

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.

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

$A_i$  = 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,  $\mu\text{Ci}/\text{sec}$ ) based upon the whole body exposure limit.

$$Q_t = \frac{500}{(\bar{x}/Q) \sum_i (K_i S_i)} \quad (3.1-2)$$

$(\bar{x}/Q)_{tb}$  = 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 ( $\text{sec}/\text{m}^3$ ) from Table A-1, Appendix A  
 =  $7.50 \text{ E-}6 \text{ sec}/\text{m}^3$

$(\bar{x}/Q)_{rb}$  = 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 ( $\text{sec}/\text{m}^3$ ) from Table A-7, Appendix A  
 =  $2.0 \text{ E-}7 \text{ sec}/\text{m}^3$

NOTE: Use the  $x/Q$  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  $i$  ( $\text{mrem}/\text{year}/\mu\text{Ci}/\text{m}^3$ ) from Table 3.1-2.

3.1.1.3 Determine  $Q_t$  based upon the skin exposure limit.

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

$L_i + 1.1M_i$  = The total skin dose factor due to emissions from noble gas radionuclide  $i$  (mrem/year/ $\mu\text{Ci}/\text{m}^3$ ) from Table 3.1-2.

NOTE: The Turbine Building radiation monitors are designed to input the monitor high alarm setpoint in  $\mu\text{Ci}/\text{sec}$  or  $\mu\text{Ci}/\text{cc}$ . The monitor setpoint in  $\mu\text{Ci}/\text{sec}$  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  $\mu\text{Ci}/\text{cc}$  setpoint can be obtained by dividing the  $\mu\text{Ci}/\text{sec}$  setpoint by the design flow rate in  $\text{cc}/\text{sec}$ . The equations for calculating the setpoint in  $\text{cpm}$  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,  $\mu\text{Ci}/\text{sec}/\text{cfm}$ ).

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

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).

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

$E_m$  = The detection efficiency of the monitor for the "mix" of noble gas radionuclides in the gaseous effluent ( $\mu\text{Ci}/\text{sec}/\text{cfm}\cdot\text{cpm}$ ) from E&RC files

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

$$HSP = T_m CR + Bkg \quad (3.1-6)$$

$T_m$  = 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 Setpoint Based on Conservative Radionuclide Mix (Long-Term Elevated Release)

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.

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

$A_i$  = 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, $\mu\text{Ci}/\text{sec}$ ) 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/ $\mu$ Ci/sec) from Table 3.1-2

3.1.2.3 Determine  $Q_t$  based upon the skin exposure limit.

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

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

NOTE: The stack radiation monitor is designed to input the monitor high-high alarm setpoint in  $\mu$ Ci/sec or  $\mu$ Ci/cc. The monitor setpoint in  $\mu$ Ci/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  $\mu$ Ci/cc setpoint can be obtained by dividing the  $\mu$ Ci/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,  $\mu$ Ci/sec/cfm).



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

NOTE: Use the lowest of the  $Q_t$  values obtained in Sections 3.1.2.2 and 3.1.2.3.

$f$  = The maximum acceptable effluent 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).

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

$E_m$  = The detection efficiency of the monitor for the "mix" of noble gas radionuclides in the gaseous effluent ( $\mu\text{Ci}/\text{sec}/\text{cfm} \cdot \text{cps}$ ) from E&RC files

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

$$HHSP = T_m CR + Bkg \quad (3.1-12)$$

$T_m$  = 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 ( $\mu\text{Ci}/\text{sec}$ ) 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  $\mu\text{Ci}/\text{sec}$  (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  $\mu\text{Ci}/\text{sec}$  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                                     |   | $\mu\text{Ci}/\text{sec}^*$<br>$t = 0$ | $e^{-\lambda t}$<br>$t = 30\text{m}$ | $\mu\text{Ci}/\text{sec}$<br>$t = 30\text{m}$ | Fraction<br>of Mix<br>$t = 30\text{m}$ |
|---------|---|---|--|--------------------------------------|---|--|
|         | Steam ( $\mu\text{Ci}/\text{gm}$ )<br>$t = 0$ | Steam ( $\mu\text{Ci}/\text{gm}$ )<br>$t = 0$ |  |                                      |   |  |
|         | (for 3400 MWt)                                | (for 2436 MWt)                                |  |                                      |   |  |
| 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                               | <u>4.8E+3</u>                                 | <u>2.0E-1</u>                          |
|         |   |   |  | TOTAL                                | 2.46E+4                                       | 1.0E+0                                 |

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

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

| Nuclide | Fraction                               | Tech Spec                              | $e^{-\lambda t}$                       | Tech Spec                     |
|---------|--|--|--|-------------------------------|
|         | of Mix                                 | ( $\mu\text{Ci}/\text{sec}$ )          |  | ( $\mu\text{Ci}/\text{sec}$ ) |
|         | <u><math>t = 30 \text{ min}</math></u> | <u><math>t = 30 \text{ min}</math></u> | <u><math>t = 30 \text{ min}</math></u> | <u><math>t = 0</math></u>     |
| 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  | <u>2.0E-1</u>                          | <u>4.87E+4</u>                         | 2.3E-1                                 | <u>2.12E+5</u>                |
| TOTALS  | 1.0E+0                                 | 2.44E+5                                |  | 1.87E+6                       |

Therefore:

$$Q = 1.87E+6 \mu\text{Ci}/\text{sec} \text{ (for 30 minutes' holdup)}$$

- b. Determine  $C_m$  (the total radioactivity concentration of noble gases) in the condenser air ejector gas ( $\mu\text{Ci}/\text{sec}/\text{scfm}$ ).

$$C_m = Q/f \quad (3.1-13)$$

$Q$  = The allowable release rate ( $\mu\text{Ci}/\text{sec}$ ) 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).

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

$E_m$  = The detection efficiency of the monitor for the "mix" of noble gas radionuclides in the gaseous stream  $[(\mu\text{Ci}/\text{sec})/(\text{mR}/\text{hr} \cdot \text{cfm})]$  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,  $\mu\text{Ci}/\text{sec}$ ) 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,  $\mu\text{Ci}/\text{sec}$ , for effluent releases via the stack).

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

$T_m$  = 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  $\mu\text{Ci/cc}$ ).

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

$f$  = 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<br>nuclide | Total Whole Body            | Total Skin                  | Total Body              | Total Skin Dose           |
|------------------|-----------------------------|-----------------------------|-------------------------|---------------------------|
|                  | Dose Factor                 | Dose Factor                 | Dose Constant For       | Constant for              |
|                  | ( $K_i$ )                   | ( $L_i + 1.1M_i$ )          | ( $V_i$ )               | ( $L_i(x/Q)_s + 1.1B_i$ ) |
|                  | (mrem/yr/ $\mu$ Ci/ $m^3$ ) | (mrem/yr/ $\mu$ Ci/ $m^3$ ) | (mrem/yr/ $\mu$ Ci/sec) | (mrem/yr/ $\mu$ Ci/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.

$$\Sigma_i \left[ V_i \dot{Q}_i \Big|_s + K_i (\bar{x}/Q)_v \dot{Q}_i \Big|_v \right] \leq 500 \text{ mrem/yr} \quad (3.2-1)$$

$$\Sigma_i \left\{ \left[ L_i (\bar{x}/Q)_s + 1.1 B_i \right] \dot{Q}_i \Big|_s + (L_i + 1.1 M_i) (\bar{x}/Q)_v \dot{Q}_i \Big|_v \right\} \leq 300 \text{ mrem/yr} \quad (3.2-2)$$

where:

- $K_i$  = The total body dose factor due to gamma emissions for noble gas radionuclide  $i$ , mrem/year per  $\mu\text{Ci}/\text{m}^3$
- $L_i$  = The skin dose factor due to beta emissions for noble gas radionuclide  $i$ , mrem/year per  $\mu\text{Ci}/\text{m}^3$
- $M_i$  = The air dose factor due to gamma emissions for noble gas radionuclide  $i$ , mrad/year per  $\mu\text{Ci}/\text{m}^3$
- $V_i$  = The constant for each identified noble gas radionuclide  $i$  accounting for the gamma radiation from the elevated finite plume mrem/year per  $\mu\text{Ci}/\text{sec}$



- $B_i$  = 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  $\mu\text{Ci}/\text{sec}$
- 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,  $\mu\text{Ci}/\text{sec}$
- $\dot{Q}_i^v$  = The release rate of noble gas radionuclide  $i$  in gaseous effluents from all vent releases,  $\mu\text{Ci}/\text{sec}$

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:

$$\sum_i V_i \dot{Q}_i^s + \sum_i K_i \left[ (\bar{x}/\bar{Q})_{rb} \dot{Q}_i^{rb} + (\bar{x}/\bar{Q})_{tb} \dot{Q}_i^{tb} \right] \leq 500 \text{ mrem/yr} \quad (3.2-3)$$

For the skin dose:

$$\sum_i \left[ L_i (\overline{x/Q})_s + 1.1B_i \right] \dot{Q}_{i_s} + \sum_i \left[ L_i + 1.1M_i \right] \left[ (\overline{x/Q})_{rb} \dot{Q}_{i_{rb}} + (\overline{x/Q})_{tb} \dot{Q}_{i_{tb}} \right] \leq 3000 \text{ mrem/yr} \quad (3.2-4)$$

where:

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

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

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

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

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

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

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:

$$\sum_i V_i \dot{Q}_i + \sum_i K_i (6.5 \times 10^{-8} \dot{Q}_{i,rb} + 3.2 \times 10^{-6} \dot{Q}_{i,tb}) \leq 500 \text{ mrem/yr} \quad (3.2-5)$$

For the skin:

$$\sum_i (1.2 \times 10^{-9} L_i + 1.1B_i) \dot{Q}_i + \sum_i [(L_i + 1.1M_i) (6.5 \times 10^{-8} \dot{Q}_{i,rb} + 3.2 \times 10^{-6} \dot{Q}_{i,tb})] \leq 3000 \text{ mrem/yr} \quad (3.2-6)$$

The radioactive 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 x/Q values utilized in the equations for implementation of 10CFR20 are based upon the maximum long-term annual average ( $\overline{x/Q}$ ) 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  $\overline{(x/Q)}$  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.  $\overline{x/Q}$  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  $\overline{x/Q}$  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  $\overline{x/Q}$  value may not decrease with distance; i.e., the site boundary may not have the highest  $\overline{x/Q}$  values. Therefore, long-term annual average  $\overline{x/Q}$  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  $\overline{x/Q}$  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<sup>-1</sup> to microcuries<sup>-1</sup> 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.

$$\sum_i P_{iI} \left[ (\overline{x/Q})_s \dot{Q}_i + (\overline{x/Q})_{rb} \dot{Q}_i + (\overline{x/Q})_{tb} \dot{Q}_i \right] + \sum_i (P_{iG} + P_{iM})$$

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

where:

$P_{iI}$  = Dose parameter for radionuclide  $i$  for the inhalation pathway,  
mrem/year per  $\mu\text{Ci}/\text{sec}^3$

$P_{iG}$  = Dose parameter for radionuclide  $i$  for the ground plane pathway,  
mrem/year per  $\mu\text{Ci}/\text{sec}$  per  $\text{m}^{-2}$

$P_{iM}$  = Dose parameter for radionuclide  $i$  for either the cow milk or  
goat milk pathway, mrem/year per  $\mu\text{Ci}/\text{sec}$  per  $\text{m}^{-2}$

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

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

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

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

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

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

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:

$$\begin{aligned} & \sum_i P_i \left( 2.5 \times 10^{-8} \dot{Q}_i^s + 2.0 \times 10^{-7} \dot{Q}_i^{rb} + 2.9 \times 10^{-6} \dot{Q}_i^{tb} \right) + \\ & \sum_i (P_i^G + P_i^M) \left( 1.4 \times 10^{-9} \dot{Q}_i^s + 4.3 \times 10^{-9} \dot{Q}_i^{rb} + 1.9 \times 10^{-8} \dot{Q}_i^{tb} \right) \\ & \leq 1500 \text{ mrem/yr} \end{aligned} \tag{3.2-14}$$

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:

$$\begin{aligned} & \sum_i P_i \left( 2.4 \times 10^{-8} \dot{Q}_i^s + 4.1 \times 10^{-8} \dot{Q}_i^{rb} + 1.4 \times 10^{-7} \dot{Q}_i^{tb} \right) + \\ & \sum_i (P_i^G + P_i^M) \left( 2.2 \times 10^{-10} \dot{Q}_i^s + 2.7 \times 10^{-10} \dot{Q}_i^{rb} + 5.7 \times 10^{-10} \dot{Q}_i^{tb} \right) \\ & \leq 1500 \text{ mrem/yr} \end{aligned} \tag{3.2-15}$$

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

For tritium:

$$\dot{D}_T = 3.0 \times 10^3 (2.5 \times 10^{-8} \dot{Q}_{Ts} + 2.0 \times 10^{-7} \dot{Q}_{trb} + 2.9 \times 10^{-6} \dot{Q}_{tbt}) \quad (3.2-16)$$

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

For tritium:

$$\dot{D}_T = 3.0 \times 10^3 (2.4 \times 10^{-8} \dot{Q}_{Ts} + 4.1 \times 10^{-8} \dot{Q}_{trb} + 1.4 \times 10^{-7} \dot{Q}_{tbt}) \quad (3.2-17)$$

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,  $P_{iG}$  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 x/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. x/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 x/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)

| <u>Sector</u> | <u>Site<br/>Boundary</u> | <u>Milk<br/>Cow</u> | <u>Milk<br/>Goat</u> | <u>Meat<br/>Animal</u> | <u>Nearest<br/>Resident</u> | <u>Nearest<br/>Garden</u> |
|---------------|--------------------------|---------------------|----------------------|------------------------|-----------------------------|---------------------------|
| 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

| <u>Based on Center of<br/>Brunswick Plant</u> |  | <u>From Stack to Site Boundaries<br/>of Table 3.2-2</u> |                      |
|---|--|---|----------------------|
| <u>Direction</u>                              | <u>Site Boundary<br/>Distance (Mi)</u> | <u>Direction</u>  | <u>Distance (Mi)</u> |
| 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:

$$3.17 \times 10^{-8} \sum_i \left\{ M_i \left[ (\overline{x/Q})_{rb} (Q_{i,rb1} + Q_{i,rb2}) + (\overline{x/Q})_{tb} (Q_{i,tb1} + Q_{i,tb2}) \right] + B_i Q_{i,s} \right\}$$

$$\leq 10 \text{ mrad per quarter or } 20 \text{ mrad per year} \quad (3.3-5)$$

Beta radiation:

$$3.17 \times 10^{-8} \sum_i N_i \left[ (\overline{x/Q})_{rb} (Q_{i,rb1} + Q_{i,rb2}) + (\overline{x/Q})_{tb} (Q_{i,tb1} + Q_{i,tb2}) + (\overline{x/Q})_s Q_{i,s} \right]$$

$$\leq 20 \text{ mrad per quarter or } 40 \text{ mrad per year} \quad (3.3-6)$$

where:

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

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

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

$Q_{i,rb1}, Q_{i,rb2}$  = Release of radionuclide i from Reactor Buildings 1 and 2, respectively,  $\mu\text{Ci}$

$Q_{i,tb1}, Q_{i,tb2}$  = Release of radionuclide i from Turbine Buildings 1 and 2, respectively,  $\mu\text{Ci}$

$Q_{i,s}$  = Release of radionuclide i from the stack,  $\mu\text{Ci}$

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

During any calendar quarter or year:

Gamma radiation:

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

Beta radiation:

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

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  $\bar{x}/\bar{Q}$  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  $\overline{x/Q}$  values may not decrease with distance (i.e., the site boundary may not have the highest  $\overline{x/Q}$  values);  $\overline{x/Q}$  values were calculated at the midpoint of 10 standard distance intervals out to a distance of 5 miles. The two or three highest  $\overline{x/Q}$  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  $\overline{x/Q}$  values are utilized. These values are presented in tables in Appendix A.  $\overline{x/Q}$  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  $x/Q$  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  $M_1$  and  $N_1$ , 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:

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

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

For the calendar year:

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

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

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:

$$3.17 \times 10^{-8} \sum_i R_i (W_s Q_i + w_s q_i + W_v Q_i + w_v q_i)$$

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

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:

$$\begin{aligned}
 & 3.17 \times 10^{-8} \cdot \Sigma_i \left\{ (R_{iG} + R_{iM}) \left[ 2.2 \times 10^{-10} Q_{is} + 2.7 \times 10^{-10} (Q_{ibr1} + Q_{ibr2}) + \right. \right. \\
 & 5.7 \times 10^{-10} (Q_{itb1} + Q_{itb2}) \left. \right] + R_{iI} \left[ 2.4 \times 10^{-8} Q_{is} + 4.1 \times 10^{-8} (Q_{ibr1} + Q_{ibr2}) + \right. \\
 & \left. \left. 1.4 \times 10^{-7} (Q_{itb1} + Q_{itb2}) \right] \right\} \leq 15 \text{ mrem/quarter or } 30 \text{ mrem/year} \quad (3.3-17)
 \end{aligned}$$

For tritium, Equation 3.3-16 reduces to:

$$\begin{aligned}
 D_T = & 3.17 \times 10^{-8} (R_{TM} + R_{TI}) \left[ 2.4 \times 10^{-8} Q_{Ts} + 4.1 \times 10^{-8} (Q_{Tbr1} + Q_{Tbr2}) + \right. \\
 & \left. 1.4 \times 10^{-7} (Q_{Ttb1} + Q_{Ttb2}) \right] \quad (3.3-18)
 \end{aligned}$$

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  $\overline{x/Q}$  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.  $x/Q$



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  $x/Q$  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:

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

For the calendar year:

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

where:

$Dt$  = The dose to any organ  $t$  from radioiodines 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

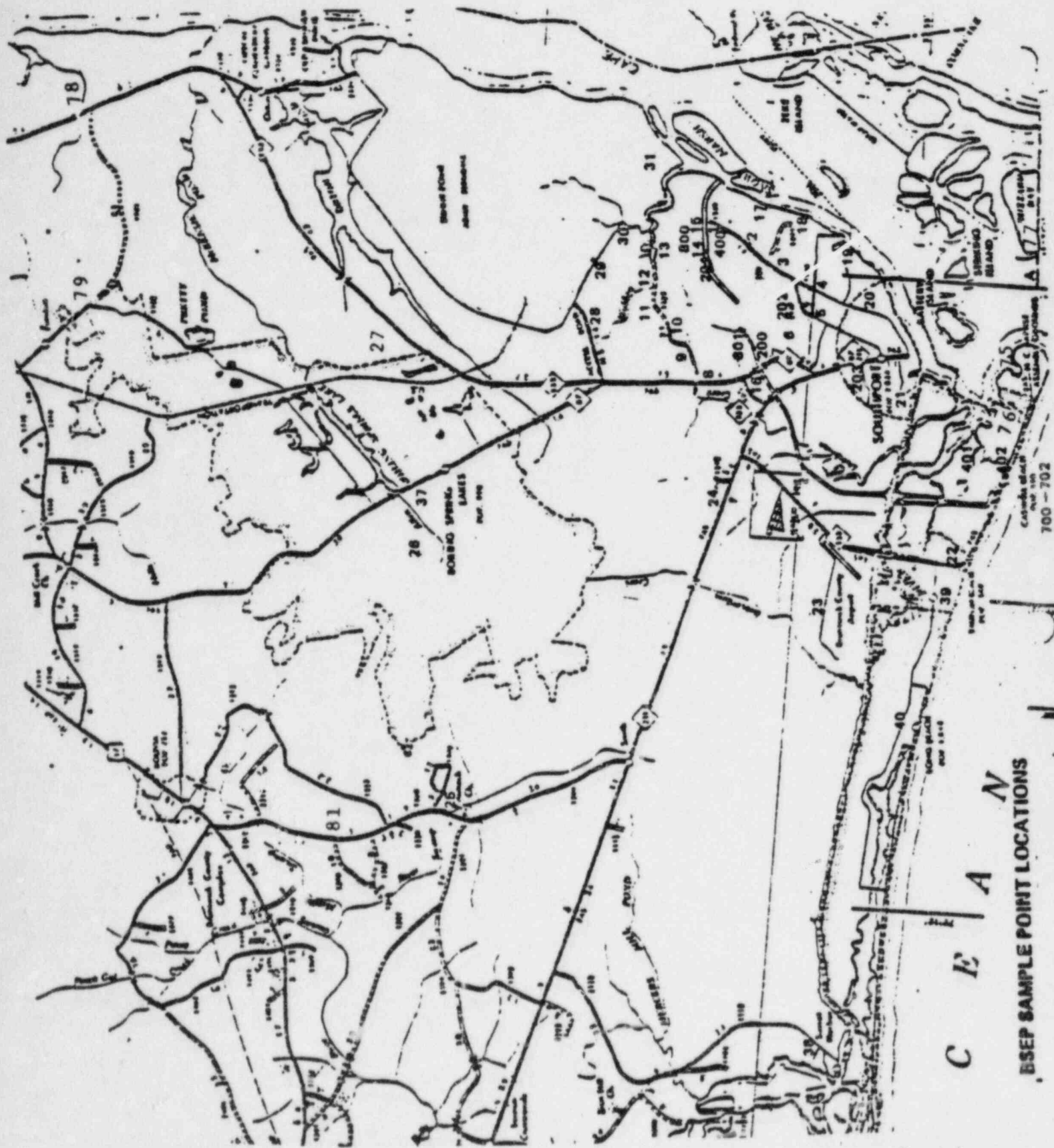
## RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

| Exposure Pathway<br>and/or Sample | Sample<br>ID No. | Sample Point Description, Approximate<br>Distance, and Direction | Sampling and<br>Collection Frequency | Analysis<br>Frequency | Analysis (a) |
|-----------------------------------|------------------|--|--------------------------------------|-----------------------|--------------|
| DIRECT RADIATION                  |                  |  |                                      |                       |              |
|                                   | 1                | 1.1 miles E - Refer to Figure 4.0-1a<br>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<br>(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  |
| <b>AIRBORNE</b>                |               |   |   |   |   |
| Radioiodine and<br>Particulate | 200           | 1.0 miles SW Visitors Center                                  | Continuous sampler operation with sample collected weekly or as required by dust loading, whichever is more frequent. | W   | Radioiodine Canister<br>T-131 analysis<br>Particulate sampler<br>Gross beta radioactivity analysis following filter change (b). |
|                                | 201           | 0.6 miles NE PMAC   |   |   |   |
|                                | 202           | 1.0 miles S Substation - Const. Rd.                           |   |   |   |
|                                | 203           | 2.3 miles SSW Southport Substation                            |   |   |   |
|                                | 204           | 23 miles NNE Sutton Plant - Control(c)                        |   |   |   |
|                                |               |   | Q   | Gamma isotopic analysis of composite by location. |   |
| <b>WATERBORNE</b>              |               |   |   |   |   |
| a. Surface                     | 400           | 0.7 miles NE Intake Canal - Control (c)                       | Composite Sample (d)<br>Collection - M  | Monthly<br>Q                                      | Gamma Isotopic-<br>Monthly Tritium  |
|                                |               | 401   |   |   |   |
| b. Sediment                    | 500           | 4.9 miles SSW Discharge - Beach                               | Semiannual  | Semiannual  | Gamma Isotopic  |

Figure 4.0 - 1a



### 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  $X/Q$ , depleted  $X/Q$ , 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

x/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      | Site            |              |             |                 |               |
|---------------|-----------------|--------------|-------------|-----------------|---------------|
| <u>Sector</u> | <u>Boundary</u> | <u>Dairy</u> | <u>Meat</u> | <u>Resident</u> | <u>Garden</u> |
| 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           | 2.3E-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 x/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\*\*<sup>-2</sup>)  
 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<br>Sect | Design<br>Dist<br>Mi | .25     | .75     | 1.25    | 1.75    | 2.25    | 2.75    | 3.25    | 3.75    | 4.25    | 4.75    |
|--------------|----------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
|              |                      | .40     | 1.21    | 2.01    | 2.82    | 3.62    | 4.42    | 5.23    | 6.03    | 6.84    | 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 | 9.8E-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

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

Carolina Power &amp; 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<br>Sector | Site<br>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 x/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<br>Sector | Site<br>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<sup>\*\*</sup>-2)  
 Calculation Points: Special  
 Model: Straight Line (ANNX009)  
 Application of Terrain Correction Factors: Yes  
 Number of Observations: 8678

| Affected      | Site            |              |             |                 |               |
|---------------|-----------------|--------------|-------------|-----------------|---------------|
| <u>Sector</u> | <u>Boundary</u> | <u>Dairy</u> | <u>Meat</u> | <u>Resident</u> | <u>Garden</u> |
| 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 | Base Distance in Miles/Kilometers |             |              |              |              |              |              |              |              |              |
|-----------|----------------|-----------------------------------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
|           |                | .25<br>.40                        | .75<br>1.21 | 1.25<br>2.01 | 1.75<br>2.82 | 2.25<br>3.62 | 2.75<br>4.42 | 3.25<br>5.23 | 3.75<br>6.03 | 4.25<br>6.84 | 4.75<br>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

## 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 Concentration  
 Calculation Points: Special  
 Model: Straight Line  
 Application of Terrain Correction Factors: Yes  
 Number of Observations: 8678

## Accounting for Stack Center Offset

| Affected<br>Sector | Site<br>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 &amp; 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      | Site            |              |             |                 |               |
|---------------|-----------------|--------------|-------------|-----------------|---------------|
| <u>Sector</u> | <u>Boundary</u> | <u>Dairy</u> | <u>Meat</u> | <u>Resident</u> | <u>Garden</u> |
| 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<sup>\*\*</sup>-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\*\*<sup>-2</sup>)  
 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 | Base Distance in Miles/Kilometers |             |              |              |              |              |              |              |              |              |
|-----------|----------------|-----------------------------------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
|           |                | .25<br>.40                        | .75<br>1.21 | 1.25<br>2.01 | 1.75<br>2.82 | 2.25<br>3.62 | 2.75<br>4.42 | 3.25<br>5.23 | 3.75<br>6.03 | 4.25<br>6.84 | 4.75<br>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<br>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.