

V. C. Summer Nuclear Station
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April 22, 2020



ATTN: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555-001

Serial No. 20-163
LIC/TS/R0
Docket No. 50-395
License No. NPF-12

DOMINION ENERGY SOUTH CAROLINA, INC. (DESC)
VIRGIL C. SUMMER NUCLEAR STATION UNIT 1
DOCKET NO. 50-395
OPERATING LICENSE NO. NPF-12
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

Enclosed is the DESC Annual Radioactive Effluent Release Report as required by 10 CFR 50.36a, 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, 2019.

If there are any questions, please call Ms. Tracey Stewart at (803) 931-5663.

Sincerely,

A handwritten signature in black ink, appearing to read "R. Haselden", written over a horizontal line.

Robin R. Haselden
General Manager, Organization Effectiveness
V. C. Summer Nuclear Station

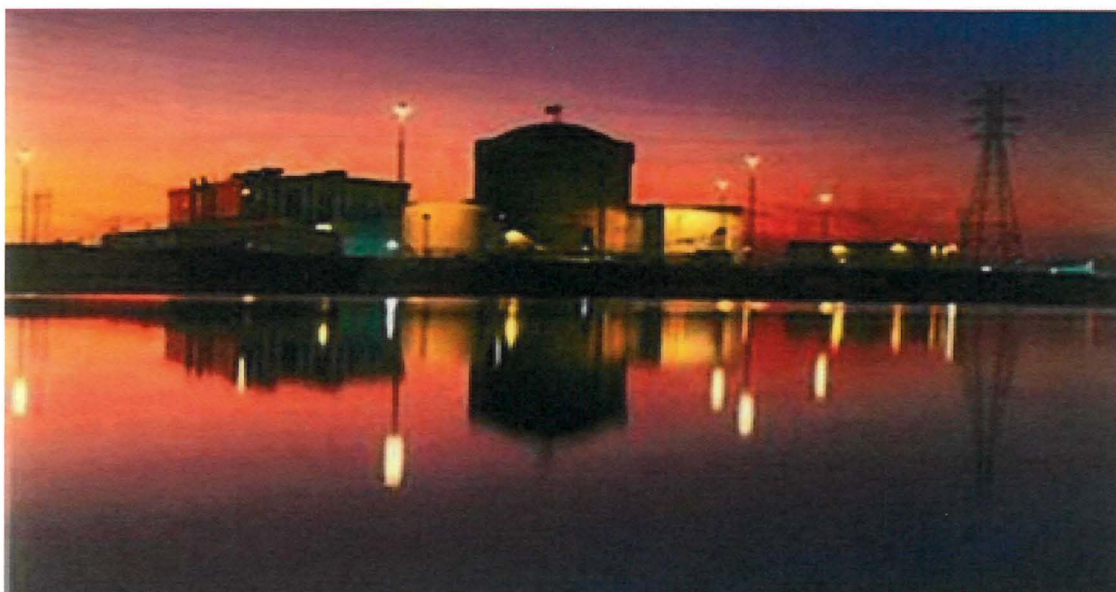
Enclosure: Annual Radioactive Effluent Release Report
Enclosure A: Meteorological Data Joint Frequency Distribution by Quarter for 2019
Enclosure B: Offsite Dose Calculation Manual, Revision 31 (June 2019)

cc: w/o Enclosures unless noted
G. J. Lindamood – Santee Cooper
L. Dudes – NRC Region II
S. A. Williams – NRC Project Manager
NRC Resident Inspector (w/Enclosures)
C. Logan – ANI (w/Enclosures)
Anu Nair – SCDHEC (w/Enclosures)

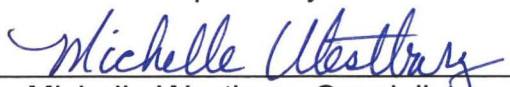


ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT VIRGIL C. SUMMER NUCLEAR STATION


FOR THE OPERATING PERIOD
JANUARY 1, 2019 - DECEMBER 31, 2019




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 04/16/2020
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ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

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VIRGIL C. SUMMER NUCLEAR STATION

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⁽¹⁾.

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.

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 error for both liquid and gaseous release totals is estimated as twenty percent for radioactive radionuclides sampled and released in effluent pathways. Error was derived using root sum of squares methodology considering known sources of error including calibration of detectors and flow measurement equipment, sample preparation, and analysis counting error.

C. Liquid Effluents

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

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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 no Waste Gas Decay Tank (WGDT) releases, 2.79 days of 6-inch Reactor Building purge releases, 5.97 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 gaseous 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 $7.78\text{E-}03$ mrad for gamma during the fourth quarter and $2.85\text{E-}03$ mrad for beta during the fourth quarter. The maximum quarterly organ dose attributed to the releases, excluding Carbon-14, was $1.34\text{E-}02$ mrem. Cumulative annual dose was $9.02\text{E-}03$ mrad, $3.30\text{E-}03$ mrad and $1.87\text{E-}02$ 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 164 Waste Monitor Tank batch releases, 9 Condensate Backwash Receiver Tank batch releases, 1 NaOH Sump batch release, 2.25 days of Steam Generator Blowdown release and a continuous Turbine Building Sump release.

Doses are summarized in Table 6 and total liquid 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 $7.41\text{E-}03$ mrem during the fourth quarter. The highest organ dose was $7.50\text{E-}03$ mrem to the GI-LLI for the fourth quarter. Cumulative annual doses for the hypothetical maximum exposed individual were $9.33\text{E-}03$ mrem for the total body and $9.43\text{E-}3$ mrem for the GI-LLI, the maximum annual organ. The GI-LLI was maximum exposed organ for all four quarters.

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

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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 $2.94\text{E-}02$ mrad gamma and $1.07\text{E-}02$ mrad beta, well below levels that can be distinguished above background. Quarterly thermoluminescent dosimetry (TLD) 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 2019 quarterly dose rates did not differ significantly from the pre-operational or 2018 dose rates.

The impact of Independent Spent Fuel Storage Installation (ISFSI) operation which began cask storage on March 26, 2016 was assessed using six TLD locations monitoring the perimeter of the ISFSI site. The TLD locations were monitored for three quarters prior to fuel storage and continued to be monitored through 2019 during which fuel storage casks were stored. Analysis of monitoring results showed no statistically significant increase in perimeter dose as a result of ISFSI operation.

Based on review of gaseous effluent dose calculations and analysis of onsite TLD monitoring 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 $4.27\text{E-}04$ and $1.56\text{E-}04$ 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 $3.67\text{E-}03$ and $1.34\text{E-}03$ mrad for gamma and beta, respectively.

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

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G. Meteorology

The meteorological data for 2019 was collected and analyzed. An annual meteorological summary report of joint frequency distributions of wind direction and speed by atmospheric stability class for each quarter is included as Enclosure A.

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 99.94%. Primary variable recovery rates were as follows: wind direction (10 m) – 99.98%, wind speed (10 m) – 99.98%, and differential temperature (61 - 10 m) – 99.92%.

H. Offsite Dose Calculation Manual

The Virgil C. Summer Nuclear Station ODCM was revised on June 11, 2019. See Enclosure B for a complete copy. The LLD formula was adjusted by dividing the Poisson distribution correction factor (2.71) by count time to align the ODCM with gamma spectroscopy software. The reference to Technical Specification 6.5 was removed because it no longer exists. A note was added to Table 4.0-1 "Radiological Environmental Monitoring Program" to clarify sample frequency requirements to be consistent with intent of NUREG 1301. The location for Radiological Environmental Monitoring Program drinking water location 28 was changed to the Jenkinsville Post Office from the NND building that no longer has water service.

I. Offsite Dose Calculation Manual Reportable Incidents

The Turbine Building Sump Effluent Line Radiation Monitor RM-L8 required by ODCM Control 1.1.1.1 was out of service from December 7, 2018 at 1100 until January 24, 2020 at 1420. Out of service condition was the result of a failed detector. Restoration and troubleshooting efforts using a spare detector and preamp by station maintenance personnel and the original equipment manufacturer were not successful. System was restored after procurement of a new detector and preamp following a significant vendor lead time. Compensatory actions were implemented during this time period in accordance with the requirements of the ODCM.

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J. Major Changes to Radioactive Waste Treatment Systems

During 2019, 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⁽²⁾, "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 2019 was 9.70 curies.

Public dose estimates were performed using Regulatory Guide 1.109 ⁽³⁾ 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 1.72E-01 mrem total body and 8.62E-01 mrem to the maximum organ (bone).

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
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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 radioiodine, 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).

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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.

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V. Batch Releases:

A. Gaseous:

1. Number of batch releases: 0
2. Total time period for batch releases: 0 min
3. Maximum time period for a batch release: 0 min
4. Average time period for a batch release: 0 min
5. Minimum time period for a batch release: 0 min

B. Liquid:

1. Number of batch releases:

| | |
|----|--------------------------|
| 38 | For first quarter, 2019 |
| 27 | For second quarter, 2019 |
| 28 | For third quarter, 2019 |
| 81 | For fourth quarter, 2019 |

2. Total time period for batch releases:

| | |
|----------|-------------------------------|
| 2.70E+03 | min. for first quarter, 2019 |
| 1.90E+03 | min. for second quarter, 2019 |
| 2.02E+03 | min. for third quarter, 2019 |
| 5.37E+03 | min. for fourth quarter 2019 |

3. Maximum time period for a batch release:

| | |
|----------|-------------------------------|
| 8.00E+01 | min. for second quarter, 2019 |
| 9.20E+01 | min. for second quarter, 2019 |
| 7.70E+01 | min. for third quarter, 2019 |
| 1.56E+02 | min. for fourth quarter, 2019 |

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4. Average time period for batch releases:

| | |
|----------|-------------------------------|
| 7.11E+01 | min. for first quarter, 2019 |
| 7.03E+01 | min. for second quarter, 2019 |
| 7.20E+01 | min. for third quarter, 2019 |
| 6.63E+01 | min. for fourth quarter, 2019 |
5. Minimum time period for a batch release:

| | |
|----------|-------------------------------|
| 6.70E+01 | min. for first quarter, 2019 |
| 1.00E+00 | min. for second quarter, 2019 |
| 6.80E+01 | min. for third quarter, 2019 |
| 1.00E+00 | min. for fourth quarter, 2019 |
6. Average stream flow during periods of release of effluent into a flowing stream:

| | |
|----------|------------------------------|
| 4.30E+06 | gpm for first quarter, 2019 |
| 5.68E+06 | gpm for second quarter, 2019 |
| 7.57E+06 | gpm for third quarter, 2019 |
| 4.10E+06 | gpm for fourth quarter, 2019 |

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

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TABLE 1

Gaseous Effluents-Summation of All Releases

| Type of Effluent | Units | Qtr 1 | Qtr 2 | Qtr 3 | Qtr 4 | Error % |
|---|---------|----------|----------|----------|----------|----------|
| A. Fission & Activation Gases | | | | | | |
| 1. Total Release | Curies | 0.00E+00 | 0.00E+00 | 7.03E-01 | 4.57E+00 | 2.00E+01 |
| 2. Average Release Rate for Period | µCi/sec | 0.00E+00 | 0.00E+00 | 8.85E-02 | 5.75E-01 | |
| 3. Percent of Applicable Limit | % | 0.00E+00 | 0.00E+00 | 2.49E-02 | 1.56E-01 | |
| B. Iodines | | | | | | |
| 1. Total Iodine-131 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 2.50E+01 |
| 2. Average Release Rate for Period | µCi/sec | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| 3. Percent of Applicable Limit | % | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| C. Particulates | | | | | | |
| 1. Total Particulates (Half-lives > 8 days) | Curies | 5.36E-07 | 6.08E-06 | 0.00E+00 | 0.00E+00 | 2.50E+01 |
| 2. Average Release Rate for Period | µCi/sec | 6.89E-08 | 7.73E-07 | 0.00E+00 | 0.00E+00 | |
| 3. Percent of Applicable Limit | % | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | |
| 4. Gross Alpha Activity | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| D. Tritium | | | | | | |
| 1. Total Release | Curies | 0.00E+00 | 3.10E+00 | 2.35E+01 | 6.19E+00 | 2.00E+01 |
| 2. Average Release Rate for Period | µCi/sec | 0.00E+00 | 3.94E-01 | 2.96E+00 | 7.79E-01 | |
| 3. Percent of Applicable Limit | % | 0.00E+00 | 2.35E-02 | 1.79E-01 | 4.70E-02 | |
| E. Carbon-14 | | | | | | |
| 1. Total Release | Curies | 2.39E+00 | 2.42E+00 | 2.44E+00 | 2.44E+00 | N/A |
| 2. Average Release Rate for Period | µCi/sec | 3.08E-01 | 3.08E-01 | 3.08E-01 | 3.08E-01 | |

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TABLE 2

Gaseous Effluents-Ground Level Releases

| Nuclides Released | Units | Continuous Mode | | | | Batch Mode | | | |
|---------------------------------|--------|-----------------|----------|----------|----------|------------|----------|----------|----------|
| | | Qtr 1 | Qtr 2 | Qtr 3 | Qtr 4 | Qtr 1 | Qtr 2 | Qtr 3 | Qtr 4 |
| 1. Fission and Activation Gases | | | | | | | | | |
| Ar-41 | Curies | 0.00E+00 | 0.00E+00 | 6.61E-01 | 4.14E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Xe-133 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 2.68E-01 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Xe-135 | Curies | 0.00E+00 | 0.00E+00 | 4.27E-02 | 1.60E-01 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Total for Period | Curies | 0.00E+00 | 0.00E+00 | 7.03E-01 | 4.57E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 2. Iodines | | | | | | | | | |
| Total for Period | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 3. Particulates | | | | | | | | | |
| Be-7 | Curies | 5.36E-07 | 6.08E-06 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Br-82 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Total for Period | Curies | 5.36E-07 | 6.08E-06 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 4. Tritium | | | | | | | | | |
| H-3 | Curies | 0.00E+00 | 3.10E+00 | 2.35E+01 | 6.19E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

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TABLE 3

Liquid Effluents-Summation of All Releases

| Type of Effluent | Units | Qtr 1 | Qtr 2 | Qtr 3 | Qtr 4 | Error % |
|--|--------|----------|----------|----------|----------|----------|
| <u>A. Fission & Activation Products</u> | | | | | | |
| 1. Total Release (not including Tritium, Gases, and Alpha) | Curies | 9.16E-04 | 8.76E-05 | 1.89E-04 | 1.66E-03 | 2.00E+01 |
| 2. Average Diluted Concentration During Period | µCi/ml | 1.96E-11 | 2.07E-12 | 3.09E-12 | 1.93E-11 | |
| 3. Percent of Applicable Limit | % | 1.83E-02 | 1.75E-03 | 3.79E-03 | 3.32E-02 | |
| <u>B. Tritium</u> | | | | | | |
| 1. Total Release | Curies | 3.24E+01 | 4.59E+01 | 1.75E+02 | 5.92E+02 | 2.00E+01 |
| 2. Average Diluted Concentration During Period | µCi/ml | 6.91E-07 | 1.09E-06 | 2.85E-06 | 6.87E-06 | |
| 3. Percent of Applicable Limit | % | 6.91E-02 | 1.09E-01 | 2.85E-01 | 6.87E-01 | |
| <u>C. Dissolved and Entrained Gases</u> | | | | | | |
| 1. Total Release | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 5.71E-04 | 2.00E+01 |
| 2. Average Diluted Concentration During Period | µCi/ml | 0.00E+00 | 0.00E+00 | 0.00E+00 | 6.62E-12 | |
| 3. Percent of Applicable Limit | % | 0.00E+00 | 0.00E+00 | 0.00E+00 | 3.31E-06 | |
| <u>D. Gross Alpha Radioactivity</u> | | | | | | |
| 1. Total Release | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| <u>E. Waste Volume Released (Pre-Dilution)</u> | | | | | | |
| | Liters | 7.28E+06 | 7.58E+06 | 8.90E+06 | 1.48E+07 | 3.00E+00 |
| <u>F. Volume of Dilution Water Used</u> | | | | | | |
| | Liters | 4.68E+10 | 4.23E+10 | 6.12E+10 | 8.62E+10 | 4.30E+00 |

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TABLE 4

Liquid Effluents

| Nuclides Released | Units | Continuous Mode | | | | Batch Mode | | | |
|-------------------|--------|-----------------|----------|----------|----------|------------|----------|----------|----------|
| | | Qtr 1 | Qtr 2 | Qtr 3 | Qtr 4 | Qtr 1 | Qtr 2 | Qtr 3 | Qtr 4 |
| Ar-41 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.45E-05 |
| As-76 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 2.87E-06 |
| Co-58 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 4.68E-05 | 5.32E-06 | 5.62E-07 | 2.75E-04 |
| Co-60 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 9.12E-05 | 1.14E-05 | 1.39E-04 | 5.83E-04 |
| Cr-51 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 3.19E-05 |
| Cs-137 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 2.12E-08 | 0.00E+00 | 0.00E+00 |
| H-3 | Curies | 3.10E-02 | 1.50E-02 | 4.56E-02 | 3.22E-02 | 3.23E+01 | 4.59E+01 | 1.74E+02 | 5.92E+02 |
| Mn-54 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 5.99E-06 | 0.00E+00 | 9.70E-06 | 3.54E-05 |
| Nb-95 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 2.77E-05 |
| Ni-63 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 2.83E-04 | 4.60E-05 | 3.18E-05 | 0.00E+00 |
| Sb-122 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 2.51E-06 |
| Sb-124 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 2.33E-05 | 0.00E+00 | 0.00E+00 | 7.87E-05 |
| Sb-125 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 6.65E-05 | 2.42E-05 | 5.80E-06 | 8.06E-05 |
| Sb-126 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.91E-06 |
| Te-123M | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.47E-05 | 6.25E-07 | 0.00E+00 | 0.00E+00 |
| Te-125m | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 3.84E-04 | 0.00E+00 | 0.00E+00 | 5.15E-04 |
| Xe-133 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 3.96E-04 |
| Xe-133m | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 2.84E-06 |
| Xe-135 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.58E-04 |
| Zn-65 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 2.72E-06 | 0.00E+00 |
| Zr-95 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.17E-05 |
| Zr-97 | Curies | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.49E-05 |
| <hr/> | | | | | | | | | |
| Total for Period | Curies | 3.10E-02 | 1.50E-02 | 4.56E-02 | 3.22E-02 | 3.23E+01 | 4.59E+01 | 1.74E+02 | 5.92E+02 |

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT
January - December 2019

Virgil C. Summer Nuclear Station
Dominion Energy

Table 5
SOLID WASTE SHIPMENTS

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

| Type of Waste | Unit | 2019 Total | Est. Total Error, % |
|---|----------------------|----------------------|---------------------|
| a. Spent resins, filters, sludge, evaporator bottoms, etc. | m ³ Ci | 3.40E+01 4.47E+01 | 2.5E+01 |
| b. Dry compressible waste, metals, contaminated equipment, etc. | m ³ Ci | 2.21E+02 5.46E-02 | 2.5E+01 |
| c. Irradiated components, control rods, etc. | m ³ Ci | 0.00E+00 0.00E+00 | N/A |
| d. Other waste, oil, etc. | m ³ Ci | 0.00E+00 0.00E+00 | N/A |

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

a.

| | | |
|--------|---------|-------------|
| Ni-63 | 37.50 % | 1.68E+01 Ci |
| Co-60 | 27.99 % | 1.25E+01 Ci |
| Fe-55 | 19.82 % | 8.88E+00 Ci |
| Cr-51 | 4.60 % | 2.06E+00 Ci |
| Mn-54 | 4.39 % | 1.97E+00 Ci |
| Sb-125 | 2.97 % | 1.33E+00 Ci |
| Co-58 | 1.16 % | 5.18E-01 Ci |

b.

| | | |
|--------|---------|-------------|
| Fe-55 | 34.57 % | 1.89E-02 Ci |
| Co-60 | 29.86 % | 1.63E-02 Ci |
| Co-58 | 12.65 % | 6.91E-03 Ci |
| Ni-63 | 11.12 % | 6.07E-03 Ci |
| Mn-54 | 3.90 % | 2.13E-03 Ci |
| Cr-51 | 1.98 % | 1.08E-03 Ci |
| Nb-95 | 1.62 % | 8.83E-04 Ci |
| Sb-125 | 1.08 % | 5.88E-04 Ci |

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT
January - December 2019

Virgil C. Summer Nuclear Station
Dominion Energy

Table 5
SOLID WASTE SHIPMENTS

c.

| | | |
|------|-----|-----|
| None | N/A | N/A |
|------|-----|-----|

d.

| | | |
|------|-----|-----|
| None | N/A | N/A |
|------|-----|-----|

3. Solid Waste Disposition

| Number of Shipments | Mode of Transportation | Destination |
|---------------------|------------------------|--|
| 1 | Cast Transportation | UniTech Services Group, Inc. Oakridge, TN |
| 5 | Hittman Transport | Energy Solutions, LLC Barnwell Processing Facility/ Barnwell Disposal Facility Barnwell, SC |
| 4 | Landstar | Alaron - Wampum, PA |

Notes:

- One** shipment by Cast Transportation containing (2) 20-foot Sealands of Green is Clean Waste was shipped to Oakridge, TN for processing.
- Five** shipments by Hittman Transport containing (1) 10-160 FR SEDS High Integrity Container of Dewatered Primary Resin; (1) 8-120 FR High Integrity Container of Dewatered Cation/Anion Resin; and (1) 8-120 FR High Integrity Container of Dewatered Mixed Bed Resin; (1) 8-120 FEXM High Integrity Container of Mechanical Filters and Dry Active Waste; and (1) 8-120 FR High Integrity Container of Dewatered Charcoal/Cation/Anion Resin were shipped to the Barnwell Processing and Barnwell Disposal facilities for processing and burial.
- Four** shipments by Landstar containing (4) 20-foot Sealands of Dry Active Waste; (2) B-25 Boxes of Gross Dewatered Nuclear Blowdown Resin; (5) B-25 Box of Gross Dewatered Mixed Bed Resin; (3) B-25 Boxes of Mopheads/Rags; (2) B-25 Boxes of Dry Active Waste; (3) B-12 Boxes of Metal; and (9) B-25 Boxes of Metal were shipped to Alaron in Wampum, PA for processing.

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT
JANUARY – DECEMBER 2019
Virgil C. Summer Nuclear Station

TABLE 6

Gaseous Effluents

| | Parameter | Location | Dose | Dose Limit | % of Limit |
|---------------------|------------------------|-----------------|-------------|-------------------|-------------------|
| <u>Qtr 1</u> | Gamma Air Dose (mrad) | 1.61 km ENE | 0.00E+00 | 5.00E+00 | 0.00 |
| | Beta Air Dose (mrad) | 1.61 km ENE | 0.00E+00 | 1.00E+01 | 0.00 |
| | Total Body Dose (mrem) | 1.61 km ENE | 0.00E+00 | 5.00E+00 | 0.00 |
| | Skin Dose (mrem) | 1.61 km ENE | 0.00E+00 | 7.50E+00 | 0.00 |
| | Max Organ Dose (mrem)* | 1.77 km E | 0.00E+00 | 7.50E+00 | 0.00 |
| | None – None | | | | |
| <u>Qtr 2</u> | Gamma Air Dose (mrad) | 1.61 km ENE | 0.00E+00 | 5.00E+00 | 0.00 |
| | Beta Air Dose (mrad) | 1.61 km ENE | 0.00E+00 | 1.00E+01 | 0.00 |
| | Total Body Dose (mrem) | 1.61 km ENE | 0.00E+00 | 5.00E+00 | 0.00 |
| | Skin Dose (mrem) | 1.61 km ENE | 0.00E+00 | 7.50E+00 | 0.00 |
| | Max Organ Dose (mrem)* | 1.77 km E | 1.76E-03 | 7.50E+00 | 0.02 |
| | Child – Liver | | | | |
| <u>Qtr 3</u> | Gamma Air Dose (mrad) | 1.61 km ENE | 1.24E-03 | 5.00E+00 | 0.02 |
| | Beta Air Dose (mrad) | 1.61 km ENE | 4.54E-04 | 1.00E+01 | 0.00 |
| | Total Body Dose (mrem) | 1.61 km ENE | 1.18E-03 | 5.00E+00 | 0.02 |
| | Skin Dose (mrem) | 1.61 km ENE | 1.74E-03 | 7.50E+00 | 0.02 |
| | Max Organ Dose (mrem)* | 1.77 km E | 1.34E-02 | 7.50E+00 | 0.18 |
| | Child – Liver | | | | |
| <u>Qtr 4</u> | Gamma Air Dose (mrad) | 1.61 km ENE | 7.78E-03 | 5.00E+00 | 0.16 |
| | Beta Air Dose (mrad) | 1.61 km ENE | 2.85E-03 | 1.00E+01 | 0.03 |
| | Total Body Dose (mrem) | 1.61 km ENE | 7.39E-03 | 5.00E+00 | 0.15 |
| | Skin Dose (mrem) | 1.61 km ENE | 1.09E-02 | 7.50E+00 | 0.14 |
| | Max Organ Dose (mrem)* | 1.77 km E | 3.53E-03 | 7.50E+00 | 0.05 |
| | Child – Liver | | | | |
| <u>Year</u> | Gamma Air Dose (mrad) | 1.61 km ENE | 9.02E-03 | 1.00E+01 | 0.09 |
| | Beta Air Dose (mrad) | 1.61 km ENE | 3.30E-03 | 2.00E+01 | 0.02 |
| | Total Body Dose (mrem) | 1.61 km ENE | 8.57E-03 | 1.00E+01 | 0.09 |
| | Skin Dose (mrem) | 1.61 km ENE | 1.26E-02 | 1.50E+01 | 0.08 |
| | Max Organ Dose (mrem)* | 1.77 km E | 1.87E-02 | 1.50E+01 | 0.12 |
| | Child - Liver | | | | |

(* Includes dose from all nuclides excluding Carbon-14. See Section K for C-14)

Liquid Effluents

| | Parameter | Max Receptor | Dose | Dose Limit | % of Limit |
|---------------------|------------------------|---------------------|-------------|-------------------|-------------------|
| <u>Qtr 1</u> | Max Organ Dose (mrem) | Adult - Gi-LLi | 4.08E-04 | 5.00E+00 | 0.01 |
| | Total Body Dose (mrem) | Adult - Total Body | 4.00E-04 | 1.50E+00 | 0.03 |
| <u>Qtr 2</u> | Max Organ Dose (mrem) | Adult - Gi-LLi | 3.84E-04 | 5.00E+00 | 0.01 |
| | Total Body Dose (mrem) | Adult - Total Body | 3.84E-04 | 1.50E+00 | 0.03 |
| <u>Qtr 3</u> | Max Organ Dose (mrem) | Adult - Gi-LLi | 1.14E-03 | 5.00E+00 | 0.02 |
| | Total Body Dose (mrem) | Adult - Total Body | 1.14E-03 | 1.50E+00 | 0.08 |
| <u>Qtr 4</u> | Max Organ Dose (mrem) | Adult - Gi-LLi | 7.50E-03 | 5.00E+00 | 0.15 |
| | Total Body Dose (mrem) | Adult - Total Body | 7.41E-03 | 1.50E+00 | 0.49 |
| <u>Year</u> | Max Organ Dose (mrem) | Adult - Gi-LLi | 9.43E-03 | 1.00E+01 | 0.09 |
| | Total Body Dose (mrem) | Adult - Total Body | 9.33E-03 | 3.00E+00 | 0.31 |

NOTE: See Section E for max organ for each quarter