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April 20, 2016

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U. S. Nuclear Regulatory Commission  
Washington, DC 20555

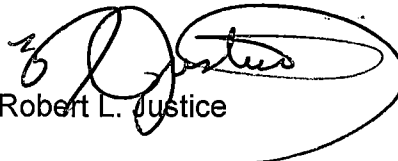
Dear Sir / Madam:

Subject: VIRGIL C. SUMMER NUCLEAR STATION UNIT 1  
DOCKET NO. 50-395  
OPERATING LICENSE NO. NPF-12  
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

Enclosed is the South Carolina Electric & Gas Company Annual Radioactive Effluent Release Report as required by 10CFR50.36a, Section 6.9.1.8 of the Virgil C. Summer Nuclear Station Technical Specifications and Section 1.6.2 of the Offsite Dose Calculation Manual. This submittal covers the period of January 1 through December 31, 2015.

Should there be any questions, please contact Ms. Susan B. Reese at (803) 345-4591.

Very truly yours,



Robert L. Justice

SBR/RLJ/sr  
Enclosures

c: w/o enclosure unless noted

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VIRGIL C. SUMMER  
JENKINSVILLE, SOUTH CAROLINA

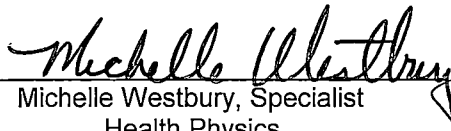
**ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT  
VIRGIL C. SUMMER NUCLEAR STATION**

**FOR THE OPERATING PERIOD  
JANUARY 1, 2015 - DECEMBER 31, 2015**

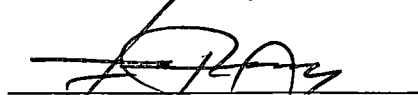
**APRIL 2016**



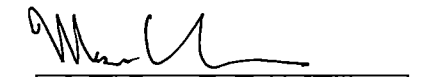
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# ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

JANUARY – DECEMBER, 2015

## VIRGIL C. SUMMER NUCLEAR STATION SOUTH CAROLINA ELECTRIC & GAS

### Introduction

This report is being submitted as a summary of quantities of radioactive liquid and gaseous effluents and solid waste released from the Virgil C. Summer Nuclear Station. This report is submitted in fulfillment of the requirements in the V. C. Summer Nuclear Station Operating License Technical Specifications Section 6.9.1.8, Offsite Dose Calculation Manual (ODCM) Section 1.6.2 and 10CFR50.36(a) and follows the reporting details specified in USNRC Regulatory guide 1.21<sup>(1)</sup>.

Summary information of radioactive gaseous and liquid effluents is presented along with a summary of radioactive waste disposal as well as an evaluation of the radiological impact on man due to operation of the Virgil C. Summer Nuclear Station. Supplemental information including release limits also required by USNRC Regulatory Guide 1.21 is provided as Appendix A.

During the reporting period there were no ODCM reportable incidents.

#### A. Supplemental Information

Regulatory limits for doses, dose rate and effluent concentration limits presented in Supplemental Information are from the Virgil C. Summer Nuclear Station ODCM and 40 CFR 190. Average energy ( $\bar{E}$ ) is not applicable to the method for determining release rate limits for fission and activation gaseous effluents; therefore, it has been omitted. A compilation of required supplemental information is provided in Appendix A.

#### B. Gaseous Effluents

Gaseous effluents released from ground level are summarized in Tables 1 and 2. An elevated release pathway does not exist at Virgil C. Summer Nuclear Station. Cumulative doses are discussed in Section E.

The errors for gaseous effluent totals are given as the square root of the sum of squares of counting errors and flow or volume measurement errors. A systematic error estimate of 15% has been included in the calculation of total error.

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## VIRGIL C. SUMMER NUCLEAR STATION SOUTH CAROLINA ELECTRIC & GAS

### C. Liquid Effluents

Liquid effluents are summarized in Tables 3 and 4. Estimated total errors are expressed as in Section B above.

### D. Solid Waste Shipments

Solid waste shipments are summarized in Table 5. Curie content of radioactive waste packages is determined by dose rates and/or gamma spectroscopy analysis of samples. The total error for each type of curie content determination is conservatively estimated to be the sum of a 15% systematic error and a 20% photon response error for the detector used.

### E. Radiological Impact on Man

Dose to the maximum exposed individual in the unrestricted area was calculated using measured plant gaseous effluents and meteorological data in accordance with the Offsite Dose Calculation Manual. The source term involved 0.3 days of Waste Gas Decay Tank (WGDT) releases, 7.4 days of 6-inch Reactor Building purge releases, 37.2 days of 36-inch Reactor Building purge releases and a continuous 12-month Main Plant vent release. Doses are summarized in Table 6. The total activities released are presented in Tables 1 and 2. The highest quarterly air doses at the station boundary resulting from the release of noble gases were  $1.25\text{E-}04$  mrad for gamma during the third quarter and  $4.46\text{E-}05$  mrad for beta during the third quarter. The maximum quarterly organ dose attributed to the releases, excluding Carbon-14, was  $1.02\text{E-}2$  mrem. Cumulative annual dose was  $2.04\text{E-}04$  mrad,  $7.23\text{E-}05$  mrad and  $1.29\text{E-}02$  mrem for gamma, beta, and organ dose, respectively. Discussion of the impact of Carbon-14 is included in Section K.

Measured plant liquid effluent data was used to calculate estimates of doses to individuals in accordance with the Offsite Dose Calculation Manual. The source term consisted of the isotopic contents of 211 Waste Monitor Tank batch releases, 18 Condensate Backwash Receiver Tank batch releases, 1 NaOH Sump batch release, 18.9 days of Steam Generator Blowdown release and a continuous Turbine Building Sump release.

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Doses are summarized in Table 6 and total radioactivity released is described in Tables 3 and 4. The highest quarterly total body dose to the maximum exposed individual resulting from the release of radioactive liquid was  $3.50\text{E-}03$  mrem during the third quarter. The highest organ dose was  $3.52\text{E-}03$  mrem to the GI-LLI also for the third quarter. Cumulative annual doses for the hypothetical maximum exposed individual were  $7.21\text{E-}03$  mrem for the total body and  $8.21\text{E-}3$  mrem for the GI-LLI, the maximum annual organ. The Liver was the maximum exposed organ for the first and second quarter and the GI-LLI was the maximum exposed organ for the third and fourth quarter.

Dose rates and concentrations were below station limits as specified in Supplemental Information, Section II A, B, and C during all the effluent releases.

Radiation exposure to members of the public within the site boundary was assessed through calculation of gamma and beta air dose at 0.25 miles of the gaseous effluent release point and direct measurement of exposure using thermoluminescent dosimeters. Onsite air dose for this reporting period was  $6.64\text{E-}04$  mrad gamma and  $2.35\text{E-}04$  mrad beta, well below levels that can be distinguished above background. Quarterly thermoluminescent dosimetry data from four onsite monitoring locations within 0.2 miles of the Reactor Building and eight locations at the site boundary were analyzed and compared with respective pre-operational background and previous year history. Results showed that the 2015 quarterly dose rates did not differ significantly from the pre-operational or 2014 dose rates. It was concluded that doses to members of the public inside the site boundary were indistinguishable from normal background dose.

Radiation doses from radioactive effluents to workers at the Fairfield Hydro Station for this reporting period were calculated to be  $9.65\text{E-}06$  and  $3.42\text{E-}06$  mrad for gamma and beta, respectively.

Radiation doses from radioactive effluents to workers at the New Nuclear Site for this reporting period were calculated to be  $8.31\text{E-}05$  and  $2.94\text{E-}05$  mrad for gamma and beta, respectively.

# ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

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## VIRGIL C. SUMMER NUCLEAR STATION SOUTH CAROLINA ELECTRIC & GAS

Radiation doses from nearby uranium fuel cycle sources were not assessed. The ODCM, Sections 1.3.1 and B/1.3 establish a five (5) mile limit beyond which doses from nearby plants are insignificant. There are no uranium fuel cycle plants within a five (5) mile radius of Virgil C. Summer Nuclear Station.

### F. Abnormal Releases

None

### G. Meteorology

The meteorological data for 2015 was collected and analyzed. An annual meteorological summary report providing joint frequency distributions of wind direction and speed by atmospheric stability class is maintained in plant records.

The wind direction and wind speed data used were acquired from the 10-meter level of the primary monitoring tower. Stability was determined by the primary differential temperature (61 to 10 meter).

The combined annual data recovery for wind direction, wind speed and stability was 92.6%. Primary variable recovery rates were as follows: wind direction (10 m) – 92.6%, wind speed (10 m) – 92.6%, and differential temperature (61 - 10 m) – 97.1%.

### H. Offsite Dose Calculation Manual

The Virgil C. Summer Nuclear Station ODCM was not revised in 2015.

# ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

JANUARY – DECEMBER, 2015

## VIRGIL C. SUMMER NUCLEAR STATION SOUTH CAROLINA ELECTRIC & GAS

### I. Offsite Dose Calculation Manual Reportable Incidents

There were no ODCM reportable incidents in 2015.

### J. Major Changes to Radioactive Waste Treatment Systems

During 2015, there were no major changes to the Radioactive Waste Treatment System.

### K. Carbon-14 Gaseous Effluents

Carbon-14 production and release estimates were calculated using EPRI Report 1021106<sup>(2)</sup>, "Estimation of Carbon-14 in Nuclear Plant Gaseous Effluents". This calculation uses active core coolant mass, average neutron flux by energy and reactor coolant nitrogen concentrations to determine Carbon-14 generation based upon an effective full power year. The estimated generation for VC Summer Nuclear station for 2015 was 8.42 curies.

Public dose estimates were performed using Regulatory Guide 1.109<sup>(3)</sup> methodology. Carbon dioxide is assumed to make up 20% of the Carbon-14 gaseous emissions from the station based upon available references and on-site testing. Carbon-14 is the highest dose contributor of all radionuclides released in gaseous effluents. Annual dose resulting from Carbon-14 releases in gaseous effluents is estimated to be 1.37E-01 mrem total body and 6.87E-01 mrem to the maximum organ (bone).

# ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

JANUARY – DECEMBER, 2015

VIRGIL C. SUMMER NUCLEAR STATION  
SOUTH CAROLINA ELECTRIC & GAS

## References

1. Regulatory Guide 1.21, "*Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents From Light Water Cooled Nuclear Power Plants*", Revision 1, US Nuclear Regulatory Commission, Washington D.C., 1974.
2. EPRI Report 1021106, "*Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents*", Electric Power Research Institute, Palo Alto, CA, 2010.
3. Regulatory Guide 1.109, "*Calculation of Annual Doses to Man from Routine Releases of Reactor effluents for the Purpose of Demonstrating compliance with 10 CFR50, Appendix I*", US Nuclear Regulatory Commission, Washington D.C., 1976.



**APPENDIX A  
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT**

**JANUARY – DECEMBER, 2015**

**VIRGIL C. SUMMER NUCLEAR STATION  
SOUTH CAROLINA ELECTRIC & GAS**

**SUPPLEMENTAL INFORMATION**

**I. Regulatory Dose Limits:**

**A. Fission and Activation Gases:**

The air dose to an individual due to noble gases released in gaseous effluents shall be limited to less than or equal to 5 mrad for gamma radiation and 10 mrad for beta radiation during any calendar quarter and 10 mrad for gamma radiation and 20 mrad for beta radiation during any calendar year (ODCM, Section 1.2.3.1).

**B. Iodines, Particulates (half-lives > 8 days) and Tritium:**

The dose to an individual from radioidines, tritium and radioactive materials in particulate form with half-lives greater than 8 days in gaseous effluents shall be limited to less than or equal to 7.5 mrem to any organ during any calendar quarter and 15 mrem to any organ during any calendar year (ODCM, Section 1.2.4.1).

**C. Liquid Effluents:**

The dose or dose commitment to an individual from radioactive materials in liquid effluents released shall be limited to less than or equal to 1.5 mrem to the total body and 5 mrem to any organ during any calendar quarter and 3 mrem to the total body and 10 mrem to any organ during any calendar year (ODCM, Section 1.1.3.1).

**D. All Sources:**

The annual dose equivalent shall not exceed 25 mrem to the whole body, 75 mrem to the thyroid and 25 mrem to any other organ (40 CFR 190).

**II. Dose Rate and Effluent Concentration Limits:**

**A. Fission and Activation Gases**

The dose rate in unrestricted areas due to radioactive materials released in gaseous effluents shall be limited to less than or equal to 500 mrem/year to the total body and less than or equal to 3000 mrem/year to the skin (ODCM, Section 1.2.2.1).

**APPENDIX A  
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT**

**JANUARY – DECEMBER, 2015**

**VIRGIL C. SUMMER NUCLEAR STATION  
SOUTH CAROLINA ELECTRIC & GAS**

**B. Iodines, Particulates (half-lives > 8 days) and Tritium:**

The dose rate in unrestricted areas due to radioactive materials in effluents shall be limited to less than or equal to 1500 mrem/year to any organ (ODCM, Section 1.2.2.1).

**C. Liquid Effluents:**

The concentration of radioactive materials released from the site shall be limited to 10 times the concentrations specified in 10 CFR 20, Appendix B, Table 2, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2E-04  $\mu\text{Ci/ml}$  total activity (ODCM, Section 1.1.2.1).

**III. Average Energy:**

Not Applicable

**IV. Measurements and Approximations of Total Radioactivity:**

- A. Fission and activation gases: Gamma spectrometry (HPGe)
- B. Iodines: Gamma spectrometry (HPGe)
- C. Particulates: Gamma spectrometry (HPGe), beta proportional counting, alpha proportional counting
- D. Tritium: Liquid scintillation
- E. Liquid effluents: Gamma spectrometry (HPGe), liquid scintillation (H-3), beta proportional counting, alpha proportional counting.

**APPENDIX A  
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT**

**JANUARY – DECEMBER, 2015**

**VIRGIL C. SUMMER NUCLEAR STATION  
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V. Batch Releases:

A. Gaseous:

1. Number of batch releases: 2
2. Total time period for batch releases: 420 min.
3. Maximum time period for a batch release: 243 min.
4. Average time period for a batch release: 210 min.
5. Minimum time period for a batch release: 177 min.

B. Liquid:

1. Number of batch releases:

43	For first quarter, 2015
29	For second quarter, 2015
55	For third quarter, 2015
103	For fourth quarter, 2015
  
2. Total time period for batch releases:

3.30E+03	min. for first quarter, 2015
2.19E+03	min. for second quarter, 2015
4.61E+03	min. for third quarter, 2015
8.00E+03	min. for fourth quarter 2015
  
3. Maximum time period for a batch release:

1.28E+02	min. for first quarter, 2015
8.90E+01	min. for second quarter, 2015
1.13E+02	min. for third quarter, 2015
1.16E+02	min. for fourth quarter, 2015

**APPENDIX A  
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT**

**JANUARY – DECEMBER, 2015**

**VIRGIL C. SUMMER NUCLEAR STATION  
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4. Average time period for batch releases:  
  
7.67E+01 min. for first quarter, 2015  
7.57E+01 min. for second quarter, 2015  
8.38E+01 min. for third quarter, 2015  
7.69E+01 min. for fourth quarter, 2015
  
5. Minimum time period for a batch release:  
  
6.90E+01 min. for first quarter, 2015  
1.00E+00 min. for second quarter, 2015\*  
7.40E+01 min. for third quarter, 2015  
1.40E+01 min. for fourth quarter, 2015  
\* NaOH sump release
  
6. Average stream flow during periods of release of effluent into a flowing stream:  
  
4.01E+06 gpm for first quarter, 2015  
8.03E+06 gpm for second quarter, 2015  
7.43E+06 gpm for third quarter, 2015  
2.44E+06 gpm for fourth quarter, 2015

VI. Abnormal Releases:

A. Gaseous:

1. Number of releases: 0
2. Total activity released: 0

B. Liquid:

1. Number of releases: 0
2. Total activity released: 0

**ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT**  
**January - December 2015**

*Virgil C. Summer Nuclear Station*  
*South Carolina Electric & Gas*

**Table 1**  
**Gaseous Effluents Summation of All Releases**

	UNITS	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER	2015 TOTAL	EST. ERROR %
<b>A. Fission &amp; Activation Gases</b>							
1. Total release	Ci	4.38E-04	1.38E-03	6.94E-02	4.06E-02	1.12E-01	1.82E+01
2. Average release rate	uCi / sec	5.64E-05	1.76E-04	8.73E-03	5.11E-03	3.54E-03	
3. Percent ODCM Qtr. gamma air dose limit	%	1.63E-05	4.92E-05	2.50E-03	1.51E-03	N/A	
4. Percent ODCM annual gamma air dose limit	%	8.14E-06	3.27E-05 *	1.28E-03 *	2.04E-03 *	2.04E-03	
5. Percent ODCM Qtr. beta air dose limit	%	2.87E-06	8.79E-06	4.46E-04	2.66E-04	N/A	
6. Percent ODCM annual beta air dose limit	%	1.44E-06	5.83E-06 *	2.29E-04 *	3.62E-04 *	3.62E-04	
<b>B. Iodines</b>							
1. Total iodine - 131	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Average release rate	uCi / sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
<b>C. Particulates</b>							
1. Particulates with half - lifes > 8 days	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Average release rate	uCi / sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
3. Gross alpha radioactivity	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
<b>D. Tritium</b>							
1. Total release	Ci	1.93E+01	1.53E-02	1.06E-01	4.99E+00	2.44E+01	1.90E+01
2. Average release rate	uCi / sec	2.48E+00	1.95E-03	1.33E-02	6.28E-01	7.74E-01	
<b>E. Carbon 14</b>							
1. Total release	Ci	2.09E+00	2.09E+00	2.12E+00	2.12E+00	8.42E+00	N/A
2. Average release rate	uCi / sec	2.66E-01	2.66E-01	2.66E-01	2.66E-01	2.66E-01	
<b>F. Organ Dose (from B,C,and D)</b>							
1. Percent ODCM Qtr. organ dose limit	%	1.36E-01	1.08E-04	7.44E-04	3.51E-02	N/A	
2. Percent ODCM annual organ dose limit	%	6.78E-02	6.79E-02 *	6.82E-02 *	8.58E-02 *	8.58E-02	

\* Cumulative

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT  
JANUARY - DECEMBER, 2015

TABLE 2  
GASEOUS EFFLUENTS -- GROUND-LEVEL RELEASES

Nuclides Released	Units	Continuous Mode					Batch Mode				
		First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Annual Total	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Annual Total
<b>1 Fission and Activation gases</b>											
Krypton-85	Ci	0	0	0	0	0	0	0	2.00E-04	0	2.00E-04
Krypton-85m	Ci	0	0	0	0	0	0	0	0	0	0
Krypton-88	Ci	0	0	0	0	0	0	0	0	0	0
Xenon-131m	Ci	0	0	0	0	0	0	0	1.38E-05	0	1.38E-05
Xenon-133	Ci	0	6.20E-05	2.39E-06	0	6.44E-05	0	0	1.79E-03	0	1.79E-03
Xenon-133m	Ci	0	0	0	0	0	0	0	2.50E-05	0	2.50E-05
Xenon-135	Ci	0	0	0	0	0	0	0	1.32E-05	0	1.32E-05
Xenon-135m	Ci	0	0	0	0	0	0	0	0	0	0
Xenon-138	Ci	0	0	0	0	0	0	0	0	0	0
Other: Ar-41	Ci	4.38E-04	1.32E-03	6.73E-02	4.06E-02	1.10E-01	0	0	0	0	0
Unidentified: None	Ci	0	0	0	0	0	0	0	0	0	0
<b>Total for Period</b>	<b>Ci</b>	<b>4.38E-04</b>	<b>1.38E-03</b>	<b>6.73E-02</b>	<b>4.06E-02</b>	<b>1.10E-01</b>	<b>0</b>	<b>0</b>	<b>2.05E-03</b>	<b>0</b>	<b>2.05E-03</b>
<b>2 Iodines and other halogen</b>											
Iodine-131	Ci	0	0	0	0	0	0	0	0	0	0
Iodine-132	Ci	0	0	0	0	0	0	0	0	0	0
Iodine-133	Ci	0	0	0	0	0	0	0	0	0	0
Bromine-82	Ci	0	0	0	7.15E-08	7.15E-08	0	0	0	0	0
Unidentified: None	Ci	0	0	0	0	0	0	0	0	0	0
<b>Total for Period</b>	<b>Ci</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>7.15E-08</b>	<b>7.15E-08</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>3 Particulates</b>											
Chromium-51	Ci	0	0	0	0	0	0	0	0	0	0
Manganese-54	Ci	0	0	0	0	0	0	0	0	0	0
Cobalt-58	Ci	0	0	0	0	0	0	0	0	0	0
Cobalt-60	Ci	0	0	0	0	0	0	0	0	0	0
Zinc-65	Ci	0	0	0	0	0	0	0	0	0	0
Strontium-89	Ci	0	0	0	0	0	0	0	0	0	0
Strontium-90	Ci	0	0	0	0	0	0	0	0	0	0
Niobium-95	Ci	0	0	0	0	0	0	0	0	0	0
Zirconium-95	Ci	0	0	0	0	0	0	0	0	0	0
Silver-110m	Ci	0	0	0	0	0	0	0	0	0	0
Antimony-125	Ci	0	0	0	0	0	0	0	0	0	0
Tellurium-125m	Ci	0	0	0	0	0	0	0	0	0	0
Cesium-134	Ci	0	0	0	0	0	0	0	0	0	0
Cesium-137	Ci	0	0	0	0	0	0	0	0	0	0
Other:	Ci	0	0	0	0	0	0	0	0	0	0
Unidentified: None	Ci	0	0	0	0	0	0	0	0	0	0
<b>Total for Period</b>	<b>Ci</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

\*Tritium and Carbon-14 not included. See Table 1.

**ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT  
JANUARY-DECEMBER, 2015**

**Virgil C. Summer Nuclear Station  
South Carolina Electric & Gas**

**TABLE 3  
Liquid Effluents Summation of All Releases**

	UNITS	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER	2015 TOTAL	EST. ERROR %
<b>A. Fission &amp; Activation Products</b>							
1. Total release	Ci	2.32E-03	1.40E-03	3.08E-03	3.30E-03	1.01E-02	2.48E+01
2. Average diluted concentration	uCi/ml	7.48E-12	4.13E-12	7.44E-12	2.13E-11	8.29E-12	
<b>B. Tritium</b>							
1. Total release	Ci	5.50E+01	2.21E+02	4.88E+02	9.74E+01	8.61E+02	1.82E+01
2. Average diluted concentration	uCi/ml	1.77E-07	6.52E-07	1.18E-06	6.29E-07	7.07E-07	
<b>C. Dissolved and entrained gases</b>							
1. Total release	Ci	1.42E-05	1.11E-04	6.35E-04	7.03E-04	1.46E-03	2.97E+01
2. Average diluted concentration	uCi/ml	4.58E-14	3.28E-13	1.53E-12	4.54E-12	1.20E-12	
3. Percent ODCM limit ( 2.0E-4 uCi/ml )	%	2.29E-08	1.64E-07	7.67E-07	2.27E-06	6.01E-07	
<b>D. Gross alpha radioactivity</b>							
1. Total release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A
<b>E. Volume of waste released (undiluted)</b>							
	liters	1.45E+07	8.48E+06	1.07E+07	7.49E+07	1.09E+08	3.00E+00
<b>F. Volume of dilution water</b>							
	liters	3.11E+11	3.38E+11	4.14E+11	1.55E+11	1.22E+12	4.30E+00
<b>G. ODCM limits ( from A and B )</b>							
1. Percent of ODCM Qtr total body limit	%	4.60E-02	9.62E-02	2.33E-01	1.05E-01	N/A	
2. Percent of ODCM annual total body limit	%	2.30E-02	7.11E-02 *	1.88E-01 *	2.40E-01 *	2.40E-01 *	
3. Percent of ODCM Qtr max. organ limit**	%	1.41E-02	2.90E-02	7.03E-02	5.11E-02	N/A	
4. Percent of ODCM annual max. organ limit**	%	7.04E-03	2.15E-02 *	5.66E-02 *	8.21E-02 *	8.21E-02 *	

\* Cumulative

\*\* See Section E for max. organ for each quarter and cumulative.

**ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT**

JANUARY - DECEMBER, 2015

Virgil C. Summer Nuclear Station, South Carolina Electric & Gas

**TABLE 4  
LIQUID EFFLUENTS**

Nuclides Released*	Units	Continuous Mode					Batch Mode				
		First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Annual Total	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Annual Total
Strontium-89	Ci	0	0	0	0	0	0	0	0	0	0
Strontium-90	Ci	0	0	0	0	0	0	0	0	0	0
Cesium-134	Ci	0	0	0	0	0	0	0	0	0	0
Cesium-137	Ci	0	0	0	0	0	4.22E-05	3.70E-05	7.64E-05	3.87E-06	1.59E-04
Iodine-131	Ci	0	0	0	0	0	0	0	0	0	0
Iodine-132	Ci	0	0	0	0	0	0	0	0	0	0
Iodine-133	Ci	0	0	0	0	0	0	0	0	0	0
Cobalt-57	Ci	0	0	0	0	0	0	0	0	2.43E-07	2.43E-07
Cobalt-58	Ci	0	0	0	0	0	1.20E-04	4.04E-05	3.14E-05	2.32E-04	4.24E-04
Cobalt-60	Ci	0	0	0	0	0	5.23E-04	2.16E-04	1.40E-03	9.27E-04	3.07E-03
Iron-59	Ci	0	0	0	0	0	1.78E-06	1.41E-06	0	3.54E-06	6.73E-06
Zinc-65	Ci	0	0	0	0	0	0	0	0	3.28E-06	3.28E-06
Manganese-54	Ci	0	0	0	0	0	5.13E-05	2.90E-05	1.36E-04	6.63E-05	2.83E-04
Chromium-51	Ci	0	0	0	0	0	0	0	0	4.17E-04	4.17E-04
Zirconium-Niobium-95	Ci	0	0	0	0	0	1.23E-05	1.19E-06	2.19E-05	5.14E-04	5.49E-04
Zirconium-97	Ci	0	0	0	0	0	0	0	0	1.27E-05	1.27E-05
Molybdenum-99	Ci	0	0	0	0	0	0	0	0	0	0
Techneium-99m	Ci	0	0	0	0	0	0	0	0	0	0
Cerium-144	Ci	0	0	0	0	0	0	0	0	0	0
Other: Be-7	Ci	0	0	0	0	0	0	0	0	0	0
Na-24	Ci	0	0	0	0	0	7.68E-06	0	0	0	7.68E-06
Fe-55	Ci	0	0	0	0	0	2.37E-04	0	0	0	2.37E-04
Ni-63	Ci	0	0	0	0	0	3.59E-04	6.11E-04	1.07E-03	1.01E-03	3.05E-03
Se-75	Ci	0	0	0	0	0	0	0	0	2.06E-06	2.06E-06
As-76	Ci	0	0	0	0	0	6.27E-07	0	0	1.53E-06	2.16E-06
Ag-110m	Ci	0	0	0	0	0	5.80E-07	0	0	0	5.80E-07
Sb-122	Ci	0	0	0	0	0	1.60E-06	0	0	0	1.60E-06
Sb-124	Ci	0	0	0	0	0	0	0	1.54E-06	2.18E-05	2.33E-05
Sb-125	Ci	0	0	0	0	0	1.05E-04	1.14E-04	3.53E-04	8.37E-05	6.56E-04
Sb-126	Ci	0	0	0	0	0	0	0	0	0	0
Te-123m	Ci	0	0	0	0	0	0	0	0	0	0
Te-125m	Ci	0	0	0	0	0	8.61E-04	3.49E-04	0	0	1.21E-03
Te-132	Ci	0	0	0	0	0	0	0	0	0	0
Total for Period (above)	Ci	0	0	0	0	0	2.32E-03	1.40E-03	3.09E-03	3.30E-03	1.01E-02
Ar-41	Ci	0	0	0	0	0	0	0	0	8.52E-07	8.52E-07
Kr-85	Ci	0	0	0	0	0	0	0	0	0	0
Xenon-133	Ci	0	0	0	0	0	7.63E-06	1.11E-04	6.27E-04	7.01E-04	1.45E-03
Xenon-133m	Ci	0	0	0	0	0	0	0	4.72E-06	0	4.72E-06
Xenon-135	Ci	0	0	0	0	0	6.60E-06	0	3.86E-06	8.71E-07	1.13E-05
Total Entrained Gases	Ci	0	0	0	0	0	1.42E-05	1.11E-04	6.36E-04	7.03E-04	1.46E-03

\*Tritium not included. See Table 3 for tritium numbers ----- No Unidentified nuclides found



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**Virgil C. Summer Nuclear Station**  
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**Table 5**  
**SOLID WASTE SHIPMENTS**

1. Solid Waste Shipped Offsite for Burial or Disposal (Not irradiated fuel).

Type of Waste	Unit	2015 Total	Est. Total Error, %
a. Spent resins, filters, sludge, evaporator bottoms, etc.	m <sup>3</sup>	3.58E+01	+/-2.5E+01
	Ci	1.58E+02	
b. Dry compressible waste contaminated equip., etc.	m <sup>3</sup>	2.71E+02	+/-2.5E+01
	Ci	5.66E-01	
c. Irradiated components, control rods, etc.	m <sup>3</sup>	0	N/A
	Ci	0	
d. Other	m <sup>3</sup>	1.93E+00	+/-2.5E+01
	Ci	2.74E-02	

2. Estimate of major nuclide composition for the year (by type of waste) for concentrations above 1.0%.

a.

Ni-63	41.55 %	6.57E+01 Ci
Co-60	27.43 %	4.34E+01 Ci
Fe-55	15.77 %	2.49E+01 Ci
Mn-54	7.09 %	1.12E+01 Ci
Sb-125	3.73 %	5.90E+00 Ci
Co-58	2.23 %	3.53E+00 Ci

b.

Fe-55	33.71 %	1.91E-01 Ci
Co-60	31.24 %	1.77E-01 Ci
Ni-63	23.58 %	1.33E-01 Ci
Co-58	2.01 %	1.14E-02 Ci
Sb-125	1.82 %	1.03E-02 Ci
Mn-54	1.74 %	9.83E-03 Ci
Nb-95	1.04 %	5.90E-03 Ci

c.

None		
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**ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT**  
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**Table 5**  
**SOLID WASTE SHIPMENTS**

d.

Ni-63	78.56 %	2.15E-02 Ci
Fe-55	9.03 %	2.48E-03 Ci
Co-60	8.00 %	2.19E-03 Ci
Co-58	1.19 %	3.27E-04 Ci

3. Solid Waste Disposition

Numbers of Shipments	Mode of Transportation	Destination
5	Hittman	Barnwell Processing/Disposal Facility
1	Hittman-Tennessee	Energy Solutions in OakRidge, Tn
1	Visionary Solutions,LLC	Toxco in Oakridge, Tn
2	Southern Pines	Alaron in Wampum, Pa.
2	Landstar	Alaron in Wampum, Pa
1	Cast	Perma Fix of Florida
1	Federal Express	Alaron in Wampum, Pa

Notes:

- Five** shipments by Hittman containing (4) High Integrity Containers of dewatered resin and (1) 6-80 HIC of DAW were sent to the Barnwell Processing/Disposal Facility for burial .
- One** shipment by Hittman-Tennessee of (1) Sealand of DAW was shipped to Energy Solutions in OakRidge, Tn for processing.
- One** shipment by Visionary Solutions of (1) Sealand of DAW was shipped to Toxco in Oakridge, Tn for processing.
- Two** shipments by Southern Pines of (4) Sealands of DAW were shipped to Alaron in Wampum, Pa for processing.

**ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT**  
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***Virgil C. Summer Nuclear Station***  
***South Carolina Electric & Gas***

**Table 5**

**SOLID WASTE SHIPMENTS**

5. **Two** shipments by Landstar of (2) Sealands of DAW, (1) B12 box of metal and (1) Sealand containing a reactor coolant pump stator were shipped to Alaron in Wampum, Pa for processing.
6. **One** shipment by Cast of (9) Drums of mixed waste and (8) B25 boxes of nuclear blowdown resin was shipped to Perma-Fix of Florida for processing.
7. **One** shipment by Federal Express of (2) Nickel 63 sources was shipped to Alaron in Wampum, Pa for processing

**ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT**

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**Virgil C. Sumner Nuclear Station  
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**Table 6  
GASEOUS AND LIQUID DOSES**

ODCM Section	GASEOUS LIMITS	FIRST QUARTER		SECOND QUARTER		THIRD QUARTER		FOURTH QUARTER		TOTAL ANNUAL DOSE
		DOSE	Percent of Limit	DOSE	Percent of Limit	DOSE	Percent of Limit	DOSE	Percent of Limit	
1.2.3.1.a,b	5 mrad gamma / qtr. 10 mrad gamma / yr.	8.14E-07 mrad	1.63E-05 8.14E-06	2.46E-06 mrad	4.92E-05 3.27E-05 *	1.25E-04 mrad	2.50E-03 1.28E-03 *	7.54E-05 mrad	1.51E-03 2.04E-03 *	2.04E-04
1.2.3.1.a,b	10 mrad beta / qtr. 20 mrad beta / yr.	2.87E-07 mrad	2.87E-06 1.44E-06	8.79E-07 mrad	8.79E-06 5.83E-06 *	4.46E-05 mrad	4.46E-04 2.29E-04 *	2.66E-05 mrad	2.66E-04 3.62E-04 *	7.23E-05
1.2.4.1.a,b	7.5 mrem organ/qtr 15 mrem organ/yr.	1.81E-01 mrem**	2.41E+00 1.21E+00	1.71E-01 mrem**	2.28E+00 2.35E+00 *	1.73E-01 mrem**	2.31E+00 3.50E+00 *	1.76E-01 mrem**	2.35E+00 4.67E+00 *	7.00E-01
1.1.3.1a,b	<b>LIQUID LIMITS</b>									
	1.5 mrem / qtr. 3 mrem / yr.	6.90E-04 mrem	4.60E-02 2.30E-02	1.44E-03 mrem	9.62E-02 7.11E-02 *	3.50E-03 mrem	2.33E-01 1.88E-01 *	1.58E-03 mrem	1.05E-01 2.40E-01 *	7.21E-03
1.1.3.1a,b	5 mrem organ/qtr*** 10 mrem organ/yr.	7.04E-04 mrem (LIVER)	1.41E-02 7.04E-03	1.45E-03 mrem (LIVER)	2.90E-02 2.15E-02 *	3.52E-03 mrem (GI-LLI)	7.03E-02 5.66E-02 *	2.56E-03 mrem (GI-LLI)	5.11E-02 8.21E-02 *	8.21E-03 (GI-LLI)

\* Includes contribution from previous quarters

\*\* Includes dose from all nuclides including Carbon-14

\*\*\* See Section E for max organ for each quarter