RADIOACTIVE EFFLUENT RELEASE REPORT FOR 2002

Brunswick Steam Electric Plant

Radioactive Effluent Release Report

January 1, through December 31, 2002

ATTACHMENT 1

EFFLUENT AND WASTE DISPOSAL REPORT SUPPLEMENTAL INFORMATION

Facility: Brunswick Steam Electric Plant
Licensee: Carolina Power and Light Company

1. Regulatory Limits

   A. Fission and activation gases (Off-Site Dose Calculation Manual Specification (ODCMS) 7.3.8)

      (1) Calendar Quarter*

         (a) ≤ 10 mrad gamma
         (b) ≤ 20 mrad beta

      (2) Calendar Year

         (a) ≤ 20 mrad gamma
         (b) ≤ 40 mrad beta

   B. Iodine-131, iodine-133, tritium, and particulates with half-lives greater than eight days (ODCMS 7.3.9)

      (1) Calendar Quarter*

         (a) ≤ 15 mrem to any organ

      (2) Calendar Year

         (a) ≤ 30 mrem to any organ

      (3) Calendar Quarter for Burning Contaminated Oil*

         (a) < 0.1 % of limits for calendar quarter of (1)
         (b) 436 µCi (ODCM Appendix H)

      (4) Calendar Year for Burning Contaminated Oil

         (a) < 0.1 % of limits for calendar year
         (b) 872 µCi (ODCM Appendix H)

   C. Liquid effluents (ODCMS 7.3.4)

      (1) Calendar Quarter**

         (a) ≤ 3 mrem to total body
         (b) ≤ 10 mrem to any organ

      (2) Calendar Year

         (a) ≤ 6 mrem to total body
         (b) ≤ 20 mrem to any organ

NOTE: Dose calculations are determined in accordance with the ODCM
* Used for percent of ODCMS limit determination in Attachment 2, Table 1A
**Used for percent of ODCMS limit determination in Attachment 2, Table 2A

ATTACHMENT 1 (cont.)

EFFLUENT AND WASTE DISPOSAL REPORT SUPPLEMENTAL INFORMATION

2. Maximum permissible concentration and dose rates which determine maximum instantaneous release rates.

   A. Fission and activation gases (ODCMS 7.3.7.a)

      (1) ≤ 500 mrem/year to total body
      (2) ≤ 3000 mrem/year to the skin

   B. Iodine-131, iodine-133, tritium, and particulates with half-lives greater than eight days (ODCMS 7.3.7.b)

      (1) ≤ 1500 mrem/year to any organ

   C. Liquid effluents (ODCMS 7.3.3)

   The concentration of radioactive material released in liquid effluents to unrestricted areas after dilution in the discharge canal shall be limited to 10 times the concentrations specified in Appendix B, Table 2, Column 2 to 10 CFR 20.1001 - 20.2401 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to the value given in the ODCM specifications.

      (1) Tritium: limit = 1.00E-03 μCi/ml**
      (2) Dissolved and entrained noble gases: limit = 2.00E-04 μCi/ml**

3. Measurements and Approximations of Total Radioactivity

   A. Fission and activation gases

      (1) Analyses for specific radionuclides in representative grab samples by gamma spectroscopy.

   B. Iodines

      (1) Analysis for specific radionuclides collected on charcoal cartridges by gamma spectroscopy.

   C. Particulates

      (1) Analysis for specific radionuclides collected on filter papers by gamma spectroscopy.

   D. Particulates for Burning Oil

      (1) Analysis for specific radionuclides by grab samples of each batch of oil to be burned.

   E. Liquid Effluents

      (1) Analysis for specific radionuclides of individual releases by gamma spectroscopy.

** Used as applicable limits for Attachment 2, Table 2A.

Nuclear counting statistics are reported utilizing 1-sigma error. Total error where reported represents a best effort to approximate the total of all individual and sampling errors.

ATTACHMENT 1 (cont.)

EFFLUENT AND WASTE DISPOSAL REPORT SUPPLEMENTAL INFORMATION

4. Batch Releases

A. Liquid

(1) Number of batch releases:	4.00E+01
(2) Total time period for batch releases:	4.66E+03 Minutes
(3) Maximum time period for a batch release:	2.63E+02 Minutes
(4) Average time period for a batch release:	1.17E+02 Minutes
(5) Minimum time period for a batch release:	1.40E+01 Minutes
(6) Average stream flow during periods of release of effluent into a flowing stream:	8.27E+05 Gallons per Minute

B. Gaseous

(1) Number of batch releases:	0.00E+00
(2) Total time period for batch releases:	0.00E+00 Minutes
(3) Maximum time period for a batch release:	0.00E+00 Minutes
(4) Average time period for a batch release:	0.00E+00 Minutes
(5) Minimum time period for a batch release:	0.00E+00 Minutes

5. Abnormal releases*

A. Liquid

(1) Number of releases:	0.00E+00
(2) Total activity released:	0.00E+00 Curies

B. Gaseous

(1) Number of releases:	0.00E+00
(2) Total activity released:	0.00E+00 Curies

* There were no abnormal releases that exceeded 10 CFR 20 or 10 CFR 50 limits. See page 5 for a discussion of release events that occurred.

ATTACHMENT 1 (cont.)

EFFLUENT AND WASTE DISPOSAL REPORT SUPPLEMENTAL INFORMATION

1. Discussion of Releases from the Storm Drain Collector Basin

Due to heavy rains, the Storm Drain Collector Basin (SDCB) was released directly to the discharge canal on September 23, 2002, for approximately 0.3 hours. The SDCB is a permitted release point during periods of inclement weather to protect plant personnel and equipment. Approximately 3.44E+04 gallons containing 1.67E-03 curies of tritium were released during this instance. This resulted in an estimated maximum dose to the individual of 7.15E-10 mrem.

2. Summary

SDCB curie totals are included in the quarterly summaries for FISSION AND ACTIVIATION PRODUCTS and TRITIUM on Attachment 2, Table 2A when applicable.

The quantity of rainwater released from the storm drain stabilization pond and/or the SDCB is not included in the average diluted concentration determination or VOLUME OF WASTE RELEASED on Attachment 2, Table 2A.

ATTACHMENT 2

EFFLUENT AND WASTE DISPOSAL DATA

ATTACHMENT 2 (cont.)

EFFLUENT AND WASTE DISPOSAL DATA
Table 1A: Gaseous Effluents - Summation of all Releases

A. FISSION AND ACTIVATION GASES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	1.68E+02	6.06E+01	8.11E+01	3.13E+01	4.50E+01
2. Average release rate for period	µCi/sec	2.17E+01	7.70E+00	1.02E+01	3.94E+00	NA
3. Percent of ODCM limit	%	6.12E-02	1.26E-02	1.46E-03	6.31E-03	NA

B. IODINES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total Iodine - 131 release	Ci	3.73E-03	1.72E-03	3.14E-03	1.74E-03	3.50E+01
2. Average release rate for period	µCi/sec	4.79E-04	2.18E-04	3.95E-04	2.19E-04	NA

C. PARTICULATES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	1.26E-03	7.19E-04	5.08E-04	4.86E-04	3.50E+01
2. Average release rate for period	µCi/sec	1.61E-04	9.15E-05	6.39E-05	6.11E-05	NA
3. Gross Alpha	Ci	1.61E-07	0.00E+00	0.00E+00	0.00E+00	3.50E+01

D. TRITIUM

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	4.68E+01	2.22E+01	2.75E+01	2.10E+01	3.00E+01
2. Average release rate for period	µCi/sec	6.01E+00	2.82E+00	3.46E+00	2.64E+00	NA

E. IODINE-131, IODINE-133, TRITIUM AND PARTICULATES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
1. Total release	Ci	4.68E+01	2.22E+01	2.76E+01	2.10E+01
2. Average release rate for period	µCi/sec	6.02E+00	2.82E+00	3.47E+00	2.64E+00
3. Percent of ODCM limit	%	1.71E-01	6.32E-02	1.16E-01	6.44E-02

ATTACHMENT 2 (cont.)

EFFLUENT AND WASTE DISPOSAL DATA
Table 1A: Gaseous Effluents - Summation of all Releases (cont.)

F. PARTICULATES VIA BURINING CONTAMINATED OIL

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
1. Total release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Average release rate for period	µCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3. Percent of ODCM limit	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00

ATTACHMENT 2 (cont.)

EFFLUENT AND WASTE DISPOSAL DATA
Table 1B: Gaseous Effluents - Elevated Releases
Continuous Release

Nuclides Released

1. FISSION GASES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
krypton-85m	Ci	5.15E+00	3.80E+00	2.26E+00	≤ LLD
krypton-87	Ci	2.54E+00	2.06E+00	1.02E+00	≤ LLD
krypton-88	Ci	3.31E+00	2.02E+00	1.06E+00	≤ LLD
xenon-133	Ci	1.34E+01	2.05E+01	3.27E+01	5.59E+00
xenon-133m	Ci	≤ LLD	≤ LLD	3.34E-02	≤ LLD
xenon-135	Ci	1.63E+01	5.77E+00	5.91E+00	8.04E+00
xenon-135m	Ci	2.45E+01	8.76E+00	9.19E+00	9.44E+00
xenon-137	Ci	6.75E+00	≤ LLD	1.82E+00	≤ LLD
xenon-138	Ci	7.23E+01	1.21E+01	5.50E+00	7.21E+00
total for period	Ci	1.44E+02	5.50E+01	5.94E+01	3.06E+01

2. GASEOUS IODINES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
iodine-131	Ci	2.76E-03	1.58E-03	2.29E-03	1.31E-03
iodine-132	Ci	1.75E-02	7.67E-03	1.12E-02	1.34E-02
iodine-133	Ci	1.65E-02	9.86E-03	1.31E-02	1.12E-02
iodine-134	Ci	2.49E-02	2.90E-03	1.26E-02	2.46E-03
iodine-135	Ci	2.80E-02	1.55E-02	1.90E-02	1.99E-02
total for period	Ci	8.97E-02	3.75E-02	5.82E-02	4.83E-02

3. PARTICULATES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
chromium-51	Ci	4.66E-05	≤LLD	≤LLD	≤LLD
manganese-54	Ci	2.89E-05	≤LLD	≤LLD	≤LLD
cobalt-58	Ci	5.98E-05	≤LLD	≤LLD	≤LLD
cobalt-60	Ci	1.53E-04	6.54E-06	7.83E-06	1.55E-05
strontium-89	Ci	3.19E-05	5.00E-05	2.52E-05	1.71E-05
strontium-90	Ci	9.47E-07	1.18E-06	7.36E-07	1.08E-06
ruthenium-106	Ci	3.20E-05	≤LLD	≤LLD	≤LLD
cesium-137	Ci	3.81E-06	3.24E-06	≤LLD	1.18E-06
barium-140	Ci	1.25E-04	1.85E-04	1.28E-04	8.28E-05
lanthanum-140	Ci	2.13E-04	3.48E-04	2.41E-04	1.14E-04
total for period	Ci	6.96E-04	5.94E-04	4.03E-04	2.32E-04

4. TRITIUM

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
hydrogen-3	Ci	5.64E+00	5.25E+00	1.06E+01	7.83E+00

ATTACHMENT 2 (cont.)

EFFLUENT AND WASTE DISPOSAL DATA
Table 1C: Gaseous Effluents - Ground Level Releases
Continuous Release

Nuclides Released

1. FISSION GASES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
xenon-133	Ci	≤ LLD	3.57E+00	1.83E+01	≤ LLD
xenon-135	Ci	1.59E+01	1.95E+00	2.75E+00	6.75E-01
xenon-135m	Ci	8.50E+00	≤ LLD	6.07E-01	≤ LLD
total for period	Ci	2.44E+01	5.52E+00	2.16E+01	6.75E-01

2. GASEOUS IODINES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
iodine-131	Ci	9.72E-04	1.32E-04	8.54E-04	4.30E-04
iodine-132	Ci	8.67E-04	≤ LLD	≤ LLD	9.38E-04
iodine-133	Ci	1.79E-03	8.68E-04	5.21E-04	1.01E-03
iodine-134	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
iodine-135	Ci	9.77E-04	6.29E-06	≤ LLD	4.62E-04
total for period	Ci	4.61E-03	1.01E-03	1.37E-03	2.84E-03

3. PARTICULATES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
chromium-51	Ci	2.77E-04	3.30E-05	2.91E-05	≤ LLD
manganese-54	Ci	2.69E-05	4.74E-07	2.78E-06	2.94E-06
cobalt-58	Ci	2.75E-05	4.83E-06	2.18E-06	5.44E-05
iron-59	Ci	2.12E-05	≤ LLD	≤ LLD	≤ LLD
cobalt-60	Ci	1.88E-04	8.36E-05	5.17E-05	5.52E-05
strontium-89	Ci	1.24E-05	4.54E-07	2.24E-06	6.89E-06
strontium-90	Ci	1.79E-08	1.38E-07	9.50E-08	6.67E-07
cesium-137	Ci	2.14E-06	3.00E-06	1.25E-05	≤ LLD
barium-140	Ci	1.06E-06	8.22E-08	4.29E-06	5.98E-05
lanthanum-140	Ci	≤ LLD	≤ LLD	≤ LLD	7.39E-05
cerium-141	Ci	3.95E-06	≤ LLD	≤ LLD	≤ LLD
total for period	Ci	5.60E-04	1.26E-04	1.05E-04	2.54E-04

4. TRITIUM

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
hydrogen-3	Ci	4.11E+01	1.69E+01	1.70E+01	1.31E+01

ATTACHMENT 2 (cont.)

EFFLUENT AND WASTE DISPOSAL DATA
Table 1D: Gaseous Effluents - Ground Level Releases For Burning Contaminated Oil

Nuclides Released

1. PARTICULATES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
No releases made	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00

ATTACHMENT 2 (cont.)

EFFLUENT WASTE AND DISPOSAL DATA
Table 2A: Liquid Effluents - Summation of all Releases

A. FISSION AND ACTIVATION PRODUCTS (NOTE 1)

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release (excluding tritium, gases, and alpha)	Ci	9.59E-04	1.73E-04	3.97E-04	2.26E-04	4.00E+01
2. Average diluted concentration (NOTE 2)	µCi/ml	1.75E-10	6.73E-11	4.30E-10	4.01E-11	NA
3. Percent of applicable limit	%	1.71E-03	2.01E-04	5.19E-04	3.06E-04	NA

B. TRITIUM (NOTE 1)

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	3.58E+00	9.86E-01	3.75E-01	1.48E+00	4.50E+01
2. Average diluted concentration (NOTE 2)	µCi/ml	6.55E-07	3.83E-07	4.07E-07	2.62E-07	NA
3. Percent of applicable limit	%	6.55E-02	3.83E-02	4.07E-02	2.62E-02	NA

C. DISSOLVED AND ENTRAINED GASES (NOTE 1)

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	1.74E-04	1.97E-05	0.00E+00	6.58E-05	4.00E+01
2. Average diluted concentration (NOTE 2)	µCi/ml	3.18E-11	7.66E-12	0.00E+00	1.17E-11	NA
3. Percent of applicable limit	%	1.59E-05	3.83E-06	0.00E+00	5.85E-06	NA

D. GROSS ALPHA RADIOACTIVITY

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD	4.00E+01

NOTE 1: Includes radionuclides released via abnormal and/or non-routine releases
NOTE 2: Does not include rainwater (i e. Storm Drain Collection Basin and/or Storm Drain Collection Pond)

ATTACHMENT 2 (cont.)

EFFLUENT AND WASTE DISPOSAL DATA
Table 2A: Liquid Effluents - Summation of all Releases (cont.)

E. VOLUME OF WASTE RELEASED (NOTE 2)

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total volume	liters	7.21E+05	3.10E+05	9.43E+04	7.20E+05	1.50E+01

F. VOLUME OF DILUTION WATER

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total volume (used during release for average diluted concentration)	liters	5.47E+09	2.57E+09	9.24E+08	5.62E+09	1.50E+01

G. VOLUME OF COOLING WATER DISCHARGED FROM PLANT

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total volume	liters	3.48E+11	4.73E+11	5.14E+11	4.62E+11	1.50E+01

NOTE 1: Includes radionuclides released via abnormal and/or non-routine releases
NOTE 2: Does not include rainwater (i e. Storm Drain Collection Basin and/or Storm Drain Collection Pond)

ATTACHMENT 2 (cont.)

EFFLUENT AND WASTE DISPOSAL DATA
Table 2B: Liquid Effluents - Batch Mode

Nuclides Released

1. FISSION AND ACTIVATION PRODUCTS

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
iron-55	Ci	9.24E-05	2.76E-05	2.20E-04	9.80E-05
cobalt-60	Ci	2.55E-04	6.67E-05	1.54E-04	8.84E-05
strontium-89	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
strontium-90	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
yitrium-91m	CI	1.38E-05	≤ LLD	≤ LLD	≤ LLD
iodine-131	Ci	2.34E-04	1.16E-05	1.78E-06	4.72E-06
iodine-133	Ci	2.64E-04	1.81E-05	≤ LLD	9.22E-06
iodine-135	Ci	3.52E-05	≤ LLD	≤ LLD	≤ LLD
cesium-137	Ci	2.26E-05	3.14E-05	2.18E-05	2.55E-05
barium-140	Ci	2.09E-05	≤ LLD	≤ LLD	≤ LLD
lanthium-140	Ci	2.12E-05	≤ LLD	≤ LLD	≤ LLD
total for period	Ci	9.59E-04	1.73E-04	3.97E-04	2.26E-04

2. DISSOLVED AND ENTRAINED GASES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
xenon-133	Ci	7.97E-05	1.07E-05	≤ LLD	1.19E-05
xenon-135	Ci	7.57E-05	9.05E-06	≤ LLD	5.39E-05
xenon-135m	Ci	1.82E-05	≤ LLD	≤ LLD	≤ LLD
total for period	Ci	1.74E-04	1.97E-05	0.00E+00	6.58E-05

ATTACHMENT 2 (cont.)

EFFLUENT AND WASTE DISPOSAL DATA

LOWER LIMITS OF DETECTION

Units: µCi/ml

1. LIQUID RELEASES

Alpha	3.73E-08
Cr-51	1.60E-07
Mn-54	2.05E-08
Fe-55	2.36E-08
Co-58	1.72E-08
Fe-59	2.52E-08
Co-60	2.32E-08
Zn-65	7.19E-08
Sr-89	4.59E-08
Sr-90	3.40E-08
Y-91m	2.56E-08
Mo-99	1.26E-07
I-131	1.69E-08
I-133	2.21E-08
I-135	9.84E-08
Cs-134	2.45E-08
Cs-137	2.59E-08
Ba-140	5.38E-08
La-140	4.67E-08
Ce-141	2.51E-08
Ce-144	9.98E-08
Kr-87	3.92E-08
Kr-88	6.02E-08
Xe-133	3.58E-08
Xe-133m	1.31E-07
Xe-135	1.58E-08
Xe-135m	8.30E-08
Xe-138	1.74E-07

2. GASEOUS RELEASES

Kr-85m	4.77E-09
Kr-87	9.18E-09
Kr-88	1.81E-08
Xe-133	1.29E-08
Xe-133m	4.92E-08
Xe-135	3.25E-09
Xe-137	1.20E-06
Xe-138	1.69E-07

3. IODINES AND PARTICULATES

Alpha	1.97E-15
Cr-51	5.04E-13
Mn-54	3.76E-14
Co-58	6.65E-14
Fe-59	5.78E-14
Co-60	5.05E-14
Zn-65	1.35E-13
Sr-89	1.77E-15
Sr-90	1.40E-15
Mo-99	5.74E-13
Ru-106	6.59E-13
I-131	6.06E-14
Cs-134	7.40E-14
Cs-137	6.02E-14
Ba-140	2.53E-13
La-140	1.09E-13
Ce-141	8.79E-14
Ce-144	3.58E-13

NOTES:

1. The above values represent typical "a priori" LLDs for isotopes where values of "≤LLD" are indicated in Tables 1A, 1B, 1C, 2A, and 2B. Also included are isotopes specified in ODCMS 7.3.3 and 7.3.7.

2. Where activity for any nuclide is reported as "Less than LLD," that nuclide is considered not present and the LLD activity listed is not considered in the summary data.

ATTACHMENT 2 (cont.)

EFFLUENT AND WASTE DISPOSAL DATA
Table 3A: Solid Waste and Irradiated Fuel Shipments – Waste Class A

Waste Class A

1. Total volume shipped (cubic meters) 5.52E+02

   Total curie quantity (estimated) 2.43E+00

2. Type of Waste

		Unit	Period	Estimated Total %Error
a.	Spent resins, filter, sludges	meter^3	0.00E+00	
		Curies	0.00E+00	
b.	Dry active waste, compacted/non-compacted	meter^3	5.52E+02	1.00E+01
		Curies	2.43E+00	1.00E+01
c.	Irradiated components	meters^3	0.00E+00	
		Curies	0.00E+00	
d.	Others (describe)	meters^3	0.00E+00	
		Curies	0.00E+00	

3. Estimate of major radionuclides composition

   a. N/A

   b.

Fe-55	3.94E+01 %
Co-60	5.09E+01 %
Ni-63	3.73E+00 %
Cs-137	1.27E+00 %
Ce-144	4.08E+00 %

   c. N/A

   d. N/A

NOTE:

Solid Radioactive Waste listed above was shipped for processing to various waste processing services or directly shipped to a licensed disposal facility.

ATTACHMENT 2 (cont.)

EFFLUENT AND WASTE DISPOSAL DATA
Table 3A: Solid Waste and Irradiated Fuel Shipments – Waste Class A (cont.)

4. Cross reference table, waste stream, form, and container type

Stream	Form	Container Type Type A/Type B	No. of shipments
a. Resin/Filters	Dewatered & Solidified*		
b. Dry active waste	Compacted/ Non-compacted	Type A or STP	1.40E+01
c. Irradiated components			
d. Others (describe)			

*Solidification agent or absorbent (e.g., cement, urea formaldehyde)

5. Shipment Disposition

a. Solid Waste

Number of Shipments	Mode of Transportation	Destination
6.00E+00	Rail	Clive, UT.
8.00E+00	Highway	Oak Ridge, TN.

b. Irradiated Fuel

Number of Shipments	Mode of Transportation	Destination
0	N/A	N/A

ATTACHMENT 2 (cont.)

EFFLUENT AND WASTE DISPOSAL DATA
Table 3B: Solid Waste and Irradiated Fuel Shipments – Waste Class B

Waste Class B

1. Total volume shipped (cubic meters) 4.79E+00

   Total curie quantity (estimated) 1.71E+01

2. Type of Waste

		Unit	Period	Estimated Total %Error
a.	Spent resins, filter, sludges	meter^3	4.79E+00	1.00E+01
		Curies	1.71E+01	1.00E+01
b.	Dry active waste, compacted/non-compacted	meter^3	0.00E+00	
		Curies	0.00E+00	
c.	Irradiated components	meters^3	0.00E+00	
		Curies	0.00E+00	
d.	Others (describe)	meters^3	0.00E+00	
		Curies	0.00E+00	

3. Estimate of major radionuclides composition

   a.

Cr-51	1.10E+00 %
Mn-54	2.10E+00 %
Fe-55	1.13E+01 %
Co-58	1.20E+00 %
Co-60	5.05E+01 %
Ni-63	1.98E+01 %
Cs-134	1.30E+00 %
Cs-137	1.19E+01 %

   b. N/A

   c. N/A

   d. N/A

NOTE:

Solid Radioactive Waste was shipped either directly for disposal or to a waste processor for processing and then transported for disposal by the processor

ATTACHMENT 2 (cont.)

EFFLUENT AND WASTE DISPOSAL DATA
Table 3B: Solid Waste and Irradiated Fuel Shipments – Waste Class B (cont.)

4. Cross reference table, waste stream, form, and container type

Stream	Form	Container Type Type A/Type B	No. of shipments
a. Resin/Filters	Dewatered & Solidified*	Type B	1.00E+00
b. Dry active waste	Compacted/ Non-compacted		
c. Irradiated components			
d. Others (describe)			

*Solidification agent or absorbent (e.g., cement, urea formaldehyde)

5. Shipment Disposition

a. Solid Waste

Number of Shipments	Mode of Transportation	Destination
1.00E+00	Highway	Barnwell, SC.

b. Irradiated Fuel

Number of Shipments	Mode of Transportation	Destination
0	N/A	N/A

ATTACHMENT 2 (cont.)

EFFLUENT AND WASTE DISPOSAL DATA
Table 3C: Solid Waste and Irradiated Fuel Shipments – Waste Class C

Waste Class C

1. Total volume shipped (cubic meters) 3.71E+00

   Total curie quantity (estimated) 7.16E+04

2. Type of Waste

		Unit	Period	Estimated Total %Error
a.	Spent resins, filter, sludges	meter^3	2.83E+00	1.00E+01
		Curies	2.07E+02	1.00E+01
b.	Dry active waste, compacted/non-compacted	meter^3	0.00E+00	
		Curies	0.00E+00	
c.	Irradiated components	meters^3	8.870E-01	1.00E+01
		Curies	7.14E+04	1.00E+01
d.	Others (describe)	meters^3	0.00E+00	
		Curies	0.00E+00	

3. Estimate of major radionuclides composition

   a. Fe-55 5.70E+01 %
      Co-60 3.69E+01 %
      Ni-63 5.06E+00 %

   b. N/A

   c. Cr-51 9.20E-01 %
      Mn-54 1.39E+00 %
      Fe-55 4.39E+01 %
      Co-60 4.84E+01 %
      Ni-63 4.60E+00 %

   d. N/A

NOTE:

Solid Radioactive Waste was shipped directly for disposal.

ATTACHMENT 2 (cont.)

EFFLUENT AND WASTE DISPOSAL DATA
Table 3C: Solid Waste and Irradiated Fuel Shipments – Waste Class C (cont.)

4. Cross reference table, waste stream, form, and container type

Stream	Form	Container Type Type A/Type B	No. of shipments
a. Resin/Filters	Dewatered & Solidified*	Type B	3.00E+00
b. Dry active waste	Compacted/ Non-compacted		
c. Irradiated components		Type B	4.00E+00
d. Others (describe)			

*Solidification agent or absorbent (e.g., cement, urea formaldehyde)

5. Shipment Disposition

a. Solid Waste

Number of Shipments	Mode of Transportation	Destination
7.00E+00	Highway	Barnwell, SC.

b. Irradiated Fuel

Number of Shipments	Mode of Transportation	Destination
1.0E+01	Rail	New Hill, NC.

ATTACHMENT 2 (cont.)

EFFLUENT AND WASTE DISPOSAL DATA

COMBUSTION OF WASTE OIL

No contaminated waste oil was incinerated during this report period.

ATTACHMENT 3

ENVIRONMENTAL MONITORING PROGRAM

Enclosure 1: Milk and Vegetable Sample Location

Enclosure 2: Land Use Census

ATTACHMENT 3 (cont.)

ENVIRONMENTAL MONITORING PROGRAM

Enclosure 1: Milk and Vegetable Sample Location

No milk animals are located in the area evaluated by the last Land Use Census, therefore, no milk sampling locations were available during this time period.

Vegetation sample locations remained unchanged.

ATTACHMENT 3 (cont.)

ENVIRONMENTAL MONITORING PROGRAM

Enclosure 2: Land Use Census

The 2002 Land Use Census did not identify any locations that are reportable in the Radioactive Effluent Release Report for 2002.

The following is a summary of the nearest resident and garden locations identified within five miles of the plant for each of the 16 meteorological sectors. No milk animals were found within five miles of the plant.

Direction	Residence	Garden
NNE	0.8 miles	1.2 miles
NE	None	None
ENE	None	None
E	None	None
ESE	1.5 miles	None
SE	0.9 miles	None
SSE	1.0 miles	None
S	1.1 miles	1.8 miles
SSW	1.2 miles	1.6 miles
SW	1.0 miles	1.5 miles
WSW	1.2 miles	1.2 miles
W	0.8 miles	0.8 miles
WNW	0.8 miles	1.0 miles
NW	0.9 miles	4.8 miles
NNW	0.8 miles	4.4 miles
N	0.7 miles	0.9 miles

ATTACHMENT 4

EFFLUENT INSTRUMENTATION

Enclosure 1: Radioactive Liquid Effluent Monitoring Instrumentation

Enclosure 2: Radioactive Gaseous Effluent Monitoring Instrumentation

Enclosure 3: Liquid Hold-Up Tank

ATTACHMENT 4 (cont.)

EFFLUENT INSTRUMENTATION

Enclosure 1: Radioactive Liquid Effluent Monitoring Instrumentation

No Radioactive Liquid Effluent Monitoring Instruments were inoperable for a period of greater than 30 days.

ATTACHMENT 4 (cont.)

EFFLUENT INSTRUMENTATION

Enclosure 2: Radioactive Gaseous Effluent Monitoring Instrumentation

No Radioactive Gaseous Effluent Monitoring Instruments were inoperable for a period of greater than 30 days.

ATTACHMENT 4 (cont.)

EFFLUENT INSTRUMENTATION

Enclosure 3: Liquid Hold-Up Tank

No Liquid Hold-Up Tank exceeded the 10-Curie limit of ODCMS 7.3.6 during this reporting period.

ATTACHMENT 5

MAJOR MODIFICATION TO THE RADIOACTIVE WASTE TREATMENT SYSTEMS

In accordance with ODCMS 7.5.1, major changes to the liquid, gaseous, and solid Radioactive Waste Treatment Systems shall be reported to the NRC as part of the Radioactive Effluent Release Report or as part of the Updated Final Safety Analysis Report (UFSAR) update. Although major modifications to the radioactive waste treatment systems will typically be submitted with the UFSAR in accordance with 10 CFR 50.71(e), a temporary modification that was installed on the Unit 1 Turbine Building ventilation system is described below:

The Unit 1 refueling outage in March 2002 incorporated a temporary modification to the Turbine Building ventilation system that provided a once-through unfiltered pathway to the environment. Normal building ventilation operates with approximately 200,000 cfm supplied into the building, a recirculation system, and an air filtration effluent pathway designed to exhaust 15,500 cfm. Brunswick's Turbine Buildings contain both units' secondary equipment and any system breach will communicate between units due to the 70' elevation turbine deck interface and the slight pressure differences between passage doors. The unique feature in Brunswick's Turbine Building pressure boundary is the ventilation system utilized for building cooling. Approximately 90% of the building air recirculates through an air wash system that, coupled with a chiller system, cools and maintains the temperature for equipment protection. The effect from this recirculated ventilation method is to concentrate any radiological contaminants inside the buildings. The main removal method due to this recirculation system is typically isotopic decay. The aforementioned once-through ventilation system modification resulted in providing, depending on the number of fans operating, a dilution input of 80,000 to 140,000 cfm of outside air to the Unit 1 Turbine Building. The discharge from the once-through modification released about the same volume to maintain the building in a negative pressure condition. Unfortunately, the design of the Turbine Building envelope, as previously mentioned, will lead to communication of air quality between the operating and shutdown units. This design, coupled with the breaching of contaminated systems during repair work on the shutdown unit, resulted in low level iodine and noble gas releases from this once-through pathway. The system operated for approximately 17 days and accounted for 8.48E+13 cc of release volume. The ventilation system was restored to its normal configuration when the temporary modification was removed. The once-through pathway contributed the following to the 2002 annual source term:

Category	Curies
Noble Gas	3.34
I-131	2.41E-04
I-133	1.22E-04

ATTACHMENT 6

METEOROLOGICAL DATA

Per Technical Specification 5.6.3 and ODCMS 7.4.2, the annual summary of meteorological data collected over the calendar year has been retained in a file and is available for NRC review upon request.

ATTACHMENT 7

ANNUAL DOSE ASSESSMENT

Enclosure 1: 2002 Annual Liquid Dose Assessment

Enclosure 2: 2002 Annual Gaseous Dose Assessment

Enclosure 3: 2002 Dose Assessment Summary

ATTACHMENT 7 (cont.)

ANNUAL DOSE ASSESSMENT

Enclosure 1: 2002 Annual Liquid Dose Assessment

Included are:

Site Specific Data

Source Term

As Low As Reasonably Achievable Maximum Individual Dose

Summary - Total Integrated and Recreation Population Dose

ATTACHMENT 7 (cont.)

ANNUAL DOSE ASSESSMENT

Enclosure 1: 2002 Annual Liquid Dose Assessment (cont.)

Site Specific Data

BSEP UNITS 1 AND 2 LIQUID RELEASES 2002,

DISCHARGE = 2.01E+03 CFS SOURCE TERM MULTIPLIER = 1.00E+00

SALTWATER SITE

NO RECONCENTRATION MODEL

50-MILE POPULATION = 3.18E+05 FRACTION --- ADULT=0.71
TEENAGER=0.11
CHILD=0.18

DOSE FACTOR LIBRARY CONTAINS 698 ENTRIES

ATTACHMENT 7 (cont.)

ANNUAL DOSE ASSESSMENT

Enclosure 1: 2002 Annual Liquid Dose Assessment (cont.)

Source Term

NUCLIDE	RELEASE CI/YR	PERSON-REM DOSE		PERSON-REM PER CURIE	
		TOTAL BODY	THYROID	TOTAL BODY	THYROID
1H 3	6.42E+00	1.29E-04	1.29E-04	2.01E-05	2.01E-05
26FE 55	4.38E-04	1.52E-04	2.18E-13	3.47E-01	4.98E-10
27CO 60	5.64E-04	7.59E-05	8.56E-06	1.35E-01	1.52E-02
39Y 91M	1.38E-05	1.08E-10	1.08E-10	7.85E-06	7.85E-06
53I 131	2.52E-04	1.10E-06	6.24E-04	4.36E-03	2.48E+00
53I 133	2.91E-04	4.53E-09	9.09E-07	1.55E-05	3.12E-03
53I 135	3.52E-05	9.63E-10	9.63E-10	2.73E-05	2.73E-05
54XE 133	1.02E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
54XE 135	1.39E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
54XE 135M	1.82E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
55CS 137	1.01E-04	5.56E-05	8.64E-07	5.49E-01	8.53E-03
56BA 140	2.09E-05	4.88E-08	3.60E-10	2.34E-03	1.73E-05
57LA 140	2.12E-05	9.46E-10	9.44E-10	4.46E-05	4.45E-05
TOTAL		4.13E-04	7.63E-04		

ATTACHMENT 7 (cont.)
ANNUAL DOSE ASSESSMENT
Enclosure 1: 2002 Annual Liquid Dose Assessment (cont.)

As Low As Reasonably Achievable Maximum Individual Dose (Page 1 of 2)

1 * * * AS LOW AS REASONABLY ACHIEVABLE * * *

0 **A D U L T D O S E S** (MREM PER YEAR INTAKE)
0

0PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
				DOSE				
FISH		1.54E-06	1.43E-06	6.82E-07	2.17E-06	3.06E-07	7.96E-07	1.70E-06
INVERT		2.26E-06	1.74E-06	6.85E-07	2.36E-06	8.03E-08	9.20E-07	3.17E-06
SHORELINE	1.02E-05	8.71E-06	8.71E-06	8.71E-06	8.71E-06	8.71E-06	8.71E-06	8.71E-06
SWIMMING		6.30E-09	6.30E-09	6.30E-09	6.30E-09	6.30E-09	6.30E-09	6.30E-09
BOATING		3.15E-09	3.15E-09	3.15E-09	3.15E-09	3.15E-09	3.15E-09	3.15E-09
TOTAL	1.02E-05	1.25E-05	1.19E-05	1.01E-05	1.33E-05	9.11E-06	1.04E-05	1.36E-05

0	USAGE (KG/YR,HR/YR)	DILUTION	TIME(HR)	SHOREWIDTH FACTOR=0.5
FISH	21.0	30.0	24.00	
INVERT	5.0	30.0	24.00	
SHORELINE	500.0	30.0	0.00	
SWIMMING	100.0	30.0	0.00	
BOATING	100.0	30.0	0.00	

0 **T E E N D O S E S** (MREM PER YEAR INTAKE)
0

0PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
				DOSE				
FISH		1.61E-06	1.46E-06	5.96E-07	2.00E-06	2.54E-07	8.66E-07	1.26E-06
INVERT		2.36E-06	1.84E-06	6.94E-07	2.21E-06	6.78E-08	1.10E-06	2.32E-06
SHORELINE	1.02E-05	8.71E-06	8.71E-06	8.71E-06	8.71E-06	8.71E-06	8.71E-06	8.71E-06
SWIMMING		6.30E-09	6.30E-09	6.30E-09	6.30E-09	6.30E-09	6.30E-09	6.30E-09
BOATING		3.15E-09	3.15E-09	3.15E-09	3.15E-09	3.15E-09	3.15E-09	3.15E-09
TOTAL	1.02E-05	1.27E-05	1.20E-05	1.00E-05	1.29E-05	9.04E-06	1.07E-05	1.23E-05

0	USAGE (KG/YR,HR/YR)	DILUTION	TIME(HR)	SHOREWIDTH FACTOR=0.5
FISH	16.0	30.0	24.00	
INVERT	3.8	30.0	24.00	
SHORELINE	500.0	30.0	0.00	
SWIMMING	100.0	30.0	0.00	
BOATING	100.0	30.0	0.00	

ATTACHMENT 7 (cont.)
ANNUAL DOSE ASSESSMENT
Enclosure 1: 2002 Annual Liquid Dose Assessment (cont.)

As Low As Reasonably Achievable Maximum Individual Dose (Page 2 of 2)

*** * * AS LOW AS REASONABLY ACHIEVABLE * * ***

0 C H I L D D O S E S (MREM PER YEAR INTAKE)
0

	DOSE							
0PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		2.11E-06	1.38E-06	6.07E-07	2.07E-06	2.13E-07	7.48E-07	5.58E-07
INVERT		3.21E-06	1.85E-06	8.44E-07	2.40E-06	5.92E-08	9.92E-07	9.17E-07
SHORELINE	1.02E-05	8.71E-06	8.71E-06	8.71E-06	8.71E-06	8.71E-06	8.71E-06	8.71E-06
SWIMMING		6.30E-09	6.30E-09	6.30E-09	6.30E-09	6.30E-09	6.30E-09	6.30E-09
BOATING		3.15E-09	3.15E-09	3.15E-09	3.15E-09	3.15E-09	3.15E-09	3.15E-09
TOTAL	1.02E-05	1.40E-05	1.19E-05	1.02E-05	1.32E-05	8.99E-06	1.05E-05	1.02E-05

0	USAGE (KG/YR,HR/YR)	DILUTION	TIME(HR)	SHOREWIDTH FACTOR=0.5
FISH	6.9	30.0	24.00	
INVERT	1.7	30.0	24.00	
SHORELINE	500.0	30.0	0.00	
SWIMMING	100.0	30.0	0.00	
BOATING	100.0	30.0	0.00	

ATTACHMENT 7 (cont.)
ANNUAL DOSE ASSESSMENT
Enclosure 1: 2002 Annual Liquid Dose Assessment (cont.)

Summary - Total Integrated and Recreation Population Dose

1CP&L
LADTAP

ANNUAL RADIOLOGICAL EFFLUENT REPORTING
RADIATION DOSES FROM LIQUID EFFLUENTS

RUN DATE: 04/15/03
RUN TIME: 11:04:06

TOTAL INTEGRATED AND RECREATION POPULATION DOSES FROM LIQUID EFFLUENTS
(PERSON-REM)

	PATHWAY	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI	SKIN
0	SPORT FISH	9.225E-04	7.995E-04	3.701E-04	7.031E-04	1.567E-04	4.474E-04	8.079E-04	0.000E+00
0	COM FISH	5.080E-05	4.404E-05	2.039E-05	3.145E-05	8.607E-06	2.465E-05	4.450E-05	0.000E+00
0	SPORT INVERT	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0	COM INVERT	4.575E-05	3.328E-05	1.341E-05	1.905E-05	1.263E-06	1.793E-05	4.861E-05	0.000E+00
0	DRINKING WATER	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0	SHORELINE	9.408E-06	9.408E-06	9.408E-06	9.408E-06	9.408E-06	9.408E-06	9.408E-06	1.106E-05
0	SWIMMING	1.794E-08	1.794E-08	1.794E-08	1.794E-08	1.794E-08	1.794E-08	1.794E-08	0.000E+00
0	BOATING	8.499E-09	8.499E-09	8.499E-09	8.499E-09	8.499E-09	8.499E-09	8.499E-09	0.000E+00
0	IRRI VEG	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0	IRRI LEAFY VEG	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0	IRRI MILK	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0	IRRI MEAT	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0	ALL PATHWAYS	1.028E-03	8.863E-04	4.134E-04	7.630E-04	1.760E-04	4.994E-04	9.104E-04	1.106E-05

ATTACHMENT 7 (cont.)

ANNUAL DOSE ASSESSMENT

Enclosure 2: 2002 Annual Gaseous Dose Assessment

Included are:

Source Term for the Three Release Modes and the Site Aggregate

Total 50 Mile Integrated Population Dose by Pathways and Organs

Hypothetical Maximum Individual Organ Dose Due to Iodine, Particulates, and Tritium for a Cow Milk Pathway at 4.75 Miles Northeast

Maximum Site Boundary Dose by Age Group and Organs for All Pathways

Estimated Individual Organ Dose Using the 2001 Land Use Census for the Worst Sector and Existing Pathway

Maximum Site Boundary Dose Due to Iodine, Particulates, and Tritium for Existing Pathways

ATTACHMENT 7 (cont.)

ANNUAL DOSE ASSESSMENT

Enclosure 2: 2002 Annual Gaseous Dose Assessment (cont.)

Source Term for the Three Release Modes and the Site Aggregate (Page 1 of 2)

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GR02YREC
GR02YRGC
GR02YRMC
1CP&L

ANNUAL RADIOLOGICAL EFFLUENT REPORTING          RUN DATE:  04/15/03
GASRPT INPUT SOURCE TERMS                       RUN TIME:  16:44:15

2002 SOURCE TERM (ELEVATED MODE) BSEP UNITS 1&2

            1 H -  3        2.928E+01
           24 CR- 51        4.655E-05
           25 MN- 54        2.894E-05
           27 CO- 58        5.980E-05
           27 CO- 60        1.833E-04
           36 KR- 85 M      1.120E+01
           36 KR- 87        5.613E+00
           36 KR- 88        6.386E+00
           38 SR- 89        1.243E-04
           38 SR- 90        3.936E-06
           44 RU-106        3.203E-05
           53 I -131        7.937E-03
           53 I -132        4.977E-02
           53 I -133        5.073E-02
           53 I -134        4.283E-02
           53 I -135        8.239E-02
           54 XE-133        7.211E+01
           54 XE-133 M      3.344E-02
           54 XE-135        3.634E+01
           54 XE-135 M      5.185E+01
           54 XE-137        8.574E+00
           54 XE-138        9.714E+01
           55 CS-137        8.233E-06
           56 BA-140        5.209E-04
           57 LA-140        9.165E-04


SOURCE TERM (GROUND LEVEL) 2002 BSEP UNITS 1 AND 2

            1 H -  3        7.202E+01
           38 SR- 89        1.480E-05
           38 SR- 90        1.641E-07
           53 I -131        8.713E-04
           53 I -133        8.477E-04
           53 I -135        4.098E-05
           54 XE-133        1.525E+01
           54 XE-135        1.658E+01
           56 BA-140        1.142E-06
           58 CE-141        3.947E-06
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ATTACHMENT 7 (cont.)

ANNUAL DOSE ASSESSMENT

Enclosure 2: 2002 Annual Gaseous Dose Assessment (cont.)

Source Term for the Three Release Modes and the Site Aggregate (Page 2 of 2)

ANNUAL RADIOLOGICAL EFFLUENT REPORTING RUN DATE: 04/15/03
GASRPT INPUT SOURCE TERMS RUN TIME: 16:44:15

BRUNSWICK UNIT 1 AND 2, MIXED MODE CONTINUOUS GASEOUS RELEASES, 2002

1	H - 3	1.613E+01
24	CR- 51	3.395E-04
25	MN- 54	3.308E-05
27	CO- 58	8.889E-05
27	CO- 60	3.781E-04
38	SR- 89	7.170E-06
38	SR- 90	7.536E-07
53	I -131	1.515E-03
53	I -132	1.805E-03
53	I -133	3.341E-03
53	I -135	1.404E-03
54	XE-133	6.574E+00
54	XE-135	4.671E+00
54	XE-135 M	9.105E+00
55	CS-137	1.763E-05
56	BA-140	6.408E-05
57	LA-140	7.392E-05

AGGREGATE SOURCE TERM

1	H - 3	1.1744E+02
24	CR- 51	3.8601E-04
25	MN- 54	6.2021E-05
27	CO- 58	1.4869E-04
27	CO- 60	5.6142E-04
36	KR- 85 M	1.1203E+01
36	KR- 87	5.6130E+00
36	KR- 88	6.3860E+00
38	SR- 89	1.4624E-04
38	SR- 90	4.8539E-06
44	RU-106	3.2030E-05
53	I -131	1.0324E-02
53	I -132	5.1575E-02
53	I -133	5.4920E-02
53	I -134	4.2829E-02
53	I -135	8.3835E-02
54	XE-133	9.3936E+01
54	XE-133 M	3.3440E-02
54	XE-135	5.7591E+01
54	XE-135 M	6.0957E+01
54	XE-137	8.5740E+00
54	XE-138	9.7137E+01
55	CS-137	2.5864E-05
56	BA-140	5.8611E-04
57	LA-140	9.9042E-04
58	CE-141	3.9470E-06

ATTACHMENT 7 (cont.)

ANNUAL DOSE ASSESSMENT

Enclosure 2: 2002 Annual Gaseous Dose Assessment (cont.)

Total 50 Mile Integrated Population Dose by Pathways and Organs

1CP&L ANNUAL RADIOLOGICAL EFFLUENT REPORTING RUN DATE: 04/15/03
GASRPT ALARA ANNUAL INTEGRATED POPULATION DOSE SUMMARY (MANREM) RUN TIME: 16:44:15

2002 SOURCE TERM (ELEVATED MODE) BSEP UNITS 1&2
SOURCE TERM (GROUND LEVEL) 2002 BSEP UNITS 1 AND 2
BRUNSWICK UNIT 1 AND 2, MIXED MODE CONTINUOUS GASEOUS RELEASES, 2002

	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
** TOTAL **	5.120E-02	5.130E-02	8.031E-03	5.123E-02	5.128E-02	6.721E-02	5.153E-02	6.387E-02
PLUME	6.385E-03	6.385E-03	6.385E-03	6.385E-03	6.385E-03	6.385E-03	6.580E-03	1.884E-02
	12.47%	12.45%	79.50%	12.46%	12.45%	9.50%	12.77%	29.49%
GROUND PLANE	1.518E-03	1.518E-03	1.518E-03	1.518E-03	1.518E-03	1.518E-03	1.518E-03	1.786E-03
	2.96%	2.96%	18.90%	2.96%	2.96%	2.26%	2.95%	2.80%
INHALATION	3.773E-02	3.775E-02	5.888E-05	3.776E-02	3.780E-02	4.928E-02	3.788E-02	3.770E-02
	73.69%	73.58%	0.73%	73.71%	73.72%	73.32%	73.52%	59.03%
VEGETATION	3.582E-03	3.587E-03	6.358E-05	3.580E-03	3.586E-03	7.341E-03	3.566E-03	3.565E-03
	7.00%	6.99%	0.79%	6.99%	6.99%	10.92%	6.92%	5.58%
COW MILK	9.011E-05	8.976E-05	1.038E-06	9.053E-05	9.107E-05	3.769E-04	8.954E-05	8.953E-05
	0.18%	0.17%	0.01%	0.18%	0.18%	0.56%	0.17%	0.14%
MEAT & POULTRY	1.897E-03	1.975E-03	4.713E-06	1.897E-03	1.899E-03	2.312E-03	1.894E-03	1.894E-03
	3.71%	3.85%	0.06%	3.70%	3.70%	3.44%	3.68%	2.97%

ATTACHMENT 7 (cont.)
ANNUAL DOSE ASSESSMENT
Enclosure 2: 2002 Annual Gaseous Dose Assessment (cont.)

Hypothetical Maximum Individual Organ Dose Due to Iodines, Particulates, and Tritium for a Cow Milk Pathway at 4.75 Miles NE

1CP&L ANNUAL RADIOLOGICAL EFFLUENT REPORTING RUN DATE: 04/16/03
GASRPT RADIATION DOSES AT SELECTED LOCATIONS RUN TIME: 17:12:14

2002 SOURCE TERM (ELEVATED MODE) BSEP UNITS 1&2
SOURCE TERM (GROUND LEVEL) 2002 BSEP UNITS 1 AND 2
BRUNSWICK UNIT 1 AND 2, MIXED MODE CONTINUOUS GASEOUS RELEASES, 2002

	SPECIAL LOCATION	METERS	DIR	PL	GR	IN	V	CM	GM	M
#42	COW MILK	7644.0	NE	0	1	1	1	1	0	0

ANNUAL BETA AIR DOSE = 8.069E-04 MILLRADS
ANNUAL GAMMA AIR DOSE = 6.753E-04 MILLRADS

	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
ADULT	4.914E-03	4.924E-03	1.866E-04	4.919E-03	4.934E-03	1.253E-02	4.894E-03	4.911E-03
GROUND PLANE	1.251E-04	1.251E-04	1.251E-04	1.251E-04	1.251E-04	1.251E-04	1.251E-04	1.471E-04
INHALATION	1.396E-03	1.397E-03	1.676E-06	1.397E-03	1.398E-03	1.737E-03	1.400E-03	1.395E-03
VEGETATION	2.532E-03	2.545E-03	4.346E-05	2.527E-03	2.529E-03	4.228E-03	2.519E-03	2.518E-03
COW MILK	8.616E-04	8.573E-04	1.642E-05	8.697E-04	8.811E-04	6.439E-03	8.503E-04	8.501E-04
TEENAGER	5.555E-03	5.558E-03	2.131E-04	5.568E-03	5.590E-03	1.624E-02	5.528E-03	5.542E-03
GROUND PLANE	1.251E-04	1.251E-04	1.251E-04	1.251E-04	1.251E-04	1.251E-04	1.251E-04	1.471E-04
INHALATION	1.405E-03	1.406E-03	2.188E-06	1.407E-03	1.408E-03	1.841E-03	1.411E-03	1.404E-03
VEGETATION	2.899E-03	2.910E-03	5.656E-05	2.894E-03	2.894E-03	4.305E-03	2.884E-03	2.883E-03
COW MILK	1.126E-03	1.117E-03	2.928E-05	1.142E-03	1.163E-03	9.966E-03	1.108E-03	1.107E-03
CHILD	7.642E-03	7.609E-03	3.067E-04	7.661E-03	7.692E-03	2.788E-02	7.589E-03	7.604E-03
GROUND PLANE	1.251E-04	1.251E-04	1.251E-04	1.251E-04	1.251E-04	1.251E-04	1.251E-04	1.471E-04
INHALATION	1.243E-03	1.243E-03	2.729E-06	1.244E-03	1.246E-03	1.761E-03	1.247E-03	1.242E-03
VEGETATION	4.491E-03	4.484E-03	1.092E-04	4.481E-03	4.480E-03	6.640E-03	4.467E-03	4.466E-03
COW MILK	1.782E-03	1.757E-03	6.969E-05	1.810E-03	1.842E-03	1.935E-02	1.750E-03	1.750E-03
INFANT	3.555E-03	3.501E-03	2.652E-04	3.641E-03	3.656E-03	4.675E-02	3.499E-03	3.516E-03
GROUND PLANE	1.251E-04	1.251E-04	1.251E-04	1.251E-04	1.251E-04	1.251E-04	1.251E-04	1.471E-04
INHALATION	7.148E-04	7.144E-04	1.931E-06	7.162E-04	7.166E-04	1.189E-03	7.182E-04	7.140E-04
COW MILK	2.715E-03	2.662E-03	1.382E-04	2.800E-03	2.814E-03	4.544E-02	2.656E-03	2.654E-03

ATTACHMENT 7 (cont.)

ANNUAL DOSE ASSESSMENT

Enclosure 2: 2002 Annual Gaseous Dose Assessment (cont.)

Maximum Site Boundary Dose by Age Group and Organs for All Pathways (Page 1 of 2)

1CP&L ANNUAL RADIOLOGICAL EFFLUENT REPORTING RUN DATE: 04/15/03
GASRPT RADIATION DOSES AT SELECTED LOCATIONS RUN TIME: 16:44:15

2002 SOURCE TERM (ELEVATED MODE) BSEP UNITS 1&2
SOURCE TERM (GROUND LEVEL) 2002 BSEP UNITS 1 AND 2
BRUNSWICK UNIT 1 AND 2, MIXED MODE CONTINUOUS GASEOUS RELEASES, 2002

	SPECIAL LOCATION	METERS	DIR	PL	GR	IN	V	CM	GM	M
# 3	SITE BOUNDARY	1127.0	NE	1	1	1	1	1	1	1

ANNUAL BETA AIR DOSE = 1.739E-02 MILLRADS
ANNUAL GAMMA AIR DOSE = 1.222E-02 MILLRADS

	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
ADULT	1.483E-01	1.485E-01	1.047E-02	1.486E-01	1.490E-01	3.782E-01	1.479E-01	1.604E-01
PLUME	7.945E-03	7.945E-03	7.945E-03	7.945E-03	7.945E-03	7.945E-03	8.120E-03	2.042E-02
GROUND PLANE	1.275E-03	1.275E-03	1.275E-03	1.275E-03	1.275E-03	1.275E-03	1.275E-03	1.500E-03
INHALATION	2.818E-02	2.818E-02	1.635E-05	2.819E-02	2.820E-02	3.208E-02	2.819E-02	2.817E-02
VEGETATION	5.102E-02	5.114E-02	6.067E-04	5.097E-02	5.101E-02	7.801E-02	5.086E-02	5.085E-02
COW MILK	1.734E-02	1.727E-02	2.502E-04	1.746E-02	1.765E-02	1.067E-01	1.717E-02	1.717E-02
GOAT MILK	3.525E-02	3.513E-02	3.605E-04	3.541E-02	3.561E-02	1.425E-01	3.502E-02	3.502E-02
MEAT & POULTRY	7.322E-03	7.596E-03	1.874E-05	7.321E-03	7.329E-03	9.696E-03	7.309E-03	7.309E-03
TEENAGER	1.690E-01	1.689E-01	1.114E-02	1.695E-01	1.703E-01	5.094E-01	1.683E-01	1.808E-01
PLUME	7.945E-03	7.945E-03	7.945E-03	7.945E-03	7.945E-03	7.945E-03	8.120E-03	2.042E-02
GROUND PLANE	1.275E-03	1.275E-03	1.275E-03	1.275E-03	1.275E-03	1.275E-03	1.275E-03	1.500E-03
INHALATION	2.836E-02	2.836E-02	2.138E-05	2.837E-02	2.839E-02	3.325E-02	2.838E-02	2.835E-02
VEGETATION	5.842E-02	5.852E-02	7.971E-04	5.836E-02	5.838E-02	8.078E-02	5.823E-02	5.822E-02
COW MILK	2.264E-02	2.250E-02	4.478E-04	2.289E-02	2.323E-02	1.642E-01	2.236E-02	2.236E-02
GOAT MILK	4.598E-02	4.576E-02	6.412E-04	4.631E-02	4.668E-02	2.158E-01	4.563E-02	4.561E-02
MEAT & POULTRY	4.370E-03	4.535E-03	1.493E-05	4.370E-03	4.377E-03	6.089E-03	4.360E-03	4.360E-03

ATTACHMENT 7 (cont.)

ANNUAL DOSE ASSESSMENT

Enclosure 2: 2002 Annual Gaseous Dose Assessment (cont.)

Maximum Site Boundary Dose by Age Group and Organs for All Pathways (Page 2 of 2)

1CP&L ANNUAL RADIOLOGICAL EFFLUENT REPORTING RUN DATE: 04/15/03
GASRPT RADIATION DOSES AT SELECTED LOCATIONS RUN TIME: 16:44:15

2002 SOURCE TERM (ELEVATED MODE) BSEP UNITS 1&2
SOURCE TERM (GROUND LEVEL) 2002 BSEP UNITS 1 AND 2
BRUNSWICK UNIT 1 AND 2, MIXED MODE CONTINUOUS GASEOUS RELEASES, 2002

	SPECIAL LOCATION	METERS	DIR	PL	GR	IN	V	CM	GM	M
# 3	SITE BOUNDARY	1127.0	NE	1	1	1	1	1	1	1

	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
CHILD	2.386E-01	2.377E-01	1.344E-02	2.395E-01	2.406E-01	8.987E-01	2.374E-01	2.498E-01
PLUME	7.945E-03	7.945E-03	7.945E-03	7.945E-03	7.945E-03	7.945E-03	8.120E-03	2.042E-02
GROUND PLANE	1.275E-03	1.275E-03	1.275E-03	1.275E-03	1.275E-03	1.275E-03	1.275E-03	1.500E-03
INHALATION	2.508E-02	2.508E-02	2.671E-05	2.509E-02	2.510E-02	3.071E-02	2.509E-02	2.507E-02
VEGETATION	9.050E-02	9.038E-02	1.573E-03	9.037E-02	9.038E-02	1.246E-01	9.019E-02	9.018E-02
COW MILK	3.584E-02	3.544E-02	1.070E-03	3.625E-02	3.677E-02	3.167E-01	3.533E-02	3.533E-02
GOAT MILK	7.270E-02	7.219E-02	1.521E-03	7.328E-02	7.384E-02	4.097E-01	7.209E-02	7.207E-02
MEAT & POULTRY	5.281E-03	5.371E-03	2.641E-05	5.279E-03	5.288E-03	7.877E-03	5.267E-03	5.267E-03
INFANT	1.887E-01	1.868E-01	1.434E-02	1.917E-01	1.922E-01	1.696E+00	1.868E-01	1.993E-01
PLUME	7.945E-03	7.945E-03	7.945E-03	7.945E-03	7.945E-03	7.945E-03	8.120E-03	2.042E-02
GROUND PLANE	1.275E-03	1.275E-03	1.275E-03	1.275E-03	1.275E-03	1.275E-03	1.275E-03	1.500E-03
INHALATION	1.442E-02	1.442E-02	1.878E-05	1.444E-02	1.444E-02	1.957E-02	1.443E-02	1.442E-02
COW MILK	5.455E-02	5.371E-02	2.144E-03	5.584E-02	5.611E-02	7.373E-01	5.361E-02	5.360E-02
GOAT MILK	1.105E-01	1.095E-01	2.960E-03	1.122E-01	1.124E-01	9.298E-01	1.094E-01	1.093E-01

ATTACHMENT 7 (cont.)
ANNUAL DOSE ASSESSMENT
Enclosure 2: 2002 Annual Gaseous Dose Assessment (cont.)

Estimated Individual Organ Dose Using the 2002 Land Use Census for the Worst Sector and Existing Pathway

1CP&L ANNUAL RADIOLOGICAL EFFLUENT REPORTING RUN DATE: 04/15/03
GASRPT RADIATION DOSES AT SELECTED LOCATIONS RUN TIME: 16:44:15

2002 SOURCE TERM (ELEVATED MODE) BSEP UNITS 1&2
SOURCE TERM (GROUND LEVEL) 2002 BSEP UNITS 1 AND 2
BRUNSWICK UNIT 1 AND 2, MIXED MODE CONTINUOUS GASEOUS RELEASES, 2002

SPECIAL LOCATION	METERS	DIR	PL	GR	IN	V	CM	GM	M
#21 RESIDENCE	1609.0	SSE	1	1	1	0	0	0	0

ANNUAL BETA AIR DOSE = 3.530E-02 MILLRADS
ANNUAL GAMMA AIR DOSE = 2.290E-02 MILLRADS

	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
ADULT	7.915E-02	7.915E-02	1.513E-02	7.917E-02	7.919E-02	8.719E-02	7.951E-02	1.037E-01
PLUME	1.483E-02	1.483E-02	1.483E-02	1.483E-02	1.483E-02	1.483E-02	1.518E-02	3.934E-02
GROUND PLANE	2.720E-04	2.720E-04	2.720E-04	2.720E-04	2.720E-04	2.720E-04	2.720E-04	3.201E-04
INHALATION	6.405E-02	6.405E-02	3.255E-05	6.407E-02	6.409E-02	7.209E-02	6.405E-02	6.404E-02
TEENAGER	7.956E-02	7.956E-02	1.514E-02	7.958E-02	7.961E-02	8.959E-02	7.993E-02	1.041E-01
PLUME	1.483E-02	1.483E-02	1.483E-02	1.483E-02	1.483E-02	1.483E-02	1.518E-02	3.934E-02
GROUND PLANE	2.720E-04	2.720E-04	2.720E-04	2.720E-04	2.720E-04	2.720E-04	2.720E-04	3.201E-04
INHALATION	6.446E-02	6.446E-02	4.258E-05	6.448E-02	6.451E-02	7.449E-02	6.447E-02	6.444E-02
CHILD	7.211E-02	7.209E-02	1.515E-02	7.213E-02	7.215E-02	8.357E-02	7.247E-02	9.664E-02
PLUME	1.483E-02	1.483E-02	1.483E-02	1.483E-02	1.483E-02	1.483E-02	1.518E-02	3.934E-02
GROUND PLANE	2.720E-04	2.720E-04	2.720E-04	2.720E-04	2.720E-04	2.720E-04	2.720E-04	3.201E-04
INHALATION	5.701E-02	5.699E-02	5.320E-05	5.702E-02	5.705E-02	6.847E-02	5.701E-02	5.698E-02
INFANT	4.788E-02	4.787E-02	1.514E-02	4.791E-02	4.791E-02	5.838E-02	4.825E-02	7.242E-02
PLUME	1.483E-02	1.483E-02	1.483E-02	1.483E-02	1.483E-02	1.483E-02	1.518E-02	3.934E-02
GROUND PLANE	2.720E-04	2.720E-04	2.720E-04	2.720E-04	2.720E-04	2.720E-04	2.720E-04	3.201E-04
INHALATION	3.278E-02	3.277E-02	3.734E-05	3.280E-02	3.281E-02	4.328E-02	3.279E-02	3.277E-02

ATTACHMENT 7 (cont.)

ANNUAL DOSE ASSESSMENT

Enclosure 2: 2002 Annual Gaseous Dose Assessment (cont.)

Maximum Site Boundary Dose Due to Iodines, Particulates, and Tritium for Existing Pathways

1CP&L ANNUAL RADIOLOGICAL EFFLUENT REPORTING RUN DATE: 04/16/03
GASRPT RADIATION DOSES AT SELECTED LOCATIONS RUN TIME: 17:12:14

2002 SOURCE TERM (ELEVATED MODE) BSEP UNITS 1&2
SOURCE TERM (GROUND LEVEL) 2002 BSEP UNITS 1 AND 2
BRUNSWICK UNIT 1 AND 2, MIXED MODE CONTINUOUS GASEOUS RELEASES, 2002

	SPECIAL LOCATION	METERS	DIR	PL	GR	IN	V	CM	GM	M
# 8	SITE BOUNDARY	1127.0	SSE	0	1	1	0	0	0	0

ANNUAL BETA AIR DOSE = 6.859E-02 MILLRADS
ANNUAL GAMMA AIR DOSE = 4.449E-02 MILLRADS

	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
ADULT	1.206E-01	1.206E-01	4.082E-04	1.207E-01	1.207E-01	1.358E-01	1.206E-01	1.207E-01
GROUND PLANE	3.467E-04	3.467E-04	3.467E-04	3.467E-04	3.467E-04	3.467E-04	3.467E-04	4.081E-04
INHALATION	1.203E-01	1.203E-01	6.148E-05	1.203E-01	1.203E-01	1.355E-01	1.203E-01	1.203E-01
TEENAGER	1.214E-01	1.214E-01	4.271E-04	1.214E-01	1.215E-01	1.403E-01	1.214E-01	1.214E-01
GROUND PLANE	3.467E-04	3.467E-04	3.467E-04	3.467E-04	3.467E-04	3.467E-04	3.467E-04	4.081E-04
INHALATION	1.210E-01	1.210E-01	8.041E-05	1.211E-01	1.211E-01	1.400E-01	1.211E-01	1.210E-01
CHILD	1.074E-01	1.074E-01	4.471E-04	1.074E-01	1.075E-01	1.290E-01	1.074E-01	1.074E-01
GROUND PLANE	3.467E-04	3.467E-04	3.467E-04	3.467E-04	3.467E-04	3.467E-04	3.467E-04	4.081E-04
INHALATION	1.070E-01	1.070E-01	1.004E-04	1.071E-01	1.071E-01	1.287E-01	1.071E-01	1.070E-01
INFANT	6.191E-02	6.189E-02	4.171E-04	6.195E-02	6.196E-02	8.174E-02	6.192E-02	6.194E-02
GROUND PLANE	3.467E-04	3.467E-04	3.467E-04	3.467E-04	3.467E-04	3.467E-04	3.467E-04	4.081E-04
INHALATION	6.156E-02	6.154E-02	7.046E-05	6.160E-02	6.161E-02	8.139E-02	6.158E-02	6.153E-02

ATTACHMENT 7 (cont.)

ANNUAL DOSE ASSESSMENT

Enclosure 3: 2002 Dose Assessment Summary

I. Liquid Effluents:

Maximum Dose to Individual: (mrem)		Limit: (mrem)
Child - Bone	1.40E-05	2.00E+01
Child - Total Body	1.02E-05	6.00E+00

Total Integrated and Recreation Population Dose: (person-rem)

Total Body	4.13E-04

II. Gaseous Effluents

Noble Gas Air Dose at Site Boundary: (mrad)		Limit: (mrad)
Gamma	4.45E-02	2.00E+01
Beta	6.86E-02	4.00E+01

Iodine-131, Iodine-133, Tritium and Particulates: (mrem) Limit: 3.00E+01

Maximum hypothetical dose at site boundary for all pathways (infant thyroid):	1.70E+00
Maximum hypothetical dose due to iodines, particulates, and tritium at 4.75 miles for the cow milk pathway per ODCM (infant thyroid):	6.22E-02
Estimated organ dose due to iodines, particulates, and tritium for existing pathways to maximum exposed individual (teenager thyroid):	8.96E-02

Total 50 Mile Annual Integrated Population Dose: (person-rem)

Thyroid:	6.72E-02
Total Body:	5.12E-02

ATTACHMENT 8

OFF-SITE DOSE CALCULATION MANUAL (ODCM) AND
PROCESS CONTROL PROGRAM (PCP) REVISIONS

The PCP was not revised during the report period. ODCM Revision 26 was effective on 8/19/02. An analysis of the fourteen major changes is as follows:

ODCM Analysis:

Item

1. **Updated the List of Effective Pages for Revision 26.**

The list of effective pages and revision bars denotes the method the ODCM utilizes to track changes and to meet the intent for administrative controls in Technical Specifications 5.5.1.

2. **Enhanced the ODCM introduction section to reference that the annual dose assessment will be performed utilizing the methodology of the ODCM. Appendix H reference to NRC approved computer codes was included in this enhancement.**

A Progress Energy Nuclear Generation Group peer group initiative prompted an evaluation of the annual dose assessment methodology. The evaluation led to deleting the requirements for utilizing LADTAP and GASPARS computer codes for assessing integrated population dose and dose to each pathway. The existing site effluent management software will now be used for the annual assessment. The site program utilizes the ODCM methodology to calculate dose to the maximum exposed individual for liquid and gaseous discharges. Based on the fact that 10CFR50.36a, Technical specifications on effluents from nuclear power reactors, criteria for estimating the maximum potential radiation doses to the public resulting from effluent releases is met utilizing the site software, there is no need to perform integrated population dose calculations. The aforementioned LADTAP and GASPARS computer codes will still be available for evaluation of an on-demand event. Additionally, worst-case receptors are verified by the annual Land Use Census and substantiated using the ODCM methodology.

3. **Added the Low-Level Warehouse as a release point in the ODCM methodology.**
4. **Added the Low-Level Warehouse to the gaseous radwaste effluent system figure.**

Enhanced site solid radioactive waste processing capabilities led to establishing effluent monitoring at the Low-Level Warehouse facility. A continuous particulate sampler, with local alarming function, has been installed on the effluent of the ventilation system and will be in service during all facility venting operations. The effluent from this facility will be included in the ground level release criteria of the ODCM. The facility has HEPA filters on the exhaust of the ventilation system and preliminary sample results indicate that all effluent data is below the lower limit of detection.

ATTACHMENT 8 (cont.)

OFF-SITE DOSE CALCULATION MANUAL (ODCM) AND
PROCESS CONTROL PROGRAM (PCP) REVISIONS

5. **Updated Table 3.2-2 to reflect the 2002 Land Use and Garden Census.**

The Land Use and Garden Census information is included in the Off-Site Dose Calculation Manual (ODCM) to aid in evaluating worst sector receptor environmental sampling requirements. The census is required to be conducted annually to determine the location of the nearest resident, garden, and milk or beef animal in each of the 16 meteorological sectors surrounding the plant. The resident portion of the census conducted in June of 2002 identified no changes in the distance of the nearest residents for all 16 sectors. The garden portion of the census identified changes in the distances of the nearest garden in 4 sectors, with 3 in the less conservative direction. All changes have been evaluated with no changes required in current sampling locations. The changes requiring evaluation were in the S, SW, and W sectors. Each change was evaluated against the criteria in ODCMS 7.3.16. The results conclude that the changes have a calculated dose less that than the values calculated by ODCMS TR 7.3.9.1 and are $\leq$ 120% from the current sample locations identified in ODCMS Table 7.3.15-1. The evaluations were performed using 2001 annual source term. No milk animals were identified. The ODCM is being updated to reflect these new locations.

6. **Revised section 4.0, Radiological Environmental Monitoring Program, to reference Figure F-2. Duplicate Figure 4.0-1b was deleted.**
7. **Enhanced Table 4.0-1, note (b), to specify the appropriate criteria for performing gamma isotopic analysis on environmental air particulate samples.**
8. **Enhanced sampling criteria for environmental fish and invertebrates to clarify the number of control samples needed.**
9. **Adjusted Co-58 limits for the level of radioactivity in environmental samples to reflect the standard branch technical position.**
10. **Enhanced LLD criteria for I-131 to denote options when no drinking water pathway is present.**

Section 4.0, Radiological Environmental Monitoring Program, was revised to include comments and suggestions following an E&C radiological environmental assessment. The changes include deleting a duplicate figure indicating gaseous effluent release streams (see Figure F-2), specifying the appropriate criteria for the number of control samples for fish and invertebrates, clarifying the criteria for air particulate sampling gamma isotopic requirements, and adding enhancements to detection limits for Co-58 and I-131 that correspond to the Branch Technical Position for Radiological Effluent Technical Specifications.

ATTACHMENT 8 (cont.)

OFF-SITE DOSE CALCULATION MANUAL (ODCM) AND
PROCESS CONTROL PROGRAM (PCP) REVISIONS

11. Revised section 5.0, Interlaboratory Comparison Studies, to reference the criteria established in the NRC Inspection Manual (Procedure 84750).

The Harris E&EC laboratory performs the environmental sample analysis for Brunswick. AR 50067 denoted the laboratory's challenges with the previous three-sigma criteria for acceptability due to the lack of participants in the current program to provide good statistical analysis. Since the end of the EPA Crosscheck program, the nuclear utilities have participated in a variety of equivalent programs. However, the number of participants in a particular program typically is not sufficient to provide good statistical sampling. The HE&EC participates in the Analytics Crosscheck Program that fails to provide the required number of participants. Due to this limitation, an NGG peer group concluded that the most appropriate acceptance criteria for a small population would be the NRC Inspection Manual method. All NGG nuclear facilities will be adopting this methodology in future ODCM revisions.

12. Updated the definition for Rated Thermal Power (RTP) to reflect the Unit 1 power uprate.

Section 7.0, Definitions, was updated to reflect the up-rated MWt for Unit 1. Unit 2 value remained the same.

13. Deleted test requirements note related to "High – voltage low" for circuit failure channel functional testing.

Testing requirements (TR) in Section 7.0 for gaseous and liquid instruments included the term "High – voltage low" in parentheses next to the circuit failure test. It is apparent that this criterion was related to a qualifying term for power supply for antiquated instruments. Instruments and Controls (I&C) and engineering stated that the "High – voltage low" testing of the currently installed instruments results in duplication of other test requirements and is an invasive test not needed to meet the channel functional test. Additionally, this "High – voltage low" criteria is not part of the description for channel functional test in the Branch Technical Position for Radiological Effluent Technical Specifications or any of the ODCM's of the NGG fleet. Based on this evidence, the note was removed.

14. Corrected typographical errors on Figure F-1 and F-2.

Changed MED LOW PURITY LIQUID WASTES for the Floor Drain Collection Tank on Figure F-1 to MED/ LOW PURITY LIQUID WASTES. Corrected the 1-8 min delay annotation to 1.8 min delay on Figure F-2 for the associated holdup line for gaseous radwaste effluent systems.

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NOS. 1 AND 2
DOCKET NOS. 50-325 AND 50-324
LICENSE NOS. DPR-71 AND DPR-62

OFFSITE DOSE CALCULATION MANUAL
REVISION 26

BRUNSWICK STEAM ELECTRIC PLANT

OFF-SITE DOSE CALCULATION MANUAL

(ODCM)

REVISION 26

DOCKET NOS. 50-324
50-325

CAROLINA POWER & LIGHT COMPANY

Effective Date 8-19-02

Approved By: _____
PNSC

LIST OF EFFECTIVE PAGES
ODCM

NOTE: **FOR ELECTRONIC USERS,** revision levels as shown on this page are correct; footers that show Rev. 26 that are not reflected on this page are there due to limitations associated with the Word format in the electronic version.

Page(s)	Revision	Page(s)	Revision
i	26	7.3.11-1 - 7.3.11-2	25
ii - xi	25	7.3.12-1	25
1-1	26	7.3.13-1	25
2-1 - 2-15	25	7.3.14-1 - 7.3.14-3	25
3-1 - 3-23	25	7.3.15-1 - 7.3.15-6	25
3-24	26	7.3.15-7 - 7.3.15-8	26
3-25 - 3-30	25	7.3.15-9 - 7.3.15-10	25
3-31	26	7.3.15-11	26
3-32 - 3-66	25	7.3.15-12 - 7.3.15-13	25
4-1 - 4-2	25	7.3.15-14	26
4-3 - 4-4	26	7.3.16-1 - 7.3.16-4	25
4-5 - 4-8	25	7.3.17-1	25
4-9 - 4-10	26	7.4.0-1 - 7.4.0-3	25
4-11 deleted - see F-3		7.5.0-1	25
5-1	25	B 7.3.0-1 - B 7.3.0-10	25
5-2 - 5-3	26	B 7.3.1-1	25
6-1 - 6-4	25	B 7.3.2-1 - B 7.3.2-2	25
7-0	25	B 7.3.3-1	25
7-i - 7-iv	25	B 7.3.4-1	25
7.1.1-1 - 7.1.1-2	25	B 7.3.5-1	25
7.1.1-3	26	B 7.3.6-1	25
7.1.1-4 - 7.1.1-5	25	B 7.3.7-1	25
7.1.2-1 - 7.1.2-3	25	B 7.3.8-1	25
7.1.3-1 - 7.1.3-12	25	B 7.3.9-1	25
7.1.4-1 - 7.1.4-5	25	B 7.3.10-1	25
7.2.0-1	25	B 7.3.11-1	25
7.3.0-1 - 7.3.0-4	25	B 7.3.12-1	25
7.3.1-1 - 7.3.1-4	25	B 7.3.13-1	25
7.3.1-5	26	B 7.3.14-1	25
7.3.1-6 - 7.3.1-7	25	B 7.3.15-1	25
7.3.2-1 - 7.3.2-6	25	B 7.3.16-1	25
7.3.2-7	26	B 7.3.17-1	25
7.3.2-8 - 7.3.2-11	25	A-1 - A-28	25
7.3.2-12	26	B-1 - B-36	25
7.3.3-1 - 7.3.3-8	25	C-1 - C-16	25
7.3.4-1 - 7.3.4-2	25	D-1	25
7.3.5-1 - 7.3.5-2	25	E-1 - E-3	25
7.3.6-1 - 7.3.6-2	25	F-1	25
7.3.7-1	25	F-2 - F-3	26
7.3.7-2	26	G-1	25
7.3.7-3 - 7.3.7-5	25	H-1 - H-3	25
7.3.8-1 - 7.3.8-2	25	H-4	26
7.3.9-1 - 7.3.9-2	25	H-5	25
7.3.10-1	25		

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES

LIST OF TABLES

LIST OF TABLES

LIST OF TABLES

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The Off-Site Dose Calculation Manual (ODCM) provides the information and methodologies to be used by the Brunswick Steam Electric Plant (BSEP) to show compliance with 10CFR20, 10CFR50.36a, Appendix I of 10CFR50, and 40CFR190 and to assure compliance with ODCM Specifications (ODCMS).

The ODCM is based on "Radiological Effluent Technical Specifications for BWR's" (NUREG 0473, Draft), "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants" (NUREG 0133), and guidance from the United Stated Nuclear Regulatory Commission (NRC). Specific plant procedures for implementation of this manual are provided elsewhere. These procedures will be utilized to assure compliance with ODCMS and Test Requirements (TRs) provided in the Radioactive Effluents Control Program.

The ODCM has been prepared as generically as possible to minimize the need for future revisions. Any changes to the ODCM will be reviewed and approved as indicated in the Administrative Control section of the BSEP Technical Specifications.

The Radioactive Effluent Release Report prepared after January 1 of each year will include an assessment of the annual radiation doses to members of the public from radioactive liquid and gaseous effluents using the methodology in the ODCM for the report period. This report will be inclusive of the requirements outlined in the BSEP Technical Specifications and ODCM Specifications.

INDEX

LIST OF TABLES

2.0 LIQUID EFFLUENT

2.1 COMPLIANCE WITH 10CFR PART 20 (LIQUIDS)

2.1.1 Batch Releases

A batch release is the discharge of liquid waste of a discrete volume. Batch releases from the BSEP liquid radwaste system may occur from the waste sample tank, floor drain sample tank, detergent drain tank and the salt water tanks. The maximum release rate possible due to pump capacity is 200 GPM from all release tanks except the detergent drain tank, which has a maximum release rate of 50 GPM. All of the above liquid radwaste discharges go to the circulating water discharge canal. Circulating water leakage collected in the circulating water pits and low purity, low activity liquids are transferred to the salt water release tanks where they are recirculated, sampled, and released to the environment. For any batch release, if the radwaste monitor effluent is inoperable, then two independent samples are analyzed and must be within 15% of each other before the release is approved. The two samples may differ by more than 15% upon approval of the E&C Supervisor or equivalent. The maximum release rate is determined so that 10CFR Part 20 limits are not exceeded after dilution in the discharge canal.

The sampling and analysis frequency and the type of analysis required by the BSEP ODCM Specifications is given in Table 7.3.3-1. All applicable instrument numbers may be found in Appendix E.

1. Prerelease

The radioactive content of each batch release will be determined prior to release in accordance with Table 7.3.3-1 of the BSEP ODCM Specifications. Compliance with 10CFR Part 20 will be shown in the following manner:

a. Minimum acceptable dilution factor:

$$DF_o = \Sigma_i \left(\frac{C_i}{EC_i} \right) \qquad \text{(Eq. 2.1-1)}$$

Where:

DF_o = Minimum acceptable dilution factor determined from analysis of liquid effluent to be released

C_i = Concentration of radionuclide i in the batch to be released, μCi/ml

EC_i = Annual average effluent concentration limit of radionuclide i from Appendix B, Table 2, Column 2 of 10CFR20, μCi/ml.

DF_B = (10) (DF_o) (Eq. 2.1-2)

Where:

DF_B = Conservative dilution factor used by BSEP to calculate maximum release rate prior to release in order to assure compliance with 10CFR Part 20

10 = A factor of 10 less than 10CFR Part 20 limits as specified in Appendix B, Table 2, Column 2. This factor represents one layer of conservatism for all releases at BSEP

DF_o = Minimum acceptable dilution factor per Equation 2.1-1

b. Maximum release rate:

$$MRR = \frac{n-1(RPF_{cw}) + p-1(RPF_{sw})}{2(DF_B)} \quad \text{(Eq. 2.1-3)}$$

Where:

MRR = Maximum release rate of the batch to be released, GPM

n = Number of operating circulating water pumps

p = Number of operating service water pumps

RPF_{CW} = Minimum rated pump flow of each circulating water pump

= 1.357 E5 GPM

RPF_{SW} = Rated pump flow of each service water pump

= 8 E3 GPM

2 = Engineering factor to prevent spurious alarms caused by deviations in the mixtures of radionuclides which affect the monitor response

DF_B = Minimum acceptable dilution factor (DF_o) made conservative by a factor of 10 per Equation 2.1-2

c. Monitor Alarm/Trip Setpoint:

Monitor alarm/trip setpoints are determined to ensure that the concentration of radionuclides in the liquid effluent released from the site to unrestricted areas does not exceed the limits specified in 10CFR Part 20, Appendix B, Table 2, Column 2, for radionuclides other than dissolved or entrained noble gases. An effluent concentration (EC) of 2 E-4 μCi/ml has been established for noble gases dissolved or entrained in liquid effluents, based on the assumption that Xenon-135 is the controlling radionuclide. (NUREG 0133)

$$SP = \frac{C_T\,(E_m)\,[(n-1)\,(RPF_{CW}) + (p-1)\,(RPF_{SW})]}{RR} + Bkg \qquad \text{(Eq. 2.1-4)}$$

Where:

SP = Monitor alarm/trip setpoint, cps

E_m = The monitor efficiency for the mixture of radionuclides in the liquid effluent prior to dilution, cps/μCi/ml

C_T = 3 E-7 μCi/ml; engineering factor to ensure that the final concentration for the mixture of radionuclides will be less than 10CFR Part 20 limits at unrestricted areas

n = Number of operating circulating water pumps

p = Number of operating service water pumps

RPF_{CW} = 1.357 E5 GPM

RPF_{SW} = 8 E3 GPM

RR = 200 GPM; maximum design release rate

Bkg = Background count rate 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 an uncontaminated fluid, cps

$$SP = \frac{3\text{ E-}7\,(E_m)\,[(n-1)\,(1.357\text{ E5}) + (p-1)\,(8.0\text{ E3})]}{200} + Bkg \qquad \text{(Eq. 2.1-5)}$$

d. Calculated concentration at unrestricted area:

$$Conc_i = \frac{(C_i)\,(MRR)}{(n-1)\,(RPF_{cw}) + (p-1)\,(RPF_{sw})} \qquad \text{(Eq. 2.1-6)}$$

Where:

$Conc_i$ = Calculated concentration of radionuclide i at the unrestricted area, µCi/ml

C_i = Concentration of radionuclide i in the batch to be released, µCi/ml

MRR = Maximum release rate of the batch to be released (see Equation 2.1-3), GPM

n = Number of operating circulating water pumps

p = Number of operating service water pumps

RPF_{cw} = 1.357 E5 GPM

RPF_{sw} = 8 E3 GPM

e. 10CFR Part 20 Prerelease Compliance Check:

Before initiating the batch release, one final check for compliance with 10CFR Part 20 will be performed. If the calculated dilution factor at the unrestricted area is less than or equal to 1, then 10CFR Part 20 limits have been met. The following equation must be true:

$$\Sigma_i\,(Conc/EC_i) \leq 1 \qquad \text{(Eq. 2.1-7)}$$

Where:

$Conc_i$ = Concentration of radionuclide i at the unrestricted area per Equation 2.1-6, µCi/ml

EC_i = Annual average effluent concentration limit of radionuclide i from Appendix B, Table 2, Column 2 of 10CFR20, µCi/ml.

2. Postrelease

The actual concentration of each radionuclide following release from a batch tank will be calculated to show final compliance with 10CFR Part 20 as follows:

a. Actual concentration at unrestricted area:

$$Conc_{ik} = \frac{(C_i)\,(V_{eff})}{V_{dil}} \qquad \text{(Eq. 2.1-8)}$$

Where:

$Conc_{ik}$ = The actual concentration of radionuclide i at the unrestricted area during release k, µCi/ml

C_i = Concentration of radionuclide i in tne batch released, µCi/ml

V_{eff} = Actual volume of liquid effluent released, gal

V_{dil} = Actual volume of dilution water during release k, gal

= $[n\,(RPF_{cw}) + p\,(RPF_{sw})]\,(t_k)$

Where:

n = Number of operating circulating water pumps

p = Number of operating service water pumps

RPF_{cw} = 1.357 E5 GPM

RPF_{sw} = 8 E3 GPM

t_k = Total release time, min

b. 10CFR Part 20 Postrelease Compliance Check:

To show final compliance with 10CFR Part 20, the following relationship must hold:

$$\Sigma_i\,(Conc_{ik}/EC_i) \leq 1 \qquad \text{(Eq. 2.1-9)}$$

Where:

$Conc_{ik}$ = The actual concentration of radionuclide i during release k (from Equation 2.1-8), µCi/ml

EC_i = Annual average effluent concentration limit of radionuclide i from Appendix B, Table 2, Column 2 of 10CFR20, µCi/ml.

2.1.2 Continuous Releases

A continuous release is the discharge of liquid wastes of a nondiscrete volume; e.g., from a volume or system that has an input flow during the continuous release. Planned continuous releases do not presently occur at BSEP, although the potential does exist in the service water system. Weekly tests are performed during system operation as specified in Table 7.3.3-1 of the BSEP ODCM Specifications. If a continuous release does occur, the concentration of various radionuclides in the unrestricted area would be calculated using Equation 2.1-8 with C_i being the concentration of radionuclide i in the continuous release stream. To show compliance with 10CFR Part 20, the sum of the concentration of radionuclide i in the unrestricted area due to both continuous and batch releases divided by that isotope's EC must again be less than 1.

1. Service Water Effluent Monitor Setpoint Determination

This procedure determines the monitor alarm setpoints that indicate the abnormal presence of radionuclides in the service water liquid effluents released from the site to unrestricted areas. This procedure is applicable to any service water effluent monitor.

a. Determine the monitor efficiency factor, EF, in

$$\frac{\mu Ci/ml}{cps}$$

$$EF = (E_m)(C_f) \qquad \text{(Eq. 2.1-10)}$$

Where:

E_m = The detector efficiency (dpm/ml/cps) from the appropriate RST

C_f = Conversion factor, (1 μCi/2.22 x 10^6 dpm)

b. Determine the monitor trigger level setpoint, TLS, in cps

$$TLS = TL/EF + Bkg \qquad \text{(Eq. 2.1-11)}$$

Where:

TL = The alarm trigger level (μCi/ml) as per ODCM TR 7.3.3.2

= 5.0 x 10^{-6} μCi/ml

Bkg = Monitor background, (cps)

2.1.3 Stabilization Pond Releases

Prerelease and post-release compliance checks similar to those of Section 2.1.1 may be performed for releases from the stabilization pond. Prerelease calculations will be based on a gamma isotopic assay of a grab sample prior to release. Post-release calculations will be based on a composite sample that is collected in proportion to flow during the release period (if possible). Dilution flow will be estimated from the minimum number of circulating water and service water pumps that were in use during the release period. Typical release times are on the order of days. (Note: Calculated doses as in Section 2.2 will be compiled along with those resulting from normal radwaste discharges.)

TABLE 2.1-1

ECs FOR SELECTED RADIONUCLIDES

Radionuclide	EC_i (µCi/ml)
H-3	1 E-3
Na-24	5 E-5
Cr-51	5 E-4
Mn-54	3 E-5
Co-58	2 E-5
Fe-59	1 E-5
Co-60	3 E-6
Cu-64	2 E-4
Zn-65	5 E-6
Zn-69m	6 E-5
Sr-89	8 E-6
Sr-90	5 E-7
Sr-91	2 E-5
Zr-95	2 E-5
Mo-99	2 E-5
I-131	1 E-6
I-132	1 E-4
I-133	7 E-6
Cs-134	9 E-7
I-134	4 E-4
I-135	3 E-5
Cs-137	1 E-6
La-141	5 E-5
Np-239	2 E-5
Am-241	2 E-8
Noble Gases	2 E-4

2.2 COMPLIANCE WITH 10CFR PART 50 (LIQUIDS)

2.2.1 Cumulation of Doses

ODCM TR 7.3.4.1 requires that the cumulative dose contributions from liquid effluents be determined at least once per 31 days, and a cumulative summation of these total body and any organ doses should be maintained for each calendar quarter. The cumulative dose contributions will consider the dose contributions from the maximum exposed individual's consumption of fish and invertebrates. At BSEP the adult is considered as the maximum exposed individual. The dose or dose commitment limits based on 10CFR Part 50, Appendix I, are defined in ODCM Specification 7.3.4 a and b. Since only batch releases occur at BSEP, the equations in the following sections pertain only to batch releases. The dose contribution for all batch releases for the quarter will be calculated using the following equation:

$$D_\tau = \sum_k \left[\sum_i \left(A_{i\tau}\, t_k\, C_{ik}\, F_k \right) \right] \qquad \text{(Eq. 2.2-1)}$$

Where:

D_τ = The cumulative dose commitment to the total body or any organ τ, from the liquid effluents releases, mrem

t_k = The length of time of release k over which C_{ik} and F_k are averaged for each liquid release, hours

C_{ik} = The concentration of radionuclide i in the undiluted liquid effluent during release k from any liquid release, μCi/ml

F_k = The near-field average dilution factor for C_{ik} during any liquid effluent release. It is defined as the ratio of the volume of undiluted liquid waste released to the product of the dilution volume from the site discharge to unrestricted receiving water times 1. (1 is the site-specific applicable factor for the mixing effect of the BSEP discharge structure as defined in NUREG 0133.)

$$= \frac{V_{eff}}{V_{dil}} \qquad \text{(See Equation 2.1-8).}$$

$A_{i\tau}$ = The ingestion dose commitment factor to the total body or any organ τ for each identified gamma and beta emitter i (as presented in Table 2.2-1). Values are for an adult, mrem-ml per hr-μCi

$$= 1.14\ E5\ (5\ BI_i + 21\ BF_i)\ DCF_{i\tau}$$

Where:

1.14 E5 = $\left(10^6 \frac{pCi}{\mu Ci}\right)\left(10^3 \frac{ml}{L}\right)\left(\frac{1yr}{8760\ hr}\right)$

5 = Maximum adult invertebrate consumption rate from Table E-5 of Regulatory Guide 1.109, Rev. 1, kg/yr

BI_i = Bioaccumulation factor for radionuclide i in invertebrates from Table A-1 of Regulatory Guide 1.109, Rev. 1, pCi/kg per pCi/L

21 = Maximum adult fish consumption rate from Table E-5 of Regulatory Guide 1.109, Rev. 1, kg/yr

BF_i = Bioaccumulation factor for radionuclide i in fish from Table A-1 of Regulatory Guide 1.109, Rev. 1, pCi/kg per pCi/L

$DCF_{i\tau}$ = Dose conversion factor for radionuclide i for adults for a particular organ τ from Table E-11 of Regulatory Guide 1.109, Rev. 1, and BSEP File: B10-10530, Letter to J. W. Davis, "Dose Factors for Hf-181 and Sn-113," May 24, 1988, and NUREG CR4653 for Am-241, mrem/pCi.

2.2.2 Projection of Doses

Dose projections for this section are required at least once per 31 days in ODCM TR 7.3.5.2.

The projection of doses for liquid effluents can be accomplished by projecting the dose(s) computed for the current month into the next month. The doses will be projected using Equation 2.2-1. Where possible, credit for expected operational evolutions (i.e., major planned liquid releases, etc.), can be taken in the dose projections. This may be accomplished by using the source-term data from similar historical operating experiences where practical.

TABLE 2.2-1
A_{it} VALUES FOR THE ADULT
(MREM/HR PER MICRO-CI/ML)

Note: Nuclides not listed in this table are assigned a value of zero.

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H 3	0.00E-01	2.82E-01	2.82E-01	2.82E-01	2.82E-01	2.82E-01	2.82E-01
C 14	1.45E 04	2.90E 03	2.90E 03	2.90E 03	2.90E 03	2.90E 03	2.90E 03
NA 24	4.57E-01	4.57E-01	4.57E-01	4.57E-01	4.57E-01	4.57E-01	4.57E-01
P 32	1.67E 07	1.04E 06	6.45E 05	0.00E-01	0.00E-01	0.00E-01	1.89E 06
CR 51	0.00E-01	0.00E-01	5.58E 00	3.34E 00	1.23E 00	7.40E 00	1.40E 03
MN 54	0.00E-01	7.06E 03	1.35E 03	0.00E-01	2.10E 03	0.00E-01	2.16E 04
MN 56	0.00E-01	1.78E 02	3.15E 01	0.00E-01	2.26E 02	0.00E-01	5.67E 03
FE 55	5.11E 04	3.53E 04	8.23E 03	0.00E-01	0.00E-01	1.97E 04	2.03E 04
FE 59	8.06E 04	1.90E 05	7.27E 04	0.00E-01	0.00E-01	5.30E 04	6.32E 05
CO 57	0.00E-01	1.42E 02	2.36E 02	0.00E-01	0.00E-01	0.00E-01	3.59E 03
CO 58	0.00E-01	6.03E 02	1.35E 03	0.00E-01	0.00E-01	0.00E-01	1.22E 04
CO 60	0.00E-01	1.73E 03	3.82E 03	0.00E-01	0.00E-01	0.00E-01	3.25E 04
NI 63	4.96E 04	3.44E 03	1.67E 03	0.00E-01	0.00E-01	0.00E-01	7.18E 02
NI 65	2.02E 02	2.62E 01	1.20E 01	0.00E-01	0.00E-01	0.00E-01	6.65E 02
CU 64	0.00E-01	2.14E 02	1.01E 02	0.00E-01	5.40E 02	0.00E-01	1.83E 04
ZN 65	1.61E 05	5.13E 05	2.32E 05	0.00E-01	3.43E 05	0.00E-01	3.23E 05
ZN 69	3.43E 02	6.56E 02	4.56E 01	0.00E-01	4.26E 02	0.00E-01	9.85E 01
BR 83	0.00E-01	0.00E-01	7.25E-02	0.00E-01	0.00E-01	0.00E-01	1.04E-01
BR 84	0.00E-01	0.00E-01	9.39E-02	0.00E-01	0.00E-01	0.00E-01	7.37E-07
BR 85	0.00E-01	0.00E-01	3.86E-03	0.00E-01	0.00E-01	0.00E-01	1.80E-18
RB 86	0.00E-01	6.24E 02	2.91E 02	0.00E-01	0.00E-01	0.00E-01	1.23E 02
RB 88	0.00E-01	1.79E 00	9.49E-01	0.00E-01	0.00E-01	0.00E-01	2.47E-11
RB 89	0.00E-01	1.19E 00	8.34E-01	0.00E-01	0.00E-01	0.00E-01	6.89E-14
SR 89	4.99E 03	0.00E-01	1.43E 02	0.00E-01	0.00E-01	0.00E-01	8.00E 02
SR 90	1.23E 05	0.00E-01	3.01E 04	0.00E-01	0.00E-01	0.00E-01	3.55E 03
SR 91	9.18E 01	0.00E-01	3.71E 00	0.00E-01	0.00E-01	0.00E-01	4.37E 02
SR 92	3.48E 01	0.00E-01	1.51E 00	0.00E-01	0.00E-01	0.00E-01	6.90E 02
Y 90	6.06E 00	0.00E-01	1.63E-01	0.00E-01	0.00E-01	0.00E-01	6.42E 04
Y 91M	5.73E-02	0.00E-01	2.22E-03	0.00E-01	0.00E-01	0.00E-01	1.68E-01
Y 91	8.88E 01	0.00E-01	2.37E 00	0.00E-01	0.00E-01	0.00E-01	4.89E 04
Y 92	5.32E-01	0.00E-01	1.56E-02	0.00E-01	0.00E-01	0.00E-01	9.32E 03
Y 93	1.69E 00	0.00E-01	4.66E-02	0.00E-01	0.00E-01	0.00E-01	5.35E 04

TABLE 2.2-1 (Cont'd)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
ZR 95	1.59E 01	5.11E 00	3.46E 00	0.00E-01	8.02E 00	0.00E-01	1.62E 04
ZR 97	8.81E-01	1.78E-01	8.13E-02	0.00E-01	2.68E-01	0.00E-01	5.51E 04
NB 95	4.47E 02	2.49E 02	1.34E 02	0.00E-01	2.46E 02	0.00E-01	1.51E 06
MO 99	0.00E-01	1.28E 02	2.43E 01	0.00E-01	2.89E 02	0.00E-01	2.96E 02
TC 99M	1.30E-02	3.66E-02	4.66E-01	0.00E-01	5.56E-01	1.79E-02	2.17E 01
TC 101	1.33E-02	1.92E-02	1.88E-01	0.00E-01	3.46E-01	9.81E-03	5.77E-14
RU 103	1.07E 02	0.00E-01	4.60E 01	0.00E-01	4.07E 02	0.00E-01	1.25E 04
RU 105	8.89E 00	0.00E-01	3.51E 00	0.00E-01	1.15E 02	0.00E-01	5.44E 03
RU 106	1.59E 03	0.00E-01	2.01E 02	0.00E-01	3.06E 03	0.00E-01	1.03E 05
AG 110M	1.56E 03	1.45E 03	8.60E 02	0.00E-01	2.85E 03	0.00E-01	5.91E 05
SN 113	2.18E 03	8.43E 01	2.05E 03	2.96E 01	6.16E 01	0.00E 01	3.80E 04
TE 125M	2.17E 02	7.86E 01	2.91E 01	6.52E 01	8.82E 02	0.00E-01	8.66E 02
TE 127M	5.48E 02	1.96E 02	6.68E 01	1.40E 02	2.23E 03	0.00E-01	1.84E 03
TE 127	8.90E 00	3.20E 00	1.93E 00	6.60E 00	3.63E 01	0.00E-01	7.03E 02
TE 129M	9.31E 02	3.47E 02	1.47E 02	3.20E 02	3.89E 03	0.00E-01	4.69E 03
TE 129	2.54E 00	9.55E-01	6.19E-01	1.95E 00	1.07E 01	0.00E-01	1.92E 00
TE 131M	1.40E 02	6.85E 01	5.71E 01	1.08E 02	6.94E 02	0.00E-01	6.80E 03
TE 131	1.59E 00	6.66E-01	5.03E-01	1.31E 00	6.99E 00	0.00E-01	2.26E-01
TE 132	2.04E 02	1.32E 02	1.24E 02	1.46E 02	1.27E 03	0.00E-01	6.24E 03
I 130	3.96E 01	1.17E 02	4.61E 01	9.91E 03	1.82E 02	0.00E-01	1.01E 02
I 131	2.18E 02	3.12E 02	1.79E 02	1.02E 05	5.35E 02	0.00E-01	8.23E 01
I 132	1.06E 01	2.85E 01	9.96E 00	9.96E 02	4.54E 01	0.00E-01	5.35E 00
I 133	7.45E 01	1.30E 02	3.95E 01	1.90E 04	2.26E 02	0.00E-01	1.16E 02
I 134	5.56E 00	1.51E 01	5.40E 00	2.62E 02	2.40E 01	0.00E-01	1.32E-02
I 135	2.32E 01	6.08E 01	2.24E 01	4.01E 03	9.75E 01	0.00E-01	6.87E 01
CS 134	6.84E 03	1.63E 04	1.33E 04	0.00E-01	5.27E 03	1.75E 03	2.85E 02
CS 136	7.16E 02	2.83E 03	2.04E 03	0.00E-01	1.57E 03	2.16E 02	3.21E 02
CS 137	8.77E 03	1.20E 04	7.85E 03	0.00E-01	4.07E 03	1.35E 03	2.32E 02
CS 138	6.07E 00	1.20E 01	5.94E 00	0.00E-01	8.81E 00	8.70E-01	5.12E-05
BA 139	7.85E 00	5.59E-03	2.30E-01	0.00E-01	5.23E-03	3.17E-03	1.39E 01
BA 140	1.64E 03	2.06E 00	1.08E 02	0.00E-01	7.02E-01	1.18E 00	3.38E 03
BA 141	3.81E 00	2.88E-03	1.29E-01	0.00E-01	2.68E-03	1.63E-03	1.80E-09
BA 142	1.72E 00	1.77E-03	1.08E-01	0.00E-01	1.50E-03	1.00E-03	2.43E-18
LA 140	1.57E 00	7.94E-01	2.10E-01	0.00E-01	0.00E-01	0.00E-01	5.83E 04

TABLE 2.2-1 (Cont'd)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
LA 142	8.06E-02	3.67E-02	9.13E-03	0.00E-01	0.00E-01	0.00E-01	2.68E 02
CE 141	3.43E 00	2.32E 00	2.63E-01	0.00E-01	1.08E 00	0.00E-01	8.86E 03
CE 143	6.04E-01	4.46E 02	4.94E-02	0.00E-01	1.97E-01	0.00E-01	1.67E 04
CE 144	1.79E 02	7.47E 01	9.59E 00	0.00E-01	4.43E 01	0.00E-01	6.04E 04
PR 143	5.79E 00	2.32E 00	2.87E-01	0.00E-01	1.34E 00	0.00E-01	2.54E 04
PR 144	1.90E-02	7.87E-03	9.64E-04	0.00E-01	4.44E-03	0.00E-01	2.73E-09
ND 147	3.96E 00	4.58E 00	2.74E-01	0.00E-01	2.68E 00	0.00E-01	2.20E 04
HF 181	1.72E 02	9.66E-01	1.94E 01	6.14E-01	8.08E-01	0.00E-01	1.27E 04
W 187	9.16E 00	7.66E 00	2.68E 00	0.00E-01	0.00E-01	0.00E-01	2.51E 03
NP 239	3.53E-02	3.47E-03	1.91E-03	0.00E-01	1.08E-02	0.00E-01	7.11E 02
AM 241	4.76E 05	4.44E 05	3.41E 04	0.00E-01	2.56E 05	0.00E 01	4.67E 04
F 18	6.66E 00	0.00E-01	7.38E-01	0.00E-01	0.00E-01	0.00E-01	1.97E-01
SB 124	2.76E 02	5.22E 00	1.09E 02	6.70E-01	0.00E-01	2.15E 02	7.84E 03

INDEX

LIST OF TABLES

LIST OF TABLES

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. (NUREG-0133)

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.

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.

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

A_i = The radioactivity of noble gas radionuclide i in 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.

*If actual plant data is used, the dose constants need to be confirmed.

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

$$Q_t = \frac{500}{(\chi/Q)\Sigma_i(K_iS_i)} \quad (3.1\text{-}2)$$

$\overline{(\chi/Q)_{tb}}$ = The highest calculated annual average relative concentration of effluents released via the Turbine Building Vent for any area at or beyond the site boundary for all sectors (sec/m^3) from Table A-1, Appendix A

= 7.50 E-6 sec/m^3

$\overline{(\chi/Q)_{rb}}$ = The highest calculated annual average relative concentration of effluents released via the Reactor Building Vent for any area at or beyond the site boundary for all sectors (sec/m^3) from Table A-7, Appendix A

= 2.0 E-7 sec/m^3

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

K_i = The total whole body dose factor due to gamma emissions from noble gas radionuclide i (mrem/year/μCi/m^3) from Table 3.1-2.

3. Determine Q_t based upon the skin exposure limit.

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

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

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

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

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

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

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

= 15,500 cfm (Turbine Building Vent)

= 172,800 cfm (Reactor Building Vent)

5. Determine the monitor high alarm setpoint above background:

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

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

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

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

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

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

= 0.10 for the Unit 1 Turbine Building Vent Gas Monitor

= 0.10 for the Unit 2 Turbine Building Vent Gas Monitor

= 0.20 for the Unit 1 Reactor Building Vent Gas Monitor

= 0.20 for the Unit 2 Reactor Building Vent Gas Monitor

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

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

3.1.2 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.

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 gases radionuclide activity concentrations in the effluent.

Gaseous source teams can be obtained from:

- Table 3.1-1; Stack Release
- Actual Release Data

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.

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

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

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

*If actual plant data is used, the dose constants need to be confirmed.

$$Q_t = \frac{500}{\Sigma_i[V_i S_i]} \quad (3.1\text{-}8)$$

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

3. Determine Q_t based upon the skin exposure limit.

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

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

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

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

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

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)

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 cpm).

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

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

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

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

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

= 0.40 for the Stack Monitor

Bkg = The background count rate (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-high alarm setpoint including background (cpm) 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.

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

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

      Technical Specification 3.7.5 limits the gross radioactivity rate of noble gases measured at the main condenser air ejector to less than or equal to 243,600 μCi/sec (after 30 minutes' decay). Assume that the noble gas concentrations at the air ejector (t = 0) are representative of the GALE code. Since the holdup time between the air ejector and the stack (down the 30-minute holdup line) can vary due to operational conditions, the mix of the noble gases at the stack should be determined based on the actual decay time not to exceed 30 minutes. This mix can then be applied to the 243,600 μCi/sec limit and then back-calculated to determine the allowable release rate at the air ejector, Q. As an example, assume that the holdup time is 30 minutes. The mix of the noble gases after 30 minutes' decay (t = 30 minutes) can be determined by the following table.

Nuclide	GALE Code Rev. 0 Steam (μCi/gm) t = 0	Steam (μCi/gm) t = 0	μCi/sec* t = 0	$e^{-\lambda t}$ t = 30m	μCi/sec t = 30m	Fraction of Mix t = 30m
	(for 3400 MWt)	(for 2558 MWt)				
Kr-83m	1.1E-3	8.28E-4	1.16E+3	8.3E-1	9.57E+2	2.84E-2
Kr-85m	1.9E-3	1.43E-3	2.00E+3	9.2E-1	1.85E+3	5.49E-2
Kr-85	6.0E-6	4.51E-6	6.31E+0	1.0E+0	6.31E+0	1.87E-4
Kr-87	6.6E-3	4.97E-3	6.94E+3	7.6E-1	5.28E+3	1.57E-1
Kr-88	6.6E-3	4.97E-3	6.94E+3	8.8E-1	6.14E+3	1.82E-1
Kr-89	4.1E-2	3.08E-2	4.31E+4	1.4E-3	5.99E+1	1.78E-3
Kr-90	9.0E-2	6.77E-2	9.46E+4	1.7E-17	1.64E-12	4.88E-17
Xe-131m	4.7E-6	3.54E-6	4.94E+0	1.0E+0	4.93E+0	1.47E-4
Xe-133m	9.0E-5	6.77E-5	9.46E+1	9.9E-1	9.40E+1	2.79E-3
Xe-133	2.6E-3	1.96E-3	2.73E+3	1.0E+0	2.73E+3	8.10E-2
Xe-135m	8.4E-3	6.32E-3	8.83E+3	2.6E-1	2.28E+3	6.78E-2
Xe-135	7.2E-3	5.42E-3	7.57E+3	9.6E-1	7.28E+3	2.16E-1
Xe-137	4.7E-2	3.54E-2	4.94E+4	4.4E-3	2.17E+2	6.44E-3
Xe-138	2.8E-2	2.11E-2	2.94E+4	2.3E-1	6.76E+3	2.01E-1
				TOTAL	3.37E+4	1.00E+0

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

$$\text{*Steam Flow} = (11.088\ \text{E6 lbs/hr})\left(\frac{0.1260\text{gm/sec}}{\text{lbs/hr}}\right) = 1.40\text{E} + 6\ \text{gm/sec}$$

Nuclide	Fraction of Mix t = 30 min	Tech Spec (μCi/sec) t = 30 min	$_{e}$-λt t = 30 min	Tech Spec (μCi/sec) t = 0
Kr-83m	2.84E-2	6.92E+3	8.3E-1	8.37E+3
Kr-85m	5.49E-2	1.34E+4	9.2E-1	1.45E+4
Kr-85	1.87E-4	4.56E+1	1.0E+0	4.56E+1
Kr-87	1.57E-1	3.82E+4	7.6E-1	5.02E+4
Kr-88	1.82E-1	4.44E+4	8.8E-1	5.02E+4
Kr-89	1.78E-3	4.33 E+2	1.4E-3	3.12E+5
Kr-90	4.88E-17	1.19E-11	1.7E-17	6.85E+5
Xe-131m	1.47E-4	3.57E+1	1.0E+0	3.58E+1
Xe-133m	2.79E-3	6.80E+2	9.9E-1	6.85E+2
Xe-133	8.10E-2	1.97E+4	1.0E+0	1.98E+4
Xe-135m	6.78E-2	1.65E+4	2.6E-1	6.39E+4
Xe-135	2.16E-1	5.27E+4	9.6E-1	5.48E+4
Xe-137	6.44E-3	1.57E+3	4.4E-3	3.58E+5
Xe-138	2.01E-1	4.89E+4	2.3E-1	2.13E+5
TOTALS	1.00E+0	2.44E+5		1.83E+6

Therefore:

Q = 1.83E+6 μCi/sec (for 30 minutes' holdup)

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

C_m = Q/f (3.1-13)

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

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

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).

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

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

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

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

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

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

NOTE: Use the lowest of the Q_t values obtained.

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

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

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

= 0.4 for the stack monitor

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

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

f = Maximum design flow rate of the AOG System

= 70,800 cc/sec (150 cfm)

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

TABLE 3.1-1

GASEOUS SOURCE TERMS**
(Ci/year/unit)

	Turbine Bldg Vent		Reactor Bldg Vent		Stack	
Radionuclide	A_i (Ci/yr)	S_i	A_i (Ci/yr)	S_i	A_i (Ci/yr)	S_i
Kr-83m	*	-	*	-	3.2E+4	2.78E-2
Kr-85m	6.8E+1	1.97E-2	6.0E0	1.73E-2	6.2E+4	5.40E-2
Kr-85	*	-	*	-	2.1E+2	1.83E-4
Kr-87	1.9E+2	5.51E-2	6.0E0	1.73E-2	1.8E+5	1.57E-1
Kr-88	2.3E+2	6.67E-2	6.0E0	1.73E-2	2.1E+5	1.83E-1
Kr-89	*	-	*	-	3.0E+3	2.61E-3
Xe-131m	*	-	*	-	1.7E+2	1.48E-4
Xe-133m	*	-	*	-	3.2E+3	2.78E-3
Xe-133	2.8E+2	8.12E-2	1.3E+2	3.75E-1	9.4E+4	8.18E-2
Xe-135m	6.5E+2	1.88E-1	9.2E+1	2.65E-1	7.6E+4	6.61E-2
Xe-135	6.3E+2	1.83E-1	6.8E+1	1.96E-1	2.5E+5	2.18E-1
Xe-137	*	-	*	-	8.6E+3	7.48E-3
Xe-138	1.4E+3	4.06E-1	1.4E+1	4.03E-2	2.3E+5	2.00E-1
Ar-41	*	-	2.5E+1	7.20E-2	*	-
TOTAL	3.45E+3		3.47E+2		1.15E6	

* < 1.0E-1

**Source terms are based upon GALE code and not actual releases.

TABLE 3.1-2

DOSE FACTORS AND CONSTANTS

Radio Nuclide	Total Whole Body Dose Factor (K_i) (mrem/yr/μCi/m^3)	Total Skin Dose Factor $(L_i + 1.1M_i)$ (mrem/yr/μCi/m^3)	Total Body Dose Constant For Long-Term Releases (V_i) (mrem/yr/μCi/sec)	Total Skin Dose Constant for Long-Term Releases $(L_i(\chi/Q)_s + 1.1B_i)$ (mrem/yr/μCi/sec)
Kr-83m	7.56E-2	2.12E+1	2.93E-9	6.57E-7
Kr-85m	1.17E+3	2.81E+3	1.22E-4	2.36E-4
Kr-85	1.61E+1	1.36E+3	1.74E-6	3.64E-5
Kr-87	5.92E+3	1.65E+4	5.39E-4	1.14E-3
Kr-88	1.47E+4	1.91E+4	1.36E-3	2.31E-3
Kr-89	1.66E+4	2.91E+4	9.47E-4	1.81E-3
Xe-131m	9.15E+1	6.48E+2	2.96E-5	6.39E-5
Xe-133m	2.51E+2	1.35E+3	2.23E-5	6.58E-5
Xe-133	2.94E+2	6.94E+2	2.40E-5	4.95E-5
Xe-135m	3.12E+3	4.41E+3	2.94E-4	5.08E-4
Xe-135	1.81E+3	3.97E+3	1.92E-4	3.64E-4
Xe-137	1.42E+3	1.39E+4	8.47E-5	4.46E-4
Xe-138	8.83E+3	1.43E+4	8.60E-4	1.52E-3
Ar-41	8.84E+3	1.29E+4	1.01E-3	1.73E-3

3.2 COMPLIANCE WITH 10CFR20 (GASEOUS)

3.2.1 Noble Gases

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

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

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

$$\Sigma_i \left\{ \left[L_i \overline{(\chi/Q)_s} + 1.1 B_i \right] Q_{i_s} + (L_i + 1.1 M_i) \overline{(\chi/Q)_v} \, \dot{Q}_{i_v} \right\} \leq 3000 \text{ mrem/yr} \qquad (3.2\text{-}2)$$

where:

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

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

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

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

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

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

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

Q_{i_v} = The release rate of noble gas radionuclide i in gaseous effluents from all vent releases, μCi/sec

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

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

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

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

For the total body dose:

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

*Any effluents due to exfiltration from planned openings in the Turbine Building, Radwaste Building or AOG Building are combined with the Turbine Building's vent releases.

For the skin dose:

$$\Sigma_i \left[L_i \overline{(\chi/Q)_s} + 1.1 B_i\right] \dot{Q}_{is} + \Sigma_i \left[L_i + 1.1 M_i\right] \left[\overline{(\chi/Q)_{rb}}\, Q_{irb} + \overline{\chi/Q_{tb}}\, \dot{Q}_{itb}\right] \leq 3000 \text{ mrem/yr} \quad (3.2\text{-}4)$$

Where:

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

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

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

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

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

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

For the total body:

$$\Sigma_i V_i \dot{Q}_{is} + \Sigma_i K_i (2.0 \times 10^{-7} \dot{Q}_{irb} + 2.9 \times 10^{-6} Q_{itb}) \leq 500 \text{ mrem/yr} \quad (3.2\text{-}5)$$

For the skin:

$$\Sigma_i (2.5 \times 10^{-8} L_i + 1.1 B_i) \dot{Q}_{is} + \Sigma_i \left[(L_i + 1.1 M_i) (2.0 \times 10^{-7} Q_{irb} + 2.9 \times 10^{-6} \dot{Q}_{itb}) \right] \leq 3000 \text{ mrem/yr} \quad (3.2\text{-}6)$$

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

The χ/Q values utilized in the equations for implementation of 10CFR20 are based upon the maximum long-term annual average $\overline{(X/Q)}$ 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 (χ/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. χ/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 χ/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 χ/Q value may not decrease with distance; i.e., the site boundary may not have the

highest χ/Q values. Therefore, long-term annual average χ/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 χ/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 dominant factor in determining a control location becomes the V_i values. The controlling location is at the NE at the site boundary due to its higher V_i values.

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

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

$$B_i = \frac{K}{r_d} \Sigma_j \Sigma_k \Sigma_l \frac{f_{jk} \; A_{ik} \; \mu_a \; E_l I}{\mu_j} \qquad (3.2\text{-}7)$$

I = The results of numerical integration over the plume spatial distribution of the airborne activity as defined by the meteorological condition of wind speed (μ_j) and atmospheric stability class "K" for a particular wind direction

K = A numerical constant representing unit conversions

$$= \frac{260 \text{ mrad (radians)}(m^3)(\text{transformation})}{\text{sec(Mev)(Ci)}} \times \frac{16 \text{ sectors}}{2\pi \text{ radians}} \times \frac{10^{-6} \text{ Ci}}{\mu\text{Ci}} \times \frac{3.15 \times 10^7 \text{ sec}}{\text{yr}}$$

$$= 2.1 \times 10^4 \text{ mrad } (m^3) \text{ (transformation) / year (Mev) } (\mu\text{Ci})$$

r_d = The distance from the release point to the receptor location, meters

μ_j = The mean wind speed assigned to the jth wind speed class, meters/sec

f_{jk} = The joint frequency of occurrence of the jth wind speed class and the kth stability class (dimensionless)

A_{li} = The number of photons of energy corresponding to the lth energy group emitted per transformation of the ith radionuclide, number/transformation

E_l = The energy assigned to the lth energy group, MeV

μ_a = The energy absorption coefficient in air for photon energy E_l, meters^{-1}

The V_i factor is computed with conversion from air dose to tissue depth dose, thus;

$$V_i = 1.1\, K / r_d \; \Sigma_j \Sigma_k \Sigma_l \; \frac{f_{jk}\; A_{li}\; \mu_a\; E_l\, e^{-\mu}\; T^{Td}}{\mu_j} \qquad (3.2\text{-}8)$$

Where:

μ_T = The tissue energy absorption coefficient for photons of energy E_l, cm^2/gm

T_d = The tissue density thickness taken to represent the total body dose ($5\ gm/cm^2$)

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

3.2.2 I-131, I-133, Particulates, and Tritium*

The dose rate in unrestricted areas resulting from the release of radioiodines and particulates with half-lives greater than 8 days is limited to 1500 mrem/year to any organ. Based upon NUREG 0133, the following is used to show compliance with 10CFR20.

$$\Sigma_i P_i (W_s \dot{Q}_{i_s} + W_v Q_{i_v}) \leq 1500 \text{ mrem/yr} \quad (3.2\text{-}9)$$

Where:

P_i = Dose parameter for radioiodines and particulates with half-lives greater than 8 days based upon the critical organ and the most restrictive age group (infant)

= mrem/year per $\mu Ci/m^3$ for inhalation pathways and for tritium

= mrem/year per $\mu Ci/sec$ per m^{-2} for food and ground plane pathways

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

$\dot{Q}_{i_v}$ = The release rate of radionuclide i in gaseous effluents from all vents releases, $\mu Ci/sec$

W_v = The highest calculated annual average dispersion parameter for estimating the dose to an individual at the controlling location due to all vent releases

= sec/m^3 for the inhalation pathway

= $meters^{-2}$ for the food and ground plane pathways

*For ODCM calculations performed to comply with ODCM TRs 7.3.7.2 and 7.3.9.1, the I-133 values used are determined by actual analysis.

W_s = The highest calculated annual average dispersion parameter for estimating the dose to an individual at the controlling location due to stack releases

= sec/m^3 for the inhalation pathway

= $meters^{-2}$ for the food and ground plane pathways

Radioiodines, particulates, and tritium may be released from the stack, Reactor Buildings, and Turbine Buildings at BSEP. Radioiodines and particulates may also be released from other sources such as decontamination, waste processing, and burning of waste oil in the incinerator. Effluents from the decontamination and waste processing facilities in the Radioactive Materials Container and Storage Building, Low Level Warehouse, and hot shop, incinerator and any building exfiltration are combined with the Turbine Building's vent releases. To show compliance with 10CFR20, (see Appendix H for waste oil) Expression 3.2-9 is modified to incorporate the various release points for BSEP:

$$\Sigma_i P_i(W_s \dot{Q}_{i_s} + W_{rb}\dot{Q}_{i_{rb}} + W_{tb}\dot{Q}_{i_{tb}}) \leq 1500 \text{ mrem/yr} \qquad (3.2\text{-}10)$$

Where:

W_s = The annual average dispersion parameter for the stack

W_{rb} = The annual average dispersion parameter for the Reactor Buildings

W_{tb} = Annual average dispersion parameter for the Turbine Buildings

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

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

Q_{i_S} = Release of radionuclide i from the stack, μCi/sec

All other terms are the same as those defined previously.

In the calculation to show compliance with 10CFR20, only the inhalation, ground plane, cow milk, and goat milk pathways are considered for BSEP. In determining the dose at a particular location, W is a function of pathway. For the food and ground plane pathways, W is in terms of D/Q (i.e., deposition). If the inhalation pathway is considered, W is in terms of χ/Q. Incorporation of the various pathways into Expression 3.2-10 results in the following:

$$\Sigma_i P_{i_I} \left[\overline{(\chi/Q)_s}\, \dot{Q}_{i_S} + \overline{(\chi/Q)_{rb}}\, Q_{i_{rb}} + \overline{(\chi/Q)_{tb}}\, Q_{i_{tb}} \right] + \Sigma_i (P_{i_G} + P_{i_M}) \qquad (3.2\text{-}11)$$

$$\left[\overline{(D/Q)_s}\, \dot{Q}_{i_S} + \overline{(D/Q)_{rb}}\, \dot{Q}_{i_{rb}} + \overline{(D/Q)_{tb}}\, \dot{Q}_{i_{tb}} \right] \leq 1500 \text{ mrem/yr}$$

Where:

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

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

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

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

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

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

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

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

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

In the case of tritium, the W parameter for the food pathway (cow or goat milk) is based upon χ/Q. Since tritium is a weak beta emitter, the ground plane contribution is zero for tritium. Therefore, the left-hand side of Expression 3.2-10 can be written as the following:

For tritium:

$$D_T = \left(P_{T_I} + P_{T_M}\right)\left[\ \overline{(\chi/Q)_s}\ \dot{Q}_{T_s} + \overline{(\chi/Q)_{rb}}\ Q_{T_{rb}} + \overline{(\chi/Q)_{tb}}\ \dot{Q}_{T_{tb}}\ \right] \quad (3.2\text{-}12)$$

Where:

$\dot{D}_T$ = Dose rate due to tritium releases, mrem/year

P_{T_I} = Dose parameter for tritium for the inhalation pathway, mrem/year per $\mu Ci/m^3$

P_{T_M} = Dose parameter for tritium for the milk pathway, mrem/year per $\mu Ci/m^3$

$\dot{Q}_{T_s}$ = Release rate of tritium from the stack, $\mu Ci/sec$

$Q_{T_{rb}}$ = Release rate of tritium from the two Reactor Buildings, $\mu Ci/sec$

$Q_{T_{tb}}$ = Release rate of tritium from the two Turbine Buildings, $\mu Ci/sec$

Since P_{i_I} for tritium equals 647 and P_{i_M} equals 2380, Equation 3.2-12 reduces to:

$$D_T = 3.0 \times 10^3 \left[\overline{(\chi/Q)_s}\, \dot{Q}_{T_s} + \overline{(\chi/Q)_{rb}}\, \dot{Q}_{T_{rb}} + \overline{(\chi/Q)_{tb}}\, \dot{Q}_{T_{tb}} \right] \quad (3.2\text{-}13)$$

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 be less than 1500 mrem/year to show compliance with 10CFR20. If the 1500 mrem/year limit is exceeded at the limiting site boundary when all pathways are considered present at the site boundary but the inhalation pathway contributes less than 1500 mrem/year, then Expressions 3.2-11 and 3.2-13 are evaluated at the limiting real pathway location. The limiting site boundary location is 0.7 miles NE. Expression 3.2-11 becomes:

For radioiodines and particulates:

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

$$\Sigma_i (P_{i_G} + P_{i_M}) (1.4 \times 10^{-9}\ \dot{Q}_{i_s} + 4.3 \times 10^{-9}\ Q_{i_{rb}} + 1.9 \times 10^{-8}\ \dot{Q}_{i_{tb}}) \leq 1500 \text{ mrem/yr} \quad (3.2\text{-}14)$$

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

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

$$(2.2 \times 10^{-10}\ \dot{Q}_{i_s} + 2.7 \times 10^{-10}\ Q_{i_{rb}} + 5.7 \times 10^{-10}\ \dot{Q}_{i_{tb}}) \leq 1500 \text{ mrem/yr} \quad (3.2\text{-}15)$$

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

For tritium:

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

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

For tritium:

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

The determination of controlling location for implementation of 10CFR20 for radioiodines and particulates is a function of the same two parameters as for noble gases plus a third receptor pathway location. The 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 χ/Q and 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 release rate which dominates comes from the stack. The higher values for χ/Q and D/Q for the NE sector at the site boundary make it the dominant meteorological sector and the control location.

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 organ dose factor for each individual pathway of exposure. Because the goat milk pathway is not present at BSEP, the cow milk pathway P_i values were utilized in the determination of the various controlling locations. For the case of an infant being present at the site boundary or at the real pathway location, the ground plane pathway is not considered as a reasonable exposure pathway for the infant (i.e., $P_G = 0$). However, P_i 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 3.2-1

RELEASES FROM BRUNSWICK STEAM ELECTRIC PLANT*
(Ci/yr per unit)

Isotope	Turbine Building (Ground Level)	Reactor Building (Mixed Mode)	Stack (Elevated)
Kr-83m	0	0	3.2E4
Kr-85m	6.8E1	6.0E0	6.2E4
Kr-85	0	0	2.1E2
Kr-87	1.9E2	6.0E0	1.8E5
Kr-88	2.3E2	6.0E0	2.1E5
Kr-89	0	0	3.0E3
Xe-131m	0	0	1.7E2
Xe-133m	0	0	3.2E3
Xe-133	2.8E2	1.3E2	9.4E4
Xe-135m	6.5E2	9.2E1	7.6E4
Xe-135	6.3E2	6.8E1	2.5E5
Xe-137	0	0	8.6E3
Xe-138	1.4E3	1.4E1	2.3E5
Ar-41	0	2.5E1	0
I-131	1.9E-2	3.4E-1	5.1
I-133	7.6E-2	1.4	2.1E1
Cr-51	1.3E-4	6.0E-4	9.0E-3
Mn-54	6.0E-6	6.0E-3	3.6E-2
Fe-59	5.0E-6	8.0E-4	1.5E-2
Co-58	6.0E-6	1.2E-3	4.5E-3
Co-60	2.0E-5	2.0E-2	9.0E-2
Zn-65	2.0E-6	4.0E-3	1.0E-3
Sr-89	6.0E-5	1.8E-4	5.0E-4
Sr-90	2.0E-7	1.0E-5	3.0E-4
Zr-95	1.0E-6	8.0E-4	5.0E-5
Sb-124	3.0E-6	4.0E-4	5.0E-5
Cs-134	3.0E-6	8.0E-3	4.5E-3
Cs-136	5.0E-7	6.0E-4	4.5E-4
Cs-137	6.0E-6	1.1E-2	9.0E-3
Ba-140	1.1E-4	8.0E-4	1.0E-4
Ce-141	6.0E-6	2.0E-4	2.6E-3
C-14	0	0	9.5
H-3	0	3.0E1	0

*Calculations based upon GALE code and not actual releases.

TABLE 3.2-2

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

Sector	Site Boundary	Milk Cow	Milk Goat	Meat Animal	Nearest Resident	Nearest Garden
NNE	0.7	-	-	-	0.8	1.2
NE	0.7	4.75*	-	-	-	-
ENE	0.7	-	-	-	-	-
E	0.7	-	-	-	-	-
ESE	0.7	-	-	-	1.5	-
SE	0.7	-	-	-	0.9	-
SSE	0.7	-	-	-	1.0	-
S	0.8	-	-	-	1.1	1.8
SSW	0.8	-	-	-	1.2	1.6
SW	0.7	-	-	-	1.0	1.5
WSW	0.7	-	-	-	1.2	1.2
W	0.7	-	-	-	0.8	0.8
WNW	0.6	-	-	-	0.8	1.0
NW	0.6	-	-	-	0.9	4.8
NNW	0.6	-	-	-	0.8	4.4
N	0.7	-	-	-	0.7	0.9

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

TABLE 3.2-3

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

Based on Center of Brunswick Plant

Direction	Site Boundary Distance (Mi)
NNE	0.7
NE	0.7
ENE	0.7
E	0.7
ESE	0.7
SE	0.7
SSE	0.7
S	0.8
SSW	0.8
SW	0.7
WSW	0.7
W	0.7
WNW	0.6
NW	0.6
NNW	0.6
N	0.7

From Stack to Site Boundaries of Table 3.2-2

Direction	Distance (Mi)
NNE	0.7
NE	0.7
ENE	0.7
E	0.6
ESE	0.6
SE	0.6
SSE	0.6
S	0.6
SSW	0.7
SW	0.7
WSW	0.7
W	0.8
WNW	0.7
NW	0.7
NNW	0.7
N	0.8

TABLE 3.2-4

DOSE FACTORS FOR NOBLE GASES AND DAUGHTERS*

Radionuclide	Total Body Dose Factor K_i (mrem/yr per $\mu Ci/m^3$)	Skin Dose Factor L_i (mrem/yr per $\mu Ci/m^3$)	Gamma Air Dose Factor M_i (mrad/yr per $\mu Ci/m^3$)	Beta Air Dose Factor N_i (mrad/yr per $\mu Ci/m^3$)
Kr-83m	7.56E-02**	---	1.93E+01	2.88E+02
Kr-85m	1.17E+03	1.46E+03	1.23E+03	1.97E+03
Kr-85	1.61E+01	1.34E+03	1.72E+01	1.95E+03
Kr-87	5.92E+03	9.73E+03	6.17E+03	1.03E+04
Kr-88	1.47E+04	2.37E+03	1.52E+04	2.93E+03
Kr-89	1.66E+04	1.01E+04	1.73E+04	1.06E+04
Kr-90	1.56E+04	7.29E+03	1.63E+04	7.83E+03
Xe-131m	9.15E+01	4.76E+02	1.56E+02	1.11E+03
Xe-133m	2.51E+02	9.94E+02	3.27E+02	1.48E+03
Xe-133	2.94E+02	3.06E+02	3.53E+02	1.05E+03
Xe-135m	3.12E+03	7.11E+02	3.36E+03	7.39E+02
Xe-135	1.81E+03	1.86E+03	1.92E+03	2.46E+03
Xe-137	1.42E+03	1.22E+04	1.51E+03	1.27E+04
Xe-138	8.83E+03	4.13E+03	9.21E+03	4.75E+03
Ar-41	8.84E+03	2.69E+03	9.30E+03	3.28E+03

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

**7.56E-02 = 7.56×10^{-2}

TABLE 3.2-5

P_i VALUES FOR AN INFANT FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

Isotope	Inhalation	Ground Plane	Cow Milk	Goat Milk
H-3	6.47E2	0	2.38E3	4.86E3
P-32	2.03E6	0	1.60E11	1.93E11
Cr-51	1.28E4	6.67E6	4.79E6	5.65E5
Mn-54	1.00E6	1.09E9	3.89E7	4.68E6
Fe-59	1.02E6	3.92E8	3.93E8	5.11E6
Co-58	7.77E5	5.29E8	6.06E7	7.28E6
Co-60	4.51E6	4.40E9	2.10E8	2.52E7
Zn-65	6.47E5	6.89E8	1.90E10	2.29E9
Rb-86	1.90E5	1.28E7	2.22E10	2.67E9
Sr-89	2.03E6	3.16E4	1.27E10	2.66E10
Sr-90	4.09E7	-	1.21E11	2.55E11
Y-91	2.45E6	1.52E6	5.26E6	6.32E5
Zr-95	1.75E6	3.48E8	8.28E5	9.95E4
Nb-95	4.79E5	1.95E8	2.06E8	2.48E7
Ru-103	5.52E5	1.55E8	1.05E5	1.27E4
Ru-106	1.16E7	2.99E8	1.44E6	1.73E5
Ag-110m	3.67E6	3.14E9	1.46E10	1.75E9
Sn-113	2.30E5	5.19E7	2.25E7	2.25E6
Te-127m	1.31E6	1.18E5	1.04E9	1.24E8
Te-129m	1.68E6	2.86E7	1.40E9	1.68E8
Cs-134	7.03E5	2.81E9	6.79E10	2.04E11
Cs-136	1.35E5	2.13E8	5.76E9	1.73E10
Cs-137	6.12E5	1.15E9	6.02E10	1.81E11
Ba-140	1.60E6	2.94E7	2.41E8	2.89E7
Ce-141	5.17E5	1.98E7	1.37E7	1.65E6
Ce-144	9.84E6	5.84E7	1.33E8	1.60E7
I-131	1.48E7	2.46E7	1.06E12	1.27E12
I-132	1.69E5	1.78E6	1.39E2	1.64E2
I-133	3.56E6	3.54E6	9.80E9	1.18E10
I-135	6.96E5	3.67E6	2.27E7	2.68E7
Hf-181	6.73E5	4.02E8	6.55E5	7.86E4
Am-241	4.41E5	4.96E7	6.01E7	7.21E6

*Units are mrem/yr per $\mu Ci/m^3$ for H-3 and the inhalation pathway and mrem/yr per $\mu Ci/sec$ per m^{-2} for the food and ground plane pathways.

3.3 COMPLIANCE WITH 10CFR50 (GASEOUS)

3.3.1 Noble Gases

1. Cumulation of Doses

Section II.B.1 of Appendix I of 10CFR50 limits the releases of gaseous effluents from each reactor such that the estimated annual gamma air dose is limited to 10 millirad and the beta air dose is limited to 20 millirad. Based upon NUREG 0133, the air dose in the unrestricted area due to noble gases released in gaseous effluents can be determined by the following expressions:

During any calendar quarter, for gamma radiation:

$$3.17 \times 10^{-8} \Sigma_i \left\{ M_i \left[\overline{(\chi/Q)_v} Q_{i_v} + \overline{(\chi/q)_v} q_{i_v} \right] + B_i Q_{i_s} + b_i q_{i_s} \right\} \leq 5 \text{ mrad} \qquad (3.3\text{-}1)$$

During any calendar quarter, for beta radiation:

$$3.17 \times 10^{-8} \Sigma_i N_i \left[\overline{(\chi/Q)_v} Q_{i_v} + \overline{(\chi/q)_v} q_{i_v} + \overline{(\chi/Q)_s} Q_{i_s} + \overline{(\chi/q)_s} q_{i_s} \right] \leq 10 \text{ mrad} \qquad (3.3\text{-}2)$$

During any calendar year, for gamma radiation:

$$3.17 \times 10^{-8} \Sigma_i \left\{ M_i \left[\overline{(\chi/Q)_v} Q_{i_v} + \overline{(\chi/q)_v} q_{i_v} \right] + B_i Q_{i_s} + b_i q_{i_s} \right\} \leq 10 \text{ mrad} \qquad (3.3\text{-}3)$$

During any calendar year, for beta radiation:

$$3.17 \times 10^{-8} \Sigma_i N_i \left[\overline{(\chi/Q)_v} Q_{i_v} + \overline{(\chi/q)_v} q_{i_v} + \overline{(\chi/Q)_s} Q_{i_s} + \overline{(\chi/q)_s} q_{i_s} \right] \leq 20 \text{ mrad} \qquad (3.3\text{-}4)$$

Where:

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

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

$\overline{(\chi/Q)_v}$ = The annual average relative concentration for areas at or beyond the unrestricted area boundary for long-term vent releases (greater than 500 hrs/year), sec/m^3

$\overline{(\chi/q)_v}$ = The relative concentration for areas at or beyond the unrestricted area boundary for short-term vent releases (equal to or less than 500 hours/year), sec/m^3

$\overline{(\chi/Q)_s}$ = The annual average relative concentration for areas at or beyond the unrestricted area boundary for long-term, free-standing stack releases (greater than 500 hours/year), sec/m^3

$\overline{(\chi/q)_s}$ = The relative concentration for areas at or beyond the unrestricted area boundary for short-term, free-standing stack releases (equal to or less than 500 hours year), sec/m^3

q_{i_s} = The average release of noble gas radionuclide i in gaseous effluents for short-term stack releases (equal to or less than 500 hours/year), µCi

q_{i_v} = The average release of noble gas radionuclide i in gaseous effluents for short-term vent releases (equal to or less than 500 hours/year), µCi

Q_{i_s} = The average release of noble gas radionuclide i in gaseous effluents for long-term, free-standing stack releases (greater than 500 hours/year), µCi

Q_{i_v} = The average release of noble gas radionuclide i in gaseous effluents for long-term vent releases (greater than 500 hours/year), µCi

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, mrad/year per µCi/sec

b_i = The constant for short-term releases (equal to or less than 500 hours/year) for each identified noble gas radionuclide i accounting for the gamma radiation from the elevated finite plume, mrad/year per µCi/sec

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

For BSEP all releases are considered long-term. The incorporation of the stack, Reactor Building, and Turbine Building release points into Expressions 3.3-1 through 3.3-4 results in the following expressions for two units to show compliance with 10CFR50.

During any calendar quarter or year:

Gamma radiation:

$$3.17 \times 10^{-8} \Sigma_i \left\{ M_i \left[\overline{(\chi/Q)_{rb}} (Q_{irb1} + Q_{irb2}) + \overline{(\chi/Q)_{tb}} (Q_{itb1} + Q_{itb2}) \right] + B_i Q_{is} \right\}$$

$\leq$ 10 mrad per quarter or 20 mrad per year

(3.3-5)

Beta radiation:

$$3.17 \times 10^{-8} \Sigma_i N_i \left[\overline{(\chi/Q)_{rb}} (Q_{irb1} + Q_{irb2}) + \overline{(\chi/Q)_{tb}} (Q_{itb1} + Q_{itb2}) + \overline{(\chi/Q)_s} Q_{is} \right]$$

$\leq$ 20 mrad per quarter or 40 mrad per year

(3.3-6)

Where:

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

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

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

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

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

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

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

During any calendar quarter or year:

Gamma radiation:

$$3.17 \times 10^{-8} \Sigma_i \left\{ M_i \left[2.0 \times 10^{-7} \left(Q_{irb1} + Q_{irb2}\right) + 2.9 \times 10^{-6} \left(Q_{itb1} + Q_{itb2}\right)\right] + B_i Q_{is} \right\}$$

$\leq$ 10 mrad per quarter or 20 mrad per year

(3.3-7)

Beta radiation:

$$3.17 \times 10^{-8} \Sigma_i N_i \left[2.0 \times 10^{-7} \left(Q_{irb1} + Q_{irb2}\right) + 2.9 \times 10^{-6} \left(Q_{itb1} + Q_{itb2}\right) + 2.5 \times 10^{-8} Q_{is}\right]$$

$\leq$ 20 mrad per quarter or 40 mrad per year

(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 $\overline{(\chi / Q)}$ 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 χ/Q values may not decrease with distance (i.e., the site boundary may not have the highest χ/Q values); χ/Q values were calculated at the midpoint of 10 standard distance intervals out to a distance of 5 miles. The two or three highest χ/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 χ/Q values are utilized. These values are presented in tables in Appendix A. χ/Q values at the limiting site boundary location for releases from the Turbine Buildings, Reactor Buildings, and stack were obtained from Tables A-1, A-7, and A-13, respectively, of Appendix A. A description of the derivation of χ/Q values is also presented in Appendix A.

A particular combination of release point mix and meteorology dominates in the determination of the controlling location. For BSEP the controlling release point is the stack. The dominate factor in determining a control location becomes the B_i values. The NE sector at the site boundary is the control location because of its higher B_i values.

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

The following relationship should hold for BSEP to show compliance with ODCM Specification 7.3.8.

For the calendar quarter:

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

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

For the calendar year:

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

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

Where:

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

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

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

3.3.2 I-131, I-133, Particulates, and Tritium*

1. Cumulation of Doses

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

During any calendar quarter or year:

$$3.17 \times 10^{-8} \Sigma_i R_i (W_s Q_{i_s} + w_s q_{i_s} + W_v Q_{v_s} + w_v q_{i_v}) \leq 7.5 \text{ mrem per quarter or 15 mrem per calendar year} \quad (3.3\text{-}13)$$

Where:

Q_{i_s} = Release of radionuclide i for long-term, free-standing stack releases (greater than 500 hours/year), μCi

Q_{i_v} = Release of radionuclide i for long-term vent releases (greater than 500 hours/year), μCi

q_{i_s} = Release of radionuclide i for short-term, free-standing stack releases (equal to or less than 500 hours/year), μCi

q_{i_v} = Release of radionuclide i for short-term vent releases (equal to or less than 500 hours/year), μCi

W_s = Dispersion parameter for estimating dose to an individual at the controlling location for long-term, free-standing stack releases (greater than 500 hours/year)

= sec/m^3 for the inhalation pathway and tritium

= $meters^{-2}$ for the food and ground plane pathway

*For ODCM calculations performed to comply with ODCM TRs 7.3.7.2 and 7.3.9.1, the I-133 values used are determined by actual analysis.

W_v = The dispersion parameter for estimating the dose to an individual at the controlling location for long-term vent releases (greater than 500 hours/year)

= sec/m^3 for the inhalation pathway and tritium

= $meters^{-2}$ for the food and ground plane pathway

w_s = Dispersion parameter for estimating the dose to an individual at the controlling location for short-term stack releases (equal to or less than 500 hours/year)

= sec/m^3 for the inhalation pathway and tritium

= $meters^{-2}$ for the food and ground plane pathway

w_v = The dispersion parameter for estimating the dose to an individual at the controlling location for short-term vent releases (equal to or less than 500 hours/year)

= sec/m^3 for the inhalation pathway and tritium

= $meters^{-2}$ for the food and ground plane pathway

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

R_i = The dose factor for each identified radionuclide i of the organ of interest, mrem/yr per μCi/sec per m^{-2} or mrem/yr per $\mu Ci/m^3$

Radioiodines, particulates, and tritium may be released from the stack, Reactor Buildings, and Turbine Buildings at BSEP. Radioiodines and particulates, may also be released from other sources such as decontamination facility in the Hot Shop and burning of waste oil in the incinerator. Effluents from the decontamination facilities in the Radioactive Materials Container and Storage Building and hot shop, incinerator and any building exfiltration are combined with the Turbine Building's vent releases. Burning waste oil in the incinerator is limited to 0.1% of 10CFR50 Appendix I (see Appendix H for methodology and calculations). At BSEP all releases are considered long-term in duration. Therefore, incorporating the various release points into Expression 3.3-13 results in the following expression to show compliance with 10CFR50 for a particular organ:

$$3.17 \times 10^{-8} \Sigma_i R_i \left[W_s Q_{i_s} + W_{rb} (Q_{i_{rb1}} + Q_{i_{rb2}}) + W_{tb} (Q_{i_{tb1}} + Q_{i_{tb2}}) \right] \quad (3.3\text{-}14)$$

$\leq$ 15.0 mrem per quarter or 30 mrem per year

Where:

W_s = Dispersion parameter for releases from the stack

W_{rb} = Dispersion parameter for releases from the Reactor Building

W_{tb} = Dispersion parameter for releases from the Turbine Building

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

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

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

In determining the dose at a particular location, W (as in Section 3.2.2) is a function of the pathway. For the food and ground plane pathway, W is in terms of D/Q. If the inhalation pathway is considered, W is in terms of χ/Q. Incorporation of the various pathways into Expression 3.3-14 results in the following:

$$3.17 \times 10^{-8} \sum_i$$
$$\{(R_{iG} + R_{iM} + R_{iV} + R_{iB})\,[\overline{(D/Q)_s} Q_{i_s} + \overline{(D/Q)_{rb}}\,(Q_{i_{rb1}} + Q_{i_{rb2}}) + \overline{(D/Q)_{tb}}(Q_{i_{tb1}} + Q_{i_{tb2}})] +$$
$$R_{iI}\,[\overline{(\chi/Q)_s}\,Q_{i_s} + \overline{(\chi/Q)_{rb}}\,(Q_{i_{rb1}} + Q_{i_{rb2}}) + \overline{(\chi/Q)_{tb}}\,(Q_{i_{tb1}} + Q_{i_{tb2}})]\}$$
$$\leq 15 \text{ mrem (per quarter) or } 30 \text{ mrem (per year)} \qquad (3.3\text{-}15)$$

Where:

R_{iG} = Dose factor for an organ for radionuclide i for the ground plane exposure pathway, mrem/yr per μCi/sec per m^{-2}

R_{iM} = Dose factor for an organ for radionuclide i for either the cow milk or goat milk pathway, mrem/yr per μCi/sec per m^{-2}

R_{iV} = Dose factor for an organ for radionuclide i for the vegetable pathway, mrem/yr per μCi/sec per m^{-2}

R_{iB} = Dose factor for an organ for radionuclide i for the meat pathway. mrem/yr per μCi/sec per m^{-2}

R_{ii} = Dose factor for an organ for radionuclide i for the inhalation pathway, mrem/yr per $\mu Ci/m^3$

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

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

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

As discussed in Section 3.2.2, for tritium the parameter W for the food pathway is based upon χ/Q. The ground plane pathway is not appropriate for tritium. Therefore, the left-hand portion of Expression 3.3-15 may be modified for tritium as:

For tritium:

$$D_T = \frac{3.17 \times 10^{-8}(R_{T_M} + R_{T_V} + R_{T_B} + R_{T_I})}{\left[\overline{(\chi/Q)_s} Q_{T_s} + \overline{(\chi/Q)_{rb}}(Q_{T_{rb1}} + Q_{T_{rb2}}) + \overline{(\chi/Q)_{tb}}(Q_{T_{tb1}} + Q_{T_{tb2}})\right]} \quad (3.3\text{-}16)$$

Where:

D_T = Dose resulting from tritium, mrem

R_{T_M} = Dose factor for an organ for tritium for the milk pathway, mrem/yr per $\mu Ci/m^3$

R_{T_V} = Dose factor for an organ for tritium for the vegetable pathway, mrem/yr per $\mu Ci/m^3$

R_{T_B} = Dose factor for an organ for tritium for the beef pathway, mrem/yr per $\mu Ci/m^3$

R_{T_I} = Dose factor for an organ for tritium for the inhalation pathway, mrem/yr per $\mu Ci/m^3$

Q_{T_S} = Release of tritium from the stack, μCi

$Q_{T_{rb1}}$, $Q_{T_{rb2}}$ = Release of tritium from Reactor Buildings 1 and 2, respectively, μCi

$Q_{T_{tb1}}$, $Q_{T_{tb2}}$ = Release of tritium from Turbine Buildings 1 and 2, respectively, μCi

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

$$3.17 \times 10^{-8} \Sigma_i$$
$$\{(R_{i_G} + R_{i_M}) [2.2 \times 10^{-10} Q_{i_S} + 2.7 \times 10^{-10} (Q_{i_{rb1}} + Q_{i_{rb2}}) + 5.7 \times 10^{-10} (Q_{i_{tb1}} + Q_{i_{tb2}})] +$$
$$R_{i_I} [2.4 \times 10^{-8} Q_{i_S} + 4.1 \times 10^{-8} (Q_{i_{rb1}} + Q_{i_{rb2}}) + 1.4 \times 10^{-7} (Q_{i_{tb1}} + Q_{i_{tb2}})]\}$$
$$\leq 15 \text{ mrem / quarter or } 30 \text{ mrem / year} \qquad (3.3\text{-}17)$$

For tritium, Equation 3.3-16 reduces to:

$$D_T = 3.17 \times 10^{-8} (R_{T_M} + R_{T_I}) [2.4 \times 10^{-8} Q_{T_S} + 4.1 \times 10^{-8} (Q_{T_{rb1}} + Q_{T_{rb2}}) + 1.4 \times 10^{-7} (Q_{T_{tb1}} + Q_{T_{tb2}})] \qquad (3.3\text{-}18)$$

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

a. Radionuclide mix and isotopic release

b. Meteorology

c. Exposure pathway

d. Receptor's age

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

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

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

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

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

In the determination of the controlling location annual average $\overline{D/Q}$ and $\overline{\chi/Q}$ values are utilized. D/Q values at the limiting real pathway locations for releases from the Turbine Buildings, Reactor Buildings, and the stack were obtained from Tables A-3, A-9, and A-15, respectively, of Appendix A. χ/Q values at the same location for these same release points were obtained from Tables A-1, A-7, and A-13 of Appendix A. A description of the derivation of the various χ/Q and D/Q values is presented in Appendix A.

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

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

These values appear in tables in Appendix A. These tables may be utilized if an additional special location arises which is different from one presented in the special locations of Appendix A.

The following relationships should hold for BSEP to show compliance with BSEP ODCM Specification 7.3.9.

For the calendar quarter:

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

For the calendar year:

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

Where:

$D\tau$ = The dose to any organ τ 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.

2. Projection of Doses

Dose projections for this section are required at least once per 31 days in ODCM TR 7.3.11.2.

The doses will be projected using Expressions 3.3-17. When the operational conditions are expected to be the same as for the current month, the source term inputs into the equation for the projection can be taken directly from the current month's data. Where possible, credit for expected operational evolutions (i.e., outages, etc.) should be taken in the dose projections. This may be accomplished by using projected reactor-days of operation. For example:

If Unit 1 had 28 reactor-days of operation and the dose to the bone was 0.05 mrem (remember there are 6 organs to consider) and Unit 2 was down at 0 reactor-days, then obtain from Planning & Scheduling the projected number of reactor-days for both Units 1 and 2 in the upcoming month. Suppose that the projected reactor-days for Unit 1 will be 10 reactor-days and for Unit 2, 21 reactor-days. To calculate the projected dose "x":

$$\frac{28/2 + 0/2}{0.05} = \frac{10/2 + 21/2}{x}$$

$x = 0.06$ mrem to the bone

This projected dose to the bone is less than 0.6 mrem dose limit to any organ. If the dose to the bone or any other organ exceeds 0.6 mrem, the Turbine Building ventilation exhaust treatment system must be operational in the ensuing month.

TABLE 3.3-1 R VALUES FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

PATHWAY = Ground

Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
CR 51	4.66E 06	4.66E 06	4.66E 06	4.66E 06	4.66E 06	4.66E 06	4.66E 06	5.51E 06
MN 54	1.34E 09	1.34E 09	1.34E 09	1.34E 09	1.34E 09	1.34E 09	1.34E 09	1.57E 09
FE 59	2.75E 08	2.75E 08	2.75E 08	2.75E 08	2.75E 08	2.75E 08	2.75E 08	3.23E 08
CO 58	3.79E 08	3.79E 08	3.79E 08	3.79E 08	3.79E 08	3.79E 08	3.79E 08	4.44E 09
CO 60	2.15E 10	2.15E 10	2.15E 10	2.15E 10	2.15E 10	2.15E 10	2.15E 10	2.52E 10
ZN 65	7.49E 08	7.49E 08	7.49E 08	7.49E 08	7.49E 08	7.49E 08	7.49E 08	8.61E 08
RB 86	8.99E 06	8.99E 06	8.99E 06	8.99E 06	8.99E 06	8.99E 06	8.99E 06	1.03E 07
SR 89	2.23E 04	2.23E 04	2.23E 04	2.23E 04	2.23E 04	2.23E 04	2.23E 04	2.58E 04
Y 91	1.08E 06	1.08E 06	1.08E 06	1.08E 06	1.08E 06	1.08E 06	1.08E 06	1.22E 06
ZR 95	2.49E 08	2.49E 08	2.49E 08	2.49E 08	2.49E 08	2.49E 08	2.49E 08	2.89E 08
NB 95	1.36E 08	1.36E 08	1.36E 08	1.36E 08	1.36E 08	1.36E 08	1.36E 08	1.60E 08
RU103	1.09E 08	1.09E 08	1.09E 08	1.09E 08	1.09E 08	1.09E 08	1.09E 08	1.27E 08
RU106	4.19E 08	4.19E 08	4.19E 08	4.19E 08	4.19E 08	4.19E 08	4.19E 08	5.03E 08
AG110M	3.48E 09	3.48E 09	3.48E 09	3.48E 09	3.48E 09	3.48E 09	3.48E 09	4.06E 09
SN113	1.44E 07	6.28E 06	1.22E 07	6.21E 06	1.00E 07	1.33E 07	8.14E 06	4.09E 07
TE127M	9.15E 04	9.15E 04	9.15E 04	9.15E 04	9.15E 04	9.15E 04	9.15E 04	1.08E 05
TE129M	2.00E 07	2.00E 07	2.00E 07	2.00E 07	2.00E 07	2.00E 07	2.00E 07	2.34E 07
I 131	1.72E 07	1.72E 07	1.72E 07	1.72E 07	1.72E 07	1.72E 07	1.72E 07	2.09E 07
I 132	1.24E 06	1.24E 06	1.24E 06	1.24E 06	1.24E 06	1.24E 06	1.24E 06	1.46E 06
I 133	2.47E 06	2.47E 06	2.47E 06	2.47E 06	2.47E 06	2.47E 06	2.47E 06	3.00E 06
I 135	2.56E 06	2.56E 06	2.56E 06	2.56E 06	2.56E 06	2.56E 06	2.56E 06	2.99E 06
CS134	6.82E 09	6.82E 09	6.82E 09	6.82E 09	6.82E 09	6.82E 09	6.82E 09	7.96E 09
CS136	1.49E 08	1.49E 08	1.49E 08	1.49E 08	1.49E 08	1.49E 08	1.49E 08	1.69E 08
CS137	1.03E 10	1.03E 10	1.03E 10	1.03E 10	1.03E 10	1.03E 10	1.03E 10	1.20E 10
BA140	2.05E 07	2.05E 07	2.05E 07	2.05E 07	2.05E 07	2.05E 07	2.05E 07	2.34E 07
CE141	1.36E 07	1.36E 07	1.36E 07	1.36E 07	1.36E 07	1.36E 07	1.36E 07	1.53E 07
CE144	6.95E 07	6.95E 07	6.95E 07	6.95E 07	6.95E 07	6.95E 07	6.95E 07	8.03E 07
HF181	1.97E 08	1.63E 08	2.30E 08	1.70E 08	1.76E 08	2.33E 08	1.82E 08	2.82E 08
AM-241	5.16E 08	5.16E 08	5.16E 08	5.16E 08	5.16E 08	5.16E 08	5.16E 08	7.45E 08

*R Values in units of mrem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2-mrem/yr per μCi/sec for all others.

TABLE 3.3-2 R VALUES FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

PATHWAY = Vegetable

AGE GROUP = Adult

Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H 3	2.28E 03	2.28E 03	0.00E 01	2.28E 03	2.28E 03	2.28E 03	2.28E 03	2.28E 03
P 32	5.91E 07	1.72E 08	1.53E 09	9.51E 07	0.00E 01	0.00E 01	0.00E01	0.00E 01
CR 51	4.60E 04	1.16E 07	0.00E 01	0.00E 01	1.01E 04	2.75E 04	6.10E 04	0.00E 01
MN 54	5.83E 07	9.36E 08	0.00E 01	3.05E 08	9.09E 07	0.00E 01	0.00E 01	0.00E 01
FE 59	1.12E 08	9.75E 08	1.24E 08	2.93E 08	0.00E 01	0.00E 01	8.17E 07	0.00E 01
CO 58	6.71E 07	6.07E 08	0.00E 01	2.99E 07	0.00E 01	0.00E 01	0.00E 01	0.00E 01
CO 60	3.67E 08	3.12E 09	0.00E 01	1.66E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
ZN 65	5.77E 08	8.04E 08	4.01E 08	1.28E 09	8.54E 08	0.00E 01	0.00E 01	0.00E 01
RB 86	1.03E 08	4.36E 07	0.00E 01	2.21E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
SR 89	2.87E 08	1.60E 09	1.00E 10	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
SR 90	1.64E 11	1.93E 10	6.70E 11	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Y 91	1.34E 05	2.76E 09	5.01E 06	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
ZR 95	2.51E 05	1.17E 09	1.16E 06	3.71E 05	5.82E 05	0.00E 01	0.00E 01	0.00E 01
NB 95	4.19E 04	4.73E 08	1.40E 05	7.79E 04	7.70E 04	0.00E 01	0.00E 01	0.00E 01
RU103	2.04E 06	5.53E 08	4.74E 06	0.00E 01	1.81E 07	0.00E 01	0.00E 01	0.00E 01
RU106	2.46E 07	1.26E 10	1.94E 08	0.00E 01	3.75E 08	0.00E 01	0.00E 01	0.00E 01
AG110M	6.23E 06	4.28E 09	1.13E 07	1.05E 07	2.06E 07	0.00E 01	0.00E 01	0.00E 01
SN 113	1.36E 07	2.53E 08	1.44E 07	5.60E 05	4.09E 05	1.96E 05	0.00E 01	0.00E 01
TE127M	6.12E 07	1.68E 09	5.02E 08	1.80E 08	2.04E 09	1.28E 08	0.00E 01	0.00E 01
TE129M	4.71E 07	1.50E 09	2.98E 08	1.11E 08	1.24E 09	1.02E 08	0.00E 01	0.00E 01
I 131	6.61E 07	3.04E 07	8.07E 07	1.15E 08	1.98E 08	3.78E 10	0.00E 01	0.00E 01
I 132	5.21E 01	2.80E 01	5.57E 01	1.49E 02	2.37E 02	5.21E 03	0.00E 01	0.00E 01
I 133	1.12E 06	3.30E 06	2.11E 06	3.67E 06	6.40E 06	5.39E 08	0.00E 01	0.00E 01
I 135	3.91E 04	1.20E 05	4.05E 04	1.06E 05	1.70E 05	7.00E 06	0.00E 01	0.00E 01
CS134	8.83E 09	1.89E 08	4.54E 09	1.08E 10	3.49E 09	0.00E 01	1.16E 09	0.00E 01
CS136	1.19E 08	1.88E 07	4.19E 07	1.66E 08	9.21E 07	0.00E 01	1.26E 07	0.00E 01
CS137	5.94E 09	1.76E 08	6.63E 09	9.07E 09	3.08E 09	0.00E 01	1.02E 09	0.00E 01
BA140	8.40E 06	2.64E 08	1.28E 08	1.61E 05	5.47E 04	0.00E 01	9.22E 04	0.00E 01
CE141	1.48E 04	4.99E 08	1.93E 05	1.31E 05	6.07E 04	0.00E 01	0.00E 01	0.00E 01
CE144	1.69E 06	1.06E 10	3.15E 07	1.32E 07	7.80E 06	0.00E 01	0.00E 01	0.00E 01
HF 181	1.08E 06	7.06E 08	9.51E 06	5.36E 04	4.48E 04	3.41E 04	0.00E 01	0.00E 01
AM 241	4.12E 09	5.65E 09	5.75E 10	5.37E 10	3.10E 10	0.00E 01	0.00E 01	0.00E 01

*R Values in units of mrem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2-mrem/yr per $\mu Ci/sec$ for all others.

TABLE 3.3-3 R VALUES FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

PATHWAY = Vegetable

AGE GROUP = Teen

Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H 3	2.61E 03	2.61E 03	0.00E 01	2.61E 03	2.61E 03	2.61E 03	2.61E 03	2.61E 03
P 32	6.80E 07	1.47E 08	1.75E 09	1.09E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
CR 51	6.11E 04	1.03E 07	0.00E 01	0.00E 01	1.34E 04	3.39E 04	8.72E 04	0.00E 01
MN 54	8.79E 07	9.09E 08	0.00E 01	4.43E 08	1.32E 08	0.00E 01	0.00E 01	0.00E 01
FE 59	1.60E 08	9.78E 08	1.77E 08	4.14E 08	0.00E 01	0.00E 01	1.30E 08	0.00E 01
CO 58	9.79E 07	5.85E 08	0.00E 01	4.25E 07	0.00E 01	0.00E 01	0.00E 01	0.00E 01
CO 60	5.57E 08	3.22E 09	0.00E 01	2.47E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
ZN 65	8.68E 08	7.88E 08	5.36E 08	1.86E 09	1.19E 09	0.00E 01	0.00E 01	0.00E 01
RB 86	1.30E 08	4.09E 07	0.00E 01	2.76E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
SR 89	4.36E 08	1.81E 09	1.52E 10	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
SR 90	2.05E 11	2.33E 10	8.32E 11	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Y 91	2.06E 05	3.15E 09	7.68E 06	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
ZR 95	3.68E 05	1.23E 09	1.69E 06	5.35E 05	7.86E 05	0.00E 01	0.00E 01	0.00E 01
NB 95	5.77E 04	4.48E 08	1.89E 05	1.05E 05	1.02E 05	0.00E 01	0.00E 01	0.00E 01
RU103	2.90E 06	5.66E 08	6.78E 06	0.00E 01	2.39E 07	0.00E 01	0.00E 01	0.00E 01
RU106	3.93E 07	1.50E 10	3.12E 08	0.00E 01	6.02E 08	0.00E 01	0.00E 01	0.00E 01
AG110M	9.39E 06	4.34E09	1.63E 07	1.54E 07	2.95E 07	0.00E 01	0.00E 01	0.00E 01
SN 113	2.02E 07	2.29E 08	1.91E 07	8.03E 05	5.65E 05	2.63E 05	0.00E 01	0.00E 01
TE127M	9.44E 07	1.98E 09	7.93E 08	2.81E 08	3.22E 09	1.89E 08	0.00E 01	0.00E 01
TE129M	6.79E 07	1.61E 09	4.29E 08	1.59E 08	1.79E 08	1.38E 08	0.00E 01	0.00E 01
I 131	5.77E 07	2.13E 07	7.68E 07	1.07E 08	1.85E 08	3.14E 10	0.00E 01	0.00E 01
I 132	4.72E 01	5.72E 01	5.02E 01	1.31E 02	2.07E 02	4.43E 03	0.00E 01	0.00E 01
I 133	1.01E 06	2.51E 06	1.96E 06	3.32E 06	5.83E 06	4.64E 08	0.00E 01	0.00E 01
I 135	3.49E 04	1.04E 05	3.66E 04	9.42E 04	1.49E 05	6.06E 06	0.00E 01	0.00E 01
CS134	7.54E 09	2.02E 08	6.90E 09	1.62E 10	5.16E 09	0.00E 01	1.97E 09	0.00E 01
CS136	1.13E 08	1.35E 07	4.28E 07	1.68E 08	9.16E 07	0.00E 01	1.44E 07	0.00E 01
CS137	4.90E 09	2.00E 08	1.06E 10	1.41E 10	4.78E 09	0.00E 01	1.86E 09	0.00E 01
BA140	8.88E 06	2.12E 08	1.38E 08	1.69E 05	5.72E 04	0.00E 01	1.14E 05	0.00E 01
CE141	2.12E 04	5.29E 08	2.77E 05	1.85E 05	8.70E 04	0.00E 01	0.00E 01	0.00E 01
CE144	2.71E 06	1.27E 10	5.04E 07	2.09E 07	1.25E 07	0.00E 01	0.00E 01	0.00E 01
HF 181	1.54E 06	6.90E 08	1.38E 07	7.58E 04	6.32E 04	4.63E 04	0.00E 01	0.00E 01
AM 241	4.97E 09	6.80E 09	6.89E 10	6.50E 10	3.72E 10	0.00E 01	0.00E 01	0.00E 01

*R Values in units of mrem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2-mrem/yr per $\mu Ci/sec$ for all others.

TABLE 3.3-4 R VALUES FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

PATHWAY = Vegetable

AGE GROUP = Child

Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H 3	4.04E 03	4.04E 03	0.00E 01	4.04E 03	4.04E 03	4.04E 03	4.04E 03	4.04E 03
P 32	1.42E 08	1.01E 08	3.67E 09	1.72E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
CR 51	1.16E 05	6.15E 06	0.00E 01	0.00E 01	1.76E 04	6.44E 04	1.18E 05	0.00E 01
MN 54	1.73E 08	5.44E 08	0.00E 01	6.49E 08	1.82E 08	0.00E 01	0.00E 01	0.00E 01
FE 59	3.17E 08	6.62E 08	3.93E 08	6.36E 08	0.00E 01	0.00E 01	1.84E 08	0.00E 01
CO 58	1.92E 08	3.66E 08	0.00E 01	6.27E 07	0.00E 01	0.00E 01	0.00E 01	0.00E 01
CO 60	1.11E 09	2.08E 09	0.00E 01	3.76E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
ZN 65	1.70E 09	4.81E 08	1.03E 09	2.74E 09	1.73E 09	0.00E 01	0.00E 01	0.00E 01
RB 86	2.81E 08	2.94E 07	0.00E 01	4.56E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
SR 89	1.03E 09	1.40E 09	3.62E 10	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
SR 90	3.49E 11	1.86E 10	1.38E 12	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Y 91	4.89E 05	2.44E 09	1.83E 07	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
ZR 95	7.44E 05	8.71E 08	3.80E 06	8.35E 05	1.20E 06	0.00E 01	0.00E 01	0.00E 01
NB 95	1.12E 05	2.91E 08	4.04E 05	1.57E 05	1.48E 05	0.00E 01	0.00E 01	0.00E 01
RU103	5.86E 06	3.94E 08	1.52E 07	0.00E 01	3.84E 07	0.00E 01	0.00E 01	0.00E 01
RU106	9.38E 07	1.17E 10	7.52E 08	0.00E 01	1.02E 09	0.00E 01	0.00E 01	0.00E 01
AG110M	1.87E 07	2.78E 09	3.46E 07	2.34E 07	4.35E 07	0.00E 01	0.00E 01	0.00E 01
SN 113	3.98E 07	1.46E 08	3.64E 07	1.18E 06	8.09E 05	4.82E 05	0.00E 01	0.00E 01
TE127M	2.26E 08	1.54E 09	1.90E 09	5.12E 08	5.42E 09	4.55E 08	0.00E 01	0.00E 01
TE129M	1.55E 08	1.22E 09	9.98E 08	2.79E 08	2.93E 09	3.22E 08	0.00E 01	0.00E 01
I 131	8.16E 07	1.23E 07	1.43E 08	1.44E 08	2.36E 08	4.75E 10	0.00E 01	0.00E 01
I 132	7.53E 01	1.93E 02	8.91E 01	1.64E 02	2.51E 02	7.60E 03	0.00E 01	0.00E 01
I 133	1.67E 06	1.78E 06	3.57E 06	4.42E 06	7.36E 06	8.21E 08	0.00E 01	0.00E 01
I 135	5.54E 04	8.92E 04	6.50E 04	1.17E 05	1.79E 05	1.04E 07	0.00E 01	0.00E 01
CS134	5.40E 09	1.38E 08	1.56E 10	2.56E 10	7.93E 09	0.00E 01	2.84E 09	0.00E 01
CS136	1.43E 08	7.77E 06	8.04E 07	2.21E 08	1.18E 08	0.00E 01	1.76E 07	0.00E 01
CS137	3.52E 09	1.50E 08	2.49E 10	2.39E 10	7.78E 09	0.00E 01	2.80E 09	0.00E 01
BA140	1.61E 07	1.40E 08	2.76E 08	2.42E 05	7.87E 04	0.00E 01	1.44E 05	0.00E 01
CE141	4.75E 04	3.99E 08	6.42E 05	3.20E 05	1.40E 05	0.00E 01	0.00E 01	0.00E 01
CE144	6.49E 06	9.94E 09	1.22E 08	3.81E 07	2.11E 07	0.00E 01	0.00E 01	0.00E 01
HF 181	3.15E 06	3.17E 08	3.13E 07	1.22E 05	9.78E 04	1.03E 05	0.00E 01	0.00E 01
AM 241	7.12E 09	5.34E 09	9.50E 10	8.17E 10	4.35E 10	0.00E 01	0.00E 01	0.00E 01

*R Values in units of mrem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2-mrem/yr per μCi/sec for all others.

TABLE 3.3-5 R VALUES FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

PATHWAY = Meat

AGE GROUP = Adult

Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H 3	3.27E 02	3.27E 02	0.00E 01	3.27E 02	3.27E 02	3.27E 02	3.27E 02	3.27E 02
P 32	1.18E 08	3.43E 08	3.05E 09	1.89E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
CR 51	4.27E 03	1.08E 06	0.00E 01	0.00E 01	9.42E 02	2.56E 03	5.67E 03	0.00E 01
MN 54	1.06E 06	1.71E 07	0.00E 01	5.57E 06	1.66E 06	0.00E 01	0.00E 01	0.00E 01
FE 59	1.43E 08	1.25E 09	1.59E 08	3.74E 08	0.00E 01	0.00E 01	1.04E 08	0.00E 01
CO 58	2.43E 07	2.20E 08	0.00E 01	1.08E 07	0.00E 01	0.00E 01	0.00E 01	0.00E 01
CO 60	1.03E 08	8.76E 08	0.00E 01	4.66E 07	0.00E 01	0.00E 01	0.00E 01	0.00E 01
ZN 65	3.58E 08	4.98E 08	2.49E 08	7.91E 08	5.29E 08	0.00E 01	0.00E 01	0.00E 01
RB 86	1.42E 08	6.00E 07	0.00E 01	3.04E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
SR 89	5.23E 06	2.92E 07	1.82E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
SR 90	2.02E 09	2.38E 08	8.22E 09	0.00E 01	0.00E 01	0.00E 01	0.00E01	0.00E 01
Y 91	1.80E 04	3.71E 08	6.75E 05	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
ZR 95	2.43E 05	1.14E 09	1.12E 06	3.59E 05	5.64E 05	0.00E 01	0.00E 01	0.00E 01
NB 95	4.12E 05	4.65E 09	1.38E 06	7.66E 05	7.58E 05	0.00E 01	0.00E 01	0.00E 01
RU103	2.72E 07	7.38E 09	6.32E 07	0.00E 01	2.41E 08	0.00E 01	0.00E 01	0.00E 01
RU106	2.19E 08	1.12E 11	1.73E 09	0.00E 01	3.35E 09	0.00E 01	0.00E 01	0.00E 01
AG110M	2.34E 06	1.61E 09	4.27E 06	3.95E 06	7.76E 06	0.00E 01	0.00E 01	0.00E 01
SN 113	2.80E 07	5.19E 08	2.97E 07	1.15E 06	8.40E 05	4.03E 05	0.00E 01	0.00E 01
TE127M	1.00E 08	2.76E 09	8.22E 08	2.94E 08	3.34E 09	2.10E 08	0.00E 01	0.00E 01
TE129M	1.17E 08	3.73E 09	7.40E 08	2.76E 08	3.09E 09	2.54E 08	0.00E 01	0.00E 01
I 131	5.77E 06	2.66E 06	7.04E 06	1.01E 07	1.73E 07	3.30E 09	0.00E 01	0.00E 01
I 133	1.51E-01	4.46E-01	2.85E-01	4.96E-01	8.66E-01	7.29E 01	0.00E 01	0.00E 01
I 135	6.07E-17	1.86E-16	6.28E-17	1.64E-16	2.64E-16	1.08E-14	0.00E 01	0.00E 01
CS134	7.81E 08	1.67E 07	4.01E 08	9.55E 08	3.09E 08	0.00E 01	1.03E 08	0.00E 01
CS136	2.14E 07	3.33E 06	7.53E 06	2.97E 07	1.65E 07	0.00E 01	2.27E 06	0.00E 01
CS137	4.99E 08	1.47E 07	5.57E 08	7.61E 08	2.58E 08	0.00E 01	8.59E 07	0.00E 01
BA140	1.20E 06	3.77E 07	1.83E 07	2.30E 04	7.82E 03	0.00E 01	1.32E 04	0.00E 01
CE141	6.46E 02	2.18E 07	8.42E 03	5.69E 03	2.65E 03	0.00E 01	0.00E 01	0.00E 01
CE144	4.70E 04	2.96E 08	8.75E 05	3.66E 05	2.17E 05	0.00E 01	0.00E 01	0.00E 01
HF 181	1.52E 06	9.97E 08	1.34E 07	7.57E 04	6.33E 04	4.81E 04	0.00E 01	0.00E 01
AM 241	1.80E 07	2.47E 07	2.52E 08	2.35E 08	1.36E 08	0.00E 01	0.00E 01	0.00E 01

*R Values in units of mrem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2-mrem/yr per μCi/sec for all others.

TABLE 3.3-6 R VALUES FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

PATHWAY = Meat

AGE GROUP = Teen

Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H 3	1.95E 02	1.95E 02	0.00E 01	1.95E 02	1.95E 02	1.95E 02	1.95E 02	1.95E 02
P 32	9.98E 07	2.16E 08	2.58E 09	1.60E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
CR 51	3.42E 03	5.75E 05	0.00E 01	0.00E 01	7.49E 02	1.90E 03	4.88E 03	0.00E 01
MN 54	8.43E 05	8.72E 06	0.00E 01	4.25E 06	1.27E 06	0.00E 01	0.00E 01	0.00E 01
FE 59	1.15E 08	7.02E 08	1.27E 08	2.97E 08	0.00E 01	0.00E 01	9.36E 07	0.00E 01
CO 58	1.93E 07	1.15E 08	0.00E 01	8.36E 06	0.00E 01	0.00E 01	0.00E 01	0.00E 01
CO 60	8.15E 07	4.71E 08	0.00E 01	3.62E 07	0.00E 01	0.00E 01	0.00E 01	0.00E 01
ZN 65	2.83E 08	2.57E 08	1.75E 08	6.07E 08	3.89E 08	0.00E 01	0.00E 01	0.00E 01
RB 86	1.19E 08	3.76E 07	0.00E 01	2.54E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
SR 89	4.40E 06	1.83E 07	1.54E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
SR 90	1.31E 09	1.49E 08	5.32E 09	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Y 91	1.52E 04	2.33E 08	5.68E 05	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
ZR 95	1.95E 05	6.53E 08	8.97E 05	2.83E 05	4.16E 05	0.00E 01	0.00E 01	0.00E 01
NB 95	3.29E 05	2.55E 09	1.08E 06	5.97E 05	5.79E 05	0.00E 01	0.00E 01	0.00E 01
RU103	2.20E 07	4.30E 09	5.15E 07	0.00E 01	1.82E 08	0.00E 01	0.00E 01	0.00E 01
RU106	1.84E 08	7.00E 10	1.46E 09	0.00E 01	2.81E 09	0.00E 01	0.00E 01	0.00E 01
AG110M	1.86E 06	8.59E 08	3.23E 06	3.06E 06	5.83E 06	0.00E 01	0.00E 01	0.00E 01
SN 113	2.22E 07	2.51E 08	2.09E 07	8.80E 05	6.19E 05	2.89E 05	0.00E 01	0.00E 01
TE127M	8.25E 07	1.73E 09	6.94E 08	2.46E 08	2.81E 09	1.65E 08	0.00E 01	0.00E 01
TE129M	9.81E 07	2.33E 09	6.20E 08	2.30E 08	2.59E 09	2.00E 08	0.00E 01	0.00E 01
I 131	4.40E 06	1.62E 06	5.85E 06	8.20E 06	1.41E 07	2.39E 09	0.00E 01	0.00E 01
I 133	1.23E-01	3.06E-01	2.39E-01	4.05E-01	7.10E-01	5.65E 01	0.00E 01	0.00E 01
I 135	4.88E-17	1.46E-16	5.11E-17	1.32E-16	2.08E-16	8.46E-15	0.00E 01	0.00E 01
CS134	3.48E 08	9.34E 06	3.19E 08	7.51E 08	2.39E 08	0.00E 01	9.11E 07	0.00E 01
CS136	1.55E 07	1.86E 06	5.87E 06	2.31E 07	1.26E 07	0.00E 01	1.98E 06	0.00E 01
CS137	2.14E 08	8.75E 06	4.62E 08	6.15E 08	2.09E 08	0.00E 01	8.13E 07	0.00E 01
BA140	9.76E 05	2.34E 07	1.51E 07	1.86E 04	6.29E 03	0.00E 01	1.25E 04	0.00E 01
CE141	5.42E 02	1.35E 07	7.07E 03	4.72E 03	2.22E 03	0.00E 01	0.00E 01	0.00E 01
CE144	3.96E 04	1.85E 08	7.37E 05	3.05E 05	1.82E 05	0.00E 01	0.00E 01	0.00E 01
HF 181	1.23E 06	5.50E 08	1.10E 07	6.05E 04	5.04E 04	3.69E 04	0.00E 01	0.00E 01
AM 241	1.13E 07	1.55E 07	1.57E 08	1.48E 08	8.49E 07	0.00E 01	0.00E 01	0.00E 01

*R Values in units of mrem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2-mrem/yr per μCi/sec for all others.

TABLE 3.3-7 R VALUES FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

PATHWAY = Meat

AGE GROUP = Child

Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H 3	2.36E 02	2.36E 02	0.00E 01	2.36E 02	2.36E 02	2.36E 02	2.36E 02	2.36E 02
P 32	1.87E 08	1.34E 08	4.86E 09	2.27E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
CR 51	5.33E 03	2.83E 05	0.00E 01	0.00E 01	8.09E 02	2.96E 03	5.40E 03	0.00E 01
MN 54	1.30E 06	4.08E 06	0.00E 01	4.86E 06	1.36E 06	0.00E 01	0.00E 01	0.00E 01
FE 59	1.82E 08	3.80E 08	2.25E 08	3.65E 08	0.00E 01	0.00E 01	1.06E 08	0.00E 01
CO 58	2.99E 07	5.70E 07	0.00E 01	9.76E 06	0.00E 01	0.00E 01	0.00E 01	0.00E 01
CO 60	1.27E 08	2.38E 08	0.00E 01	4.30E 07	0.00E 01	0.00E 01	0.00E 01	0.00E 01
ZN 65	4.35E 08	1.23E 08	2.62E 08	6.99E 08	4.40E 08	0.00E 01	0.00E 01	0.00E 01
RB 86	2.21E 08	2.32E 07	0.00E 01	3.60E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01
SR 89	8.31E 06	1.13E 07	2.91E 08	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
SR 90	1.74E 09	9.26E 07	6.87E 09	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
Y 91	2.87E 04	1.43E 08	1.07E 06	0.00E 01	0.00E 01	0.00E 01	0.00E 01	0.00E 01
ZR 95	3.12E 05	3.65E 08	1.59E 06	3.50E 05	5.01E 05	0.00E 01	0.00E 01	0.00E 01
NB 95	5.17E 05	1.34E 09	1.86E 06	7.23E 05	6.80E 05	0.00E 01	0.00E 01	0.00E 01
RU103	3.58E 07	2.41E 09	9.31E 07	0.00E 01	2.34E 08	0.00E 01	0.00E 01	0.00E 01
RU106	3.43E 08	4.27E 10	2.75E 09	0.00E 01	3.71E 09	0.00E 01	0.00E 01	0.00E 01
AG110M	2.89E 06	4.30E 08	5.36E 06	3.62E 06	6.74E 06	0.00E 01	0.00E 01	0.00E 01
SN 113	3.43E 07	1.25E 08	3.14E 07	1.01E 06	6.97E 05	4.15E 05	0.00E 01	0.00E 01
TE127M	1.55E 08	1.06E 09	1.31E 09	3.52E 08	3.73E 09	3.13E 08	0.00E 01	0.00E 01
TE129M	1.81E 08	1.42E 09	1.17E 09	3.26E 08	3.43E 09	3.77E 08	0.00E 01	0.00E 01
I 131	6.20E 06	9.72E 05	1.09E 07	1.09E 07	1.79E 07	3.61E 09	0.00E 01	0.00E 01
I 133	2.07E-01	2.21E-01	4.43E-01	5.48E-01	9.13E-01	1.02E 02	0.00E 01	0.00E 01
I 135	7.87E-17	1.27E-16	9.25E-17	1.66E-16	2.55E-16	1.47E-14	0.00E 01	0.00E 01
CS 134	1.95E 08	4.93E 06	5.63E 08	9.23E 08	2.86E 08	0.00E 01	1.03E 08	0.00E 01
CS 136	1.80E 07	9.78E 05	1.01E 07	2.78E 07	1.48E 07	0.00E 01	2.21E 06	0.00E 01
CS 137	1.20E 08	5.10E 06	8.51E 08	8.15E 08	2.65E 08	0.00E 01	9.55E 07	0.00E 01
BA 140	1.63E 06	1.42E 07	2.80E 07	2.45E 04	7.97E 03	0.00E 01	1.46E 04	0.00E 01
CE 141	9.86E 02	8.28E 06	1.33E 04	6.64E 03	2.91E 03	0.00E 01	0.00E 01	0.00E 01
CE 144	7.42E 04	1.14E 08	1.39E 06	4.36E 05	2.41E 05	0.00E 01	0.00E 01	0.00E 01
HF 181	2.02E 06	3.31E 08	2.01E07	7.79E 04	6.26E 04	6.56E 04	0.00E 01	0.00E 01
AM 241	1.27E 07	9.49E 06	1.69E 08	1.45E 08	7.74E 07	0.00E 01	0.00E 01	0.00E 01

*R Values in units of mrem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2-mrem/yr per μCi/sec for all others.

TABLE 3.3-8 R VALUES FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

PATHWAY = Cow Milk

AGE GROUP = Adult

Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H 3	7.69E 02	7.69E 02	0.00E-01	7.69E 02	7.69E 02	7.69E 02	7.69E 02	7.69E 02
P 32	4.32E 08	1.26E 09	1.12E 10	6.95E 08	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CR 51	1.73E 04	4.36E 06	0.00E-01	0.00E-01	3.82E 03	1.04E 04	2.30E 04	0.00E-01
MN 54	9.76E 05	1.57E 07	0.00E-01	5.11E 06	1.52E 06	0.00E-01	0.00E-01	0.00E-01
FE 59	1.60E 07	1.39E 08	1.77E 07	4.17E 07	0.00E-01	0.00E-01	1.17E 07	0.00E-01
CO 58	6.28E 06	5.68E 07	0.00E-01	2.80E 06	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CO 60	2.24E 07	1.91E 08	0.00E-01	1.02E 07	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ZN 65	1.38E 09	1.92E 09	9.59E 08	3.05E 09	2.04E 09	0.00E-01	0.00E-01	0.00E-01
RB 86	7.54E 08	3.19E 08	0.00E-01	1.62E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 89	2.50E 07	1.40E 08	8.70E 08	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 90	7.59E 09	8.94E 08	3.09E 10	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y 91	1.37E 02	2.81E 06	5.11E 03	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ZR 95	1.22E 02	5.71E 05	5.62E 02	1.80E 02	2.83E 02	0.00E-01	0.00E-01	0.00E-01
NB 95	1.48E 04	1.67E 08	4.95E 04	2.75E 04	2.72E 04	0.00E-01	0.00E-01	0.00E-01
RU 103	2.63E 02	7.14E 04	6.11E 02	0.00E-01	2.33E 03	0.00E-01	0.00E-01	0.00E-01
RU 106	1.60E 03	8.17E 05	1.26E 04	0.00E-01	2.44E 04	0.00E-01	0.00E-01	0.00E-01
AG110M	2.04E 07	1.40E 10	3.71E 07	3.44E 07	6.76E 07	0.00E-01	0.00E-01	0.00E-01
SN 113	1.32E 06	2.44E 07	1.40E 06	5.41E 04	3.96E 04	1.90E 04	0.00E 01	0.00E 01
TE127M	4.11E 06	1.13E 08	3.37E 07	1.21E 07	1.37E 08	8.62E 06	0.00E-01	0.00E-01
TE129M	6.19E 06	1.97E 08	3.91E 07	1.46E 07	1.63E 08	1.34E 07	0.00E-01	0.00E-01
I 131	1.59E 08	7.32E 07	1.94E 08	2.77E 08	4.76E 08	9.09E 10	0.00E-01	0.00E-01
I 132	1.03E-01	5.51E-02	1.10E-01	2.93E-01	4.67E-01	1.03E 01	0.00E-01	0.00E-01
I 133	1.40E 06	4.13E 06	2.64E 06	4.59E 06	8.01E 06	6.75E 08	0.00E-01	0.00E-01
I 135	9.03E 03	2.76E 04	9.34E 03	2.45E 04	3.92E 04	1.61E 06	0.00E-01	0.00E-01
CS 134	6.71E 09	1.44E 08	3.45E 09	3.21E 09	2.66E 09	0.00E-01	8.82E 08	0.00E-01
CS 136	4.73E 08	7.46E 07	1.66E 08	6.57E 08	3.65E 08	0.00E-01	5.01E 07	0.00E-01
CS 137	4.22E 09	1.25E 08	4.71E 09	6.44E 09	2.19E 09	0.00E-01	7.27E 08	0.00E-01
BA 140	1.12E 06	3.53E 07	1.71E 07	2.15E 04	7.32E 03	0.00E-01	1.23E 04	0.00E-01
CE 141	2.23E 02	7.52E 06	2.91E 03	1.97E 03	9.14E 02	0.00E-01	0.00E-01	0.00E-01
CE 144	1.15E 04	7.26E 07	2.15E 05	8.97E 04	5.32E 04	0.00E-01	0.00E-01	0.00E-01
HF 181	6.68E 02	4.39E 05	5.91E 03	3.33E 01	2.79E 01	2.12E 01	0.00E 01	0.00E 01
AM 241	1.27E 06	1.74E 06	1.77E 07	1.66E 07	9.56E 06	0.00E 01	0.00E 01	0.00E 01

*R Values in units of mrem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2-mrem/yr per μCi/sec for all others.

TABLE 3.3-9 R VALUES FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

PATHWAY = Cow Milk

AGE GROUP = Teen

Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H 3	1.00E 03	1.00E 03	0.00E-01	1.00E 03	1.00E 03	1.00E 03	1.00E 03	1.00E 03
P 32	8.00E 08	1.73E 09	2.06E 10	1.28E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CR 51	3.02E 04	5.08E 06	0.00E-01	0.00E-01	6.63E 03	1.68E 04	4.32E 04	0.00E-01
MN 54	1.69E 06	1.75E 07	0.00E-01	8.52E 06	2.54E 06	0.00E-01	0.00E-01	0.00E-01
FE 59	2.79E 07	1.71E 08	3.10E 07	7.23E 07	0.00E-01	0.00E-01	2.28E 07	0.00E-01
CO 58	1.09E 07	6.50E 07	0.00E-01	4.72E 06	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CO 60	3.88E 07	2.25E 08	0.00E-01	1.72E 07	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ZN 65	2.38E 09	2.16E 09	1.47E 09	5.11E 09	3.27E 09	0.00E-01	0.00E-01	0.00E-01
RB 86	1.39E 09	4.37E 08	0.00E-01	2.95E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 89	4.59E 07	1.91E 08	1.60E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 90	1.08E 10	1.23E 09	4.37E 10	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y 91	2.52E 02	3.85E 06	9.40E 03	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ZR 95	2.13E 02	7.16E 06	9.83E 02	3.10E 02	4.56E 02	0.00E-01	0.00E-01	0.00E-01
NB 95	2.58E 04	2.00E 08	8.45E 04	4.68E 04	4.54E 04	0.00E-01	0.00E-01	0.00E-01
RU 103	4.65E 02	9.08E 04	1.09E 03	0.00E-01	3.83E 03	0.00E-01	0.00E-01	0.00E-01
RU 106	2.93E 03	1.11E 06	2.32E 04	0.00E-01	4.48E 04	0.00E-01	0.00E-01	0.00E-01
AG110M	3.53E 07	1.63E 10	6.14E 07	5.81E 07	1.11E 08	0.00E-01	0.00E-01	0.00E-01
SN 113	2.28E 06	2.58E 07	2.15E 06	9.06E 04	6.37E 04	2.97E 04	0.00E 04	0.00E 01
TE127M	7.39E 06	1.55E 08	6.22E 07	2.21E 07	2.52E 08	1.48E 07	0.00E-01	0.00E-01
TE129M	1.13E 07	2.69E 08	7.15E 07	2.65E 07	2.99E 08	2.31E 07	0.00E-01	0.00E-01
I 131	2.65E 08	9.75E 07	3.52E 08	4.93E 08	8.48E 08	1.44E 11	0.00E-01	0.00E-01
I 132	1.83E-01	2.22E-01	1.94E-01	5.09E-01	8.02E-01	1.71E 01	0.00E-01	0.00E-01
I 133	2.49E 06	6.19E 06	4.82E 06	8.18E 06	1.43E 07	1.14E 09	0.00E-01	0.00E-01
I 135	1.58E 04	4.74E 04	1.66E 04	4.27E 04	6.75E 04	2.75E 06	0.00E-01	0.00E-01
CS 134	6.54E 09	1.75E 08	5.99E 09	1.41E 10	4.48E 09	0.00E-01	1.71E 09	0.00E-01
CS 136	7.48E 08	8.97E 07	2.83E 08	1.11E 09	6.07E 08	0.00E-01	9.56E 07	0.00E-01
CS 137	3.96E 09	1.62E 08	8.54E 09	1.14E 10	3.87E 09	0.00E-01	1.50E 09	0.00E-01
BA 140	1.99E 06	4.77E 07	3.09E 07	3.79E 04	1.28E 04	0.00E-01	2.55E 04	0.00E-01
CE 141	4.09E 02	1.02E 07	6.33E 03	3.56E 03	1.68E 03	0.00E-01	0.00E-01	0.00E-01
CE 144	2.12E 04	9.93E 07	3.95E 05	1.63E 05	9.76E 04	0.00E-01	0.00E-01	0.00E-01
HF 181	1.18E 03	5.28E 05	1.06E 04	5.81E 01	4.84E 01	3.55E 01	0.00E 01	0.00E 01
AM 241	1.74E 06	2.38E 06	2.42E 07	2.28E 07	1.31E 07	0.00E 01	0.00E 01	0,00E 01

*R Values in units of mrem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2-mrem/yr per μCi/sec for all others.

TABLE 3.3-10 R VALUES FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

PATHWAY = Cow Milk

AGE GROUP = Child

Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H 3	1.58E 03	1.58E 03	0.00E-01	1.58E 03	1.58E 03	1.58E 03	1.58E 03	1.58E 03
P 32	1.96E 09	1.41E 09	5.09E 10	2.38E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CR 51	6.17E 04	3.27E 06	0.00E-01	0.00E-01	9.36E 03	3.42E 04	6.25E 04	0.00E-01
MN 54	3.39E 06	1.07E 07	0.00E-01	1.27E 07	3.57E 06	0.00E-01	0.00E-01	0.00E-01
FE 59	5.79E 07	1.21E 08	7.18E 07	1.16E 08	0.00E-01	0.00E-01	3.37E 07	0.00E-01
CO 58	2.21E 07	4.20E 07	0.00E-01	7.21E 06	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CO 60	7.90E 07	1.48E 08	0.00E-01	2.68E 07	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ZN 65	4.79E 09	1.35E 09	2.89E 09	7.70E 09	4.85E 09	0.00E-01	0.00E-01	0.00E-01
RB 86	3.36E 09	3.52E 08	0.00E-01	5.47E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 89	1.13E 08	1.54E 08	3.97E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 90	1.87E 10	9.95E 08	7.38E 10	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y 91	6.21E 02	3.09E 06	2.32E 04	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ZR 95	4.47E 02	5.23E 05	2.28E 03	5.02E 02	7.18E 02	0.00E-01	0.00E-01	0.00E-01
NB 95	5.31E 04	1.37E 08	1.91E 05	7.42E 04	6.98E 04	0.00E-01	0.00E-01	0.00E-01
RU 103	9.88E 02	6.65E 04	2.57E 03	0.00E-01	6.47E 03	0.00E-01	0.00E-01	0.00E-01
RU 106	7.14E 03	8.90E 05	5.72E 04	0.00E-01	7.72E 04	0.00E-01	0.00E-01	0.00E-01
AG110M	7.19E 07	1.07E 10	1.33E 08	9.00E 07	1.68E 08	0.00E-01	0.00E-01	0.00E-01
SN 113	4.61E 06	1.69E 07	4.22E 08	4.13E 07	4.37E 08	3.66E 07	0.00E 01	0.00E 01
TE127M	1.82E 07	1.24E 08	1.53E 08	4.13E 07	4.37E 08	3.66E 07	0.00E-01	0.00E-01
TE129M	2.74E 07	2.15E 08	1.76E 08	4.92E 07	5.18E 08	5.68E 07	0.00E-01	0.00E-01
I 131	4.88E 08	7.64E 07	8.54E 08	8.59E 08	1.41E 09	2.84E 11	0.00E-01	0.00E-01
I 132	3.89E-01	9.95E-01	4.60E-01	8.45E-01	1.29E 00	3.92E 01	0.00E-01	0.00E-01
I 133	5.48E 06	5.84E 06	1.17E 07	1.45E 07	2.41E 07	2.69E 09	0.00E-01	0.00E-01
I 135	3.35E 04	5.39E 04	3.93E 04	7.07E 04	1.08E 05	6.26E 06	0.00E-01	0.00E-01
CS 134	4.78E 09	1.22E 08	1.38E 10	2.27E 10	7.03E 09	0.00E-01	2.52E 09	0.00E-01
CS 136	1.14E 09	6.17E 07	6.39E 08	1.76E 09	9.36E 08	0.00E-01	1.40E 08	0.00E-01
CS 137	2.91E 09	1.23E 08	2.06E 10	1.97E 10	6.42E 09	0.00E-01	2.31E 09	0.00E-01
BA 140	4.36E 06	3.78E 07	7.47E 07	6.54E 04	2.13E 04	0.00E-01	3.90E 04	0.00E-01
CE 141	9.73E 02	8.17E 06	1.31E 04	6.55E 03	2.87E 03	0.00E-01	0.00E-01	0.00E-01
CE 144	5.20E 04	7.96E 07	9.74E 05	3.05E 05	1.69E 05	0.00E-01	0.00E-01	0.00E-01
HF 181	2.53E 03	4.16E 05	2.51E 04	9.79E 01	7.86E 01	8.24E 01	0.00E 01	0.00E 01
AM 241	2.55E 06	1.91E 06	3.40E 07	2.92E 07	1.56E 07	0.00E 01	0.00E 01	0.00E 01

*R Values in units of mrem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2-mrem/yr per $\mu Ci/sec$ for all others.

TABLE 3.3-11 R VALUES FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

PATHWAY = Cow Milk

AGE GROUP = Infant

Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H 3	2.40E 03	2.40E 03	0.00E-01	2.40E 03	2.40E 03	2.40E 03	2.40E 03	2.40E 03
P 32	4.06E 09	1.42E 09	1.05E 11	6.17E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CR 51	9.77E 04	2.85E 06	0.00E-01	0.00E-01	1.39E 04	6.38E 04	1.24E 05	0.00E-01
MN 54	5.37E 06	8.71E 06	0.00E-01	2.37E 07	5.25E 06	0.00E-01	0.00E-01	0.00E-01
FE 59	9.23E 07	1.12E 08	1.34E 08	2.34E 08	0.00E-01	0.00E-01	6.92E 07	0.00E-01
CO 58	3.60E 07	3.59E 07	0.00E-01	1.44E 07	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CO 60	1.29E 08	1.30E 08	0.00E-01	5.47E 07	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ZN 65	6.14E 09	1.12E 10	3.88E 09	1.33E 10	6.45E 09	0.00E-01	0.00E-01	0.00E-01
RB 86	6.86E 09	3.55E 08	0.00E-01	1.39E 10	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 89	2.17E 08	1.55E 08	7.55E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 90	2.05E 10	1.00E 09	8.04E 10	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y 91	1.16E 08	3.12E 06	4.36E 04	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ZR 95	7.01E 02	4.92E 05	4.05E 03	9.88E 02	1.06E 03	0.00E-01	0.00E-01	0.00E-01
NB 95	8.48E 04	1.24E 08	3.56E 05	1.47E 05	1.05E 05	0.00E-01	0.00E-01	0.00E-01
RU 103	1.74E 03	6.33E 04	5.21E 03	0.00E-01	1.08E 04	0.00E-01	0.00E-01	0.00E-01
RU 106	1.47E 04	8.95E 05	1.18E 05	0.00E-01	1.39E 05	0.00E-01	0.00E-01	0.00E-01
AG110M	1.19E 08	9.32E 09	2.46E 08	1.80E 08	2.57E 08	0.00E-01	0.00E-01	0.00E-01
SN 113	6.66E 06	1.37E 07	6.46E 06	2.45E 05	1.32E 05	9.34E 04	0.00E 01	0.00E 01
TE127M	3.75E 07	1.25E 08	3.10E 08	1.03E 08	7.64E 08	8.96E 07	0.00E-01	0.00E-01
TE129M	5.57E 07	2.16E 08	3.62E 08	1.24E 08	9.05E 08	1.39E 08	0.00E-01	0.00E-01
I 131	9.23E 08	7.49E 07	1.78E 09	2.10E 09	2.45E 09	6.90E 11	0.00E-01	0.00E-01
I 132	6.90E-01	1.57E-00	9.55E-01	1.94E 00	2.16E 00	9.09E 01	0.00E-01	0.00E-01
I 133	1.05E 07	6.09E 06	2.47E 07	3.60E 07	4.23E 07	6.55E 09	0.00E-01	0.00E-01
I 135	5.93E 04	5.83E 04	8.17E 04	1.63E 05	1.81E 05	1.46E 07	0.00E-01	0.00E-01
CS 134	4.19E 09	1.13E 08	2.23E 10	4.15E 10	1.07E 10	0.00E-01	4.38E 09	0.00E-01
CS 136	1.37E 09	5.58E 07	1.25E 09	3.67E 09	1.46E 09	0.00E-01	2.99E 08	0.00E-01
CS 137	2.72E 09	1.20E 08	3.28E 10	3.84E 10	1.03E 10	0.00E-01	4.18E 09	0.00E-01
BA 140	7.91E 06	3.77E 07	1.54E 08	1.54E 05	3.65E 04	0.00E-01	9.43E 04	0.00E-01
CE 141	1.87E 03	3.21E 06	2.60E 04	1.59E 04	4.90E 03	0.00E-01	0.00E-01	0.00E-01
CE 144	7.82E 04	8.01E 07	1.40E 06	5.71E 05	2.31E 05	0.00E-01	0.00E-01	0.00E-01
HF 181	4.23E 03	3.94E 05	4.78E 04	2.26E 02	1.32E 02	1.91E 02	0.00E 01	0.00E 01
AM 241	2.72E 06	1.92E 06	3.65E 07	3.17E 07	1.64E 07	0.00E 01	0.00E 01	0.00E 01

*R Values in units of mrem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2-mrem/yr per μCi/sec for all others.

TABLE 3.3-12 R VALUES FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

PATHWAY = Goat Milk

AGE GROUP = Adult

Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H 3	1.57E 03	1.57E 03	0.00E-01	1.57E 03	1.57E 03	1.57E 03	1.57E 03	1.57E 03
P 32	5.19E 08	1.51E 09	1.34E 10	8.34E 08	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CR 51	2.08E 03	5.23E 05	0.00E-01	0.00E-01	4.58E 02	1.24E 03	2.76E 03	0.00E-01
MN 54	1.17E 05	1.88E 06	0.00E-01	6.14E 05	1.83E 05	0.00E-01	0.00E-01	0.00E-01
FE 59	2.08E 05	1.81E 06	2.31E 05	5.42E 05	0.00E-01	0.00E-01	1.51E 05	0.00E-01
CO 58	7.54E 05	6.82E 06	0.00E-01	3.36E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CO 60	2.69E 06	2.29E 07	0.00E-01	1.22E 06	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ZN 65	1.65E 08	2.31E 08	1.15E 08	3.66E 08	2.45E 08	0.00E-01	0.00E-01	0.00E-01
RB 86	9.05E 07	3.83E 07	0.00E-01	1.94E 08	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 89	5.24E 07	2.93E 08	1.83E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 90	1.59E 10	1.88E 09	6.49E 10	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y 91	1.64E 01	3.37E 05	6.13E 02	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ZR 95	1.46E 01	6.85E 04	6.74E 01	2.16E 01	3.39E 01	0.00E-01	0.00E-01	0.00E-01
NB 95	1.78E 03	2.01E 07	5.94E 03	3.31E 03	3.27E 03	0.00E-01	0.00E-01	0.00E-01
RU 103	3.16E 01	8.56E 03	7.33E 01	0.00E-01	2.80E 02	0.00E-01	0.00E-01	0.00E-01
RU 106	1.92E 02	9.81E 04	1.52E 03	0.00E-01	2.93E 03	0.00E-01	0.00E-01	0.00E-01
AG110M	2.45E 06	1.68E 09	4.46E 06	4.12E 06	8.11E 06	0.00E-01	0.00E-01	0.00E-01
SN 113	1.32E 05	2.44E 06	1.40E 05	5.41E 03	3.96E 03	1.90E 03	0.00E 01	0.00E 01
TE127M	4.93E 05	1.36E 07	4.05E 06	1.45E 06	1.64E 07	1.03E 06	0.00E-01	0.00E-01
TE129M	7.43E 05	2.36E 07	4.69E 06	1.75E 06	1.96E 07	1.61E 06	0.00E-01	0.00E-01
I 131	1.91E 08	8.78E 07	2.33E 08	3.33E 08	5.71E 08	1.09E 11	0.00E-01	0.00E-01
I 132	1.23E-01	6.61E-02	1.32E-01	3.52E-01	5.61E-01	1.23E 01	0.00E-01	0.00E-01
I 133	1.68E 06	4.95E 06	3.17E 06	5.51E 06	9.61E 06	8.10E 08	0.00E-01	0.00E-01
I 135	1.08E 04	3.32E 04	1.12E 04	2.94E 04	4.71E 04	1.94E 06	0.00E-01	0.00E-01
CS 134	2.01E 10	4.31E 08	1.03E 10	2.46E 10	7.97E 09	0.00E-01	2.65E 09	0.00E-01
CS 136	1.42E 09	2.24E 08	4.99E 08	1.97E 09	1.10E 09	0.00E-01	1.50E 08	0.00E-01
CS 137	1.27E 10	3.74E 08	1.41E 10	1.93E 10	6.56E 09	0.00E-01	2.18E 09	0.00E-01
BA 140	1.35E 05	4.23E 06	2.06E 06	2.58E 03	8.78E 02	0.00E-01	1.48E 03	0.00E-01
CE 141	2.68E 01	9.03E 05	3.49E 02	2.36E 02	1.10E 02	0.00E-01	0.00E-01	0.00E-01
CE 144	1.38E 03	8.71E 06	2.58E 04	1.08E 04	6.39E 03	0.00E-01	0.00E-01	0.00E-01
HF 181	8.02E 01	5.26E 04	7.09E 02	3.99E 00	3.34E 00	2.54E 00	0.00E 01	0.00E 01
AM 241	1.52E 05	2.09E 05	2.12E 06	1.99E 06	1.15E 06	0.00E 01	0.00E 01	0.00E 01

*R Values in units of mrem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2-mrem/yr per μCi/sec for all others.

TABLE 3.3-13 R VALUES FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

PATHWAY = Goat Milk

AGE GROUP = Teen

Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H 3	2.04E 03	2.04E 03	0.00E-01	2.04E 03	2.04E 03	2.04E 03	2.04E 03	2.04E 03
P 32	9.60E 08	2.08E 09	2.48E 10	1.53E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CR 51	3.63E 03	6.10E 05	0.00E-01	0.00E-01	7.95E 02	2.02E 03	5.18E 03	0.00E-01
MN 54	2.03E 05	2.10E 06	0.00E-01	1.02E 06	3.05E 05	0.00E-01	0.00E-01	0.00E-01
FE 59	3.63E 05	2.22E 06	4.03E 05	9.40E 05	0.00E-01	0.00E-01	2.96E 05	0.00E-01
CO 58	1.30E 06	7.80E 06	0.00E-01	5.66E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CO 60	4.66E 06	2.69E 07	0.00E-01	2.07E 06	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ZN 65	2.86E 08	2.60E 08	1.77E 08	6.13E 08	3.93E 08	0.00E-01	0.00E-01	0.00E-01
RB 86	1.66E 08	5.24E 07	0.00E-01	3.54E 08	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 89	9.65E 07	4.01E 08	3.37E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 90	2.27E 10	2.58E 09	9.18E 10	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y 91	3.02E 01	4.62E 05	1.13E 03	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ZR 95	2.56E 01	8.59E 04	1.18E 02	3.72E 01	5.47E 01	0.00E-01	0.00E-01	0.00E-01
NB 95	3.09E 03	2.40E 07	1.01E 04	5.62E 03	5.45E 03	0.00E-01	0.00E-01	0.00E-01
RU 103	5.58E 01	1.09E 04	1.30E 02	0.00E-01	4.60E 02	0.00E-01	0.00E-01	0.00E-01
RU 106	3.51E 02	1.34E 05	2.79E 03	0.00E-01	5.38E 03	0.00E-01	0.00E-01	0.00E-01
AG110M	4.24E 06	1.96E 09	7.37E 06	6.97E 06	1.33E 07	0.00E-01	0.00E-01	0.00E-01
SN 113	2.28E 05	2.58E 06	2.15E 05	9.06E 03	6.37E 03	2.97E 03	0.00E 01	0.00E 01
TE127M	8.87E 05	1.86E 07	7.46E 06	2.65E 06	3.02E 07	1.77E 06	0.00E-01	0.00E-01
TE129M	1.36E 06	3.22E 07	8.58E 06	3.19E 06	3.59E 07	2.77E 06	0.00E-01	0.00E-01
I 131	3.18E 08	1.17E 08	4.22E 08	5.91E 08	1.02E 09	1.73E 11	0.00E-01	0.00E-01
I 132	2.19E-01	2.66E-01	2.33E-01	6.11E-01	9.62E-01	2.06E 01	0.00E-01	0.00E-01
I 133	2.99E 06	7.43E 06	5.79E 06	9.81E 06	1.72E 07	1.37E 09	0.00E-01	0.00E-01
I 135	1.90E 04	5.63E 04	1.99E 04	5.13E 04	8.10E 04	3.30E 06	0.00E-01	0.00E-01
CS 134	1.96E 10	5.26E 08	1.80E 10	4.23E 10	1.34E 10	0.00E-01	5.13E 09	0.00E-01
CS 136	2.25E 09	2.69E 07	8.50E 08	3.34E 09	1.82E 09	0.00E-01	2.87E 08	0.00E-01
CS 137	1.19E 10	4.85E 08	2.56E 10	3.41E 10	1.16E 10	0.00E-01	4.51E 09	0.00E-01
BA 140	2.39E 05	5.72E 06	3.71E 06	4.55E 03	1.54E 03	0.00E-01	3.06E 03	0.00E-01
CE 141	4.91E 01	1.22E 06	6.40E 02	4.27E 02	2.01E 02	0.00E-01	0.00E-01	0.00E-01
CE 144	2.55E 03	1.19E 07	4.74E 04	1.96E 04	1.17E 04	0.00E-01	0.00E-01	0.00E-01
HF 181	1.41E 02	6.34E 04	1.27E 03	6.97E 00	5.81E 00	4.26E 00	0.00E 01	0.00E 01
AM 241	2.09E 05	2.86E 05	2.90E 06	2.74E 06	1.57E 06	0.00E 01	0.00E 01	0.00E 01

*R Values in units of mrem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2-mrem/yr per μCi/sec for all others.

TABLE 3.3-14 R VALUES FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

PATHWAY = Goat Milk

AGE GROUP = Child

Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H 3	3.23E 03	3.23E 03	0.00E-01	3.23E 03	3.23E 03	3.23E 03	3.23E 03	3.23E 03
P 32	2.35E 09	1.69E 09	6.11E 10	2.86E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CR 51	7.40E 03	3.93E 05	0.00E-01	0.00E-01	1.12E 03	4.11E 03	7.50E 03	0.00E-01
MN 54	4.07E 05	1.28E 06	0.00E-01	1.53E 06	4.29E 05	0.00E-01	0.00E-01	0.00E-01
FE 59	7.52E 05	1.57E 06	9.34E 05	1.51E 06	0.00E-01	0.00E-01	4.38E 05	0.00E-01
CO 58	2.65E 06	5.05E 06	0.00E-01	8.65E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CO 60	9.48E 06	1.78E 07	0.00E-01	3.21E 06	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ZN 65	5.74E 08	1.62E 08	3.47E 08	9.24E 08	5.82E 08	0.00E-01	0.00E-01	0.00E-01
RB 86	4.04E 08	4.22E 07	0.00E-01	6.57E 08	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 89	2.38E 08	3.23E 08	8.34E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 90	3.93E 10	2.09E 09	1.55E 11	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y 91	7.45E 01	3.71E 05	2.79E 03	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ZR 95	5.36E 01	6.28E 04	2.74E 02	6.02E 01	8.62E 01	0.00E-01	0.00E-01	0.00E-01
NB 95	6.37E 03	1.65E 07	2.29E 04	8.91E 03	8.37E 03	0.00E-01	0.00E-01	0.00E-01
RU 103	1.19E 02	7.98E 03	3.09E 02	0.00E-01	7.77E 02	0.00E-01	0.00E-01	0.00E-01
RU 106	8.56E 02	1.07E 05	6.86E 03	0.00E-01	9.27E 03	0.00E-01	0.00E-01	0.00E-01
AG110M	8.63E 06	1.28E 09	1.60E 07	1.08E 07	2.01E 07	0.00E-01	0.00E-01	0.00E-01
SN 113	4.61E 05	1.69E 06	4.22E 05	1.36E 04	9.38E 03	5.59E 03	0.00E 01	0.00E 01
TE127M	2.18E 06	1.49E 07	1.84E 07	4.95E 06	5.24E 07	4.40E 06	0.00E-01	0.00E-01
TE129M	3.28E 06	2.58E 07	2.12E 07	5.91E 06	6.21E 07	6.82E 06	0.00E-01	0.00E-01
I 131	5.85E 08	9.17E 07	1.02E 09	1.03E 09	1.69E 09	3.41E 11	0.00E-01	0.00E-01
I 132	4.67E-01	1.19E 00	5.52E-01	1.01E 00	1.55E 00	4.71E 01	0.00E-01	0.00E-01
I 133	6.58E 06	7.00E 06	1.41E 07	1.74E 07	2.90E 07	3.23E 09	0.00E-01	0.00E-01
I 135	4.01E 04	6.47E 04	4.72E 04	8.49E 04	1.30E 05	7.52E 06	0.00E-01	0.00E-01
CS 134	1.43E 10	3.67E 08	4.14E 10	6.80E 10	2.11E 10	0.00E-01	7.56E 09	0.00E-01
CS 136	3.41E 09	1.85E 08	1.92E 09	5.27E 09	2.81E 09	0.00E-01	4.19E 08	0.00E-01
CS 137	8.72E 09	3.70E 08	6.17E 10	5.91E 10	1.93E 10	0.00E-01	6.93E 09	0.00E-01
BA 140	5.23E 05	4.54E 05	8.96E 06	7.85E 03	2.56E 03	0.00E-01	4.68E 03	0.00E-01
CE 141	1.17E 02	9.81E 05	1.53E 03	7.36E 02	3.45E 02	0.00E-01	0.00E-01	0.00E-01
CE 144	6.24E 03	9.55E 06	1.17E 05	3.66E 04	2.03E 04	0.00E-01	0.00E-01	0.00E-01
HF 181	3.04E 02	4.99E 04	3.02E 03	1.17E 01	9.43E 00	9.89E 00	0.00E 01	0.00E 01
AM 241	3.06E 05	2.29E 05	4.08E 06	3.50E 06	1.87E 06	0.00E 01	0.00E 01	0.00E 01

*R Values in units of mrem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2-mrem/yr per μCi/sec for all others.

TABLE 3.3-15 R VALUES FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

PATHWAY = Goat Milk

AGE GROUP = Infant

Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H 3	4.90E 03	4.90E 03	0.00E-01	4.90E 03	4.90E 03	4.90E 03	4.90E 03	4.90E 03
P 32	4.88E 09	1.70E 09	1.26E 11	7.40E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CR 51	1.17E 04	3.42E 05	0.00E-01	0.00E-01	1.67E 03	7.65E 03	1.49E 04	0.00E-01
MN 54	6.45E 05	1.04E 06	0.00E-01	2.84E 06	6.30E 05	0.00E-01	0.00E-01	0.00E-01
FE 59	1.20E 06	1.45E 06	1.74E 06	3.04E 06	0.00E-01	0.00E-01	9.00E 05	0.00E-01
CO 58	4.31E 06	4.31E 06	0.00E-01	1.73E 06	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CO 60	1.55E 07	1.56E 07	0.00E-01	6.56E 06	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ZN 65	7.36E 08	1.35E 09	4.66E 08	1.60E 09	7.74E 08	0.00E-01	0.00E-01	0.00E-01
RB 86	8.23E 08	4.26E 07	0.00E-01	1.67E 09	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 89	4.55E 08	3.26E 08	1.59E 10	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 90	4.30E 10	2.11E 09	1.69E 11	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y 91	1.39E 02	3.75E 05	5.23E 03	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ZR 95	8.41E 01	5.90E 04	4.85E 02	1.19E 02	1.28E 02	0.00E-01	0.00E-01	0.00E-01
NB 95	1.02E 04	1.48E 07	4.27E 04	1.76E 04	1.26E 04	0.00E-01	0.00E-01	0.00E-01
RU 103	2.09E 02	7.60E 03	6.25E 02	0.00E-01	1.30E 03	0.00E-01	0.00E-01	0.00E-01
RU 106	1.77E 03	1.07E 05	1.41E 04	0.00E-01	1.67E 04	0.00E-01	0.00E-01	0.00E-01
AG110M	1.43E 07	1.12E 09	2.95E 07	2.16E 07	3.08E 07	0.00E-01	0.00E-01	0.00E-01
SN 113	6.66E 05	1.37E 06	6.46E 05	2.45E 04	1.32E 04	9.34E 03	0.00E 01	0.00E 01
TE127M	4.51E 06	1.50E 07	3.72E 07	1.23E 07	9.16E 07	1.08E 07	0.00E-01	0.00E-01
TE129M	6.69E 06	2.59E 07	4.34E 07	1.49E 07	1.09E 08	1.67E 07	0.00E-01	0.00E-01
I 131	1.11E 09	8.99E 07	2.14E 09	2.52E 09	2.94E 09	8.28E 11	0.00E-01	0.00E-01
I 132	8.28E-01	1.88E 00	1.15E 00	2.33E 00	2.59E 00	1.09E 02	0.00E-01	0.00E-01
I 133	1.27E 07	7.31E 06	2.97E 07	4.32E 07	5.08E 07	7.86E 09	0.00E-01	0.00E-01
I 135	7.11E 04	7.06E 04	9.81E 04	1.95E 05	2.17E 05	1.75E 07	0.00E-01	0.00E-01
CS 134	1.26E 10	3.38E 08	6.68E 10	1.25E 11	3.21E 10	0.00E-01	1.31E 10	0.00E-01
CS 136	4.11E 09	1.67E 08	3.75E 09	1.10E 10	4.39E 09	0.00E-01	8.98E 08	0.00E-01
CS 137	8.17E 09	3.61E 08	9.85E 10	1.15E 11	3.10E 10	0.00E-01	1.25E 10	0.00E-01
BA 140	9.50E 05	4.53E 06	1.84E 07	1.84E 04	4.38E 03	0.00E-01	1.13E 04	0.00E-01
CE 141	2.24E 02	9.85E 05	3.13E 03	1.91E 03	5.88E 02	0.00E-01	0.00E-01	0.00E-01
CE 144	9.39E 03	9.61E 06	1.67E 05	6.86E 04	2.77E 04	0.00E-01	0.00E-01	0.00E-01
HF 181	5.08E 02	4.72E 04	5.74E 03	2.71E 01	1.58E 01	2.30E 01	0.00E 01	0.00E 01
AM 241	3.26E 05	2.30E 05	4.38E 06	3.80E 06	1.97E 06	0.00E 01	0.00E 01	0.00E 01

*R Values in units of mrem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2-mrem/yr per μCi/sec for all others.

TABLE 3.3-16 R VALUES FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

PATHWAY = Inhalation

AGE GROUP = Adult

Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H 3	1.26E 03	1.26E 03	0.00E-01	1.26E 03	1.26E 03	1.26E 03	1.26E 03	1.26E 03
P 32	5.00E 04	8.63E 04	1.32E 06	7.70E 04	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CR 51	9.99E 01	3.32E 03	0.00E-01	0.00E-01	2.28E 01	5.94E 01	1.44E 04	0.00E-01
MN 54	6.29E 03	7.72E 04	0.00E-01	3.95E 04	9.83E 03	0.00E-01	1.40E 06	0.00E-01
FE 59	1.05E 04	1.88E 05	1.17E 04	2.77E 04	0.00E-01	0.00E-01	1.01E 06	0.00E-01
CO 58	2.07E 03	1.06E 05	0.00E-01	1.58E 03	0.00E-01	0.00E-01	9.27E 05	0.00E-01
CO 60	1.48E 04	2.84E 05	0.00E-01	1.15E 04	0.00E-01	0.00E-01	5.96E 06	0.00E-01
ZN 65	4.65E 04	5.34E 04	3.24E 04	1.03E 05	6.89E 04	0.00E-01	8.63E 05	0.00E-01
RB 86	5.89E 04	1.66E 04	0.00E-01	1.35E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 89	8.71E 03	3.49E 05	3.04E 05	0.00E-01	0.00E-01	0.00E-01	1.40E 06	0.00E-01
SR 90	6.09E 06	7.21E 05	9.91E 07	0.00E-01	0.00E-01	0.00E-01	9.59E 06	0.00E-01
Y 91	1.24E 04	3.84E 05	4.62E 05	0.00E-01	0.00E-01	0.00E-01	1.70E 06	0.00E-01
ZR 95	2.32E 04	1.50E 05	1.07E 05	3.44E 04	5.41E 04	0.00E-01	1.77E 06	0.00E-01
NB 95	4.20E 03	1.04E 05	1.41E 04	7.80E 03	7.72E 03	0.00E-01	5.04E 05	0.00E-01
RU 103	6.57E 02	1.10E 05	1.53E 03	0.00E-01	5.82E 03	0.00E-01	5.04E 05	0.00E-01
RU 106	8.71E 03	9.11E 05	6.90E 04	0.00E-01	1.33E 05	0.00E-01	9.35E 06	0.00E-01
AG110M	5.94E 03	3.02E 05	1.08E 04	9.99E 03	1.97E 04	0.00E-01	4.63E 06	0.00E-01
SN 113	6.48E 03	2.48E 04	6.87E 03	2.66E 02	1.97E 02	9.33E 01	2.99E 05	0.00E 01
TE127M	1.57E 03	1.49E 05	1.26E 04	5.76E 03	4.57E 04	3.28E 03	9.59E 05	0.00E-01
TE129M	1.58E 03	3.83E 05	9.75E 03	4.67E 03	3.65E 04	3.44E 03	1.16E 06	0.00E-01
I 131	2.05E 04	6.27E 03	2.52E 04	3.57E 04	6.12E 04	1.19E 07	0.00E-01	0.00E-01
I 132	1.16E 03	4.06E 02	1.16E 03	3.25E 03	5.18E 03	1.14E 05	0.00E-01	0.00E-01
I 133	4.51E 03	8.87E 03	8.63E 03	1.48E 04	2.58E 04	2.15E 06	0.00E-01	0.00E-01
I 135	2.56E 03	5.24E 03	2.68E 03	6.97E 03	1.11E 04	4.47E 05	0.00E-01	0.00E-01
CS 134	7.27E 05	1.04E 04	3.72E 05	8.47E 05	2.87E 05	0.00E-01	9.75E 04	0.00E-01
CS 136	1.10E 05	1.17E 04	3.90E 04	1.46E 05	8.55E 04	0.00E-01	1.20E 04	0.00E-01
CS 137	4.27E 05	8.39E 03	4.78E 05	6.20E 05	2.22E 05	0.00E-01	7.51E 04	0.00E-01
BA 140	2.56E 03	2.18E 05	3.90E 04	4.90E 01	1.67E 01	0.00E-01	1.27E 06	0.00E-01
CE 141	1.53E 03	1.20E 05	1.99E 04	1.35E 04	6.25E 03	0.00E-01	3.61E 05	0.00E-01
CE 144	1.84E 05	8.15E 05	3.43E 06	1.43E 06	8.47E 05	0.00E-01	7.76E 06	0.00E-01
HF 181	5.16E 03	1.29E 05	4.56E 04	2.57E 02	2.15E 02	1.63E 02	5.99E 05	0.00E 01
AM 241	5.37E 08	3.68E 05	1.34E 10	9.04E 09	4.03E 09	0.00E 01	4.85E 08	0.00E 01

*R Values in units of mrem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2-mrem/yr per $\mu Ci/sec$ for all others.

TABLE 3.3-17 R VALUES FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

PATHWAY = Inhalation

AGE GROUP = Teen

Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H 3	1.27E 03	1.27E 03	0.00E-01	1.27E 03	1.27E 03	1.27E 03	1.27E 03	1.27E 03
P 32	7.15E 04	9.27E 04	1.89E 06	1.09E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CR 51	1.35E 02	3.00E 03	0.00E-01	0.00E-01	3.07E 01	7.49E 01	2.09E 04	0.00E-01
MN 54	8.39E 03	6.67E 04	0.00E-01	5.10E 04	1.27E 04	0.00E-01	1.98E 06	0.00E-01
FE 59	1.43E 04	1.78E 05	1.59E 04	3.69E 04	0.00E-01	0.00E-01	1.53E 06	0.00E-01
CO 58	2.77E 03	9.51E 04	0.00E-01	2.07E 03	0.00E-01	0.00E-01	1.34E 06	0.00E-01
CO 60	1.98E 04	2.59E 05	0.00E-01	1.51E 04	0.00E-01	0.00E-01	8.71E 06	0.00E-01
ZN 65	6.23E 04	4.66E 04	3.85E 04	1.33E 05	8.63E 04	0.00E-01	1.24E 06	0.00E-01
RB 86	8.39E 04	1.77E 04	0.00E-01	1.90E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 89	1.25E 04	3.71E 05	4.34E 05	0.00E-01	0.00E-01	0.00E-01	2.41E 06	0.00E-01
SR 90	6.67E 06	7.64E 05	1.08E 08	0.00E-01	0.00E-01	0.00E-01	1.65E 07	0.00E-01
Y 91	1.77E 04	4.08E 05	6.60E 05	0.00E-01	0.00E-01	0.00E-01	2.93E 06	0.00E-01
ZR 95	3.15E 04	1.49E 05	1.45E 05	4.58E 04	6.73E 04	0.00E-01	2.68E 06	0.00E-01
NB 95	5.66E 03	9.67E 04	1.85E 04	1.03E 04	9.99E 03	0.00E-01	7.50E 05	0.00E-01
RU 103	8.95E 02	1.09E 05	2.10E 03	0.00E-01	7.42E 03	0.00E-01	7.82E 05	0.00E-01
RU 106	1.24E 04	9.59E 05	9.83E 04	0.00E-01	1.90E 05	0.00E-01	1.61E 07	0.00E-01
AG110M	7.98E 03	2.72E 05	1.38E 04	1.31E 04	2.50E 04	0.00E-01	6.74E 06	0.00E-01
SN 113	8.69E 03	2.03E 04	8.19E 03	3.45E 02	2.46E 02	1.13E 02	4.27E 05	0.00E 01
TE127M	2.18E 03	1.59E 05	1.80E 04	8.15E 03	6.53E 04	4.38E 03	1.65E 06	0.00E-01
TE129M	2.24E 03	4.04E 05	1.39E 04	6.57E 03	5.18E 04	4.57E 03	1.97E 06	0.00E-01
I 131	2.64E 04	6.48E 03	3.54E 04	4.90E 04	8.39E 04	1.46E 07	0.00E-01	0.00E-01
I 132	1.57E 03	1.27E 03	1.59E 03	4.37E 03	6.91E 03	1.51E 05	0.00E-01	0.00E-01
I 133	6.21E 03	1.03E 04	1.21E 04	2.05E 04	3.59E 04	2.92E 06	0.00E-01	0.00E-01
I 135	3.48E 03	6.94E 03	3.69E 03	9.43E 03	1.49E 04	6.20E 05	0.00E-01	0.00E-01
CS 134	5.48E 05	9.75E 03	5.02E 05	1.13E 06	3.75E 05	0.00E-01	1.46E 05	0.00E-01
CS 136	1.37E 05	1.09E 04	5.14E 04	1.93E 05	1.10E 05	0.00E-01	1.77E 04	0.00E-01
CS 137	3.11E 05	8.48E 03	6.69E 05	8.47E 05	3.04E 05	0.00E-01	1.21E 05	0.00E-01
BA 140	3.51E 03	2.28E 05	5.46E 04	6.69E 01	2.28E 01	0.00E-01	2.03E 06	0.00E-01
CE 141	2.16E 03	1.26E 05	2.84E 04	1.89E 04	8.87E 03	0.00E-01	6.13E 05	0.00E-01
CE 144	2.62E 05	8.63E 05	4.88E 06	2.02E 06	1.21E 06	0.00E-01	1.33E 07	0.00E-01
HF 181	7.05E 03	1.21E 05	6.32E 04	3.48E 02	2.90E 02	2.12E 02	9.39E 05	0.00E 01
AM 241	5.68E 08	3.90E 05	1.42E 10	9.60E 09	4.26E 09	0.00E 01	8.40E 08	0.00E 01

*R Values in units of mrem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2-mrem/yr per $\mu Ci/sec$ for all others.

TABLE 3.3-18 R VALUES FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

PATHWAY = Inhalation

AGE GROUP = Child

Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H 3	1.12E 03	1.12E 03	0.00E-01	1.12E 03	1.12E 03	1.12E 03	1.12E 03	1.12E 03
P 32	9.86E 04	4.21E 04	2.60E 06	1.14E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CR 51	1.54E 02	1.08E 03	0.00E-01	0.00E-01	2.43E 01	8.53E 01	1.70E 04	0.00E-01
MN 54	9.50E 03	2.29E 04	0.00E-01	4.29E 04	1.00E 04	0.00E-01	1.57E 06	0.00E-01
FE 59	1.67E 04	7.06E 04	2.07E 04	3.34E 04	0.00E-01	0.00E-01	1.27E 06	0.00E-01
CO 58	3.16E 03	3.43E 04	0.00E-01	1.77E 03	0.00E-01	0.00E-01	1.10E 06	0.00E-01
CO 60	2.26E 04	9.61E 04	0.00E-01	1.31E 04	0.00E-01	0.00E-01	7.06E 06	0.00E-01
ZN 65	7.02E 04	1.63E 04	4.25E 04	1.13E 05	7.13E 04	0.00E-01	9.94E 05	0.00E-01
RB 86	1.14E 05	7.98E 03	0.00E-01	1.98E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 89	1.72E 04	1.67E 05	5.99E 05	0.00E-01	0.00E-01	0.00E-01	2.15E 06	0.00E-01
SR 90	6.43E 06	3.43E 05	1.01E 08	0.00E-01	0.00E-01	0.00E-01	1.47E 07	0.00E-01
Y 91	2.43E 04	1.84E 05	9.13E 05	0.00E-01	0.00E-01	0.00E-01	2.62E 06	0.00E-01
ZR 95	3.69E 04	6.10E 04	1.90E 05	4.17E 04	5.95E 04	0.00E-01	2.23E 06	0.00E-01
NB 95	6.54E 03	3.69E 04	2.35E 04	9.16E 03	8.61E 03	0.00E-01	6.13E 05	0.00E-01
RU 103	1.07E 03	4.47E 04	2.79E 03	0.00E-01	7.02E 03	0.00E-01	6.61E 05	0.00E-01
RU 106	1.69E 04	4.29E 05	1.36E 05	0.00E-01	1.84E 05	0.00E-01	1.43E 07	0.00E-01
AG110M	9.13E 03	1.00E 05	1.68E 04	1.14E 04	2.12E 04	0.00E-01	5.47E 06	0.00E-01
SN 113	9.84E 03	7.45E 03	9.01E 03	2.91E 02	2.03E 02	1.19E 02	3.40E 05	0.00E 01
TE127M	3.01E 03	7.13E 04	2.48E 04	8.53E 03	6.35E 04	6.06E 03	1.48E 06	0.00E-01
TE129M	3.04E 03	1.81E 05	1.92E 04	6.84E 03	5.02E 04	6.32E 03	1.76E 06	0.00E-01
I 131	2.72E 04	2.84E 03	4.80E 04	4.80E 04	7.87E 04	1.62E 07	0.00E-01	0.00E-01
I 132	1.87E 03	3.20E 03	2.11E 03	4.06E 03	6.24E 03	1.93E 05	0.00E-01	0.00E-01
I 133	7.68E 03	5.47E 03	1.66E 04	2.03E 04	3.37E 04	3.84E 06	0.00E-01	0.00E-01
I 135	4.14E 03	4.43E 03	4.91E 03	8.72E 03	1.34E 04	7.91E 05	0.00E-01	0.00E-01
CS 134	2.24E 05	3.84E 03	6.50E 05	1.01E 06	3.30E 05	0.00E-01	1.21E 05	0.00E-01
CS 136	1.16E 05	4.17E 03	6.50E 04	1.71E 05	9.53E 04	0.00E-01	1.45E 04	0.00E-01
CS 137	1.28E 05	3.61E 03	9.05E 05	8.24E 05	2.82E 05	0.00E-01	1.04E 05	0.00E-01
BA 140	4.32E 03	1.02E 05	7.39E 04	6.47E 01	2.11E 01	0.00E-01	1.74E 06	0.00E-01
CE 141	2.89E 03	5.65E 04	3.92E 04	1.95E 04	8.53E 03	0.00E-01	5.43E 05	0.00E-01
CE 144	3.61E 05	3.88E 05	6.76E 06	2.11E 06	1.17E 06	0.00E-01	1.19E 07	0.00E-01
HF 181	8.50E 03	5.31E 04	8.44E 04	3.28E 02	2.64E 02	2.76E 02	7.95E 05	0.00E 01
AM 241	4.59E 08	1.75E 05	1.10E 10	6.81E 09	2.82E 09	0.00E 01	7.47E 08	0.00E 01

*R Values in units of mrem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2-mrem/yr per μCi/sec for all others.

TABLE 3.3-19 R VALUES FOR THE BRUNSWICK STEAM ELECTRIC PLANT*

PATHWAY = Inhalation

AGE GROUP = Infant

Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H 3	6.46E 02	6.46E 02	0.00E-01	6.46E 02	6.46E 02	6.46E 02	6.46E 02	6.46E 02
P 32	7.73E 04	1.61E 04	2.03E 06	1.12E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CR 51	8.93E 01	3.56E 02	0.00E-01	0.00E-01	1.32E 01	5.75E 01	1.28E 04	0.00E-01
MN 54	4.98E 03	7.05E 03	0.00E-01	2.53E 04	4.98E 03	0.00E-01	9.98E 05	0.00E-01
FE 59	9.46E 03	2.47E 04	1.35E 04	2.35E 04	0.00E-01	0.00E-01	1.01E 06	0.00E-01
CO 58	1.82E 03	1.11E 04	0.00E-01	1.22E 03	0.00E-01	0.00E-01	7.76E 05	0.00E-01
CO 60	1.18E 04	3.19E 04	0.00E-01	8.01E 03	0.00E-01	0.00E-01	4.50E 06	0.00E-01
ZN 65	3.10E 04	5.13E 04	1.93E 04	6.25E 04	3.24E 04	0.00E-01	6.46E 05	0.00E-01
RB 86	8.81E 04	3.03E 03	0.00E-01	1.90E 05	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR 89	1.14E 04	6.39E 04	3.97E 05	0.00E-01	0.00E-01	0.00E-01	2.03E 06	0.00E-01
SR 90	2.59E 06	1.31E 05	4.08E 07	0.00E-01	0.00E-01	0.00E-01	1.12E 07	0.00E-01
Y 91	1.57E 04	7.02E 04	5.87E 05	0.00E-01	0.00E-01	0.00E-01	2.45E 06	0.00E-01
ZR 95	2.03E 04	2.17E 04	1.15E 05	2.78E 04	3.10E 04	0.00E-01	1.75E 06	0.00E-01
NB 95	3.77E 03	1.27E 04	1.57E 04	6.42E 03	4.71E 03	0.00E-01	4.78E 05	0.00E-01
RU 103	6.78E 02	1.61E 04	2.01E 03	0.00E-01	4.24E 03	0.00E-01	5.51E 05	0.00E-01
RU 106	1.09E 04	1.64E 05	8.67E 04	0.00E-01	1.06E 05	0.00E-01	1.15E 07	0.00E-01
AG110M	4.99E 03	3.30E 04	9.97E 03	7.21E 03	1.09E 04	0.00E-01	3.66E 06	0.00E-01
SN 113	4.89E 03	2.29E 03	4.68E 03	1.74E 02	9.94E 01	6.73E 01	2.30E 05	0.00E 01
TE127M	2.07E 03	2.73E 04	1.66E 04	6.89E 03	3.75E 04	4.86E 03	1.31E 06	0.00E-01
TE129M	2.22E 03	6.89E 04	1.41E 04	6.08E 03	3.17E 04	5.47E 03	1.68E 06	0.00E-01
I 131	1.96E 04	1.06E 03	3.79E 04	4.43E 04	5.17E 04	1.48E 07	0.00E-01	0.00E-01
I 132	1.26E 03	1.90E 03	1.69E 03	3.54E 03	3.94E 03	1.69E 05	0.00E-01	0.00E-01
I 133	5.59E 03	2.15E 03	1.32E 04	1.92E 04	2.24E 04	3.55E 06	0.00E-01	0.00E-01
I 135	2.77E 03	1.83E 03	3.86E 03	7.59E 03	8.46E 03	6.95E 05	0.00E-01	0.00E-01
CS 134	7.44E 04	1.33E 03	3.96E 05	7.02E 05	1.90E 05	0.00E-01	7.95E 04	0.00E-01
CS 136	5.28E 04	1.43E 03	4.82E 04	1.34E 05	5.63E 04	0.00E-01	1.17E 04	0.00E-01
CS 137	4.54E 04	1.33E 03	5.48E 05	6.11E 05	1.72E 05	0.00E-01	7.12E 04	0.00E-01
BA 140	2.89E 03	3.83E 04	5.59E 04	5.59E 01	1.34E 01	0.00E-01	1.59E 06	0.00E-01
CE 141	1.99E 03	2.15E 04	2.77E 04	1.66E 04	5.24E 03	0.00E-01	5.16E 05	0.00E-01
CE 144	1.76E 05	1.48E 05	3.19E 06	1.21E 06	5.37E 05	0.00E-01	9.83E 06	0.00E-01
HF 181	5.05E 03	1.90E 04	5.65E 04	2.66E 02	1.59E 02	2.26E 02	6.73E 05	0.00E 01
AM 241	1.83E 08	6.69E 04	4.41E 09	2.73E 09	1.11E 09	0.00E 01	5.68E 08	0.00E 01

*R Values in units of mrem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2-mrem/yr per $\mu Ci/sec$ for all others.

INDEX

LIST OF TABLES

4.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Table 4.0-1 contains the sample point description, sampling and collection frequency analysis, and analysis frequency for various exposure pathways in the vicinity of the BSEP for the radiological monitoring program. Figure 4.0-1 shows the location of various sample points. Figure F-2, Gaseous Radwaste Effluent System, denotes the various release pathways.

TABLE 4.0-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM*

Exposure Pathway and/or Sample	Sample ID No.	Sample Point Description - Approximate Distance and Direction	Sampling and Collection Frequency	Analysis Frequency	Analysis [a]
DIRECT RADIATION	1	1.1 miles E	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

*Refer to Figure 4.0-1 and Figure F-2.

TABLE 4.0-1 (Cont'd)

Exposure Pathway and/or Sample	Sample ID No.	Sample Point Description, Approximate Distance, and Direction	Sampling and Collection Frequency	Analysis Frequency	Analysis [a]
DIRECT RADIATION (Cont'd)	18	1.7 miles SE	Q	Q	Gamma Dose
	77	5.3 miles S	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 ENE	Q	Q	Gamma Dose
	33	4.0 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

TABLE 4.0-1 (Cont'd)

Exposure Pathway and/or Sample	Sample ID No.	Sample Point Description, Approximate Distance, and Direction	Sampling and Collection Frequency	Analysis Frequency	Analysis [a]
DIRECT RADIATION (Cont'd)	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
	20	2.0 miles S	Q	Q	Gamma Dose
	21	2.9 miles SSW	Q	Q	Gamma Dose
	28	4.2 miles NW	Q	Q	Gamma Dose
	29	2.6 miles SSW	Q	Q	Gamma Dose
	35	7.5 miles SSE	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]
AIRBORNE Radioiodine and 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 I-131 analysis
				W	Particulate sampler
	201	0.6 miles NE PMAC			Gross beta radioactivity analysis following filter change [b]
	202	1.0 miles S Substation - Const. Rd.		Q	Gamma isotopic analysis of composite by location
	203	2.3 miles SSW Southport Substation			
	204	23 miles NNE Sutton Plant - Control [c]			
	205	0.6 SSE Spoil Pond			

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]
WATERBORNE a. Surface	400	0.7 miles NE Intake Canal - Control [c]	Composite sample [d] Collection-M	Monthly	Gamma Isotopic
	401	4.9 miles SSW Discharge Canal at OD Pumps		Q	Tritium
b. Sediment	500	4.9 miles SSW Discharge - Beach near OD Pumps	Semiannual	Semiannual	Gamma Isotopic
INGESTION a. Milk	600	To be identified as available	With animals on pasture - semi-monthly At other times - monthly	Semi-monthly	Gamma isotopic and I-131 analyses (animals on pasture)
	601				
	602			Monthly	Gamma isotopic and I-131 analysis (other times)
	603				
b. Fish and Invertebrates (shrimp)	700	5.5 mile SSW Atlantic Ocean [e] at Discharge	When in Season - Semiannual	Semiannual	Gamma isotopic on edible portions
	701				
	702				
	703-705	Not Specified - Atlantic Ocean [c][e]			

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]
c. Broadleaf Vegetation	800	0.7 miles NE Intake Canal	When available - Monthly	Monthly	Gamma Isotopic
	801	0.6 miles SW Discharge Canal		Monthly	I-131
	802	10 miles - Control - Location not Specified (c)			
	803	0.6 miles SSE Spoil Pond			

(a) The LLD for each analysis is specified in Table 7.3.15-3 of the ODCM Specifications for the Brunswick Steam Electric Plant.

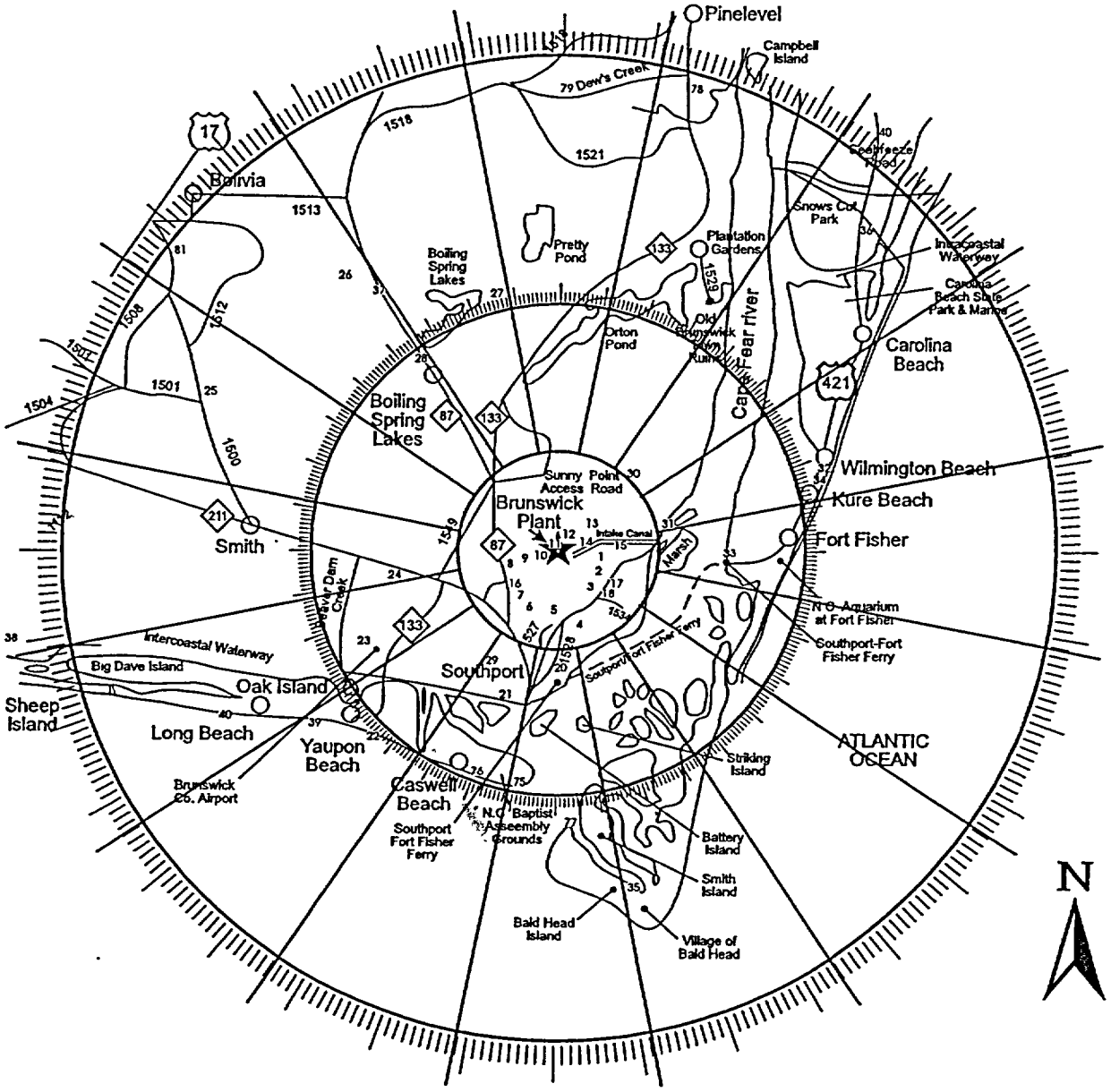
(b) Particulate samples will be analyzed for gross beta radiation 24 hours or more following filter change. If gross beta activity in air particulate samples is greater than ten times the yearly mean of control samples, gamma isotopic analysis shall be performed on the individual samples.

(c) Control Station - These stations are presumed to be outside the influence of plant effluents.

(d) Composite samples shall be collected by collecting an aliquot at intervals not exceeding 6 hours.

(e) A sample of one free swimmer, one bottom feeder, and one shellfish (shrimp) will be collected if available. A control sample of each species collected will be obtained if available.

FIGURE 4.0-1


Pinelevel
Campbell Island
79 Dew's Creek
78
1518
1521
17
Bolivia
1513
81
26
37
27
Boiling Spring Lakes
Pretty Pond
133
Plantation Gardens
1523
Old Brunswick Town
Orton Pond
Cape Fear river
Snows Cut Park
Intracoastal Waterway
Carolina Beach State Park & Marina
Carolina Beach
421
1508
1512
1507
1504
1501
25
1500
28
87
133
Boiling Spring Lakes
Sunny Point Access Road
Brunswick Plant
Wilmington Beach
Kure Beach
211
Smith
87
Intake Canal
Marsh
Fort Fisher
24
Beaver Dam Creek
133
N.C. Aquarium at Fort Fisher
Southport-Fort Fisher Ferry
38
Intercoastal Waterway
Big Dave Island
23
Southport
29
20
21
Oak Island
Sheep Island
40
39
Long Beach
Yaupon Beach
22
Brunswick Co. Airport
Caswell Beach
76
75
Southport Fort Fisher Ferry
N.C. Baptist Assembly Grounds
77
Striking Island
ATLANTIC OCEAN
Battery Island
Smith Island
35
Bald Head Island
Village of Bald Head
N

INDEX

5.0 INTERLABORATORY COMPARISON STUDIES

5.1 OBJECTIVE

The objective of this program is to evaluate the total laboratory analysis process by comparing results with results obtained by a separate laboratory or laboratories for an equivalent sample.

5.2 PROGRAM

5.2.1 Environmental Sample Analyses Comparison Program

Environmental samples from the BSEP environs will be analyzed by the Harris Energy & Environmental Center or by a qualified contracting laboratory. These laboratories will participate at least annually in a interlaboratory comparison study.

The results of the laboratories' performances in the study will be provided to BSEP E&RC and will be included in the Annual Radiological Environmental Operating Report. The results will be provided to the NRC upon request.

5.2.2 Effluent Release Analyses Program

BSEP E&RC will perform sample analyses for gamma-emitting radionuclides in effluent releases. The E&RC radiochemistry laboratory will participate annually in a corporate interlaboratory comparison study or equivalent study. The results of these studies will be provided to the NRC upon request.

5.2.3 Abnormal Results

CP&L laboratory or vendor laboratory results shall be compared to the criteria established in the NRC Inspection Manual (Procedure 84750) for Radioactive Waste Treatment, Effluent, and Environmental Monitoring. The referenced criteria is as follows:

a. Divide each standard result by its associated uncertainty to obtain resolution (the uncertainty is defined as the relative standard deviation, or sigma, of the standard result as calculated from counting statistics).

b. Divide each laboratory result by the corresponding standard result to obtain the ratio (laboratory result/standard).

c. The laboratory measurement is in agreement if the value of the ratio falls within the limits shown below for the corresponding resolution:

Resolution	Ratio
< 4	
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
> 200	0.85 - 1.18

If the CP&L laboratory or vendor laboratory results lie outside the ratio criteria, an evaluation will be performed to identify any recommended remedial actions to reduce anomalous errors. Complete documentation of the evaluation will be available to BSEP and will be provided to the NRC upon request.