



Brunswick Nuclear Plant  
P.O. Box 10429  
Southport, NC 28461

APR 28 2016

10 CFR 50.36a

Serial: BSEP 16-0031

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, DC 20555-0001

Subject: Brunswick Steam Electric Plant, Unit Nos. 1 and 2  
Renewed Facility Operating License Nos. DPR-71 and DPR-62  
Docket Nos. 50-325 and 50-324  
Annual Radioactive Effluent Release Report - 2015

Ladies and Gentlemen:

In accordance with 10 CFR 50.36a and Technical Specification (TS) 5.6.3 for the Brunswick Steam Electric Plant (BSEP), Unit Nos. 1 and 2, Duke Energy Progress, Inc., is submitting the enclosed Radioactive Effluent Release Report for 2015. This report covers the period from January 1, 2015, through December 31, 2015.

TS 5.5.1, "Offsite Dose Calculation Manual (ODCM)," requires changes to the ODCM be submitted as part of, or concurrent with, the Radioactive Effluent Release Report. The ODCM was not revised during this report period.

No regulatory commitments are contained in this submittal. Please refer any questions regarding this submittal to Mr. Lee Grzeck, Manager - Regulatory Affairs, at (910) 457-2487.

Sincerely,

Annette H. Pope  
Director - Organizational Effectiveness  
Brunswick Steam Electric Plant

MAT/mat

Enclosure: Annual Radioactive Effluent Release Report - 2015

IE48  
NRR

cc (with enclosure):

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## Annual Radioactive Effluent Release Report - 2015



# **Brunswick Steam Electric Plant Units 1 and 2**

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## **Annual Radioactive Effluent Release Report**

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**January 1, 2015 through December 31, 2015**

**Dockets 50-325 and 50-324**





# **Introduction**

The Annual Radioactive Effluent Release Report is pursuant to Brunswick Steam Electric Plant Technical Specification 5.6.3 and ODCM Specification 7.4.2. The below listed attachments to this report provide the required information. In addition, if a revision to the ODCM has occurred during the report period, it is included pursuant to Brunswick Steam Electric Plant Technical Specification 5.5.1.

Attachment 1	Summary of Gaseous and Liquid Effluents
Attachment 2	Supplemental Information
Attachment 3	Solid Radioactive Waste Disposal
Attachment 4	Meteorological Data
Attachment 5	Unplanned Offsite Releases
Attachment 6	Assessment of Radiation Dose from Radioactive Effluents to Members of the Public
Attachment 7	Information to Support the NEI Ground Water Protection Initiative
Attachment 8	Inoperable Equipment
Attachment 9	Summary of Changes to the Offsite Dose Calculation Manual
Attachment 10	Summary of Changes to the Process Control Program
Attachment 11	Summary of Major Modifications to the Radioactive Waste Treatment Systems
Attachment 12	Errata to a Previous Year's ARERR

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 1**

**Summary of Gaseous and Liquid Effluents**

This attachment includes a summary of the quantities of radioactive liquid and gaseous effluents as outlined in Regulatory Guide 1.21, Appendix B.

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Gaseous Effluents - Summation of All Releases

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Gases						
1. Total Release	Ci	3.36E+01	6.12E+01	5.84E+01	3.56E+01	1.89E+02
2. Avg. Release Rate	µCi/sec	4.32E+00	7.79E+00	7.35E+00	4.48E+00	5.99E+00
B. Iodine-131						
1. Total Release	Ci	7.40E-04	6.57E-04	9.13E-04	5.71E-04	2.88E-03
2. Avg. Release Rate	µCi/sec	9.51E-05	8.35E-05	1.15E-04	7.18E-05	9.14E-05
C. Particulates Half-Life ≥ 8 days						
1. Total Release	Ci	6.81E-04	4.39E-04	4.59E-04	2.28E-04	1.81E-03
2. Avg. Release Rate	µCi/sec	8.76E-05	5.59E-05	5.78E-05	2.87E-05	5.73E-05
D. Tritium						
1. Total Release	Ci	1.31E+02	1.27E+02	1.69E+02	9.55E+01	5.23E+02
2. Avg. Release Rate	µCi/sec	1.69E+01	1.62E+01	2.13E+01	1.20E+01	1.66E+01
E. Carbon-14						
1. Total Release	Ci	4.48E+00	5.67E+00	5.99E+00	5.81E+00	2.20E+01
2. Avg. Release Rate	µCi/sec	5.76E-01	7.21E-01	7.54E-01	7.30E-01	6.96E-01
F. Gross Alpha						
1. Total Release	Ci	0.00E+00	3.76E-08	4.46E-07	0.00E+00	4.84E-07
2. Avg. Release Rate	µCi/sec	0.00E+00	4.78E-09	5.61E-08	0.00E+00	1.53E-08

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**Gaseous Effluents - Elevated Releases - Continuous Mode**

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
<b>A. Fission and Activation Gases</b>						
Ar-41	Ci	7.93E-01	0.00E+00	0.00E+00	0.00E+00	7.93E-01
Kr-85m	Ci	2.22E-01	0.00E+00	0.00E+00	0.00E+00	2.22E-01
Kr-87	Ci	1.92E-01	0.00E+00	0.00E+00	0.00E+00	1.92E-01
Kr-88	Ci	5.18E-01	0.00E+00	0.00E+00	0.00E+00	5.18E-01
Xe-133	Ci	1.41E-02	0.00E+00	0.00E+00	0.00E+00	1.41E-02
Xe-135	Ci	2.12E+01	4.17E+01	4.28E+01	1.38E+01	1.20E+02
Xe-138	Ci	0.00E+00	0.00E+00	4.53E+00	2.00E+01	2.45E+01
Total for Period	Ci	2.29E+01	4.17E+01	4.73E+01	3.38E+01	1.46E+02
<b>B. Iodines</b>						
I-131	Ci	3.12E-04	3.39E-04	4.26E-04	5.34E-04	1.61E-03
I-133	Ci	1.80E-03	2.13E-03	2.63E-03	3.68E-03	1.02E-02
I-135	Ci	2.91E-03	3.52E-03	3.53E-03	5.42E-03	1.54E-02
Total for Period	Ci	5.02E-03	5.99E-03	6.58E-03	9.63E-03	2.72E-02
<b>C. Particulates Half-Life ≥ 8 days</b>						
Co-58	Ci	1.49E-06	0.00E+00	0.00E+00	0.00E+00	1.49E-06
Co-60	Ci	3.05E-06	0.00E+00	9.30E-07	0.00E+00	3.98E-06
Sr-89	Ci	1.14E-05	1.54E-05	1.11E-05	1.99E-05	5.78E-05
Ba-140	Ci	4.36E-05	2.13E-05	5.15E-05	7.43E-05	1.91E-04
La-140	Ci	6.38E-05	7.20E-05	1.10E-04	1.14E-04	3.60E-04
Total for Period	Ci	1.23E-04	1.09E-04	1.74E-04	2.08E-04	6.14E-04
<b>D. Tritium</b>						
H-3	Ci	2.32E+01	4.60E+01	5.50E+01	4.47E+01	1.69E+02
<b>E. Carbon-14</b>						
C-14	Ci	1.79E+00	2.27E+00	2.40E+00	2.32E+00	8.78E+00
<b>F. Gross Alpha</b>						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00



**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**Gaseous Effluents - Elevated Releases - Batch Mode \***

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Gases						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
B. Iodines						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
C. Particulates Half-Life $\geq$ 8 days						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
D. Tritium						
N/A	Ci	-	-	-	-	-
E. Carbon-14						
N/A	Ci	-	-	-	-	-
F. Gross Alpha						
Total for Period	Ci	-	-	-	-	-

\* Brunswick Steam Electric Plant Units 1 and 2 do not have batch elevated releases.

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**Gaseous Effluents - Ground Releases - Continuous Mode**

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
<b>A. Fission and Activation Gases</b>						
Xe-133	Ci	7.12E-01	0.00E+00	0.00E+00	0.00E+00	7.12E-01
Xe-135	Ci	1.40E+00	1.55E+00	1.76E+00	1.07E+00	5.78E+00
Xe-138	Ci	8.59E+00	1.80E+01	9.33E+00	7.81E-01	3.67E+01
Total for Period	Ci	1.07E+01	1.95E+01	1.11E+01	1.85E+00	4.32E+01
<b>B. Iodines</b>						
I-131	Ci	3.92E-04	3.08E-04	4.60E-04	6.61E-07	1.16E-03
I-133	Ci	3.91E-03	3.58E-03	4.24E-03	3.89E-06	1.17E-02
I-135	Ci	7.84E-03	6.00E-03	5.35E-03	0.00E+00	1.92E-02
Total for Period	Ci	1.21E-02	9.89E-03	1.00E-02	4.55E-06	3.20E-02
<b>C. Particulates Half-Life ≥ 8 days</b>						
Co-60	Ci	3.09E-07	2.82E-04	0.00E+00	0.00E+00	2.82E-04
Sr-89	Ci	6.76E-07	0.00E+00	0.00E+00	0.00E+00	6.76E-07
Sr-90	Ci	1.28E-06	3.53E-09	0.00E+00	0.00E+00	1.28E-06
Total for Period	Ci	2.27E-06	2.82E-04	0.00E+00	0.00E+00	2.84E-04
<b>D. Tritium</b>						
H-3	Ci	1.01E+02	7.05E+01	1.02E+02	4.15E+01	3.15E+02
<b>E. Carbon-14</b>						
C-14	Ci	8.96E-01	1.13E+00	1.20E+00	1.16E+00	4.39E+00
<b>F. Gross Alpha</b>						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Gaseous Effluents - Ground Releases - Batch Mode \*

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Gases						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
B. Iodines						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
C. Particulates Half-Life $\geq$ 8 days						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
D. Tritium						
N/A	Ci	-	-	-	-	-
E. Carbon-14						
N/A	Ci	-	-	-	-	-
F. Gross Alpha						
Total for Period	Ci	-	-	-	-	-

\* Brunswick Steam Electric Plant Units 1 and 2 do not have batch ground releases.

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**Gaseous Effluents - Mixed-Mode Releases - Continuous Mode**

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Gases						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B. Iodines						
I-131	Ci	3.55E-05	9.43E-06	2.72E-05	3.64E-05	1.09E-04
I-133	Ci	9.77E-05	1.66E-04	2.30E-04	2.63E-04	7.57E-04
Total for Period	Ci	1.33E-04	1.75E-04	2.57E-04	2.99E-04	8.64E-04
C. Particulates Half-Life $\geq$ 8 days						
Cr-51	Ci	1.98E-04	0.00E+00	0.00E+00	0.00E+00	1.98E-04
Mn-54	Ci	1.17E-05	0.00E+00	4.84E-06	0.00E+00	1.65E-05
Fe-59	Ci	9.69E-06	0.00E+00	0.00E+00	0.00E+00	9.69E-06
Co-58	Ci	3.21E-05	1.62E-05	1.86E-05	0.00E+00	6.69E-05
Co-60	Ci	2.86E-04	3.22E-05	2.45E-04	2.03E-05	5.84E-04
Zn-65	Ci	8.03E-06	0.00E+00	0.00E+00	0.00E+00	8.03E-06
Sb-124	Ci	1.45E-06	0.00E+00	0.00E+00	0.00E+00	1.45E-06
Cs-137	Ci	7.85E-06	0.00E+00	1.71E-05	0.00E+00	2.50E-05
Total for Period	Ci	5.55E-04	4.84E-05	2.86E-04	2.03E-05	9.10E-04
D. Tritium						
H-3	Ci	7.30E+00	1.06E+01	1.22E+01	9.27E+00	3.94E+01
E. Carbon-14						
C-14	Ci	1.79E+00	2.27E+00	2.40E+00	2.32E+00	8.78E+00
F. Gross Alpha						
Total for Period	Ci	0.00E+00	3.76E-08	4.46E-07	0.00E+00	4.84E-07



**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Gaseous Effluents - Mixed-Mode Releases - Batch Mode \*

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Gases						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
B. Iodines						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
C. Particulates Half-Life $\geq$ 8 days						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
D. Tritium						
N/A	Ci	-	-	-	-	-
E. Carbon-14						
N/A	Ci	-	-	-	-	-
F. Gross Alpha						
Total for Period	Ci	-	-	-	-	-

\* Brunswick Steam Electric Plant Units 1 and 2 do not have batch mixed-mode releases.

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**Liquid Effluents - Summation of All Releases - Discharge Canal**

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Products *						
1. Total Release	Ci	3.01E-03	5.07E-04	3.42E-04	3.47E-03	7.33E-03
2. Avg. Diluted Conc.	µCi/ml	9.29E-12	1.05E-12	6.52E-13	7.42E-12	4.07E-12
B. Tritium						
1. Total Release	Ci	4.81E+01	3.24E+01	4.77E+01	7.03E+01	1.99E+02
2. Avg. Diluted Conc.	µCi/ml	1.49E-07	6.69E-08	9.09E-08	1.50E-07	1.10E-07
C. Dissolved & Entrained Gases						
1. Total Release	Ci	5.30E-05	1.49E-04	1.88E-04	1.61E-04	5.51E-04
2. Avg. Diluted Conc.	µCi/ml	1.64E-13	3.07E-13	3.57E-13	3.44E-13	3.06E-13
D. Gross Alpha						
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Avg. Diluted Conc.	µCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E. Volume of Liquid Waste						
1. Continuous Releases	liters	8.40E+07	9.22E+07	8.02E+07	2.10E+08	4.66E+08
2. Batch Releases	liters	1.78E+06	3.52E+06	4.25E+06	2.39E+06	1.19E+07
F. Volume of Dilution Water						
1. All Releases	liters	3.24E+11	4.84E+11	5.25E+11	4.68E+11	1.80E+12

\* Excludes tritium, dissolved and entrained noble gases, and gross alpha.

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**Liquid Effluents - Summation of All Releases - Marsh Area**

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Products *						
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Avg. Diluted Conc.	µCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B. Tritium						
1. Total Release	Ci	6.05E-02	3.55E-02	1.20E-02	3.39E-02	1.42E-01
2. Avg. Diluted Conc.	µCi/ml	1.21E-06	7.00E-07	2.35E-07	6.62E-07	6.97E-07
C. Dissolved & Entrained Gases						
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Avg. Diluted Conc.	µCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D. Gross Alpha						
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Avg. Diluted Conc.	µCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E. Volume of Liquid Waste						
1. Continuous Releases	liters	5.02E+07	5.07E+07	5.13E+07	5.13E+07	2.04E+08
2. Batch Releases	liters	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F. Volume of Dilution Water						
1. All Releases	liters	5.02E+07	5.07E+07	5.13E+07	5.13E+07	2.04E+08

\* Excludes tritium, dissolved and entrained noble gases, and gross alpha.

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Liquid Effluents - Continuous Mode - Discharge Canal

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Products						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B. Tritium						
H-3	Ci	9.41E-03	9.41E-03	1.03E-02	9.73E-03	3.88E-02
C. Dissolved & Entrained Gases						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D. Gross Alpha						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00



**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Liquid Effluents - Continuous Mode - Marsh Area

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Products						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B. Tritium						
H-3	Ci	6.05E-02	3.55E-02	1.20E-02	3.39E-02	1.42E-01
C. Dissolved & Entrained Gases						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D. Gross Alpha						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Liquid Effluents - Batch Mode - Discharge Canal

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Products						
Na-24	Ci	1.04E-04	0.00E+00	0.00E+00	0.00E+00	1.04E-04
Co-58	Ci	0.00E+00	0.00E+00	0.00E+00	1.55E-05	1.55E-05
Co-60	Ci	7.98E-04	2.36E-04	0.00E+00	1.41E-03	2.44E-03
Ni-63	Ci	1.83E-03	9.02E-05	0.00E+00	1.55E-03	3.47E-03
Zn-65	Ci	0.00E+00	0.00E+00	0.00E+00	1.04E-04	1.04E-04
As-76	Ci	0.00E+00	2.13E-06	2.78E-06	0.00E+00	4.91E-06
Mo-99	Ci	2.27E-05	0.00E+00	0.00E+00	0.00E+00	2.27E-05
Tc-99m	Ci	4.08E-05	0.00E+00	0.00E+00	0.00E+00	4.08E-05
Sb-125	Ci	5.54E-05	0.00E+00	0.00E+00	0.00E+00	5.54E-05
I-131	Ci	5.24E-05	5.32E-05	9.77E-05	1.71E-04	3.74E-04
I-132	Ci	0.00E+00	0.00E+00	8.57E-06	0.00E+00	8.57E-06
I-133	Ci	6.15E-05	1.23E-04	2.33E-04	2.04E-04	6.22E-04
Cs-137	Ci	4.38E-05	3.20E-06	0.00E+00	2.45E-05	7.15E-05
Total for Period	Ci	3.01E-03	5.07E-04	3.42E-04	3.47E-03	7.33E-03
B. Tritium						
H-3	Ci	4.81E+01	3.24E+01	4.77E+01	7.03E+01	1.99E+02
C. Dissolved & Entrained Gases						
Xe-133	Ci	0.00E+00	1.87E-05	2.92E-05	2.20E-05	6.99E-05
Xe-135	Ci	5.30E-05	1.30E-04	1.59E-04	1.39E-04	4.81E-04
Total for Period	Ci	5.30E-05	1.49E-04	1.88E-04	1.61E-04	5.51E-04
D. Gross Alpha						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Liquid Effluents - Batch Mode - Marsh Area

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Products						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B. Tritium						
H-3	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C. Dissolved & Entrained Gases						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D. Gross Alpha						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**Attachment 2**  
**Supplemental Information**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 2**

**Supplemental Information**

This attachment includes supplemental information to the gaseous and liquid effluents report.

## Attachment 2 Supplemental Information

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

### I. Regulatory Limits - Per Unit

#### A. Noble Gases - Air Dose

1. Calendar Quarter Gamma Dose	= 5	mRAD
2. Calendar Quarter Beta Dose	= 10	mRAD
3. Calendar Year Gamma Dose	= 10	mRAD
4. Calendar Year Beta Dose	= 20	mRAD

#### B. Liquid Effluents - Dose

1. Calendar Quarter Total Body Dose	= 1.5	mREM
2. Calendar Quarter Organ Dose	= 5	mREM
3. Calendar Year Total Body Dose	= 3	mREM
4. Calendar Year Organ Dose	= 10	mREM

#### C. Gaseous Effluents - Iodine-131 & 133, Tritium, and Particulates with Half-lives > 8 days

1. Calendar Quarter Organ Dose	= 7.5	mREM
2. Calendar Year Organ Dose	= 15	mREM

### II. Maximum Permissible Effluent Concentrations

#### A. Gaseous Effluents

1. Information found in Offsite Dose Calculation Manual

#### B. Liquid Effluents

1. Information found in 10 CFR Part 20, Appendix B, Table 2, Column 2

### III. Average Energy

(not applicable)

### IV. Measurements and Approximations of Total Radioactivity

Analyses of specific radionuclides in selected or composited samples as described in the ODCM are used to determine the radionuclide composition of the effluent. A summary description of the method used for estimating overall errors associated with radioactivity measurements is provided as part of this attachment.

### V. Batch Releases

#### A. Liquid Effluents

		Jan - Jun	Jul - Dec
1. Total Number of Batch Releases	=	9.80E+01	1.03E+02
2. Total Time (min) for Batch Releases	=	2.73E+05	2.08E+05
3. Maximum Time (min) for a Batch Release	=	2.01E+04	2.60E+04
4. Average Time (min) for Batch Releases	=	2.79E+03	2.02E+03
5. Minimum Time (min) for a Batch Release	=	1.20E+01	1.40E+01
6. Average Dilution Water Flow During Release (gpm)	=	5.69E+05	7.60E+05

#### B. Gaseous Effluents

		Jan - Jun	Jul - Dec
1. Total Number of Batch Releases	=	N/A	N/A
2. Total Time (min) for Batch Releases	=	N/A	N/A
3. Maximum Time (min) for a Batch Release	=	N/A	N/A
4. Average Time (min) for Batch Releases	=	N/A	N/A
5. Minimum Time (min) for a Batch Release	=	N/A	N/A

### VI. Abnormal Releases

See Attachment 5, Unplanned Offsite Releases.

## Attachment 2 Supplemental Information

### Brunswick Steam Electric Plant Units 1 & 2 Period 1/1/2015 - 12/31/2015

#### Carbon-14

In Regulatory Guide 1.21, Revision 2, "Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste", the NRC recommends U.S. nuclear power plants evaluate whether C-14 is a "principal radionuclide" in gaseous effluents, and if so, report the amount of C-14 released. Improvements over the years in effluent management practices and fuel performance have resulted in a decrease in gaseous radionuclide (non-C-14) concentrations, and a change in the distribution of gaseous radionuclides released to the environment. As a result, many sites show C-14 has become a "principal radionuclide" for the gaseous effluent pathway, as defined in Regulatory Guide 1.21, Rev. 2. Although committed to Regulatory Guide 1.21, Rev. 1, the Brunswick Steam Electric Plant the 2015 ARERR contains estimates of C-14 radioactivity released in 2015, and estimates of public dose resulting from the C-14 effluent.

Because the dose contribution of C-14 from liquid radioactive waste is much less than that contributed by gaseous radioactive waste, evaluation of C-14 in liquid radioactive waste is not required (Ref. Reg. Guide 1.21, Rev. 2). The quantity of gaseous C-14 released to the environment can be estimated by use of a C-14 source term scaling factor based on power generation (Ref. Reg. Guide 1.21, Rev. 2). The Brunswick Steam Electric Plant Updated Final Safety Analysis Report (UFSAR) states the C-14 release rate from a BWR is approximately 9.5 Ci/yr per unit assuming 80% plant capacity factor, or 292 Effective Full Power Days (EFPD). Since Brunswick Steam Electric Plant has two reactors, the total release rate would be 19.0 Ci/yr. This value was scaled using actual EFPD of 356.54 for Unit 1 and 317.41 for Unit 2 in 2015 to give a total release rate of 22.0 Ci/yr.

Public dose estimates from airborne C-14 are performed using dose models in Regulatory Guide 1.109. The dose models and assumptions used are documented in the Brunswick Steam Electric Plant ODCM 3.3.3, Carbon-14. The estimated C-14 dose impact on the maximum organ dose from airborne effluents released from Brunswick Steam Electric Plant in 2015 is well below the 10CFR50, Appendix I, ALARA design objective (i.e., 15 mrem/yr per unit).

Based on the 2015 Land Use Census, the critical receptor is located in the south sector at 1.8 miles with a garden. There are no meat or milk pathways within 5 miles. Regulatory Guide 1.109 methodology was used to determine the dose to this critical receptor. The bone dose for 2015 was 2.02E+00 mrem and the total body dose was 4.05E-01 mrem.

	<u>Units</u>	<u>Year</u>
1. C-14 Activity Released	Ci	2.20E+01
2. C-14 Total Body Dose	mREM	4.05E-01
3. C-14 Organ Dose	mREM	2.02E+00

Receptor Location **1.8 miles S**

Critical Age **CHILD**

Critical Organ **BONE**

## **Attachment 2 Supplemental Information**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

### **Discussion of liquid release from the BSEP Sewage Treatment Plant**

In accordance with the Brunswick Steam Electric Plant (BSEP) National Pollutant Discharge Elimination System (NPDES) Permit Number NC0007064 the decant from the BSEP Sewage Treatment Plant is released to Outfall Number 004. Outfall Number 004 discharges to the discharge canal which is a designated release point. The BSEP sewage decant is sampled monthly for gamma and tritium analysis. On December 11, 2013 the monthly effluent sample contained tritium, there was no detectable gamma activity. Condition Report (CR) 651320 was generated and daily sampling was initiated for effluent accountability. Inputs to the system were sampled and it was discovered that tritiated groundwater is leaking into the Number 6 lift station. The source of tritium is from pre-existing groundwater contamination in the general area surrounding the Number 6 lift station. Regulatory Affairs confirmed this was not reportable per NEI 07-07 groundwater reporting. Approximately  $2.01\text{E}+06$  gallons containing  $3.88\text{E}-02$  curies of tritium was released in 2015 to the discharge canal.

### **Discussion of liquid releases from the Storm Drain Collector Basin (SDCB)**

During periods of heavy rain, the contents of the SDCB may be released to the discharge canal in accordance with regulatory requirements to protect plant personnel and equipment. The SDCB was released directly to the discharge canal on eighteen occasions in 2015 due to heavy rains. Approximately  $9.87\text{E}+06$  gallons containing  $2.57\text{E}-01$  curies of tritium were released. There was no detectable gamma radioactivity.

### **Discussion of liquid releases from the Storm Drain Stabilization Pond (SDSP) Infiltration**

On August 22, 2014 water was found flowing from the Storm Drain Stabilization Facility (SDSF) outfall pipe into the intake canal when a permitted release was not in progress. The water was analyzed and found to contain tritium. Condition Report 704775 was generated and daily sampling was initiated for effluent accountability. Subsequent investigation determined the water was infiltrating through the side of the first collection box in the drainage line located near the SDSP discharge weir. The pipe was repaired by installing a fiberglass liner inside the existing outfall pipe and sealing the original pipe/liner interface. This repair was completed in 2015. Approximately  $2.74\text{E}+04$  gallons containing  $1.51\text{E}-03$  curies of tritium was released in 2015. There was no detectable gamma radioactivity.

### **Discussion of liquid releases from the Storm Drain Stabilization Facility (SDSF)**

The SDSF collects rainwater, water from miscellaneous low volume drains on plant site, water from the Groundwater Extraction System, and water from the Unit 1 CST Remediation Facility. Treatment consists of filtration and evaporation. When sufficient water has accumulated in the pond it is released into the intake canal where it is drawn into the plant circulating and service water system and eventually released into the discharge canal. There were twenty SDSF releases in 2015. Approximately  $8.44\text{E}+07$  gallons containing  $5.60\text{E}+00$  curies of tritium were released from the SDSF. There was no detectable gamma radioactivity.

### **Discussion of water evaporation from the Storm Drain Stabilization Pond (SDSP)**

It was calculated that  $5.82\text{E}+07$  gallons of tritiated water was released via evaporation from the SDSP in 2015. This yields  $4.17\text{E}-01$  curies of tritium released to the atmosphere as a ground release. The nearest resident to the pond is in the northwest sector at approximately 0.3 miles. The maximum exposed individuals at that location received a calculated dose of  $1.28\text{E}-04$  mrem via the inhalation pathway in 2015. Only inhalation dose was determined because the exposed individuals do not have a garden and also do not have any milk or meat animals at this location.

## **Attachment 2 Supplemental Information**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

### **Discussion of water evaporation from the Storm Drain Stabilization Facility (SDSF)**

It was calculated that  $4.71\text{E}+06$  gallons of tritiated water was released via evaporation from the SDFS in 2015. This yields  $3.89\text{E}-01$  curies of tritium released to the atmosphere as a ground release. The nearest resident to the pond is in the north northwest sector at approximately 0.5 miles. The maximum exposed individuals at that location received a calculated dose of  $2.51\text{E}-04$  mrem via the inhalation pathway in 2015. Only inhalation dose was determined because the exposed individuals do not have a garden and also do not have any milk or meat animals at this location.

### **Discussion of liquid releases from the Marsh to Nancy's Creek**

Samples are routinely analyzed from the marsh areas that drain into Nancy's Creek during falling tides. The marsh areas are all on company owned property. The marsh land is under the influence of high and low tides and releases to Nancy's Creek, which is offsite. This constitutes a release point for evaluation. The sampling program consists of weekly sampling and analysis at eight locations. All gamma analyses performed in 2015 were less than the Lower Limit of Detection (LLD). There were 416 tritium analyses performed, which resulted in 41 positive tritium results. The average concentration each month, two high tides per day, the area of the marsh at high tide, the days in the month, and a conservative factor of 2 was used to calculate the amount of tritium released each month. In 2015, it was calculated that  $5.38\text{E}+07$  gallons were released to Nancy's Creek containing  $1.42\text{E}-01$  curies of tritium. This yielded a Total Body dose of  $1.72\text{E}-03$  mrem to an adult from eating fish and invertebrate (shrimp, crabs, etc.).

### **Discussion of liquid releases from the Storm Drain Stabilization Pond (SDSP)**

The SDSP collects rainwater as its only input source. Treatment from this location consists of sedimentation, evaporation, and transpiration. When sufficient water has accumulated in the pond, it is released into the intake canal where it is drawn into the circulating and service water system and eventually released into the discharge canal. There were six SDSP releases in 2015. Approximately  $2.70\text{E}+07$  gallons were released in 2015 containing  $0.00\text{E}+00$  curies of tritium. There was no detectable gamma radioactivity.



**Attachment 2  
Supplemental Information**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**Overall Estimate of Error for Effluent Radioactivity Release Reported**

The estimated percentage of overall error for Gaseous effluent release data at Brunswick Steam Electric Plant is listed below. These values were derived by taking the square root of the sum of the squares of the discrete individual estimates of error.

- |                                 |              |
|---------------------------------|--------------|
| 1. Fission and Activation Gases | = $\pm 25\%$ |
| 2. Particulates and Iodine      | = $\pm 25\%$ |
| 3. Tritium                      | = $\pm 15\%$ |

The estimated percentage of overall error for Liquid effluent release data at Brunswick Steam Electric Plant is listed below. These values were derived by taking the square root of the sum of the squares of the discrete individual estimates of error.

- |   |              |
|---|--------------|
| 1. Fission and Activation Products and<br>Dissolved and Entrained Noble Gases | = $\pm 17\%$ |
| 2. Tritium  | = $\pm 23\%$ |
| 3. Gross Alpha  | = $\pm 32\%$ |

**Overall Estimate of Error for Solid Waste Radioactivity Reported**

The estimated percentage of overall error for Solid Waste data at Brunswick Steam Electric Plant has been determined to be  $\pm 10\%$ .

**Attachment 2  
Supplemental Information**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**Summary of Changes in Land Use Census Affecting Effluent Dose Calculations**

The 2015 Land Use Census was performed June 23-24, 2015 and June 29-30, 2015. The results were certified and made available for use on July 20, 2015. The following are changes to residences, gardens, and milk animals from the previous year.

**Residences**

The address for the nearest residence in the S sector at 1.1 miles changed but the distance remains 1.1 miles.

**Gardens**

The garden in the N sector at 1.0 miles was replaced by a garden at 1.1 miles.  
The garden in the W sector at 1.1 miles was replaced by a garden at 1.2 miles.

**Milk Animals**

No changes to nearest milk animal in each sector.

**Environmental Monitoring Locations**

No changes to environmental monitoring locations in each sector.

**Attachment 3**  
**Solid Radioactive Waste Disposal**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 3**

**Solid Radioactive Waste Disposal**

This attachment includes a summary of the solid waste shipped off-site for burial and/or disposal, including:

- Container volume
- Total Curie content
- Principal Radionuclides
- Source/Type of waste
- Solidification agent or absorbent
- Type of shipping container
- Number of shipments
- Other relevant information as necessary

### Attachment 3 Solid Radioactive Waste Disposal

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Type of Waste Shipped	Number of Shipments	Number of Containers	Waste Class	Container Type	Solidification Agent	Burial Volume (m <sup>3</sup> )	Total Activity (Curies)
<b>1. <u>Waste from Liquid Systems</u></b>							
a. Spent Resins, Filters, Sludges (dewatered)	8	-	A	Type A GDP	N/A	21.2	3.26E+01
b. Solidified (cement) Acids, Oily Water	0	-	-	-	-	-	-
<b>2. <u>Dry Solid Waste</u></b>							
a. Dry Active Waste (compacted & non-compacted)	73	-	A	Type A GDP	N/A	3720	2.34E+00
b. Irradiated Components	0	-	-	-	-	-	-
<b>3. <u>Total Solid Waste</u></b>	<b>81</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>3750</b>	<b>3.50E+01</b>

**NOTE:** Total Activity determined by estimate. Solid Waste listed above shipped for processing to various waste processing services or directly shipped to licensed disposal facility. No Waste Class B or Waste Class C shipments were made in 2015.

### Attachment 3 Solid Radioactive Waste Disposal

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Type of Waste Shipped	Radionuclide	% Abundance
<b>1. <u>Waste from Liquid Systems</u></b>		
a. Spent Resins, Filters, Sludges (dewatered)	C-14	2.08E+00%
	Fe-55	1.60E+01%
	Mn-54	1.03E+00%
	Co-60	5.61E+01%
	Ni-63	2.04E+01%
	Cs-137	3.12E+00%
b. Solidified (cement) Acids, Oily Water	N/A	N/A
<b>2. <u>Dry Solid Waste</u></b>		
a. Dry Active Waste (compacted & non-compacted)	Fe-55	4.37E+01%
	Mn-54	1.58E+00%
	Co-60	4.59E+01%
	Ni-63	5.38E+00%
	Cs-137	2.11E+00%
b. Irradiated Components	N/A	N/A

**Attachment 4  
Meteorological Data**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 4**

**Meteorological Data**

This attachment includes a summary of meteorological joint frequency distributions of wind speed, wind direction, and atmospheric stability (hours of occurrence).

# Attachment 4 Meteorological Data

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

## Ground Releases

Stability Class	Wind Speed (mph)	Hours of Occurrence															
		Sector															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
A	0.75-3.50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3.51-7.50	5	3	0	1	7	8	5	7	2	1	0	4	1	1	2	1
	7.51-12.50	0	1	4	5	2	5	0	0	1	4	26	51	0	0	0	0
	12.51-18.50	0	0	0	0	0	0	0	0	0	1	2	4	0	0	0	0
	18.51-25.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	25+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	0.75-3.50	4	1	0	0	0	0	0	0	0	0	0	0	0	1	1	2
	3.51-7.50	12	9	5	12	18	19	17	20	5	6	5	11	2	0	2	8
	7.51-12.50	5	1	8	29	21	3	0	0	3	21	63	55	0	0	3	4
	12.51-18.50	0	0	0	0	0	0	0	0	0	1	11	2	0	0	0	0
	18.51-25.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	25+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	0.75-3.50	8	3	3	0	0	4	3	1	0	0	0	1	4	7	4	8
	3.51-7.50	33	23	33	35	31	28	19	33	16	10	9	26	10	6	16	22
	7.51-12.50	12	11	12	30	16	3	0	0	4	19	71	47	1	0	0	3
	12.51-18.50	0	0	0	0	0	0	0	0	0	1	14	9	0	0	0	0
	18.51-25.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	25+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	0.75-3.50	46	39	25	17	13	26	24	24	10	9	18	32	33	27	31	43
	3.51-7.50	197	261	237	231	85	52	36	56	59	62	117	318	41	18	47	111
	7.51-12.50	95	153	142	130	22	3	1	1	19	34	226	396	3	2	8	24
	12.51-18.50	2	3	6	10	2	0	0	0	4	4	35	52	0	0	0	1
	18.51-25.00	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0
	25+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

# Attachment 4 Meteorological Data

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

## Ground Releases

Stability Class	Wind Speed (mph)	Hours of Occurrence															
		Sector															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
E	0.75-3.50	117	86	48	51	29	38	46	41	47	17	27	87	79	53	49	60
	3.51-7.50	63	122	40	52	41	18	8	31	45	37	79	192	19	4	8	35
	7.51-12.50	2	4	6	6	3	1	0	4	16	50	49	44	1	0	1	2
	12.51-18.50	0	0	0	2	1	2	2	3	2	6	16	6	0	0	0	1
	18.51-25.00	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	25+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F	0.75-3.50	103	51	13	10	7	7	5	9	8	4	10	34	22	20	26	52
	3.51-7.50	10	3	2	1	0	1	0	0	10	0	8	21	0	1	4	4
	7.51-12.50	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
	12.51-18.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	18.51-25.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	25+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	0.75-3.50	120	26	1	0	2	0	2	0	0	1	4	12	10	14	21	46
	3.51-7.50	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0
	7.51-12.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12.51-18.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	18.51-25.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	25+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



# Attachment 4 Meteorological Data

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

## Elevated Releases

Stability Class	Wind Speed (mph)	Hours of Occurrence															
		Sector															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
A	0.75-3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3.51-7.50	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
	7.51-12.50	5	3	0	2	9	8	6	7	4	1	10	9	0	1	2	1
	12.51-18.50	0	1	2	5	4	2	0	0	0	4	22	34	0	0	0	0
	18.51-25.00	0	0	0	0	0	0	0	0	0	2	7	1	0	0	0	0
	25+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	0.75-3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3.51-7.50	7	3	2	1	2	1	6	4	1	0	0	0	2	0	2	2
	7.51-12.50	6	3	4	15	32	14	11	16	6	11	19	22	2	0	1	6
	12.51-18.50	6	0	4	24	14	5	0	1	7	16	46	28	1	0	4	4
	18.51-25.00	0	1	2	1	0	0	0	0	0	1	16	3	0	0	2	3
	25+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	0.75-3.50	3	1	0	1	1	0	0	0	0	0	0	0	1	0	1	2
	3.51-7.50	7	6	8	4	12	9	17	8	4	2	4	8	9	7	4	12
	7.51-12.50	23	16	18	32	27	14	14	21	8	16	30	26	5	7	10	12
	12.51-18.50	15	10	11	26	14	6	0	2	5	13	33	30	1	2	4	8
	18.51-25.00	5	4	2	6	1	0	0	0	0	0	31	6	0	0	0	2
	25+	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0
D	0.75-3.50	4	8	5	3	6	2	4	3	1	2	1	4	5	3	5	2
	3.51-7.50	33	18	21	19	25	18	28	24	18	19	22	31	45	11	10	18
	7.51-12.50	85	70	92	93	58	41	30	32	38	51	69	144	64	19	28	51
	12.51-18.50	119	197	171	196	61	18	12	8	25	39	198	269	19	12	31	56
	18.51-25.00	45	96	107	98	17	4	7	9	12	21	146	155	1	10	11	21
	25+	18	5	31	17	13	1	0	0	6	16	31	22	0	3	3	4

## Attachment 4 Meteorological Data

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

### Elevated Releases

Stability Class	Wind Speed (mph)	Hours of Occurrence															
		Sector															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
E	0.75-3.50	3	0	0	3	2	2	2	2	3	3	5	3	1	1	1	3
	3.51-7.50	5	3	8	9	8	11	10	9	8	14	16	11	25	3	9	12
	7.51-12.50	29	37	41	46	51	41	35	24	39	28	40	89	104	20	20	15
	12.51-18.50	49	107	107	51	36	33	28	24	21	29	63	115	19	33	19	37
	18.51-25.00	11	15	16	3	6	10	6	22	47	38	49	64	1	14	10	9
	25+	0	1	3	7	2	3	2	8	8	30	28	15	0	0	0	2
F	0.75-3.50	0	2	0	1	3	1	3	1	3	0	3	1	1	1	1	0
	3.51-7.50	4	4	6	9	13	9	9	7	13	5	7	11	6	8	3	3
	7.51-12.50	12	8	15	25	23	11	14	14	14	18	16	20	29	24	10	12
	12.51-18.50	11	25	37	20	12	4	5	10	6	12	12	28	11	13	4	13
	18.51-25.00	9	11	11	2	0	0	2	0	11	0	6	14	0	9	15	6
	25+	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
G	0.75-3.50	2	0	0	0	4	1	2	5	2	2	5	1	8	1	2	3
	3.51-7.50	9	6	6	8	11	10	11	17	9	6	13	12	14	5	7	4
	7.51-12.50	12	28	13	26	15	10	17	9	9	9	23	19	10	8	14	7
	12.51-18.50	12	25	30	23	10	1	13	4	5	4	7	11	2	9	12	10
	18.51-25.00	3	3	13	0	0	0	0	0	0	1	1	1	0	3	7	5
	25+	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	1

**Attachment 5**  
**Unplanned Offsite Releases**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 5**

**Unplanned Offsite Releases**

This attachment includes a summary of the unplanned offsite releases of gaseous and liquid radioactive effluents.

**Attachment 5**  
**Unplanned Offsite Releases**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Brunswick Steam Electric Plant did not experience any unplanned offsite effluent releases in 2015.

**Attachment 6**  
**Assessment of Radiation Dose from Radioactive Effluents to Members of the Public**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 6**

**Assessment of Radiation Dose from Radioactive Effluents to Members of the Public**  
**(includes fuel cycle dose calculation results)**

This attachment includes an assessment of radiation doses to the maximum exposed member of the public due to radioactive liquid and gaseous effluents released from the site for each calendar quarter for the calendar year of the report as well as the total dose for the calendar year.

This attachment also includes an assessment of radiation doses to the maximum exposed member of the public from all uranium fuel cycle sources within 8 km of the site for the calendar year of this report to show conformance with 40 CFR Part 190.

Methods for calculating the dose contribution from liquid and gaseous effluents are given in the Offsite Dose Calculation Manual (ODCM).

# **Attachment 6** **Assessment of Radiation Dose from Radioactive Effluents to Members of the Public**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

## **Gaseous Effluents Dose Summary**

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
<b>A. Noble Gases</b>						
1. Maximum Beta Air	mRAD	8.62E-03	1.71E-02	9.39E-03	1.34E-03	3.64E-02
(a) Limit	mRAD	2.00E+01	2.00E+01	2.00E+01	2.00E+01	4.00E+01
(b) % of Limit		4.31E-02	8.54E-02	4.69E-02	6.69E-03	9.11E-02
2. Maximum Gamma Air	mRAD	1.59E-02	3.24E-02	1.75E-02	2.65E-03	6.85E-02
(a) Limit	mRAD	1.00E+01	1.00E+01	1.00E+01	1.00E+01	2.00E+01
(b) % of Limit		1.59E-01	3.24E-01	1.75E-01	2.65E-02	3.42E-01

Receptor Location **0.7 miles ENE**

## **B. Iodine, H-3, & Particulates**

1. Maximum Organ Dose	mREM	1.31E-02	1.07E-02	1.50E-02	5.80E-03	4.45E-02
(a) Limit	mREM	1.50E+01	1.50E+01	1.50E+01	1.50E+01	3.00E+01
(b) % of Limit		8.71E-02	7.10E-02	1.00E-01	3.87E-02	1.48E-01

Receptor Location **4.75 miles NE**

Critical Age **INFANT**

Critical Organ **THYROID**

**Attachment 6**  
**Assessment of Radiation Dose from Radioactive Effluents to Members of the Public**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**Liquid Effluents Dose Summary**

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
<b>A. Batch &amp; Continuous Mode</b>						
1. Maximum Organ Dose	mREM	7.77E-04	4.49E-04	1.65E-04	4.94E-04	1.88E-03
(a) Limit	mREM	1.00E+01	1.00E+01	1.00E+01	1.00E+01	2.00E+01
(b) % of Limit		7.77E-03	4.49E-03	1.65E-03	4.94E-03	9.41E-03
2. Maximum Total Body Dose	mREM	7.61E-04	4.46E-04	1.65E-04	4.61E-04	1.83E-03
(a) Limit	mREM	3.00E+00	3.00E+00	3.00E+00	3.00E+00	6.00E+00
(b) % of Limit		2.54E-02	1.49E-02	5.50E-03	1.54E-02	3.05E-02

Critical Age **ADULT**

Critical Organ **GI-LLI**

## Attachment 6 Assessment of Radiation Dose from Radioactive Effluents to Members of the Public

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

### 40 CFR Part 190 Uranium Fuel Cycle Dose Calculation Results

In accordance with the requirements of 40 CFR Part 190, the annual dose commitment to any member of the general public shall be calculated to assure that doses are limited to 25 millirems to the total body or any organ with the exception of the thyroid which is limited to 75 millirems. The fuel cycle dose assessment for Brunswick Steam Electric Plant includes liquid and gaseous effluent dose contributions from Brunswick Steam Electric Plant and direct and air-scatter dose from the onsite ISFSI and Turbine Buildings. No other uranium fuel cycle facility contributes significantly to the maximum exposed individual. Also included is dose from Carbon-14, evaporation of tritium from both the SDSP and SDSF, and marsh releases containing tritium to Nancy's Creek (Ref. Attachment 2, Supplemental Information, of this report for further information). The combined dose to a maximum exposed individual from effluent releases and direct and air-scatter dose is below 40 CFR Part 190 limits as shown by the following summary.

*Note: The 40 CFR Part 190 effluent dose analysis to the maximum exposed individual from liquid and gas releases does not include the dose from noble gases (i.e., total body and skin) due to the low significance compared to other dose pathways.*

#### 40 CFR Part 190 Effluent Dose Summary

<b>A. Gaseous Effluent Dose</b>		<b>D. SDSP Evaporation H-3 Dose</b>	
1. Location	4.75 miles NE	1. Location	0.30 miles NW
2. Critical Age	INFANT	2. Critical Age	TEEN
3. Critical Organ	THYROID	3. Critical Organ	N/A
4. Organ Dose (mREM)	4.45E-02	4. Organ Dose (mREM)	1.28E-04
5. Total Body Dose (mREM)	1.13E-02	5. Total Body Dose (mREM)	1.28E-04
<b>B. Liquid Effluent Dose</b>		<b>E. SDSF Evaporation H-3 Dose</b>	
1. Location	0.10 miles SW	1. Location	0.50 miles NNW
2. Critical Age	ADULT	2. Critical Age	TEEN
3. Critical Organ	GI-LLI	3. Critical Organ	N/A
4. Organ Dose (mREM)	1.62E-04	4. Organ Dose (mREM)	2.51E-04
5. Total Body Dose (mREM)	1.10E-04	5. Total Body Dose (mREM)	2.51E-04
<b>C. Carbon-14 Dose</b>		<b>F. Nancy's Creek Marsh H-3 Dose</b>	
1. Location	1.80 miles S	1. Location	Nancy's Creek
2. Critical Age	CHILD	2. Critical Age	ADULT
3. Critical Organ	BONE	3. Critical Organ	N/A
4. Organ Dose (mREM)	2.02E+00	4. Organ Dose (mREM)	1.72E-03
5. Total Body Dose (mREM)	4.05E-01	5. Total Body Dose (mREM)	1.72E-03



## Attachment 6 Assessment of Radiation Dose from Radioactive Effluents to Members of the Public

### Brunswick Steam Electric Plant Units 1 & 2 Period 1/1/2015 - 12/31/2015

Direct and air-scatter radiation dose contributions from the onsite ISFSI and Turbine Buildings are shown in plant operating manual OPLP-36, 10 CFR 72.212 Report, revision 3. The maximum dose rate to the nearest real individual from the ISFSI and Turbine Buildings is conservatively calculated to be less than 14.8 mrem/yr. The below excerpt from plant operating manual OPLP-36, 10 CFR 72.212 Report, revision 3, is provided to document the method used to calculate the dose from the onsite ISFSI and Turbine Buildings as less than 14.8 mrem/yr to the nearest real individual.

#### **5.2.2.2 Radiation from Plant Operations**

*Offsite direct dose measurements are obtained and analyzed in accordance with the Radiological Environmental Monitoring Program (REMP) and submitted annually to the NRC. As part of the REMF, two rings of stations are established for monitoring direction radiation. The inner ring of stations is established in the general area of the site boundary. The outer ring of stations is located at distances of 8 km or greater from the site (Ref. 10.4.8). Environmental data on external radiation exposure does not indicate a significant higher exposure rate for the inner ring versus the outer ring. This demonstrates that no discernible off-site exposure occurs as a result of plant operations (Ref. 10.5.3, 10.5.4).*

*For conservatism, an approach is taken for quantifying the plant contribution to direct dose at the controlled area boundary. The ODCM TLD sample point along either the inner or outer ring of stations with the highest dose reading for each quarter was used as a bounding indicator dose...*

*...The real dose contribution from direct radiation sources during plant operations at BSEP is taken at 14.8 mrem/year.*

Dose contributions from Carbon-14 in gaseous effluents have been determined from ODCM 3.3.3, Carbon-14. The maximum dose rate to the nearest real individual from the release of Carbon-14 in gaseous effluents is conservatively calculated to be less than 2.02E+00 mrem/yr based on 22.0 Curies released in 2015 (Ref. Attachment 2, Supplemental Information, of this report).

Dose contributions from evaporation of the Storm Drain Stabilization Pond (SDSP) have been determined from ODCM 3.3.2, I-131, I-133, Particulates, and Tritium, equation 3.2-19. The maximum dose rate to the nearest real individual from evaporation of tritium in the SDSP is conservatively calculated to be less than 1.28E-04 mrem/yr based on 4.17E-01 Curies released in 2015 (Ref. Attachment 2, Supplemental Information, of this report).

Dose contributions from evaporation of the Storm Drain Stabilization Facility (SDSF) have been determined from ODCM 3.3.2, I-131, I-133, Particulates, and Tritium, equation 3.2-19. The maximum dose rate to the nearest real individual from evaporation of tritium in the SDSF is conservatively calculated to be less than 2.51E-04 mrem/yr based on 3.89E-01 Curies released in 2015 (Ref. Attachment 2, Supplemental Information, of this report).

Dose contributions from marsh releases to Nancy's Creek from ODCM 2.1.5, Marsh Releases. The maximum dose rate to the nearest real individual from marsh releases to Nancy's Creek is conservatively calculated to be less than 1.72E-03 mrem/yr based on 1.42E-01 Curies released in 2015 (Ref. Attachment 2, Supplemental Information, of this report).

Total dose from liquid and gaseous effluents from Brunswick Steam Electric Plant and the additional pathways mentioned above is conservatively estimated to be less than 17 mrem/yr for total body and organ. It is recognized summing dose for different organs and age groups is not entirely accurate. However, the sum of the organ and age specific doses will always be less than the sum of the maximums of each. Therefore, summing the maximum values of each provides the most conservative value to ensure compliance with 40 CFR 190. The dose from all pathways related to operation of Brunswick Steam Electric Plant meets the 40 CFR Part 190 requirements of an annual dose commitment to any member of the general public of less than 25 mrem total body or any organ and 75 mrem to the thyroid.

**Attachment 7**  
**Information to Support the NEI Ground Water Protection Initiative**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 7**

**Information to Support the NEI Ground Water Protection Initiative**

This attachment includes a summary of voluntary reports made in accordance with the NEI Ground Water Protection Initiative and a summary of ground water well sample data.

## Attachment 7 Information to Support the NEI Ground Water Protection Initiative

### Brunswick Steam Electric Plant Units 1 & 2 Period 1/1/2015 - 12/31/2015

The Brunswick Steam Electric Plant groundwater sampling and analysis program is a significant surveillance program. Wells are installed around the Storm Drain Stabilization Pond (SDSP), in the Protected Area (PA), and throughout the Owner Controlled Area (OCA). The wells listed in the ODCM are collected as part of the Radiological Environmental Monitoring Program (REMP) and reported in the Annual Radiological Environmental Operating Report (AREOR). The monitoring wells not described in the ODCM are listed below. The list consists of shallow and intermediate wells in different locations around the OCA and PA. They are used to evaluate groundwater movement and for remediation of the Unit 1 Condensate Storage Tank (CST) leak and the SDSP.

**Unit 1 CST Groundwater Wells** - The investigation into groundwater impacts resulting from the December 2010 Unit 1 Condensate Storage Tank line leak resulted in the installation of numerous monitoring/recovery wells. Three of these wells (U1CSTREM-01, U1CSTREM-07, and U1CSTREM-09) are installed in the Castle Hayne aquifer (greater than 70' below ground surface) to investigate and monitor potential impacts to the aquifer. Ten of these wells (U1CSTREM-05, U1CSTREM-02B, U1CSTREM-08/GWM-17, U1CSTREM-09B, U1CSTREM-15/GWM-15, U1CSTREM-21B, U1CSTREM-22B, U1CSTREM-27B, MW-01B, and MWPA-111B/GWM-01) are installed in the dense sand unit (45' - 70' below ground surface) to investigate and monitor impacts to this flow zone comprised of native material beneath the plant excavation backfill. Three of these dense sand wells are currently being used as recovery wells as part of the groundwater remediation effort (GWM-01, GWM-15, GWM-17). Twenty-four of these wells (U1CSTREM-02C/GWM-01, U1CSTREM-09C, U1CSTREM-10/GWM-04, U1CSTREM-11, U1CSTREM-12, U1CSTREM-13/GWM-13, U1CSTREM-14/GWM-15, U1CSTREM-16/GWM-16, U1CSTREM-18/GWM-18, U1CSTREM-19/GWM-19, U1CSTREM-21C, U1CSTREM-22C/GWM-07, U1CSTREM-23/GWM-11, U1CSTREM-24/GWM-22, U1CSTREM-25/GWM-21, U1CSTREM-26/GWM-06, U1CSTREM-27C/GWM-05, U1CSTREM-28/GWM-03, U1CSTREM-29/GWM-02, U1CSTREM-30/GWM-08, U1CSTREM-31/GWM-09, U1CSTREM-32, U1CSTREM-33/GWM-10, and MWPA-112C/GWM-12) are installed in the plant excavation backfill (up to 45' below ground surface) to investigate and monitor impacts to this flow zone where the leak occurred. Fifteen of these wells are currently used as recovery wells as part of the groundwater remediation effort.

Wells are typically sampled quarterly or semi-annually. Ground water samples are regularly analyzed for tritium and several wells are analyzed for gamma emitters. No gamma emitters, other than naturally occurring radionuclides, were identified in well samples during 2015.

Results from sampling during 2015 are shown in the table below.

No events meeting the criteria for voluntary notification per NEI 07-07, Industry Ground Water Protection Initiative, occurred at Brunswick Steam Electric Plant in 2015.

*Key to below table.*

NS	- Not scheduled to be sampled, not sampled due to insufficient volume in well, or well inaccessible during outage.
pCi/l	- picocuries per liter.
< LLD	- less than lower limit of detection, typically 250 pCi/l.
20,000 pCi/l	- the Environmental Protection Agency drinking water standard for tritium. This standard applies only to water used for drinking.
1,000,000 pCi/l	- the 10 CFR Part 20, Appendix B, Table 2, Column 2, Effluent Concentration Limit for tritium.

**Attachment 7**  
**Information to Support the NEI Ground Water Protection Initiative**

**Brunswick Steam Electric Plant Units 1 & 2**  
**Period 1/1/2015 - 12/31/2015**

<b>Brunswick <u>Shallow</u> Wells for Plant Site</b>						
<b>Well Name</b>	<b>Number of Samples in 2015</b>	<b>Number of Positive H-3 Samples in 2015</b>	<b>Average H-3 Activity (pCi/L)</b>	<b>Minimum H-3 Activity (pCi/L)</b>	<b>Maximum H-3 Activity (pCi/L)</b>	<b>Depth of Well (ft)</b>
ESS-2C	4	4	1.15E+04	8.61E+03	1.62E+04	27
ESS-3C	2	2	1.29E+03	1.17E+03	1.41E+03	14
ESS-12C	2	2	2.71E+02	2.65E+02	2.76E+02	15
ESS-13C	2	0	< LLD	< LLD	< LLD	25
ESS-16	5	5	5.27E+03	1.19E+03	2.05E+04	27
ESS-17C	4	4	7.88E+03	5.60E+03	1.03E+04	26
ESS-18C	4	4	1.45E+04	7.56E+02	2.73E+04	20
ESS-19C	2	2	1.44E+05	1.40E+05	1.48E+05	20
ESS-20C	4	4	2.63E+04	1.69E+04	3.19E+04	20
ESS-21C	1	1	3.63E+02	3.63E+02	3.63E+02	20
ESS-22C	1	1	1.71E+05	1.71E+05	1.71E+05	20
ESS-23C	2	2	8.96E+04	8.22E+04	9.69E+04	23
ESS-24C	3	3	3.53E+03	2.84E+03	4.47E+03	18
ESS-25C	1	0	< LLD	< LLD	< LLD	22
ESS-26C	2	2	3.09E+04	1.26E+04	4.92E+04	15
ESS-27C	2	2	1.57E+05	1.56E+05	1.58E+05	16
ESS-28C	2	2	5.40E+02	4.62E+02	6.18E+02	23
ESS-29C	2	0	< LLD	< LLD	< LLD	28
ESS-30C	5	5	2.14E+04	5.33E+02	6.57E+04	15
ESS-31C	2	0	< LLD	< LLD	< LLD	15
ESS-38C	1	0	< LLD	< LLD	< LLD	15
ESS-39C	1	0	< LLD	< LLD	< LLD	20
ESS-40C	1	0	< LLD	< LLD	< LLD	30
ESS-41C	1	0	< LLD	< LLD	< LLD	27
ESS-42C	1	0	< LLD	< LLD	< LLD	30
ESS-44C	1	0	< LLD	< LLD	< LLD	15
ESS-45C	1	0	< LLD	< LLD	< LLD	21
ESS-46C	1	0	< LLD	< LLD	< LLD	18
ESS-48C	1	0	< LLD	< LLD	< LLD	18
ESS-49C	1	0	< LLD	< LLD	< LLD	19
ESS-50C	1	0	< LLD	< LLD	< LLD	22
ESS-51C	1	0	< LLD	< LLD	< LLD	22
ESS-54C	1	0	< LLD	< LLD	< LLD	24
ESS-55C	1	0	< LLD	< LLD	< LLD	38
ESS-56C	1	0	< LLD	< LLD	< LLD	32
ESS-58C	1	0	< LLD	< LLD	< LLD	18

**Attachment 7**  
**Information to Support the NEI Ground Water Protection Initiative**

**Brunswick Steam Electric Plant Units 1 & 2**  
**Period 1/1/2015 - 12/31/2015**

<b>Brunswick <u>Shallow</u> Wells for Plant Site - continued</b>						
<b>Well Name</b>	<b>Number of Samples in 2015</b>	<b>Number of Positive H-3 Samples in 2015</b>	<b>Average H-3 Activity (pCi/L)</b>	<b>Minimum H-3 Activity (pCi/L)</b>	<b>Maximum H-3 Activity (pCi/L)</b>	<b>Depth of Well (ft)</b>
ESS-59C	1	0	< LLD	< LLD	< LLD	18
ESS-60C	1	0	< LLD	< LLD	< LLD	19
ESS-67C	1	1	4.90E+02	4.90E+02	4.90E+02	25
ESS-68C	1	0	< LLD	< LLD	< LLD	19
ESS-69C	1	0	< LLD	< LLD	< LLD	30
ESS-70C	1	0	< LLD	< LLD	< LLD	18
ESS-71C	1	0	< LLD	< LLD	< LLD	19
ESS-72C	2	0	< LLD	< LLD	< LLD	18
ESS-73C	1	0	< LLD	< LLD	< LLD	15
ESS-74C	1	0	< LLD	< LLD	< LLD	25
ESS-201C	5	4	5.18E+03	3.76E+02	1.17E+04	19
ESS-202C	5	5	3.93E+04	2.26E+04	5.49E+04	19
ESS-203C	5	5	3.57E+03	2.03E+03	6.81E+03	19
ESS-STAB	2	2	5.42E+03	4.41E+03	6.43E+03	31
ESS-NC-4A	2	2	7.40E+03	7.03E+03	7.76E+03	17
MW-1	2	2	4.59E+02	4.03E+02	5.15E+02	24
MW-2	2	1	3.47E+02	3.47E+02	3.47E+02	24
MW-3	2	2	3.20E+02	3.04E+02	3.35E+02	26
MWPA-100C	2	1	6.43E+02	6.43E+02	6.43E+02	30
MWPA-101C	2	2	6.36E+02	5.55E+02	7.16E+02	29
MWPA-102C	3	1	4.93E+02	4.93E+02	4.93E+02	30
MWPA-103C	2	0	< LLD	< LLD	< LLD	30
MWPA-104C	4	4	4.21E+03	1.78E+03	6.83E+03	29
MWPA-105C	2	2	7.36E+02	6.88E+02	7.84E+02	30
MWPA-106C	2	2	6.34E+02	5.14E+02	7.54E+02	29
MWPA-107C	5	5	1.87E+03	1.48E+03	2.80E+03	29
MWPA-108C	4	4	6.42E+02	4.70E+02	7.45E+02	29
MWPA-109C	2	2	1.02E+03	9.61E+02	1.08E+03	29
MWPA-110C	4	3	1.09E+03	7.50E+02	1.47E+03	29
MWPA-113C	2	2	7.92E+02	6.66E+02	9.18E+02	25
MWPA-114C	5	5	1.49E+03	7.99E+02	2.05E+03	30
MWPA-115C	4	3	6.29E+03	4.03E+03	9.48E+03	34
MWPA-116C	2	0	< LLD	< LLD	< LLD	30
MWPA-117C	2	2	5.89E+02	5.48E+02	6.29E+02	30
MWPA-118C	2	2	8.92E+02	8.36E+02	9.48E+02	30

**Attachment 7**  
**Information to Support the NEI Ground Water Protection Initiative**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Brunswick <u>Intermediate</u> Wells for Plant Site						
Well Name	Number of Samples in 2015	Number of Positive H-3 Samples in 2015	Average H-3 Activity (pCi/L)	Minimum H-3 Activity (pCi/L)	Maximum H-3 Activity (pCi/L)	Depth of Well (ft)
ESS-2B	1	0	< LLD	< LLD	< LLD	58
ESS-3B	1	0	< LLD	< LLD	< LLD	52
ESS-18B	4	4	3.89E+02	3.62E+02	4.12E+02	23
ESS-19B	4	4	6.82E+03	4.02E+03	1.31E+04	42
ESS-20B	4	0	< LLD	< LLD	< LLD	43
ESS-22B	4	4	2.14E+03	1.78E+03	2.40E+03	76
ESS-38B	1	0	< LLD	< LLD	< LLD	55
ESS-39B	1	0	< LLD	< LLD	< LLD	55
ESS-51B	1	0	< LLD	< LLD	< LLD	45
ESS-52B	1	0	< LLD	< LLD	< LLD	51
ESS-53B	1	0	< LLD	< LLD	< LLD	76
MWPA-104B	4	4	8.04E+03	4.87E+03	9.80E+03	59
MWPA-107B	5	5	2.07E+04	1.72E+04	2.71E+04	60

**Attachment 7**  
**Information to Support the NEI Ground Water Protection Initiative**

**Brunswick Steam Electric Plant Units 1 & 2**  
**Period 1/1/2015 - 12/31/2015**

<b>Brunswick Unit 1 CST Groundwater Wells</b>						
<b>Well Name</b>	<b>Number of Samples in 2015</b>	<b>Number of Positive H-3 Samples in 2015</b>	<b>Average H-3 Activity (pCi/L)</b>	<b>Minimum H-3 Activity (pCi/L)</b>	<b>Maximum H-3 Activity (pCi/L)</b>	<b>Depth of Well (ft)</b>
MWPA-111B/GWM-01	178	106	4.50E+03	2.85E+03	7.98E+03	61
MWPA-112C/GWM-12	174	173	1.89E+04	3.36E+03	8.49E+04	33
U1CSTREM-01C	5	0	< LLD	< LLD	< LLD	85
U1CSTREM-02B	7	0	< LLD	< LLD	< LLD	68
U1CSTREM-02C/GWM-20	172	172	3.66E+04	7.90E+03	6.03E+04	45
U1CSTREM-05B	9	0	< LLD	< LLD	< LLD	65
U1CSTREM-07BCH	9	0	< LLD	< LLD	< LLD	85
U1CSTREM-08/GWM-17	163	57	4045	2619	18625	68
U1CSTREM-09BCH	9	0	< LLD	< LLD	< LLD	85
U1CSTREM-09B	9	5	3559	2922	3972	68
U1CSTREM-09C	9	3	4401	3332	5834	45
U1CSTREM-10/GWM-04	8	0	< LLD	< LLD	< LLD	45
U1CSTREM-11C	9	0	< LLD	< LLD	< LLD	40
U1CSTREM-12C	3	0	< LLD	< LLD	< LLD	34
U1CSTREM-13/GWM-13	176	176	1.56E+05	1.17E+04	4.15E+05	44
U1CSTREM-14/GWM-14	177	175	2.49E+05	3.25E+03	6.43E+05	44
U1CSTREM-15/GWM-15	174	174	2.37E+04	1.48E+04	4.82E+04	59
U1CSTREM-16/GWM-16	172	172	2.43E+05	1.78E+04	5.49E+05	40
U1CSTREM-18/GWM-18	174	174	1.16E+06	3.15E+04	3.06E+06	29
U1CSTREM-19/GWM-19	158	158	6.42E+04	4.64E+03	1.57E+05	40
U1CSTREM-21B	7	1	4.40E+03	4.40E+03	4.40E+03	69
U1CSTREM-21C	6	1	4.55E+03	4.55E+03	4.55E+03	45
U1CSTREM-22B	4	0	< LLD	< LLD	< LLD	69
U1CSTREM-22C/GWM-07	58	24	4.40E+03	2.92E+03	1.49E+04	45
U1CSTREM-23/GWM-11	174	170	1.58E+04	4.56E+03	1.78E+05	45
U1CSTREM-24/GWM-22	176	176	3.20E+04	4.10E+03	4.50E+04	29
U1CSTREM-25/GWM-21	168	168	3.99E+04	1.70E+04	5.87E+04	45
U1CSTREM-26GWM-06	54	10	4.21E+03	2.77E+03	6.44E+03	45
U1CSTREM-27B	7	0	< LLD	< LLD	< LLD	68
U1CSTREM-27C/GWM-05	7	0	< LLD	< LLD	< LLD	45
U1CSTREM-28/GWM-03	9	5	11283	6882	21187	45
U1CSTREM-29/GWM-02	123	123	5.24E+04	7.31E+03	1.02E+05	45
U1CSTREM-30/GWM-08	141	118	5.73E+03	3.08E+03	1.32E+04	45
U1CSTREM-31/GWM-09	159	19	3.70E+03	2.79E+03	8.02E+03	46
U1CSTREM-32	7	0	< LLD	< LLD	< LLD	45
U1CSTREM-33/GWM-10	156	153	1.25E+04	6.86E+03	1.37E+05	45
MW-1B	9	1	4.33E+03	4.33E+03	4.33E+03	45

**Attachment 8  
Inoperable Equipment**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 8**

**Inoperable Equipment**

This attachment includes an explanation of inoperable instruments related to effluent monitoring in excess of allowed time defined by licensing bases and an explanation of liquid hold-up tanks exceeding 10 Curies total activity (excluding tritium and dissolved or entrained noble gases).



## Attachment 8 Inoperable Equipment

### Brunswick Steam Electric Plant Units 1 & 2 Period 1/1/2015 - 12/31/2015

Brunswick Steam Electric Plant experienced three (3) instances of inoperable equipment relevant to effluent monitoring in excess of ODCM Specification 7.3.0 limits during 2015. Details of each are described below.

Brunswick Steam Electric Plant experienced no Liquid Hold-Up Tank exceeding the 10 Curie limit of ODCMS 7.3.6 during 2015.

ODCM # from Table 7.3.1-1	Title	Completion Time	Description
3	Main Service Water System Effluent Radioactivity Monitor	30 Days	2-D12-RM-K605 was out of service greater than 30 days starting on 2/21/2015 due to reading below minimum background and declared operable on 5/1/15. The detector was replaced under WO 13492860-01 and calibration performed under WO 13492860-03. Compensatory sampling of once per 12 hours (ODCM 7.3.1) was performed during the time the monitor was inoperable. Reference NCR 00733936 and 00742209.

ODCM # from Table 7.3.2-1	Title	Completion Time	Description
5	Main Condenser Off-Gas Treatment System Explosive Gas Monitoring System - Hydrogen Monitor	30 Days	2-OG-AIT-4324 was out of service greater than 30 days starting on 4/4/2015 due to power loss during bus maintenance outage. When power was restored, analyzer program did not reinitialize. The monitor was declared operable on 7/31/15. Compensatory sampling of once per 24 hours and analyze within 4 hours (ODCM 7.3.2) was performed during the time the monitor was inoperable. Reference NCR 00742128, 00748698, and 00747153.

ODCM # from Table 7.3.2-1	Title	Completion Time	Description
5	Main Condenser Off-Gas Treatment System Explosive Gas Monitoring System - Hydrogen Monitor	30 Days	1-OG-AIT-4284 was out of service greater than 30 days starting on 9/8/2015 due to spurious alarms. Entered ODCM 7.3.2, Radioactive Gaseous Effluent Monitoring Instrumentation, conditions A.1, F.3 and F.4 for EC to replace 1-OG-AIT-4284. 1-OG-AIT-4284, H2/O2 analyzer was verified functional and operable on 2/13/16. Reference NCR 01962842 and 01951094.

**Attachment 9**  
**Summary of Changes to the Offsite Dose Calculation Manual**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 9**

**Summary of Changes to the Offsite Dose Calculation Manual**

This attachment includes a summary of changes to the ODCM and Radiological Effluent Controls.

**Attachment 9**  
**Summary of Changes to the Offsite Dose Calculation Manual**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ODCM Revision 37**

The Brunswick Steam Electric Plant ODCM was not revised in 2015. The most recent revision is 37.

**Attachment 10**  
**Summary of Changes to the Process Control Program**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 10**

**Summary of Changes to the Process Control Program**

This attachment includes a summary of changes to the PCP.

**Attachment 10**  
**Summary of Changes to the Process Control Program**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

The Brunswick Steam Electric Plant PCP was not revised in 2015. The most recent revision is 5.

**Attachment 11**  
**Summary of Major Modifications to the Radioactive Waste Treatment Systems**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 11**

**Summary of Major Modifications to the Radioactive Waste Treatment Systems**

This attachment includes a description of major modifications to the radioactive waste treatment systems that are anticipated to affect effluent releases.

**Attachment 11**  
**Summary of Major Modifications to the Radioactive Waste Treatment Systems**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

No major modifications to Brunswick Steam Electric Plant liquid, gaseous, solid, or mobile radioactive waste treatment systems occurred in 2015.

**Attachment 12**  
**Errata to a Previous Year's ARERR**

Brunswick Steam Electric Plant Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 12**

**Errata to a Previous Year's ARERR**

This attachment includes any amended pages from a previous year's ARERR.



## Attachment 12 Errata to a Previous Year's ARERR

### Brunswick Steam Electric Plant Units 1 & 2 Period 1/1/2015 - 12/31/2015

The following contains amended pages to the Brunswick Steam Electric Plant 2013 ARERR. Amended pages are identified with "Amendment #" on page. Specific changes are identified with change bars in right margin.

#### NCR 00747696

The Carbon-14 average release rate for period values on the OpenEMS Annual Radioactive Effluent Release Report (ARERR) are not correct. The values being calculated are in the units of Curies per second, however, the printout states it is in microCuries per second. The value reported should be in microCuries per second. This was not found until preparing the 2014 ARERR, therefore, the 2013 ARERR was submitted with an incorrect value. Previous years were not affected as OpenEMS was placed into service during the 4th quarter of 2013. The vendor has corrected the code within the software.

The Brunswick Steam Electric Plant 2013 ARERR Amendment #1 requires the following change from Page 15 of 45:

Brunswick Steam Electric Plant 2013 ARERR as submitted:

#### E. CARBON-14

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	4.74E+00	4.18E+00	5.89E+00	5.90E+00	NA
2. Average release rate for period	μCi/sec	6.10E-07	5.32E-07	7.41E-07	7.42E-07	NA

Brunswick Steam Electric Plant 2013 ARERR Amendment #1 as revised:

#### E. CARBON-14

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	4.74E+00	4.18E+00	5.89E+00	5.90E+00	NA
2. Average release rate for period	μCi/sec	<del>6.10E-07</del> 6.10E-01	<del>5.32E-07</del> 5.32E-01	<del>7.41E-07</del> 7.41E-01	<del>7.42E-07</del> 7.42E-01	NA

# **Attachment 12** **Errata to a Previous Year's ARERR**

## **Brunswick Steam Electric Plant Units 1 & 2** **Period 1/1/2015 - 12/31/2015**

### Attachment 2 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	2.84E+01	2.02E+01	2.02E+01	4.24E+01	2.50E+01
2. Average release rate for period	µCi/sec	3.66E+00	2.57E+00	2.55E+00	5.33E+00	NA

**B. IODINES**

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total Iodine - 131 release	Ci	1.82E-03	4.69E-04	1.19E-03	1.28E-03	2.50E+01
2. Average release rate for period	µCi/sec	2.34E-04	5.96E-05	1.50E-04	1.62E-04	NA

**C. PARTICULATES**

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	3.98E-04	2.94E-04	2.24E-04	3.74E-04	2.50E+01
2. Average release rate for period	µCi/sec	5.12E-05	3.74E-05	2.82E-05	4.71E-05	NA
3. Gross Alpha	Ci	2.82E-07	1.40E-09	≤ LLD	≤ LLD	2.50E+01

**D. TRITIUM**

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	6.10E+01	5.38E+01	7.98E+01	1.16E+02	1.50E+01
2. Average release rate for period	µCi/sec	7.84E+00	6.84E+00	1.00E+01	1.46E+01	NA

**E. CARBON-14**

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	4.74E+00	4.18E+00	5.89E+00	5.90E+00	NA
2. Average release rate for period	µCi/sec	6.10E-01	5.32E-01	7.41E-01	7.42E-01	NA