1B_i\right]\dot{Q}_{i_s} + \Sigma_i \left[L_i + 1.1M_i\right]\left[(\overline{\chi/Q})_{rb}\,\dot{Q}_{i_{rb}} + (\overline{\chi/Q})_{tb}\,\dot{Q}_{i_{tb}}\right]$$

$$\leq 3000 \text{ mrem/yr} \qquad (3.2\text{-}4)$$

where:

$\dot{Q}_{i_s}$ = Release rate of radionuclide i from the stack, μCi/sec

$\dot{Q}_{i_{rb}}$ = Release rate of radionuclide i from the two Reactor Buildings, μCi/sec

$\dot{Q}_{i_{tb}}$ = Release rate of radionuclide i from the two Turbine Buildings, μCi/sec

$(\overline{\chi/Q})_s$ = Annual average relative concentration for releases from the stack, sec/m³

$(\overline{\chi/Q})_{rb}$ = Annual average relative concentration for releases from the Reactor Buildings, sec/m³

$(\overline{\chi/Q})_{tb}$ = Annual average relative concentration for releases from the Turbine Buildings, sec/m³

All other terms remain the same as those defined previously.

The determination of controlling location for implementation of 10CFR20 for noble gases is a function of the radionuclide mix, the isotopic release rate, and the meteorology.

The incorporation of these variables into Expressions 3.2-3 and 3.2-4 result in the following expressions for the controlling locations for the BSEP. This location is 0.7 miles, the ENE site boundary.

For the total body:

$$\Sigma_i V_i \dot{Q}_{i_s} + \Sigma_i K_i \left(6.5 \times 10^{-8}\, \dot{Q}_{i_{rb}} + 3.2 \times 10^{-6}\, \dot{Q}_{i_{tb}}\right) \leq 500 \text{ mrem/yr} \qquad (3.2\text{-}5)$$

For the skin:

$$\Sigma_i \left(7.2 \times 10^{-9} L_i + 1.1 B_i\right) \dot{Q}_{i_s} +$$

$$\Sigma_i \left[\left(L_i + 1.1 M_i\right)\left(6.5 \times 10^{-8}\, \dot{Q}_{i_{rb}} + 3.2 \times 10^{-6}\, \dot{Q}_{i_{tb}}\right)\right] \leq 3000 \text{ mrem/yr} \qquad (3.2\text{-}6)$$

The radionuclide mix was based upon source terms calculated using the NRC GALE code. They were calculated based upon the present operating mode of BSEP. They are presented in Table 3.2-1 as a function of release point. It should be noted, however, that the releases in Table 3.2-1 do not reflect the actual BSEP release data to date. The releases to date have been substantially less. This table was used as a calculational tool to determine the controlling location.

The χ/Q values utilized in the equations for implementation of 10CFR20 are based upon the maximum long-term annual average $(\overline{\chi/Q})$ in the unrestricted area. Table 3.2-2 presents the distances from the Reactor and Turbine Buildings to the nearest unrestricted area for each of the 16 sectors as well as to the nearest residence, vegetable garden, cow, goat, and beef animal. Table 3.2-3 presents the distances and directions from the stack to the same site boundaries of Table 3.2-2. Note that only distance has changed in relation to Table 3.2-2.

Long-term annual $\overline{(\chi/Q)}$ values for the stack, Reactor Building, and Turbine Building release points from BSEP to the special locations in Table 3.2-2 are presented in Appendix A. A description of the derivation is also provided in this appendix. $\overline{\chi/Q}$ values at the limiting site boundary for releases from the Turbine Building, Reactor Building, and stack were obtained from Tables A-1, A-7, and A-13, respectively, of the appendix.

To determine the controlling location for implementation of 10CFR20, the two or three highest site boundary $\overline{\chi/Q}$ values for each release point were utilized in conjunction with the radionuclide mix and release rate for each release point. Since mixed mode and elevated releases occur from BSEP, their maximum $\overline{\chi/Q}$ value may not decrease with distance; i.e., the site boundary may not have the highest $\overline{\chi/Q}$ values. Therefore, long-term annual average $\overline{\chi/Q}$ values were calculated at the midpoint of the 10 standard distances as given in Table A-4 of Appendix A. The highest two or three $\overline{\chi/Q}$ values for each release point at a distance greater than the site boundary were used in conjunction with the radionuclide mix to determine the controlling location. A particular combination of release point mix and meteorology dominates in the determination of the controlling location. For BSEP, it is the stack, and the controlling location is at the ENE site boundary.

Values for K_i, L_i, and M_i, which were used in the determination of the controlling locations and which are to be used by BSEP in Expressions 3.2-5 and 3.2-6 to show compliance with 10CFR20, are presented in Table 3.2-4. These values originate from NUREG 0472, Revision 0, and were taken from Table B-1 of the NRC Regulatory Guide 1.109, Revision 1. The values have been multiplied by 10^6 to convert picocuries^{-1} to microcuries^{-1} for use in Expressions 3.2-5 and 3.2-6.

Values for V_i and B_i for the finite plume model can be expressed as shown in Equations 3.2-7 and 3.2-8. They were calculated at the site boundary of each of the 16 sectors using the NRC code RABFIN. Values for V_i and B_i for each of the 16 sectors are presented in Appendix B.

$$\Sigma_i P_{i_I} \left[(\overline{X/Q})_s \dot{Q}_{i_s} + (\overline{X/Q})_{rb} \dot{Q}_{i_{rb}} + (\overline{X/Q})_{tb} \dot{Q}_{i_{tb}} \right] + \Sigma_i (P_{i_G} + P_{i_M})$$

$$\left[(\overline{D/Q})_s \dot{Q}_{i_s} + (\overline{D/Q})_{rb} \dot{Q}_{i_{rb}} + (\overline{D/Q})_{tb} \dot{Q}_{i_{tb}} \right] \leq 1500 \text{ mrem/yr} \qquad (3.2\text{-}11)$$

where:

P_{i_I} = Dose parameter for radionuclide i for the inhalation pathway, mrem/year per µCi/sec[3]

P_{i_G} = Dose parameter for radionuclide i for the ground plane pathway, mrem/year per µCi/sec per m^{-2}

P_{i_M} = Dose parameter for radionuclide i for either the cow milk or goat milk pathway, mrem/year per µCi/sec per m^{-2}

$(\overline{X/Q})_{rb}$ = Annual average relative concentrations for releases from the Reactor Buildings, sec/m^3

$(\overline{X/Q})_{tb}$ = Annual average relative concentrations for releases from the Turbine Buildings, sec/m^3

$(\overline{X/Q})_s$ = Annual average relative concentrations for releases from the stack, sec/m^3

$(\overline{D/Q})_{rb}$ = Annual average deposition for releases from the Reactor Buildings, m^{-2}

$(\overline{D/Q})_{tb}$ = Annual average deposition for releases from the Turbine Buildings, m^{-2}

$(\overline{D/Q})_s$ = Annual average deposition for releases from the stack, m^{-2}

To show compliance with 10CFR20, Expressions 3.2-11 and 3.2-13 are evaluated first at the limiting site boundary. It should be noted that the sum of the dose rates from radioiodines and particulates and from tritium must be summed and their combined dose rates less than 1500 mrem/year to show compliance with 10CFR20. If the 1500 mrem/year limit is exceeded at the limiting site boundary when all pathways are considered present at the site boundary but the inhalation pathway contributes less than 1500 mrem/year, then Expressions 3.2-11 and 3.2-13 are evaluated at the limiting real pathway location.

The limiting site boundary location is 0.7 miles NE. Expression 3.2-11 becomes:

For radioiodines and particulates:

$$\Sigma_i P_{i_I} \left(2.5 \times 10^{-8}\, \dot{Q}_{i_s} + 2.0 \times 10^{-7}\, \dot{Q}_{i_{rb}} + 2.9 \times 10^{-6}\, \dot{Q}_{i_{tb}}\right) +$$

$$\Sigma_i \left(P_{i_G} + P_{i_M}\right) \left(1.4 \times 10^{-9}\, \dot{Q}_{i_s} + 4.3 \times 10^{-9}\, \dot{Q}_{i_{rb}} + 1.9 \times 10^{-8}\, \dot{Q}_{i_{tb}}\right)$$

$$\leq 1500 \text{ mrem/yr} \qquad (3.2\text{-}14)$$

For BSEP, the limiting "hypothetical" real pathway location is the cow milk pathway 4.75 miles NE. At this location, Expression 3.2-11 becomes:

$$\Sigma_i P_{i_I} \left(2.4 \times 10^{-8}\, \dot{Q}_{i_s} + 4.1 \times 10^{-8}\, \dot{Q}_{i_{rb}} + 1.4 \times 10^{-7}\, \dot{Q}_{i_{tb}}\right) +$$

$$\Sigma_i \left(P_{i_G} + P_{i_M}\right) \left(2.2 \times 10^{-10}\, \dot{Q}_{i_s} + 2.7 \times 10^{-10}\, \dot{Q}_{i_{rb}} + 5.7 \times 10^{-10}\, \dot{Q}_{i_{tb}}\right)$$

$$\leq 1500 \text{ mrem/yr} \qquad (3.2\text{-}15)$$

For tritium, at the limiting site boundary, Equation 3.2-13 becomes:

For tritium:

$$\dot{D}_T = 3.0 \times 10^3 \; (2.5 \times 10^{-8} \; \dot{Q}_{T_s} + 2.0 \times 10^{-7} \; \dot{Q}_{t_{rb}} + 2.9 \times 10^{-6} \; \dot{Q}_{t_{tb}}) \quad (3.2\text{-}16)$$

At the "hypothetical" limiting real pathway location, Equation 3.2-13 becomes:

For tritium:

$$\dot{D}_T = 3.0 \times 10^3 \; (2.4 \times 10^{-8} \; \dot{Q}_{T_s} + 4.1 \times 10^{-8} \; \dot{Q}_{t_{rb}} + 1.4 \times 10^{-7} \; \dot{Q}_{t_{tb}}) \quad (3.2\text{-}17)$$

The determination of controlling location for implementation of 10CFR20 for radioiodines and particulates is a function of the same two parameters as for noble gases plus a third receptor pathway location. The incorporation of these parameters into Expression 3.2-11 results in the respective expressions at the controlling locations. The radionuclide mix was again based upon the source terms calculated using the GALE code. The mix and the source terms are presented in Table 3.2-1 as a function of release point.

In the determination of the controlling site boundary location, the highest two or three site boundary D/Q values for each release point were utilized in conjunction with the radionuclide mix and the release rate for each release point. At BSEP, the combination of meteorology and release rate which dominates comes from the stack.

In the determination of receptor controlling location, the highest two or three D/Q values from each release point to the pathway locations of Table 3.2-2 are utilized in conjunction with the radionuclide mix and release rate for each release point. For BSEP, the controlling location is a hypothetical cow milk pathway 4.75 miles NE of the Reactor Building and Turbine Buildings.

Values for P_i were calculated for an infant for various radionuclides for the inhalation, ground plane, cow milk, and goat milk pathways using the methodology of NUREG 0133. The P_i values are presented in Table 3.2-5. The values of P_i reflect, for each radionuclide, the maximum P_i value for any organ for each individual pathway of exposure. Because the goat milk pathway is not present at BSEP, the cow milk pathway P_i values were utilized in the determination of the various controlling locations. For the case of an infant being present at the site boundary or at the real pathway location, the ground plane pathway is not considered as a reasonable exposure pathway for the infant (i.e., $P_G = 0$). However, P_{i_G} values are presented in Table 3.2-5 for completeness. Appendix C presents the methodology which was utilized in calculating P_i values.

Annual average D/Q values at the special locations for the stack, Reactor Building, and Turbine Building release points, respectively, which were utilized in Expressions 3.2-14 through 3.2-17 were obtained from the tables presented in Appendix A. The χ/Q values in Expressions 3.2-14 through 3.2-17 were also obtained from the tables presented in Appendix A. D/Q values at the limiting site boundary location and the limiting real pathway location for releases from the Turbine Buildings, the Reactor Buildings, and the stack were obtained from Tables A-3, A-9, and A-15, respectively, of Appendix A. χ/Q values at these same locations for these same release points were obtained from Tables A-1, A-7, and A-13 of Appendix A. A description of the derivation of the χ/Q and D/Q values is provided in Appendix A.

TABLE 3.2-2

DISTANCE TO CONTROLLING LOCATIONS AS MEASURED FROM THE BRUNSWICK PLANT CENTER (Mi)

Sector	Site Boundary	Milk Cow	Milk Goat	Meat Animal	Nearest Resident	Nearest Garden
NNE	0.7	-	-	1.4	1.4	1.4
NE	0.7	4.75*	-	-	-	-
ENE	0.7	-	-	-	-	-
E	0.7	-	-	1.1	1.3	-
ESE	0.7	-	-	0.9	1.6	1.6
SE	0.7	-	-	1.0	1.0	-
SSE	0.7	-	-	0.9	0.9	0.9
S	0.8	-	-	-	1.4	1.8
SSW	0.8	-	-	1.5	1.4	1.5
SW	0.7	-	-	1.0	1.0	1.0
WSW	0.7	-	-	1.8	1.1	1.1
W	0.7	-	-	-	0.9	0.9
WNW	0.6	-	-	-	0.9	0.9
NW	0.6	-	-	-	0.9	0.9
NNW	0.6	-	-	-	0.9	0.9
N	0.7	-	-	-	0.9	1.0

* A "hypothetical" cow milk pathway is located at this point in accordance with 5.3.1 of NUREG 0133.

TABLE 3.2-3

DISTANCE TO SITE BOUNDARIES BASED UPON BRUNSWICK PLANT CENTER AND DIRECTIONS FROM THE STACK

Based on Center of Brunswick Plant		From Stack to Site Boundaries of Table 3.2-2	
Direction	Site Boundary Distance (Mi)	Direction	Distance (Mi)
NNE	0.7	NNE	0.7
NE	0.7	NE	0.7
ENE	0.7	ENE	0.7
E	0.7	E	0.6
ESE	0.7	ESE	0.6
SE	0.7	SE	0.6
SSE	0.7	SSE	0.6
S	0.8	S	0.6
SSW	0.8	SSW	0.7
SW	0.7	SW	0.7
WSW	0.7	WSW	0.7
W	0.7	W	0.8
WNW	0.6	WNW	0.7
NW	0.6	NW	0.7
NNW	0.6	NNW	0.7
N	0.7	N	0.8

Gamma radiation:

$$3.17 \times 10^{-8}\ \Sigma_i \left\{ M_i \left[\overline{(\chi/Q)}_{rb} \left(Q_{i_{rb1}} + Q_{i_{rb2}}\right) + \overline{(\chi/Q)}_{tb} \left(Q_{i_{tb1}} + Q_{i_{tb2}}\right) \right] + B_i Q_{i_s} \right\}$$

$\leq$ 10 mrad per quarter or 20 mrad per year (3.3-5)

Beta radiation:

$$3.17 \times 10^{-8}\ \Sigma_i N_i \left[\overline{(\chi/Q)}_{rb} \left(Q_{i_{rb1}} + Q_{i_{rb2}}\right) + \overline{(\chi/Q)}_{tb} \left(Q_{i_{tb1}} + Q_{i_{tb2}}\right) + \overline{(\chi/Q)}_s Q_{i_s} \right]$$

$\leq$ 20 mrad per quarter or 40 mrad per year (3.3-6)

where:

$\overline{(\chi/Q)}_{rb}$ = Annual average relative concentration for releases from the Reactor Building, sec/m^3

$\overline{(\chi/Q)}_{tb}$ = Annual average relative concentration for releases from the Turbine Building, sec/m^3

$\overline{(\chi/Q)}_s$ = Annual average relative concentration for releases from the stack, sec/m^3

$Q_{i_{rb1}}$, $Q_{i_{rb2}}$ = Release of radionuclide i from Reactor Buildings 1 and 2, respectively, μCi

$Q_{i_{tb1}}$, $Q_{i_{tb2}}$ = Release of radionuclide i from Turbine Buildings 1 and 2, respectively, μCi

Q_{i_s} = Release of radionuclide i from the stack, μCi

At BSEP, the limiting location for noble gases is 0.7 miles ENE. Substitution of the appropriate χ/Q values into Expressions 3.3-5 and 3.3-6 results in the following:

During any calendar quarter or year:

Gamma radiation:

$$3.17 \times 10^{-8} \Sigma_i \left\{ M_i \left[6.5 \times 10^{-8} (Q_{i_{rb1}} + Q_{i_{rb2}}) + 3.2 \times 10^{-6} (Q_{i_{tb1}} + Q_{i_{tb2}}) \right] + B_i Q_{i_s} \right\} \leq 10 \text{ mrad per quarter or 20 mrad per year} \quad (3.3\text{-}7)$$

Beta radiation:

$$3.17 \times 10^{-8} \Sigma_i \; N_i \left[6.5 \times 10^{-8} (Q_{i_{rb1}} + Q_{i_{rb2}}) + 3.2 \times 10^{-6} (Q_{i_{tb1}} + Q_{i_{tb2}}) + 7.2 \times 10^{-9} Q_{i_s} \right] \leq 20 \text{ mrad per quarter or 40 mrad per year} \quad (3.3\text{-}8)$$

The determination of the controlling locations for implementation of 10CFR50 is a function of parameters such as radionuclide mix, isotopic release, and meteorology.

The incorporation of these parameters into Expressions 3.3-1 through 3.3-4 resulted in the expressions for the controlling locations as presented in Expressions 3.3-7 and 3.3-8. The radionuclide mix was based upon source terms calculated using the NRC GALE Code and is presented in Table 3.2-1 as a function of release point.

The two or three highest site boundary $\overline{X/Q}$ values for each release point were utilized in conjunction with the radionuclide mix and release for each release point to determine the controlling site boundary location. Since mixed mode

and elevated releases occur from BSEP and their maximum $\overline{\chi/Q}$ values may not decrease with distance (i.e., the site boundary may not have the highest $\overline{\chi/Q}$ values); $\overline{\chi/Q}$ values were calculated at the midpoint of 10 standard distance intervals out to a distance of 5 miles. The two or three highest $\overline{\chi/Q}$ values were considered in conjunction with the radionuclide mix and releases to determine the controlling location.

In the determination of the controlling location, annual average $\overline{\chi/Q}$ values are utilized. These values are presented in tables in Appendix A. $\overline{\chi/Q}$ values at the limiting site boundary location for releases from the Turbine Buildings, Reactor Buildings, and stack were obtained from Tables A-1, A-7, and A-13, respectively, of Appendix A. A description of the derivation of χ/Q values is also presented in Appendix A.

A particular combination of release point mix and meteorology dominates in the determination of the controlling location. For BSEP the controlling release point is the stack.

Values for M_i and N_i, which were used in the determination of the controlling location and which are to be used by BSEP in Expressions 3.3-7 and 3.3-8 to show compliance with 10CFR50 were presented in Table 3.2-4. These values originate from NUREG 0472, Revision 0, and were taken from Table B-1 of NRC Regulatory Guide 1.109, Revision 1. The values have been multiplied by 10^6 to convert from picocuries to microcuries.

The following relationship should hold for BSEP to show compliance with Radiological Effluent Technical Specification 3.11.2.2.

For the calendar quarter:

$$D\gamma \leq 10 \text{ mrad} \quad (3.3\text{-}9)$$

$$D\beta \leq 20 \text{ mrad} \quad (3.3\text{-}10)$$

For the calendar year:

$$D\gamma \leq 20 \text{ mrad} \qquad (3.3\text{-}11)$$

$$D\beta \leq 40 \text{ mrad} \qquad (3.3\text{-}12)$$

where:

$D\gamma$ = The air dose from gamma radiation, mrad

$D\beta$ = The air dose from beta radiation, mrad

The quarterly limits given above represent one-half the annual design objective of Section II.B.1 of Appendix I of 10CFR50. If any of the limits of Expressions 3.3-9 through 3.3-12 are exceeded, a special report pursuant to Section IV.A of Appendix I of 10CFR50 must be filed with the NRC.

3.3.2 Radioiodines and Particulates

3.3.2.1 Cumulation of Doses

Section II.C of Appendix I of 10CFR50 limits the release of radioiodines and radioactive material in particulate form from each reactor such that estimated dose or dose commitment to an individual in an unrestricted area from all pathways of exposure is not in excess of 15 mrem to any organ. Based upon NUREG 0133, the dose to an organ of an individual from radioiodines and particulates, with half-lives greater than 8 days in gaseous effluents released to unrestricted areas, can be determined by the following expression:

During any calendar quarter or year:

$$3.17 \times 10^{-8} \Sigma_i R_i (W_s Q_{i_s} + w_s q_{i_s} + W_v Q_{i_v} + w_v q_{i_v})$$

$$\leq 7.5 \text{ mrem per quarter or 15 mrem per calendar year} \qquad (3.3\text{-}13)$$

To show compliance with 10CFR50, Expression 3.3-15 is evaluated at the controlling pathway location. At BSEP the controlling location is a milk cow 4.75 miles in the NE sector. Expression 3.3-15 becomes:

$$3.17 \times 10^{-8} \Sigma_i \left\{ (R_{i_G} + R_{i_M}) \left[2.2 \times 10^{-10} Q_{i_s} + 2.7 \times 10^{-10} (Q_{i_{rb1}} + Q_{i_{rb2}}) + \right. \right.$$

$$\left. 5.7 \times 10^{-10} (Q_{i_{tb1}} + Q_{i_{tb2}}) \right] + R_i \left[2.4 \times 10^{-8} Q_{i_s} + 4.1 \times 10^{-8} (Q_{i_{rb1}} + Q_{i_{rb2}}) + \right.$$

$$\left. \left. 1.4 \times 10^{-7} (Q_{i_{tb1}} + Q_{i_{tb2}}) \right] \right\} \leq 15 \text{ mrem/quarter or } 30 \text{ mrem/year} \qquad (3.3\text{-}17)$$

For tritium, Equation 3.3-16 reduces to:

$$D_T = 3.17 \times 10^{-8} (R_{T_M} + R_{T_I}) \left[2.4 \times 10^{-8} Q_{T_s} + 4.1 \times 10^{-8} (Q_{T_{rb1}} + Q_{T_{rb2}}) + \right.$$

$$\left. 1.4 \times 10^{-7} (Q_{T_{tb1}} + Q_{T_{tb2}}) \right] \qquad (3.3\text{-}18)$$

The determination of a controlling location for implementation of 10CFR50 for radioiodines and particulates is a function of:

(1) Radionuclide mix and isotopic release
(2) Meteorology
(3) Exposure pathway
(4) Receptor's age

The incorporation of these parameters into Expression 3.3-14 results in the respective equations at the controlling location.

In the determination of the controlling location, the radionuclide mix of radioiodines and particulates was based upon the source terms calculated using the GALE code. This mix was presented in Table 3.2-1 as a function of release point.

In the determination of the controlling location, all of the exposure pathways, as presented in Table 3.2-2, were evaluated. These include cow milk, goat milk, beef and vegetable ingestion, and inhalation ground plane exposure. An infant was assumed to be present at all milk pathway locations. A child was assumed to be present at all vegetable garden and beef animal locations. The ground plane exposure pathway was only considered to be present where an infant was not present. Naturally, inhalation was present everywhere an individual was present.

For the determination of the controlling location, the highest D/Q values for each release point and release mode for the vegetable garden, cow milk, and goat milk pathways were selected. At BSEP, no cow milk or goat milk pathways are present. In accordance with NUREG 0133, dose to a "hypothetical" cow milk pathway located 4.75 miles NE was evaluated against existing vegetable garden pathways. The thyroid dose was calculated at each of these locations using the radionuclide mix and releases of Table 3.2-1. Based upon these calculations, it was determined that the controlling receptor pathway is the "hypothetical" cow milk-infant pathway in the NE sector, at 4.75 miles.

Tables 3.3-1 through 3.3-19 present R_i values for the total body, GI tract, bone, liver, kidney, thyroid, and lung organs for the ground plane, inhalation, cow milk, goat milk, and vegetable and meat ingestion pathways for the infant, child, teen, and adult age groups as appropriate to the pathways. These values were calculated using the methodology described in NUREG 0133 using a grazing period of eight months. A discussion of their calculation is presented in Appendix C.

In the determination of the controlling location annual average $\overline{D/Q}$ and $\overline{\chi/Q}$ values are utilized. D/Q values at the limiting real pathway locations for releases from the Turbine Buildings, Reactor Buildings, and the stack were obtained from Tables A-3, A-9, and A-15, respectively, of Appendix A. χ/Q

values at the same location for these same release points were obtained from Tables A-1, A-7, and A-13 of Appendix A. A description of the derivation of the various χ/Q and D/Q values is presented in Appendix A.

Long-term $\overline{D/Q}$ values for the stack, Reactor Buildings, and Turbine Buildings are provided for the midpoints of the following distances:

0.0-0.5 mi.	0.5-1.0 mi.	1.0-1.5 mi.	1.5-2.0 mi.
2.0-2.5 mi.	2.5-3.0 mi.	3.0-3.5 mi.	3.5-4.0 mi.
4.0-4.5 mi.	4.5-5.0 mi.		

These values appear in tables in Appendix A. These tables may be utilized if an additional special location arises different from those presented in the special locations of Table 3.2-2.

The following relationships should hold for BSEP to show compliance with BSEP Technical Specification 3.11.2.3.

For the calendar quarter:

$$D\tau \leq 15 \text{ mrem} \quad (3.3\text{-}19)$$

For the calendar year:

$$D\tau \leq 30 \text{ mrem} \quad (3.3\text{-}20)$$

where:

$D\tau$ = The dose to any organ τ from radioiodiines and particulates, mrem

The quarterly limits given above represent one-half the annual design objective of Section II.C of Appendix I of 10CFR50. If any of the limits of Expressions 3.3-19 or 3.3-20 are exceeded, a special report pursuant to Section IV.A of Appendix I of 10CFR50 must be filed with the NRC.

TABLE 4.0-1

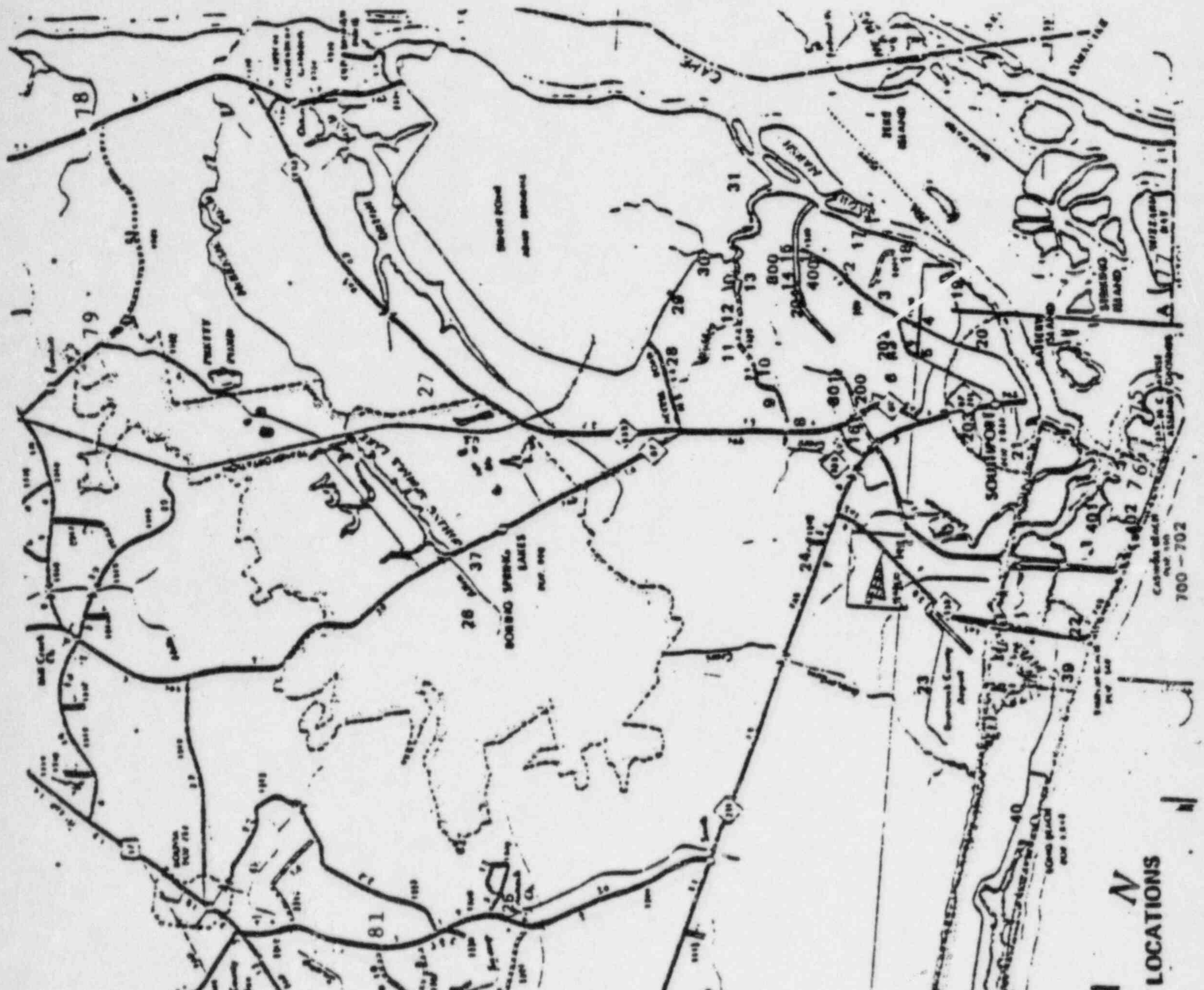
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample ID No.	Sample Point Description, Approximate Distance, and Direction	Sampling and Collection Frequency	Analysis Frequency	Analysis (a)
DIRECT RADIATION					
	1	1.1 miles E - Refer to Figure 4.0-1a and Figure 4.0-1b	Q	Q	Gamma Dose
	2	1.0 miles ESE	Q	Q	Gamma Dose
	3	0.9 miles SE	Q	Q	Gamma Dose
	4	1.1 miles SSE	Q	Q	Gamma Dose
	5	1.1 miles S	Q	Q	Gamma Dose
	6	1.0 miles SSW	Q	Q	Gamma Dose
	7	1.0 miles SW	Q	Q	Gamma Dose
	8	1.2 miles W	Q	Q	Gamma Dose
	9	1.0 miles WNW	Q	Q	Gamma Dose
	10	0.9 miles NW	Q	Q	Gamma Dose
	11	0.9 miles NNW	Q	Q	Gamma Dose
	12	1.0 miles N	Q	Q	Gamma Dose
	13	1.2 miles NNE	Q	Q	Gamma Dose
	14	0.5 miles NE	Q	Q	Gamma Dose
	15	0.9 miles ENE	Q	Q	Gamma Dose
	16	1.0 miles WSW	Q	Q	Gamma Dose
	17	1.5 miles ESE	Q	Q	Gamma Dose
	18	1.7 miles SE	Q	Q	Gamma Dose
	77	5.3 miles SSE	Q	Q	Gamma Dose
	75	4.5 miles S	Q	Q	Gamma Dose
	76	4.8 miles SSW	Q	Q	Gamma Dose
	22	5.3 miles SW	Q	Q	Gamma Dose
	23	4.6 miles WSW	Q	Q	Gamma Dose
	24	3.0 miles W	Q	Q	Gamma Dose
	25	8.7 miles WNW	Q	Q	Gamma Dose
	26	5.9 miles NW	Q	Q	Gamma Dose
	27	5.0 miles NNW	Q	Q	Gamma Dose
	79	9.5 miles N	Q	Q	Gamma Dose
	78	10.0 miles NNE	Q	Q	Gamma Dose
	30	2.0 miles NE	Q	Q	Gamma Dose
	31	2.6 miles ENE	Q	Q	Gamma Dose
	32	5.7 miles E	Q	Q	Gamma Dose

TABLE 4.0-1 (Cont'd)

Exposure Pathway and/or Sample	Sample ID No.	Sample Point Description, Approximate Distance, and Direction	Sampling and Collection Frequency	Analysis Frequency	Analysis (a)
DIRECT RADIATION (Cont'd)	33	4.3 miles E	Q	Q	Gamma Dose
	34	5.5 miles ENE	Q	Q	Gamma Dose
	81	10.0 miles WNW (C)	Q	Q	Gamma Dose
	36	9.3 miles NE	Q	Q	Gamma Dose
	37	5.5 miles NW	Q	Q	Gamma Dose
	38	11.0 miles W	Q	Q	Gamma Dose
	39	5.3 miles SW	Q	Q	Gamma Dose
	40	6.9 miles WSW	Q	Q	Gamma Dose
AIRBORNE					
Radioiodine and Particulate	200	1.0 miles SW Vistors Center	Continuous sampler operation with sample collected weekly or as required by dust loading, whichever is more frequent.	W	Radioiodine Canister I-131 analysis
	201	0.6 miles NE PMAC		-	Particulate sampler Gross beta radioactivity analysis following filter change (b).
	202	1.0 miles S Substation - Const. Rd.		Q	Gamma isotopic analysis of composite by location.
	203	2.3 miles SSW Southport Substation			
	204	23 miles NNE Sutton Plant - Control(c)			
WATERBORNE					
a. Surface	400	0.7 miles NE Intake Canal - Control (c)	Composite Sample (d) Collection - M	Monthly	Gamma Isotopic-
				Q	Monthly Tritium
	401	4.9 miles SSW Discharge Canal at Still Pond			
b. Sediment	500	4.9 miles SSW Discharge - Beach	Semiannual	Semiannual	Gamma Isotopic

Figure 4.0 - 1a



BSEP SAMPLE POINT LOCATIONS

6.3.2 Inhalation Dose

The inhalation dose will be determined at the calculational locations for each age class at risk according to the methods outlined in Section 3.3 of this manual.

6.3.3 Ingestion Pathway

The dose via the ingestion pathway will be calculated at the consumer locations for the consumers at risk. If no milk pathway exists in a sector, the dose via this pathway will be treated as < 1 mrem/yr.

6.3.4 Other Uranium Fuel Cycle Sources

The dose from other fuel cycle sources will be treated as < 1 mrem/yr.

6.4 THYROID DOSE

The dose to the thyroid will be calculated for each sector as the sum of inhalation dose and milk ingestion dose (if existing). The calculational methods will be those identified in Section 3.3 of this manual.

6.4.1 Dose projections can incorporate planned plant operations such as power reduction or outages for the projected period.

were the source of the X/Q and D/Q values utilized to show compliance with 10CFR20 and 10CFR50 for noble gases and radioiodines and particulates.

Tables A-1 through A-6	Relative undepleted concentration, relative depleted concentration, and relative deposition flux estimates for ground-level release for both standard distances and special locations.
Tables A-7 through A-12	Relative undepleted concentration, relative depleted concentration, and relative deposition flux estimates for mixed-mode release for both standard distances and special locations.
Tables A-13 through A-18	Relative undepleted concentration, relative depleted concentration, and relative deposition flux estimates for elevated release for both standard distances and special locations.

Values for χ/Q, depleted χ/Q, and D/Q for releases to special locations are from the standard distance tables. The values used are from the distance nearest the special location in the appropriate sector.

Future Operation Computations

The NRC "XOQDOQ" Program (Revision 1) was obtained and installed on the CP&L computer system. For routine meteorological dispersion evaluations, the "XOQDOQ" Program will be run with the appropriate physical plant data, appropriate meteorological information for the standard distances, and special locations of interest without a terrain/recirculation factor. The input to "XOQDOQ" for ground-level releases are presented in Table A-19 and for

Table A-1

χ/Q Values at the Special Locations for Releases From the Turbine Buildings

Carolina Power & Light Company - Brunswick
Release Type: Annual
Release Mode: Ground Level
Variable: Relative Concentration (Sec./Cubic Meter)
Calculation Points: Special
Model: Straight Line (ANNX009)
Application of Terrain Correction Factors: Yes
Number of Observations: 8678

Affected Sector	Site Boundary	Dairy	Meat	Resident	Garden
NNE	2.3E-06	0.	9.4E-07	9.4E-07	9.4E-07
NE	2.9E-06	1.4E-07	0.	0.	0.
ENE	3.2E-06	0.	0.	0.	0.
E	3.9E-06	0.	1.5E-06	1.5E-06	0.
ESE	5.2E-06	0.	5.2E-06	1.0E-06	1.0E-06
SE	3.4E-06	0.	3.4E-06	3.4E-06	0.
SSE	7.5E-06	0.	7.5E-06	7.5E-06	7.5E-06
S	3.8E-06	0.	0.	1.6E-06	9.8E-07
SSW	2.8E-06	0.	1.2E-06	1.2E-06	1.2E-06
SW	2.5E-06	0.	2.5E-06	2.5E-06	2.5E-06
WSW	1.8E-06	0.	3.8E-07	7.5E-07	7.5E-07
W	1.5E-06	0.	0.	1.5E-06	1.5E-06
WNW	1.2E-06	0.	0.	1.2E-06	1.2E-06
NW	9.7E-07	0.	0.	9.7E-07	9.7E-07
NNW	1.3E-06	0.	0.	1.3E-06	1.3E-06
N	1.4E-06	0.	0.	1.4E-06	1.4E-06

* A zero indicates that this point was not calculated.

Table A-2

Depleted χ/Q Values at the Special Locations for Releases From the Turbine Buildings

Carolina Power & Light Company - Brunswick

Release Type: Annual

Release Mode: Ground Level

Variable: Relative Depleted Concentration (Sec./Cubic Meter)

Calculation Points: Special

Model: Straight Line (ANNX009)

Application of Terrain Correction Factors: Yes

Number of Observations: 8678

Affected Sector	Site Boundary	Dairy	Meat	Resident	Garden
NNE	2.0E-06	0.	8.1E-07	8.1E-07	8.1E-07
NE	2.6E-06	1.0E-07	0.	0.	0.
ENE	2.9E-06	0.	0.	0.	0.
E	3.4E-06	0.	1.3E-06	1.3E-06	0.
ESE	4.6E-06	0.	4.6E-06	8.7E-07	8.7E-07
SE	3.1E-06	0.	3.1E-06	3.1E-06	0.
SSE	6.8E-06	0.	6.8E-06	6.8E-06	6.8E-06
S	3.5E-06	0.	0.	1.3E-06	8.1E-07
SSW	2.5E-06	0.	1.0E-06	1.0E-06	1.0E-06
SW	2.4E-06	0.	2.4E-06	2.4E-06	2.4E-06
WSW	1.5E-06	0.	3.2E-07	6.4E-07	6.4E-07
W	1.3E-06	0.	0.	1.3E-06	1.3E-06
WNW	1.1E-06	0.	0.	1.1E-06	1.1E-06
NW	8.7E-07	0.	0.	8.7E-07	8.7E-07
NNW	1.1E-06	0.	0.	1.1E-06	1.1E-06
N	1.2E-06	0.	0.	1.2E-06	1.2E-06

* A zero indicates that this point was not calculated.

Table A-3

D/Q Values at the Special Locations for Releases From the Turbine Buildings

Carolina Power & Light Company - Brunswick
Release Type: Annual
Release Mode: Ground Level
Variable: Relative Deposition (Meter**-2)
Calculation Points: Special
Model: Straight Line (ANNX009)
Application of Terrain Correction Factors: Yes
Number of Observations: 8678

Affected Sector	Site Boundary	Dairy	Meat	Resident	Garden
NNE	1.3E-08	0.	4.8E-09	4.8E-09	4.8E-09
NE	1.9E-08	5.7E-10	0.	0.	0.
ENE	9.4E-09	0.	0.	0.	0.
E	8.6E-09	0.	3.1E-09	3.1E-09	0.
ESE	1.3E-08	0.	1.3E-08	2.2E-09	2.2E-09
SE	8.4E-09	0.	8.4E-09	8.4E-09	0.
SSE	1.5E-08	0.	1.5E-08	1.5E-08	1.5E-08
S	8.3E-09	0.	0.	3.2E-09	1.8E-09
SSW	7.7E-09	0.	3.0E-09	3.0E-09	3.0E-09
SW	1.1E-08	0.	1.1E-08	1.1E-08	1.1E-08
WSW	7.0E-09	0.	1.3E-09	2.7E-09	2.7E-09
W	5.1E-09	0.	0.	5.1E-09	5.1E-09
WNW	3.8E-09	0.	0.	3.8E-09	3.8E-09
NW	3.5E-09	0.	0.	3.5E-09	3.5E-09
NNW	5.0E-09	0.	0.	5.0E-09	5.0E-09
N	6.3E-09	0.	0.	6.3E-09	6.3E-09

* A zero indicates that this point was not calculated.

Table A-6

D/Q Values at the Standard Distances for Releases from the Turbine Buildings

Carolina Power & Light Company - Brunswick
Release Type: Annual
Release Mode: Ground Level
Variable: Relative Deposition (Meter**-2)
Calculation Points: Standard
Model: Straight Line (ANNX009)
Application of Terrain Correction Factors: Yes
Number of Observations: 8678

Base Distance in Miles/Kilometers

Aftd Sect	Design Dist Mi	.25 .40	.75 1.21	1.25 2.01	1.75 2.82	2.25 3.62	2.75 4.42	3.25 5.23	3.75 6.03	4.25 6.84	4.75 7.64
NNE	0.	8.6E-08	1.3E-08	4.8E-09	2.8E-09	1.5E-09	9.9E-10	7.7E-10	5.7E-10	4.3E-10	3.3E-10
NE	0.	1.3E-07	1.9E-08	7.6E-09	4.0E-09	2.3E-09	1.6E-09	1.3E-09	8.8E-10	6.8E-10	5.7E-10
ENE	0.	5.8E-08	9.4E-09	3.2E-09	1.6E-09	1.1E-09	7.5E-10	5.5E-10	3.9E-10	3.0E-10	2.3E-10
E	0.	6.2E-08	8.6E-09	3.1E-09	1.7E-09	1.1E-09	6.9E-10	5.1E-10	3.9E-10	2.9E-10	2.3E-10
ESE	0.	7.2E-08	1.3E-08	5.0E-09	2.2E-09	1.2E-09	7.6E-10	6.0E-10	4.7E-10	3.5E-10	2.6E-10
SE	0.	5.1E-08	8.4E-09	3.3E-09	1.6E-09	8.6E-10	5.6E-10	3.8E-10	3.3E-10	2.6E-10	2.2E-10
SSE	0.	8.2E-08	1.5E-08	5.8E-09	3.0E-09	1.8E-09	1.1E-09	6.8E-10	4.9E-10	3.8E-10	2.9E-10
S	0.	5.6E-08	8.3E-09	3.2E-09	1.8E-09	1.2E-09	7.5E-10	5.4E-10	3.9E-10	2.9E-10	2.3E-10
SSW	0.	5.2E-08	7.7E-09	3.0E-09	1.9E-09	1.1E-09	5.8E-10	4.3E-10	3.8E-10	2.2E-10	1.8E-10
SW	0.	7.5E-08	1.1E-08	4.3E-09	2.4E-09	1.6E-09	8.8E-10	6.4E-10	4.6E-10	3.7E-10	3.1E-10
WSW	0.	6.0E-08	7.0E-09	2.7E-09	1.3E-09	8.8E-10	5.2E-10	4.0E-10	3.3E-10	2.4E-10	2.0E-10
W	0.	4.1E-08	5.1E-09	2.0E-09	9.2E-10	5.7E-10	3.6E-10	2.6E-10	2.1E-10	1.7E-10	1.0E-10
WNW	0.	3.4E-08	3.8E-09	1.7E-09	7.3E-10	3.9E-10	3.0E-10	1.9E-10	1.5E-10	1.1E-10	8.4E-11
NW	0.	2.7E-08	3.5E-09	1.1E-09	6.6E-10	4.7E-10	3.3E-10	2.1E-10	1.7E-10	1.1E-10	9.6E-11
NNW	0.	3.6E-08	5.0E-09	1.9E-09	8.5E-10	5.0E-10	3.8E-10	2.8E-10	2.4E-10	1.6E-10	1.3E-10
N	0.	4.4E-08	6.3E-09	2.1E-09	1.3E-09	8.0E-10	5.6E-10	4.5E-10	3.5E-10	2.5E-10	2.1E-10

Number of Valid Observations 8678
Number of Invalid Observations 82
Number of Calms Lower Level 125
Number of Calms Upper Level 0

Table A-7

χ/Q Values at the Special Locations for Releases From the Reactor Buildings

Carolina Power & Light Company - Brunswick
Release Type: Annual
Release Mode: Mixed Mode
Variable: Relative Concentration (Sec./Cubic Meter)
Calculation Points: Special
Model: Straight Line (ANNX009)
Application of Terrain Correction Factors: Yes
Number of Observations: 8678

Affected Sector	Site Boundary	Dairy	Meat	Resident	Garden
NNE	1.0E-07	0.	7.8E-08	7.8E-08	7.8E-08
NE	2.0E-07	4.1E-08	0.	0.	0.
ENE	6.5E-08	0.	0.	0.	0.
E	4.8E-08	0.	3.5E-08	3.5E-08	0.
ESE	6.9E-08	0.	6.9E-08	3.9E-08	3.9E-08
SE	4.1E-08	0.	4.1E-08	4.1E-08	0.
SSE	7.6E-08	0.	7.6E-08	7.6E-08	7.6E-08
S	4.5E-08	0.	0.	3.5E-08	2.8E-08
SSW	4.7E-08	0.	4.7E-08	4.7E-08	4.7E-08
SW	6.4E-08	0.	6.4E-08	6.4E-08	6.4E-08
WSW	4.1E-08	0.	3.9E-08	4.3E-08	4.3E-08
W	3.4E-08	0.	0.	3.4E-08	3.4E-08
WNW	1.8E-08	0.	0.	1.8E-08	1.8E-08
NW	1.9E-08	0.	0.	1.9E-08	1.9E-08
NNW	3.2E-08	0.	0.	3.2E-08	3.2E-08
N	4.0E-08	0.	0.	4.0E-08	4.0E-08

* A zero indicates that this point was not calculated.

Table A-8

Depleted χ/Q Values at the Special Locations for Releases From the Reactor Buildings

Carolina Power & Light Company - Brunswick

Release Type: Annual

Release Mode: Mixed Mode

Variable: Relative Depleted Concentration (Sec./Cubic Meter)

Calculation Points: Special

Model: Straight Line (ANNX009)

Application of Terrain Correction Factors: Yes

Number of Observations: 8678

Affected Sector	Site Boundary	Dairy	Meat	Resident	Garden
NNE	9.1E-08	0.	7.8E-08	7.8E-08	7.8E-08
NE	1.9E-07	3.7E-08	0.	0.	0.
ENE	6.1E-08	0.	0.	0.	0.
E	4.4E-08	0.	3.2E-08	3.2E-08	0.
ESE	6.4E-08	0.	6.4E-08	3.7E-08	3.7E-08
SE	3.8E-08	0.	3.8E-08	3.8E-08	0.
SSE	7.1E-08	0.	7.1E-08	7.1E-08	7.1E-08
S	4.2E-08	0.	0.	3.3E-08	2.7E-08
SSW	4.3E-08	0.	4.4E-08	4.4E-08	4.4E-08
SW	6.0E-08	0.	6.0E-08	6.0E-08	6.0E-08
WSW	3.9E-08	0.	3.8E-08	4.2E-08	4.2E-08
W	3.3E-08	0.	0.	3.3E-08	3.3E-08
WNW	1.7E-08	0.	0.	1.7E-08	1.7E-08
NW	1.8E-08	0.	0.	1.8E-08	1.8E-08
NNW	3.0E-08	0.	0.	3.0E-08	3.0E-08
N	3.7E-08	0.	0.	3.7E-08	3.7E-08

* A zero indicates that this point was not calculated.

Table A-9

D/Q Values at the Special Locations for Releases From the Reactor Buildings

Carolina Power & Light Company - Brunswick
Release Type: Annual
Release Mode: Mixed Mode
Variable: Relative Deposition (Meter**-2)
Calculation Points: Special
Model: Straight Line (ANNX009)
Application of Terrain Correction Factors: Yes
Number of Observations: 8678

Affected Sector	Site Boundary	Dairy	Meat	Resident	Garden
NNE	2.0E-09	0.	1.1E-09	1.1E-09	1.1E-09
NE	4.3E-09	2.7E-10	0.	0.	0.
ENE	1.1E-09	0.	0.	0.	0.
E	4.6E-10	0.	2.5E-10	2.5E-10	0.
ESE	1.1E-09	0.	1.1E-09	3.3E-10	3.3E-10
SE	7.6E-10	0.	7.6E-10	7.6E-10	0.
SSE	1.2E-09	0.	1.2E-09	1.2E-09	1.2E-09
S	5.7E-10	0.	0.	3.4E-10	2.3E-10
SSW	7.7E-10	0.	5.2E-10	5.2E-10	5.2E-10
SW	1.2E-09	0.	1.2E-09	1.2E-09	1.2E-09
WSW	8.9E-10	0.	4.1E-10	5.9E-10	5.9E-10
W	6.6E-10	0.	0.	6.6E-10	6.6E-10
WNW	2.7E-10	0.	0.	2.7E-10	2.7E-10
NW	3.1E-10	0.	0.	3.1E-10	3.1E-10
NNW	4.0E-10	0.	0.	4.0E-10	4.0E-10
N	5.6E-10	0.	0.	5.6E-10	5.6E-10

* A zero indicates that this point was not calculated.

Table A-12

D/Q Values at the Standard Distances for Releases from the Reactor Buildings

Carolina Power & Light Company - Brunswick
Release Type: Annual
Release Mode: Mixed Mode
Variable: Relative Deposition (Meter**-2)
Calculation Points: Standard
Model: Straight Line (ANNX009)
Application of Terrain Correction Factors: Yes
Number of Observations: 8678

Base Distance in Miles/Kilometers

Aftd Sect	Design Dist Mi	.25 .40	.75 1.21	1.25 2.01	1.75 2.82	2.25 3.62	2.75 4.42	3.25 5.23	3.75 6.03	4.25 6.84	4.75 7.64
NNE	0.	1.1E-08	2.0E-09	1.1E-09	7.2E-10	5.0E-10	3.5E-10	2.8E-10	2.2E-10	1.7E-10	1.5E-10
NE	0.	1.1E-08	4.3E-09	2.3E-09	1.5E-09	9.8E-10	7.2E-10	5.3E-10	4.2E-10	3.3E-10	2.7E-10
ENE	0.	1.9E-08	1.1E-09	5.8E-10	3.9E-10	2.8E-10	2.2E-10	1.7E-10	1.4E-10	1.1E-10	9.7E-11
E	0.	2.1E-09	4.6E-10	2.5E-10	1.6E-10	1.2E-10	9.0E-11	7.5E-11	5.7E-11	4.8E-11	3.8E-11
ESE	0.	1.3E-09	1.1E-09	5.4E-10	3.3E-10	2.4E-10	1.9E-10	1.3E-10	1.1E-10	8.3E-11	6.9E-11
SE	0.	1.3E-09	7.6E-10	4.9E-10	2.8E-10	1.8E-10	1.3E-10	1.1E-10	8.9E-11	6.7E-11	6.1E-11
SSE	0.	2.4E-09	1.2E-09	6.7E-10	4.1E-10	2.8E-10	2.1E-10	1.6E-10	1.3E-10	1.0E-10	8.2E-11
S	0.	3.6E-09	5.7E-10	3.4E-10	2.3E-10	1.7E-10	1.4E-10	1.0E-10	8.2E-11	6.5E-11	5.5E-11
SSW	0.	8.0E-09	7.7E-10	5.2E-10	3.5E-10	2.6E-10	1.8E-10	1.5E-10	1.1E-10	9.3E-11	7.4E-11
SW	0.	3.4E-09	1.2E-09	7.3E-10	4.5E-10	3.3E-10	2.3E-10	1.7E-10	1.4E-10	1.2E-10	9.4E-11
WSW	0.	1.8E-09	8.9E-10	5.9E-10	4.1E-10	2.9E-10	2.1E-10	1.7E-10	1.5E-10	1.2E-10	1.0E-10
W	0.	7.9E-10	6.6E-10	4.3E-10	2.9E-10	1.9E-10	1.5E-10	1.2E-10	8.6E-11	7.7E-11	6.4E-11
WNW	0.	5.8E-10	2.7E-10	2.0E-10	1.7E-10	1.3E-10	8.8E-11	6.8E-11	5.5E-11	4.2E-11	3.3E-11
NW	0.	5.4E-10	3.1E-10	2.3E-10	1.5E-10	1.1E-10	8.9E-11	6.9E-11	5.4E-11	4.4E-11	3.9E-11
NNW	0.	5.3E-09	4.0E-10	2.2E-10	1.6E-10	1.0E-10	7.6E-11	6.1E-11	5.0E-11	4.2E-11	3.4E-11
N	0.	8.7E-09	5.6E-10	2.8E-10	2.1E-10	1.6E-10	1.4E-10	1.1E-10	8.1E-11	6.4E-11	5.7E-11

Number of Valid Observations 8678
Number of Invalid Observations 82
Number of Calms Lower Level 12
Number of Calms Upper Level 0

Table A-13

χ/Q Values at the Special Locations for Releases From the Stack

Carolina Power & Light Company - Brunswick
Release Type: Annual
Release Mode: Elevated
Variable: Relative Concentration
Calculation Points: Special
Model: Straight Line
Application of Terrain Correction Factors: Yes
Number of Observations: 8678

Accounting for Stack Center Offset

Affected Sector	Site Boundary	Dairy	Meat	Resident	Garden
NNE	1.3E-08	0.	2.3E-08	2.3E-08	2.3E-08
NE	2.5E-08	2.4E-08	0.	0.	0.
ENE	7.2E-09	0.	0.	0.	0.
E	3.6E-09	0.	7.6E-09	7.6E-09	0.
ESE	7.7E-09	0.	7.7E-09	1.3E-08	1.3E-08
SE	8.7E-09	0.	8.7E-09	8.7E-09	0.
SSE	1.2E-08	0.	1.2E-08	1.2E-08	1.2E-08
S	4.7E-09	0.	0.	8.5E-09	9.6E-09
SSW	6.0E-09	0.	1.4E-08	1.4E-08	1.4E-08
SW	1.3E-08	0.	1.3E-08	1.3E-08	1.3E-08
WSW	9.0E-09	0.	1.8E-08	1.6E-08	1.6E-08
W	1.0E-08	0.	0.	1.0E-08	1.0E-08
WNW	5.3E-09	0.	0.	5.3E-09	5.3E-09
NW	6.5E-09	0.	0.	6.5E-09	6.5E-09
NNW	4.2E-09	0.	0.	4.2E-09	4.2E-09
N	4.5E-09	0.	0.	4.5E-09	4.5E-09

* A zero indicates that this point was not calculated.

Table A-14

Depleted x/Q Values at the Special Locations for Releases From the Stack

Carolina Power & Light Company - Brunswick

Release Type: Annual

Release Mode: Elevated

Variable: Relative Depleted Concentrations

Calculation Points: Special

Model: Straight Line

Application of Terrain Correction Factors: Yes

Number of Observations: 8678

Accounting for Stack Center Offset

Affected Sector	Site Boundary	Dairy	Meat	Resident	Garden
NNE	1.2E-08	0.	2.2E-08	2.2E-08	2.2E-08
NE	2.5E-08	2.3E-08	0.	0.	0.
ENE	7.1E-09	0.	0.	0.	0.
E	3.6E-09	0.	7.6E-09	7.6E-09	0.
ESE	7.5E-09	0.	7.5E-09	1.2E-08	1.2E-08
SE	8.7E-09	0.	8.7E-09	8.7E-09	0.
SSE	1.2E-08	0.	1.2E-08	1.2E-08	1.2E-08
S	4.6E-09	0.	0.	8.5E-09	9.6E-09
SSW	6.0E-09	0.	1.4E-08	1.4E-08	1.4E-08
SW	1.3E-08	0.	1.3E-08	1.3E-08	1.3E-08
WSW	9.0E-09	0.	9.2E-08	1.5E-08	1.5E-08
W	1.0E-08	0.	0.	1.0E-08	1.0E-08
WNW	5.1E-09	0.	0.	5.1E-09	5.1E-09
NW	6.5E-09	0.	0.	6.5E-09	6.5E-09
NNW	4.1E-09	0.	0.	4.1E-09	4.1E-09
N	4.5E-09	0.	0.	4.5E-09	4.5E-09

* A zero indicates that this point was not calculated.

Table A-15

D/Q Values at the Special Locations for Releases from the Stack

Carolina Power & Light Company - Brunswick

Release Type: Annual

Release Mode: Elevated

Variable: Relative Deposition (Meter**-2)

Calculation Points: Special

Model: Straight Line

Application of Terrain Correction Factors: Yes

Number of Observations: 8678

Accounting for Stack Center Offset

Affected Sector	Site Boundary	Dairy	Meat	Resident	Garden
NNE	6.0E-10	0.	5.3E-10	5.3E-10	5.3E-10
NE	1.4E-09	2.2E-10	0.	0.	0.
ENE	3.2E-10	0.	0.	0.	0.
E	1.6E-10	0.	1.3E-10	1.3E-10	0.
ESE	4.1E-10	0.	4.1E-10	2.0E-10	2.0E-10
SE	4.2E-10	0.	4.2E-10	4.2E-10	0.
SSE	5.4E-10	0.	5.4E-10	5.4E-10	5.4E-10
S	2.0E-10	0.	0.	1.9E-10	1.4E-10
SSW	2.7E-10	0.	2.9E-10	2.9E-10	2.9E-10
SW	5.6E-10	0.	5.6E-10	5.6E-10	5.6E-10
WSW	3.8E-10	0.	3.0E-10	3.6E-10	3.6E-10
W	3.9E-10	0.	0.	3.9E-10	3.9E-10
WNW	1.7E-10	0.	0.	1.7E-10	1.7E-10
NW	2.0E-10	0.	0.	2.0E-10	2.0E-10
NNW	1.5E-10	0.	0.	1.5E-10	1.5E-10
N	1.9E-10	0.	0.	1.9E-10	1.9E-10

* A zero indicates that this point was not calculated.

Table A-18

D/Q Values at the Standard Distances for Releases from the Stack

Carolina Power & Light Company - Brunswick
Release Type: Annual
Release Mode: Elevated
Variable: Relative Deposition (Meter**-2)
Calculation Points: Standard
Model: Straight Line (ANNX009)
Application of Terrain Correction Factors: Yes
Number of Observations: 8678

Base Distance in Miles/Kilometers

Aftd Sect	Design Dist Mi	.25 .40	.75 1.21	1.25 2.01	1.75 2.82	2.25 3.62	2.75 4.42	3.25 5.23	3.75 6.03	4.25 6.84	4.75 7.64
NNE	0.	1.2E-09	6.0E-10	5.3E-10	4.3E-10	3.4E-10	2.5E-10	2.0E-10	1.6E-10	1.4E-10	1.2E-10
NE	0.	1.4E-09	1.4E-09	1.1E-09	8.8E-10	6.7E-10	5.2E-10	3.9E-10	3.1E-10	2.6E-10	2.2E-10
ENE	0.	1.8E-09	3.2E-10	3.0E-10	2.5E-10	2.0E-10	1.6E-10	1.3E-10	1.1E-10	9.3E-11	8.1E-11
E	0.	2.2E-10	1.6E-10	1.3E-10	1.0E-10	8.7E-11	6.6E-11	5.7E-11	4.4E-11	3.7E-11	3.1E-11
ESE	0.	1.9E-10	4.1E-10	2.7E-10	2.0E-10	1.7E-10	1.4E-10	1.1E-10	8.2E-11	6.6E-11	5.6E-11
SE	0.	3.2E-10	4.2E-10	3.1E-10	2.1E-10	1.4E-10	1.1E-10	8.7E-11	7.3E-11	5.8E-11	5.3E-11
SSE	0.	5.8E-10	5.4E-10	3.9E-10	2.8E-10	2.1E-10	1.7E-10	1.4E-10	1.1E-10	8.5E-11	7.1E-11
S	0.	5.4E-10	2.0E-10	1.9E-10	1.4E-10	1.1E-10	1.1E-10	8.3E-11	6.6E-11	5.5E-11	4.6E-11
SSW	0.	1.1E-09	2.7E-10	2.9E-10	2.4E-10	1.9E-10	1.4E-10	1.3E-10	9.5E-11	7.9E-11	6.5E-11
SW	0.	7.6E-10	5.6E-10	4.3E-10	3.1E-10	2.4E-10	1.8E-10	1.4E-10	1.1E-10	9.5E-11	8.0E-11
WSW	0.	4.1E-10	3.8E-10	3.6E-10	3.0E-10	2.3E-10	1.7E-10	1.4E-10	1.3E-10	1.0E-10	8.6E-11
W	0.	2.8E-10	3.9E-10	3.0E-10	2.1E-10	1.5E-10	1.3E-10	1.0E-10	7.8E-11	6.9E-11	5.9E-11
WNW	0.	2.4E-10	1.7E-10	1.5E-10	1.4E-10	1.0E-10	7.4E-11	5.8E-11	4.8E-11	3.7E-11	2.9E-11
NW	0.	2.6E-10	2.0E-10	1.7E-10	1.2E-10	8.8E-11	7.5E-11	6.0E-11	4.8E-11	4.0E-11	3.6E-11
NNW	0.	7.2E-10	1.5E-10	1.3E-10	1.0E-10	7.3E-11	5.4E-11	4.3E-11	3.6E-11	3.2E-11	2.6E-11
N	0.	8.1E-10	1.9E-10	1.5E-10	1.3E-10	1.1E-10	9.9E-11	7.9E-11	6.0E-11	4.9E-11	4.4E-11

Number of Valid Observations	8678
Number of Invalid Observations	82
Number of Calms Lower Level	0
Number of Calms Upper Level	0

APPENDIX E

RADIOACTIVE LIQUID AND GASEOUS EFFLUENT MONITORING
INSTRUMENTATION NUMBERS

I. Liquid Effluent Monitoring Instruments

A.	Liquid Radwaste Radioactivity Monitor	2-D12-RM-K604
B.	Liquid Radwaste Effluent Flow Measurement Device	2-G16-FIT-N057 2-G16-FIT-N058
C.	Main Service Water Effluent Radioactivity Monitor	1(2)-D12-RM-K605
D.	Stabilization Pond Effluent Composite Sampler	2-DST-XE-5027
E.	Stabilization Pond Effluent Flow Measurement Device	2-DST-FIT-5026
F.	Condensate Storage Tank Level Indicating Device	1(2)-CO-LIT-1160

5. Main Condenser Off-Gas Treatment System (AOG) Monitor

a.	Noble Gas Activity Monitor	1(2)-AOG-RM-103

6. Main Condenser Off-Gas Treatment System Explosive Gas Monitoring System

a.	Recombiner Train A		
	1.	First Hydrogen Monitor	1(2)-OG-AIT-4284
	2.	Second Hydrogen Monitor	1(2)-OG-AIT-4285
b.	Recombiner Train B		
	1.	First Hydrogen Monitor	1(2)-OG-AIT-4324
	2.	Second Hydrogen Monitor	1(2)-OG-AIT-4325

7. Hot Shop Ventilation Monitoring System

a.	Iodine Sampler Cartridge	2-VA-AX-5092
b.	Particulate Sampler Filter	2-VA-AX-5093

ATTACHMENT 4

Environmental Monitoring Program

January 1 to June 30, 1985

ENCLOSURE 1: Milk and Vegetable Sample Locations

ENCLOSURE 2: Land Use Census

ENCLOSURE 1

Milk and Vegetable Sample Locations

No milk sample locations were available during this time period.

Vegetable sample locations were unchanged during this time period.

ENCLOSURE 2

Land Use Census

No new locations were identified that are reportable in the Semiannual Radioactive Effluent Release Report as per Technical Specification 3.12.2.a and b.

ATTACHMENT 5

Inoperable Effluent Instrumentation

January 1 to June 30, 1985

ENCLOSURE 1: Radioactive Liquid Effluent Monitoring Instrumentation

ENCLOSURE 2: Radioactive Gaseous Effluent Monitoring Instrumentation

ENCLOSURE 3: Liquid Hold-Up Tank

ENCLOSURE 1

Radioactive Liquid Effluent Monitoring Instrumentation

No radwaste liquid effluent instrumentation was inoperable for greater than a 30-day period during January 1, 1985, to June 30, 1985.

ENCLOSURE 2

Radioactive Gaseous Effluent Monitoring Instrumentation

Unit 2 main condenser off-gas treatment system explosive gas monitors, 2-OG-AIT-4284, 2-OG-AIT-4285, 2-OG-AIT-4324, and 2-OG-AIT-4325 were inoperable for greater than a 30-day period during January 1, 1985, to June 30, 1985. Due to design problems, these monitors were not returned to service within 30 days.

ENCLOSURE 3

Liquid Hold-Up Tank

No liquid hold-up tank exceeded the 10 Ci limit between the dates of January 1, 1985, to June 30, 1985.

ATTACHMENT 6

Major Modifications to Radioactive Waste Treatment

January 1 to June 30, 1985

Discussion of major modifications to Radioactive Waste Treatment Systems, if any, will be submitted with Final Safety Analysis Report update as allowed by footnote 7 to Technical Specification 6.15.

ATTACHMENT 7

Meteorological Data

Brunswick Steam Electric Plant

January - June, 1985

As required by Technical Specification 6.9.1.10.a, the annual summary of meteorological data will be reported within 90 days after January 1 of each year and is not included in this report.

ATTACHMENT 8

Potential Dose Assessment

Brunswick Steam Electric Plant

January - June, 1985

As required by Technical Specification 6.9.1.10.b, an assessment of radiation doses due to the radioactive liquid and gaseous effluents released during the calendar year will be reported within 90 days after January 1 of each year and is not included in this report.