NorthStar Nuclear Decommissioning Co., LLC
Vermont Yankee Nuclear Power Station
320 Governor Hunt Rd.
Vernon, VT 05354
802-451-5354

Corey R. Daniels
ISFSI Senior Manager

10 CFR 50.36a

BVY 21-014

May 5, 2021

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

SUBJECT: 2020 Radiological Effluent Release Report
Vermont Yankee Nuclear Power Station
Docket No. 50-271
License No. DPR-28

Dear Sir or Madam:

In accordance with 10 CFR 50.36a and the Vermont Yankee (VY) Off-site Dose Calculation Manual, please find enclosed a copy of the Annual Radiological Effluent Release Report for 2020.

It is noted that there were no changes made to the ODCM during 2020.

The VY Renewed Facility Operating License Condition 3.E.10 requires that similar information to that contained within the subject report be provided to the Massachusetts Metropolitan District Commission (MDC). However, since the MDC is currently part of the Massachusetts Department of Conservation and Recreation (DCR), this report is being provided to the DCR to satisfy License Condition 3.E.10.

This letter contains no new regulatory commitments.

Should you have any questions concerning this letter, or require additional information, please contact Mr. Thomas B. Silko at (802) 451-5354, Ext 2506.

Sincerely,

CRD/tbs

IE48
NRR

Enclosure: Annual Radiological Effluent Release Report for 2020.

cc: Regional Administrator, Region 1
U.S. Nuclear Regulatory Commission
2100 Renaissance Blvd, Suite 100
King of Prussia, PA 19406-2713

Ms. June Tierney, Commissioner
Vermont Department of Public Service
112 State Street – Drawer 20
Montpelier, Vermont 05602-2601

Massachusetts Department of Public Health
Director, Radiation Control Program
529 Main Street, Suite 1 M2A
Charlestown, MA 02129

Jim Montgomery, Commissioner
Massachusetts Department of Conservation and Recreation
251 Causeway Street
Boston, MA 02114

Enclosure

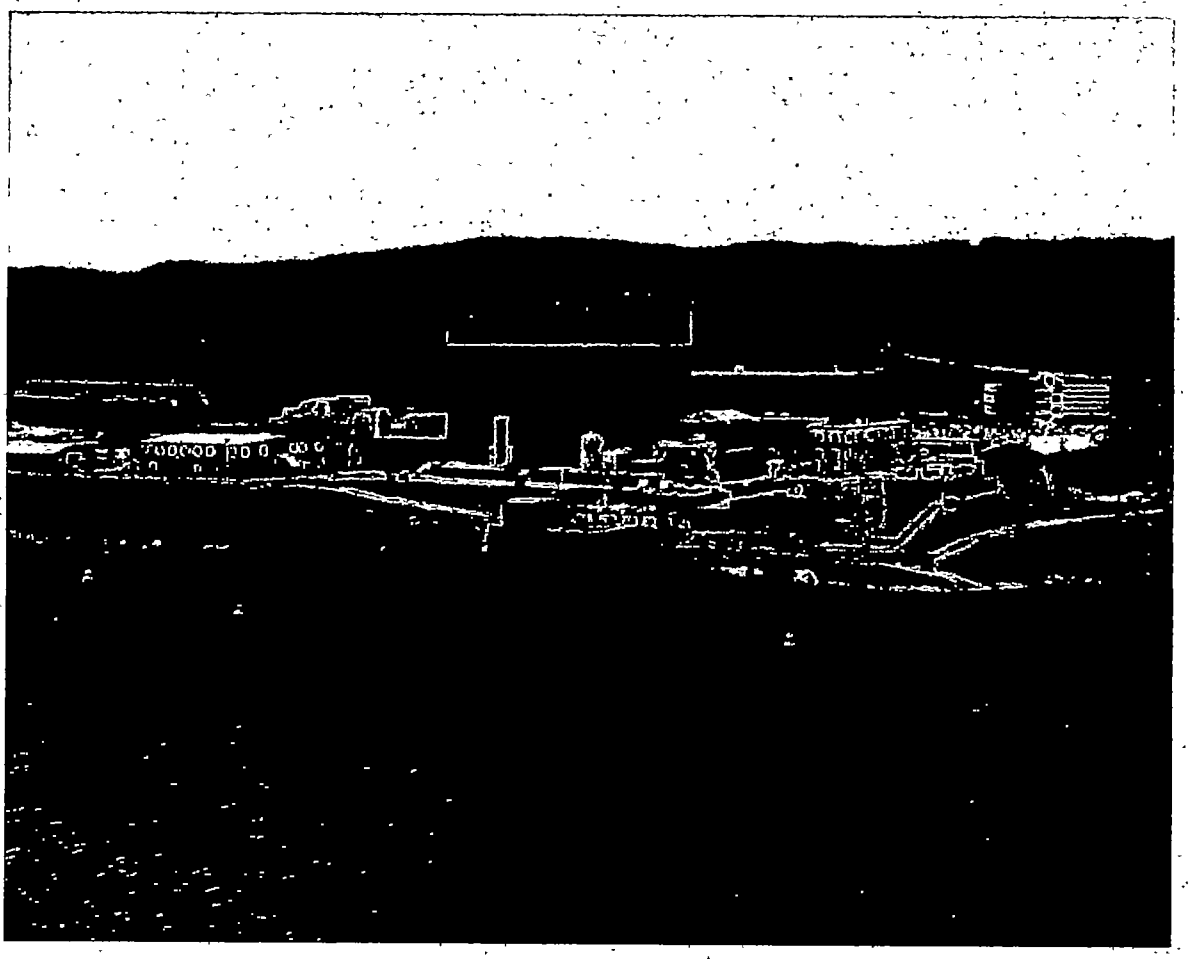
Vermont Yankee Nuclear Power Station

Annual Radiological Effluent Release Report for 2020
(52 pages excluding this cover sheet)

Vermont Yankee Nuclear Power Station

Annual Radiological Effluent Release Report

January - December 2020



NorthStar – Vermont Yankee.
Vermont Yankee Nuclear Power Station
320 Governor Hunt Road
Vernon, Vermont 05354

Docket No. 50-271

License No. DPR-28

VERMONT YANKEE
ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT
FOR 2020

Prepared by: P Hollenbeck / 4/28/21
Pete Hollenbeck, Radiation Safety & Control Services — Date

Reviewed by: Norman Hassell / 5-3-21
Norman Hassell, Chemistry Specialist — Date

Approved for Distribution: / 5/3/21
Mike Pletcher, RP/Chemistry Manager — Date

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List of Tables

1.0 INTRODUCTION

Tables 1 through 3 list the recorded radioactive liquid and gaseous effluents and solid waste shipments for 2020, with data summarized on a quarterly basis for both liquids and gases. Table 4A summarizes the estimated radiological dose commitments from all radioactive liquid and gaseous effluents released during 2020, to the maximumly exposed individual member of the public, in response to the ALARA objectives of 10 CFR Part 50, Appendix I. Table 4B presents the estimate of direct dose from fixed station sources along the limiting west site boundary line. Tables 5A through 6G present the cumulative joint frequency distributions of wind speed, wind direction, and atmospheric stability for the 5-year period, 2012 through 2016. Radioactive effluents reported in Tables 1 and 2 were used to determine the dose to the maximum exposed individual member of the public for 2020.

Dose commitments resulting from the release of radioactive materials in liquids and gases during the reporting period were estimated in accordance with the plant's Off-Site Dose Calculation Manual (ODCM), Section 10.1 (Reference 1). These dose estimates were made using a "Method I" analysis as described in the ODCM, and as reported in Tables 4A and 4B of this report. A conservative "Method I" analysis incorporates the methodology of Regulatory Guide 1.109 (Reference 2) and uses nuclide specific dose factors. Dose factors are the dose per Ci released for the age group and organ receiving the highest dose. This method is conservative since the age and organ receiving the highest dose differs from one nuclide to another.

As required by ODCM Section 10.1, this report shall also include an assessment of the radiation doses from radioactive effluents to member(s) of the public due to allowed recreational activities inside the site boundary during the year. As discussed in Section 3.6, there were no such recreational activities permitted and, therefore, there is no associated dose assessment.

An assessment of radiation doses (including direct radiation) to the likely most exposed real member(s) of the public for the calendar year for the purposes of demonstrating conformance with 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations," is also required to be included in this report if the conditions indicated in ODCM 3/4.4, "Total Dose," have been exceeded during the year. Since the conditions indicated in the action statement under ODCM 3/4.4 were not entered into during the year, no additional radiation dose assessment is required. However, Table 4B does provide the combination of off-site doses and dose commitments from plant effluents and direct radiation sources for the limiting member of the public as a demonstration of compliance with the dose standards of 40 CFR Part 190.

All calculated dose estimates for members of the public at the site boundary or beyond for the 2020 annual reporting period are below the dose criteria of 10 CFR Part 50, Appendix I, and 40 CFR Part 190.

Appendices B through J indicate the status of reportable items per the requirements of ODCM Section 10.1.

2.0 METEOROLOGICAL DATA

The scope of possible accidents is significantly reduced with all spent fuel in dry cask storage. The potential for any off-site consequences from radiological accidents are also substantially reduced. No reasonably conceivable beyond design basis event can result in a radiological release that exceeds Environmental Protection Agency (EPA) Protective Actions Guide. During the final decommissioning and dismantling phases, administrative controls over radiological source accumulation will preempt any significant radiological release to the environment. As a result, there is no need for continued on-site meteorological data accumulation or real time dose assessment. Conservative atmospheric dispersion factors have been developed from the 2012 through 2016 joint frequency data to provide both short term dose assessment and for assessment in the annual average dose from facility routine releases. There are no planned or existing Emergency Action Levels in the defueled state that could result in the need for real time accident release assessment with other than previously determined conservative atmospheric dispersion factors.

Actual measured meteorological data for the five-year period, 2012 through 2016, were analyzed to determine all the values and locations of the maximum off-site long-term average atmospheric dispersion and deposition factors. The highest offsite dispersion and deposition factors at any location beyond the site boundary, regardless of whether or not it was an actual location of a residence or food production, was used to calculate "Method I" dose factors for each nuclide. Each dose and dose rate calculation presented in the current Revision 40 of the ODCM incorporate the maximum applicable off-site long-term average atmospheric dispersion and deposition factors, and maximum organ dose to any age group from each nuclide.

Updated five-year average dispersion factors and deposition factors developed from 2012 through 2016 on-site meteorological hourly data and the nuclide specific dose factors can be used to assess either routine releases or estimate conservative off-site consequences from any on-site radiological event. As such, there is no need to continue to collect on-site meteorological data for either accessing routine releases or potential emergency events. Collection of data from on-site meteorological tower was terminated in November 2018.

The five-year aggregate joint frequency distribution tables for ground level releases are presented in Tables 5A through 5G. The five-year aggregate joint frequency distribution tables for elevated releases are presented in Tables 6A through 6G.

3.0 DOSE ASSESSMENT

3.1 Doses from Liquid Effluents

ODCM 3/4.2.2 limits total body doses (1.5 mrem per quarter, and 3 mrem per year) and organ doses (5 mrem per quarter, and 10 mrem per year) from liquid effluents to a member of the public to those specified in 10 CFR Part 50, Appendix I. By implementing the requirements of 10 CFR Part 50, Appendix I, ODCM 3/4.2.2 assures that the release of radioactive material in liquid effluents will be kept "as low as is reasonably achievable."

There were no continuous or batch routine liquid radioactive waste discharges during 2020.

Dose estimates of tritium-contaminated groundwater released from the site are based on Protected Area Boundary monitoring well data collected throughout 2020 and hydrological modeling of groundwater movement. The groundwater discharge rates from the developed portion of the site to the river are estimated using a streamtube approach based on Darcy's Law. Using a conservative estimate of groundwater flow through the affected area toward the river on a quarterly basis, an estimate of the total potential tritium released from the site during each quarter of 2020 was generated and reported in Table 2A. The quantity of tritium released from the site by groundwater in each quarter was then converted to dose by using the calculated dose conversion factors presented in ODCM Table 1.1.11. The resulting quarterly doses are presented in Table 4A.

ODCM Control 3.2.1 states, in part, that groundwater flowing to the Connecticut River from the site in radioactive concentrations above background (Unrestricted Areas for liquids is at the point of discharge from the plant discharge in Connecticut River) shall be limited to 10 times the concentrations specified in Appendix B to 10CFR Part 20.1001 – 20.2402, Table 2, Column 2. The tritium concentrations at the point of discharge from the plant ranged from 0.07% to 0.13% of the Table 2, Column 2 values.

3.2 Doses from Noble Gases

The dose limits specified in ODCM 3/4.3.2 have been deleted from Revision 40 of the ODCM. Noble gases were not produced or detected in releases from the plant stack in 2020.

3.3 Dose from Radionuclides in Particulate Form and Tritium

ODCM 3/4.3.3 limits the organ dose to a member of the public from tritium and radionuclides in particulate form in gaseous effluents released from the site to areas at and beyond the site boundary to those specified in 10 CFR Part 50, Appendix I (7.5 mrem per quarter and 15 mrem per year). By implementing the requirements of 10 CFR Part 50, Appendix I, ODCM 3/4.3.3 assures that the releases of any tritium and particulates in gaseous effluents will be kept "as low as is reasonably achievable."

There were no non-routine gaseous releases or batch releases in 2020. There was no radioactively contaminated used oil burned in 2020.

Continuous sampling of the plant stack for tritium, per ODCM Table 4.3.1, was performed by using silica gel cartridges in 2020. The cartridges were analyzed monthly. Based upon the stack flow rate and sample flow rates, the average release rate in µCi/sec and total release in Ci for each quarter was calculated. The quantity of tritium released from the site by the plant stack in each quarter was then converted to dose by using the calculated dose conversion factors presented in ODCM Table 1.1.12. The resulting quarterly doses from H-3 were combined with the particulate releases and are presented in Table 4A.

Continuous sampling of the plant stack for particulates, per ODCM Table 4.3.1, was performed in 2020. These samples are analyzed weekly for principle gamma emitters. Cobalt-60 was identified on the plant stack particulate filters in the second, third and fourth quarters in 2020. Cesium-137 was also identified on the plant stack particulate filters in the first and fourth quarters in 2020. Cobalt-60 was also identified during a ground level release in the third quarter of 2020. The quantity of Cobalt 60 and Cs-137 did not exceed any dose limits. The doses from Co-60 and Cs-137 were combined with H-3 and are presented in Table 4A.

3.4 Whole Body Doses in Unrestricted Areas from Direct Radiation

As opposed to prior years before the permanent shut down when the majority of the dose in the unrestricted area consisted of direct and skyshine radiation from N-16 decay in the Turbine Building steam cycle during power operations, there was no such source during 2020 due to the elimination of its production and its short half-life.

The other fixed sources of direct and scatter radiation to the site boundary are the Independent Spent Fuel Storage Installation (ISFSI) and old turbine rotors and casings in the Turbine Storage Facility. The annual direct radiation dose at the site boundary is driven by the cask loading at the ISFSI. All spent fuel has been transferred to the two ISFSI pads by August 2018. The method to assess the direct radiation dose in unrestricted areas has been agreed upon with the State of Vermont. Site boundary TLDs are changed out monthly. The net dose at the location of TLD DR-53A has been chosen to assess direct radiation dose to unrestricted areas.

Table 4B lists the combination of the direct radiation dose at the limiting site boundary location and the maximum offsite dose from gaseous and liquid effluents for the purpose of demonstrating compliance with the dose standards contained in 40 CFR Part 190. For 2020, this annual dose was below the 25 mrem total body and organ limit, as well as the 75 mrem thyroid limit, of 40 CFR Part 190.

3.5 Doses from On-Site Disposal of Septic Waste, Cooling Tower Silt and Soil

ODCM Appendices B, F, and I require that all septic waste, cooling tower silt, and sand/soil applied within the approved designated disposal areas be controlled to ensure the dose to a maximally exposed individual during the period of Vermont Yankee site control is limited to less than 1 mrem/year to the whole body and any organ. After the period associated with Vermont Yankee operational control, the dose to the inadvertent intruder is to be limited to 5 mrem/year. The projected dose from on-site disposals of septic waste, cooling tower silt, and sand/soil mixes is given in Appendix J of this report.

During 2020 there was no septic sludge spread on the southern on-site disposal field.

3.6 On-Site Recreational Activities

During 2020, no access to the on-site boat launching ramp located north of the intake structure was permitted for employees, their families, and guests. As such, there was no associated dose impact to members of the public due to any recreational activities on-site.

REFERENCES

1. Off-Site Dose Calculation Manual (ODCM), Revision 40, Entergy Nuclear Vermont Yankee, LLC, dated October 23, 2018.

2. Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Release of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," U. S. Nuclear Regulatory Commission, Office of Standards Development, Revision 1, October 1977.

3. Safety Guide 1.23, "Onsite Meteorological Programs," U.S. Atomic Energy Commission, February 17, 1972.

4. Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," U.S. Nuclear Regulatory Commission, Office of Standards Development, March 1976.

5. Meteorology and Atomic Energy, 1968, Section 5-3.2.2, "Cloud Depletion," page 204, U. S. Atomic Energy Commission, July 1968.

6. Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste," U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, Revision 2, June 2009.

Table 1A - Gaseous Effluents -Summation of All Releases

		Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
A.	Fission and Activation Gases						
1.	Total release	Ci	ND	ND	ND	ND	
2.	Average release rate for period	µCi/sec	ND	ND	ND	ND	
3.	Percent of ODCM limit (1)	%	NA	NA	NA	NA	
B.	Iodines						
1.	Total Iodine	Ci	ND	ND	ND	ND	
2.	Average release rate for period	µCi/sec	ND	ND	ND	ND	
3.	Percent of ODCM limit (1)	%	NA	NA	NA	NA	
C.	Particulates						
1.	Particulates with T-1/2>8 days	Ci	3.13E-07	9.26E-07	9.33E-06	1.52E-06	1.80E+01
2.	Average release rate for period	µCi/sec	3.98E-08	1.18E-07	1.17E-06	1.92E-07	
3.	Percent of ODCM limit (2)	%	(2)	(2)	(2)	(2)	
4.	Gross alpha radioactivity	Ci	ND	ND	ND	ND	
D.	Tritium						
1.	Total release	Ci	7.10E-03	1.32E-02	3.94E-02	2.44E-02	1.80E+01
2.	Average release rate for period	µCi/sec	9.03E-04	1.68E-03	4.96E-03	3.07E-03	
3.	Percent of ODCM limit (2)	%	1.24E-05	2.33E-05	6.35E-05	4.29E-05	
E.	Carbon-14						
1.	Total release	Ci	ND	ND	ND	ND	
2.	Percent of ODCM limit (1)	%	NA	NA	NA	NA	

ND = Not Detected NA = Not Applicable

(1) There is no ODCM Control for Iodines, C-14 and Fission and Activation Gases. All spent fuel is in casks on the ISFSI pads.

(2) ODCM Control 3.3.3. for dose from Tritium and radionuclides in particulate form. The values in row D.3 are based upon the total particulate and Tritium activity in each quarter.

Table 1B - Gaseous Effluents - Elevated Releases

		Continuous Mode			
		Quarter			
Nuclides Released	**Units**	**1**	**2**	**3**	**4**
1. Fission Gases					
Krypton-85	Ci	ND	ND	ND	ND
Unidentified	Ci	ND	ND	ND	ND
Total for Period	**Ci**	**ND**	**ND**	**ND**	**ND**
2. Iodines	**Ci**	ND	ND	ND	ND
3. Particulates					
Strontium-90	Ci	ND	ND	ND	ND
Cesium-134	Ci	ND	ND	ND	ND
Cesium-137	Ci	3.13E-07	ND	ND	2.44E-07
Manganese-54	Ci	ND	ND	ND	ND
Cobalt-57	Ci	ND	ND	ND	ND
Cobalt-60	Ci	ND	9.26E-07	1.25E-06	1.28E-06
Zinc-65	Ci	ND	ND	ND	ND
Total for Period	**Ci**	**3.13E-07**	**9.26E-07**	**1.25E-06**	**1.52E-06**

ND Not Detected at the plant stack

Table 1B - Gaseous Effluents - Elevated Releases
(Continued)

		Batch Mode			
		Quarter			
Nuclides Released	**Units**	**1**	**2**	**3**	**4**
1. Fission Gases					
Krypton-85	Ci				
Unidentified	Ci				
Total for Period	**Ci**	(1)	(1)	(1)	(1)
2. Iodines	**Ci**				
3. Particulates					
Strontium-90	Ci				
Cesium-134	Ci				
Cesium-137	Ci				
Manganese-54	Ci				
Cobalt-57	Ci				
Cobalt-60	Ci				
Zinc-65	Ci				
Total for Period	**Ci**	(1)	(1)	(1)	(1)

(1) There were no batch mode gaseous releases for this reporting period.

Table 1C – Gaseous Effluents Ground Level Releases

		Continuous Mode			
		Quarter			
Nuclides Released	**Units**	**1**	**2**	**3**	**4**
1. Fission Gases					
Krypton-85	Ci				
Unidentified	Ci				
Total for Period	**Ci**	(1)	(1)	(1)	(1)
2. Iodines	**Ci**				
3. Particulates					
Strontium-90	Ci				
Cesium-134	Ci				
Cesium-137	Ci				
Manganese-54	Ci				
Cobalt-57	Ci				
Cobalt-60	Ci			8.08E-06	
Zinc-65	Ci				
Total for Period	**Ci**	(1)	(1)	**8.08E-06**	(1)

(1) There were no routine ground level gaseous releases for this reporting period.

Table 1C – Gaseous Effluents Ground Level Releases
(Continued)

		Batch Mode			
		Quarter			
Nuclides Released	**Units**	**1**	**2**	**3**	**4**
1. Fission Gases					
Krypton-85	Ci				
Unidentified	Ci				
Total for Period	**Ci**	(1)	(1)	(1)	(1)
2. Iodines	**Ci**				
3. Particulates					
Strontium-90	Ci				
Cesium-134	Ci				
Cesium-137	Ci				
Manganese-54	Ci				
Cobalt-57	Ci				
Cobalt-60	Ci				
Zinc-65	Ci				
Total for Period	**Ci**	(1)	(1)	(1)	(1)

(1) There were no ground level gaseous releases for this reporting period.

Table 1D - Gaseous Effluents –Non-routine Releases

		Quarter			
Nuclides Released	**Units**	**1**	**2**	**3**	**4**
1. Fission Gases					
Krypton-85	Ci				
Unidentified	Ci				
Total for Period	**Ci**	(1)	(1)	(1)	(1)
2. Iodines	**Ci**				
3. Particulates					
Strontium-90	Ci				
Cesium-134	Ci				
Cesium-137	Ci				
Manganese-54	Ci				
Cobalt-57	Ci				
Cobalt-60	Ci				
Zinc-65	Ci				
Total for Period	**Ci**	(1)	(1)	(1)	(1)

(1) There were no non-routine gaseous releases for this reporting period.

Table 2A - Liquid Effluents - Summation of All Releases

There were continuous non-routine (groundwater flow to the Connecticut River) liquid releases during this reporting period. The data in this table is based upon monitoring well data collected throughout 2020 and hydrological modeling of groundwater movement.

Nuclides Released	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission and Activation Products						
Total Release (not including tritium, gases, alpha)	Ci	ND	ND	ND	ND	
Average diluted concentration during period	µCi/ml	ND	ND	ND	ND	
Percent of applicable limit (2)	%	NA	NA	NA	NA	
B. Tritium						
Total Release	Ci	4.79E-03	2.77E-03	2.96E-03	2.76E-03	1.8E+01
Average diluted concentration during period	µCi/ml	1.31E-06	7.56E-07	8.00E-07	7.46E-07	
Percent of applicable limit (2)	%	6.58E-05	3.80E-05	4.07E-05	3.79E-05	
C. Dissolved and Entrained Gases						
Total Release	Ci	ND	ND	ND	ND	
Average diluted concentration during period	µCi/ml	ND	ND	ND	ND	
Percent of applicable limit (1)	%	NA	NA	NA	NA	
D. Gross Alpha Radioactivity						
Total release	Ci	ND	ND	ND	ND	
E. Volume of Waste Released (prior to dilution)	Liters	(3)	(3)	(3)	(3)	NA
F. Volume of Dilution Water Used During Period	Liters	3.66E+06	3.66E+06	3.70E+06	3.70E+06	(4)

ND = Not Detected NA = Not Applicable

(1) All spent fuel is in casks on the ISFSI pads. Release of Dissolved and Entrained Gases is not possible.

(2) The percent of limit is based on the ODCM Control 3.2.2 limiting dose (1.5 mrem/quarter to the total body) from liquid effluents and is related to the abnormal leakage of tritiated plant water into the underground environment.

(3) Leakage of contaminated plant water to subsurface areas was stopped in February 2010. The release of contaminated groundwater to the Connecticut River is based on site boundary monitoring well data collected during 2020 and reported in Section B.

(4) Dilution due to groundwater flow through the affected subsurface plume area toward the Connecticut River was estimated to be 7.38 gpm (times the number of days per quarter) during 2020. An estimated total error is not applicable.

Table 2B - Liquid Effluents - Routine Releases

		Continuous Mode			
		Quarter			
Nuclides Released	**Units**	**1**	**2**	**3**	**4**
Strontium-89	Ci				
Strontium-90	Ci				
Cesium-134	Ci				
Cesium-137	Ci				
Iodine-131	Ci				
Cobalt-58	Ci				
Cobalt-60	Ci				
Iron-59	Ci				
Zinc-65	Ci				
Manganese-54	Ci				
Chromium-51	Ci				
Zirconium-Niobium-95	Ci				
Molybdenum-99	Ci				
Technetium-99m	Ci				
Barium-Lathanium-140	Ci				
Cerium-141	Ci				
Others-	Ci				
	Ci				
Unidentified	Ci				
Total for period (above)	**Ci**	(1)	(1)	(1)	(1)
Kr-85	Ci				
Xe-133	Ci				

(1) There were no continuous routine releases in this reporting period, only continuous non-routine liquid releases. See Table 2A.

Table 2B - Liquid Effluents - Routine Releases
(Continued)

		Batch Mode			
		Quarter			
Nuclides Released	**Units**	**1**	**2**	**3**	**4**
Strontium-89	Ci				
Strontium-90	Ci				
Cesium-134	Ci				
Cesium-137	Ci				
Iodine-131	Ci				
Cobalt-58	Ci				
Cobalt-60	Ci				
Iron-59	Ci				
Zinc-65	Ci				
Manganese-54	Ci				
Chromium-51	Ci				
Zirconium-Niobium-95	Ci				
Molybdenum-99	Ci				
Technetium-99m	Ci				
Barium-Lathanium-140	Ci				
Cerium-141	Ci				
Others-	Ci				
	Ci				
Unidentified	Ci				
Total for period (above)	**Ci**	(1)	(1)	(1)	(1)
Kr-85	Ci				
Xe-133	Ci				

(1) There were no batch routine releases in this reporting period, only continuous non-routine liquid releases. See Table 2A.

Table 3 – Solid Waste and Irradiated Fuel Shipments

A. Solid Waste Shipped Off-Site for Burial or Disposal (not Irradiated Fuel)

1. Type of Waste

Shipped from VY for Burial	Unit	Quarters 1 & 2	Est. Total Error %
a.Spent resins, filter sludges, etc.	m^3	1.04E+02	±25%
	Ci	9.63E+00	±25%
b.Dry Compressible Waste, equipment, etc.	m^3	1.87E+03	±25%
	Ci	2.18E+01	±25%
c. Irradiated components, control rods, etc.	m^3	3.00E+00	±25%
	Ci	9.24E+01	±25%
d.Other	m^3	1.54E+03	±25%
	Ci	1.45E-01	±25%

Shipped from Processor(s) for Burial	Unit	Quarters 1 & 2	Est. Total Error %
a.Spent resins, filter sludges, etc.	m^3	0	N/A
	Ci	0	N/A
b.Dry Compressible Waste, equipment, etc.	m^3	0	N/A
	Ci	0	N/A
c. Irradiated components, control rods, etc.	m^3	0	N/A
	Ci	0	N/A
d.Other	m^3	0	N/A
	Ci	0	N/A

2. Estimate of Major Nuclide Composition (By Type of Waste)

Spent resins, filter sludges		Dry Compressible Waste, equipment, etc.		Irradiated components, control rods, etc.		Other Waste	
Nuclide	Percent(1)	Nuclide	Percent(1)	Nuclide	Percent(1)	Nuclide	Percent(1)
C-14	23.36	H-3	0.3	C-14	0.01	H-3	2.88
Fe-55	47.02	Mn-54	0.16	Fe-55	23.33	Fe-55	33.27
Co-60	25.15	Fe-55	25.75	Co-60	75.52	Co-60	55.72
Ni-63	2.9	Co-60	68.72	Ni-63	1.12	Ni-63	2.15
Zn-65	0.88	Ni-63	2.23	Cs-137	0.02	Zn-65	0.28
Cs-137	0.39	Cs-137	2.23	Pu-241	0.01	Cs-137	5.35

(1) Includes only those nuclides that are greater than 0.1% of the total activity

3. Disposition of Solid Waste Shipments (1st & 2nd Quarters)

No. of Shipments	From VY	From Processor	Mode	To Processor	To Burial
75	75	0	Rail	0	75
7	7	0	Truck	0	7

B. Irradiated Fuel Shipments (Disposition): None

C. Additional Data (1st & 2nd Quarters)

Supplemental Information	VY to Processor	VY to Burial	Processors to Burial
Class of Solid Waste Shipped	N/A	A/B/C	N/A
Type of Containers Used	N/A	GDC/IP-1/IP-2/Type B	N/A
Solidification Agent or Absorbent Used	N/A	None	N/A

GDC = General Design Container

Table 3 – Solid Waste and Irradiated Fuel Shipments (Continued)

A. Solid Waste Shipped Off-Site for Burial or Disposal (not Irradiated Fuel)

1. Type of Waste

Shipped from VY for Burial	Unit	Quarters 3 & 4	Est. Total Error %
a.Spent resins, filter sludges, etc.	m^3	9.34E+00	±25%
	Ci	5.10E+01	±25%
b.Dry Compressible Waste, equipment, etc.	m^3	3.12E+03	±25%
	Ci	6.86E-01	±25%
c. Irradiated components, control rods, etc.	m^3	2.56E+00	±25%
	Ci	2.75E+02	±25%
d.Other	m^3	1.08E+03	±25%
	Ci	6.95E+01	±25%

Shipped from Processor(s) for Burial	Unit	Quarters 3 & 4	Est. Total Error %
a.Spent resins, filter sludges, etc.	m^3	0	N/A
	Ci	0	N/A
b.Dry Compressible Waste, equipment, etc.	m^3	0	N/A
	Ci	0	N/A
c. Irradiated components, control rods, etc.	m^3	0	N/A
	Ci	0	N/A
d.Other	m^3	0	N/A
	Ci	0	N/A

A. Estimate of Major Nuclide Composition (By Type of Waste)

Spent resins, filter sludges		Dry Compressible Waste, equipment, etc.		Irradiated components, control rods, etc.		Other Waste	
Nuclide	Percent(1)	Nuclide	Percent(1)	Nuclide	Percent(1)	Nuclide	Percent(1)
H-3	0.10	H-3	0.26	Fe-55	41.71	H-3	0.01
Fe-55	39.85	Fe-55	26.93	Co-60	43.78	Fe-55	48.60
Co-60	49.25	Co-60	65.39	Ni-59	0.14	Co-60	38.16
Ni-63	9.88	Ni-63	2.07	Ni-63	14.37	Ni-59	0.10
Zn-65	0.09	Zn-65	1.70.22			Ni-63	13.12
Cs-137	0.58	Cs-137	4.90				

(2) Includes only those nuclides that are greater than 0.1% of the total activity

B. Disposition of Solid Waste Shipments (3rd & 4th Quarters)

No. of Shipments	From VY	From Processor	Mode	To Processor	To Burial
68	68	N/A	Rail	N/A	68
7	7	N/A	Truck	N/A	7

A. Irradiated Fuel Shipments (Disposition): None

B. Additional Data (1st & 2nd Quarters)

Supplemental Information	VY to Processor	VY to Burial	Processors to Burial
Class of Solid Waste Shipped	N/A	A/B/C	N/A
Type of Containers Used	N/A	GDC/IP-1/IP-2/Type B	N/A
Solidification Agent or Absorbent Used	N/A	None	N/A

GDC = General Design Container

Table 4A – Off-Site Doses from Liquid and Gaseous Releases
(10CFR50, Appendix I)

	Dose (mrem)				
Source	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Year
Liquid Effluents					
Total Body Dose	9.87E-07	5.70E-07	6.10E-07	5.69E-07	2.74E-06
Percent of Limit (1.5 mrem)	6.58E-05	3.80E-05	4.07E-05	3.79E-05	
Footnotes	(a)	(a)	(a)	(a)	
Organ Dose	9.87E-07	5.70E-07	6.10E-07	5.69E-07	2.74E-06
Percent of Limit (5 mrem)	1.97E-05	1.14E-05	1.22E-05	1.14E-05	
Footnotes	(a)	(a)	(a)	(a)	
Airborne Effluents					
Iodines, H-3, C-14 and Particulates	9.29E-07	1.75E-06	7.27E-06	3.24E-06	1.32E-05
Percent of Limit (7.5 mrem)	1.24E-05	2.33E-05	9.69E-05	4.29E-05	
Footnotes	(b)	(b)	(b)	(b)	
Noble Gases					
Beta Air (mrad)	--	--	--	--	--
Footnotes	(c)	(c)	(c)	(c)	
Gamma Air (mrad)	--	--	--	--	--
Footnotes	(c)	(c)	(c)	(c)	

(a) The critical age group/organ for the Maximum Exposed Individual (MEI) is the Adult/Total Body and all organs (except Bone) from the release of H-3 to groundwater.

(b) These doses are based upon the maximum offsite X/Qs and D/Qs. The doses are the maximum organ dose when the Vegetable, Meat, Cow Milk, and Inhalation pathways are summed.

(c) There were no noble gas releases in this quarter.

Table 4B – Annual Off-Site Doses from Liquid, Gaseous and Direct Radiation (40CFR190)

Pathway	Total Body (mrem)	Maximum Organ (mrem)	Thyroid (mrem)
Direct External (a) (b)	8.308	8.308	8.308
Liquids (c)	2.74E-06	2.74E-06	2.74E-06
Gases (c)	1.32E-05	1.32E-05	1.32E-05
Annual Total (d)	8.308	8.308	8.308

The location of the projected maximum individual doses from combined direct radiation plus liquid and gaseous effluents correspond to residences at the southwest boundary relative to the Turbine Hall.

(a) No residential shielding credit or occupancy time fraction (i.e., occupancy is assumed to be 100%) is used. Expected direct external radiation doses would be reduced by approximately 54% with a realistic residential shielding credit and occupancy time (i.e., by using a 0.7 shielding factor from Regulatory Guide 1.109 (Reference 2) and an annual occupancy time of 6760 hours).

(b) The direct dose reported here was calculated by summing the net monthly doses at TLD location DR-53A and represents the dose to the former nearest residence, which was located in the South sector at 385 meters from the stack prior to the vacancy of this residence in 2008 and the purchase of land by Vermont Yankee. Doses are driven by the casks on the ISFSI.

(c) Maximum dose to any organ over all age groups for each release.

(d) Annual dose limits contained in 40 CFR Part 190 are 25 mrem to the total body and any organ, and 75 mrem to the thyroid for any real member of the public.

Table 4C – Receptor Locations

Sector	Site Boundary (1) (meters)	Nearest Resident (2) (meters)
N	400	1400
NNE	350	1384
NE	350	1255
ENE	400	966
E	500	933
ESE	700	1915
SE	750	1963
SSE	850	2044
S	385	644
SSW	300	451
SW	250	418
WSW	250	451
W	300	628
WNW	400	1062
NW	550	2253
NNW	550	1738

(1) Site boundary locations are taken from the Stack Releases column in Table 6.10.2 of the ODCM.

(2) The location(s) given are based on information from the Vermont Yankee 2016 Land Use Census and Table 7.1 of the ODCM and are relative to the plant stack. Gardens are assumed to be present at all resident locations.

Table 4D - Usage Factors for Environmental Pathways

Age Group	Fish (kg/yr)	Potable Water (l/yr)	Veg. (kg/yr)	Leafy Veg. (kg/yr)	Milk (l/yr)	Meat (kg/yr)	Inhalation (m3/yr)
Adult	21	730	520	64	310	110	8,000
Teen	16	510	630	42	400	65	8,000
Child	6.9	510	520	26	330	41	3,700
Infant	0	330	0	0	330	0	1,400

Data from Regulatory Guide 1.109, Table E-5 (Reference 2).

Table 4E - Environmental Parameters for Gaseous Effluents

Variable		Vegetables		Cow Milk		Goat Milk		Meat	
		Stored	**Leafy**	**Pasture**	**Stored**	**Pasture**	**Stored**	**Pasture**	**Stored**
YV	Agricultural Productivity (kg/m^2)	2	2	0.70	2	0.70	2	0.70	2
P	Soil Surface Density (kg/m^2)	240	240	240	240	240	240	240	240
T	Transport Time to User (hrs)	--	--	48	48	48	48	480	480
TB	Soil Exposure Time[(a)](hrs)	131,400	131,400	131,400	131,400	131,400	131,400	131,400	131,400
TE	Crop Exposure Time to Plume (hrs)	1,440	1,440	720	1,440	720	1,440	720	1,440
TH	Holdup After Harvest (hrs)	1,440	24	0	2,160	0	2,160	0	2,160
QF	Animals Daily Feed (kg/day)	--	--	50	50	6	6	50	50
FP	Fraction of Year on Pasture	--	--	(b)	--	(b)	--	(b)	--
FS	Fraction Pasture Feed When on Pasture[(c)]	--	--	1	--	1	--	1	--

Note: Footnotes on following page.

Table 4E - Environmental Parameters for Gaseous Effluents
(Continued)

Variable		Vegetables		Cow Milk		Goat Milk		Meat	
		Stored	**Leafy**	**Pasture**	**Stored**	**Pasture**	**Stored**	**Pasture**	**Stored**
FG	Fraction of Stored Vegetables Grown in Garden	0.76	--	--	--	--	--	--	--
FL	Fraction of Leafy Vegetables Grown in Garden	--	1.0	--	--	--	--	--	--
FI	Fraction Elemental Iodine = 0.5	--	--	--	--	--	--	--	--
H	Absolute Humidity = 5.6[(d)]	--	--	--	--	--	--	--	--

* From VY ODCM, Table 6.9.1 (Reference 1).

(a) For Method II dose/dose rate analyses of identified radioactivity releases of less than one year, the soil exposure time for that release may be set at 8,760 hours (one year) for all pathways.

(b) For Method II dose/dose rate analyses performed for releases occurring during the first or fourth calendar quarters, the fraction of time animals are assumed to be on pasture is zero (non-growing season). For the second and third calendar quarters, the fraction of time on pasture (FP) will be set at 1.0. FP may also be adjusted for specific farm locations if this information is so identified and reported as part of the land use census.

(c) For Method II analyses, the fraction of pasture feed while on pasture may be set to less than 1.0 for specific farm locations if this information is so identified and reported as part of the land use census.

(d) For all Method II analyses, an absolute humidity value equal to 5.6 (gm/m3) shall be used to reflect conditions in the Northeast (Reference: Health Physics Journal, Volume 39 (August), 1980; Pages 318-320, Pergammon Press).

Table 4F - Environmental Parameters for Liquid Releases (Tritium) Via Groundwater

Variable Name (Units)	Potable Water	Aquatic Food	Stored Veg.	Leafy Veg.	Meat	Cow Milk
Mixing Ratio	5.94E-06	1.27E-03	5.94E-06	5.94E-06	5.94E-06	5.94E-06
Transit Time (hrs)*	12	24	0	0	0	0
Water Uptake** (animal) (L/day)	--	--	--	--	50.0	60.0
Feed Uptake** (animal) (kg/day)	--	--	--	--	50.0	50.0

* Values are from Regulatory Guide 1.109, Table E-15 (Reference 2)

** Values are from Regulatory Guide 1.109, Table E-3 (Reference 2)

Tables 5A-5G - Frequency Distribution Tables for Ground Level Releases

Table 5A

Five Year Aggregate 35-foot
PASQUILL A

	Class 1 Calms	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	
Wind mph	0.95	3	7	12	18	24	>24	TOTAL
N	15	11	30	32	7	2	0	97
NNE	1	2	9	3	0	0	0	15
NE	0	5	10	0	0	0	0	15
ENE	0	5	11	1	0	0	0	17
E	0	12	41	11	0	0	0	64
ESE	1	7	36	32	1	0	0	77
SE	0	3	12	16	0	0	0	31
SSE	1	0	7	23	4	0	0	35
S	0	1	2	9	2	0	0	14
SSW	0	0	0	4	0	0	0	4
SW	0	1	2	4	0	0	0	7
WSW	0	4	2	3	0	0	0	9
W	0	1	3	2	5	0	0	11
WNW	0	0	0	1	6	1	1	9
NW	0	0	11	11	3	1	0	26
NNW	1	10	35	60	19	5	0	130
TOTALS	19	62	211	212	47	9	1	561

Table 5B

Five Year Aggregate 35-foot
PASQUILL B

	Class 1 Calms	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	
Wind mph	0.95	3	7	12	18	24	>24	TOTAL
N	2	10	65	36	5	1	0	119
NNE	0	12	15	9	0	0	0	36
NE	0	7	23	0	0	0	0	30
ENE	0	7	22	0	0	0	0	29
E	1	9	56	7	0	0	0	73
ESE	1	5	65	28	1	0	0	100
SE	0	2	39	22	0	0	0	63
SSE	0	4	31	65	8	1	0	109
S	0	3	15	29	11	1	0	59
SSW	0	0	6	4	0	0	0	10
SW	0	0	1	3	0	0	0	4
WSW	0	0	2	3	0	0	0	5
W	0	0	5	15	14	3	0	37
WNW	0	3	6	12	10	0	0	31
NW	0	2	17	18	14	7	0	58
NNW	1	5	64	72	45	6	0	193
TOTALS	5	69	432	323	108	19	0	956

Table 5C

Five Year Aggregate 35-foot
PASQUILL C

	Class 1 Calms	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	
Wind mph	0.95	3	7	12	18	24	>24	TOTAL
N	2	19	103	68	6	0	0	198
NNE	1	31	31	13	0	0	0	76
NE	0	19	23	2	0	0	0	44
ENE	0	22	56	2	0	0	0	80
E	0	28	111	2	0	0	0	141
ESE	6	25	128	25	1	0	0	185
SE	0	14	94	21	0	0	0	129
SSE	0	6	74	99	11	0	0	190
S	0	2	30	63	8	0	0	103
SSW	0	5	12	9	1	0	0	27
SW	0	5	8	7	0	0	0	20
WSW	0	3	8	10	0	0	0	21
W	1	1	5	37	22	1	0	67
WNW	0	4	14	38	33	2	1	92
NW	1	11	63	53	44	4	0	176
NNW	0	9	123	109	49	6	1	297
TOTALS	11	204	883	558	175	13	2	1846

Table 5D

Five Year Aggregate 35-foot
PASQUILL D

	Class 1 Calms	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	
Wind mph	0.95	3	7	12	18	24	>24	TOTAL
N	33	418	666	514	107	3	0	1741
NNE	21	244	203	58	2	0	0	528
NE	21	232	99	14	1	0	0	367
ENE	31	243	111	2	0	0	0	387
E	51	288	240	24	0	0	0	603
ESE	96	303	474	89	2	0	0	964
SE	102	349	901	101	7	0	0	1460
SSE	79	358	1167	583	48	3	0	2238
S	31	282	493	435	96	3	0	1340
SSW	5	206	177	92	6	0	0	486
SW	27	167	144	94	2	0	0	434
WSW	7	133	205	125	6	0	0	476
W	6	183	412	788	277	13	0	1679
WNW	3	235	370	908	471	42	1	2030
NW	10	400	895	713	359	39	2	2418
NNW	33	521	1440	1181	385	52	1	3613
TOTALS	556	4562	7997	5721	1769	155	4	20764

Table 5E

Five Year Aggregate 35-foot
PASQUILL E

	Class 1 Calms	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	
Wind mph	0.95	3	7	12	18	24	>24	TOTAL
N	51	197	161	43	15	0	0	467
NNE	19	111	23	4	0	0	0	157
NE	14	89	9	1	1	0	0	114
ENE	14	71	7	0	0	0	0	92
E	13	91	36	1	0	0	0	141
ESE	25	156	74	7	0	0	0	262
SE	71	216	277	15	0	0	0	579
SSE	77	346	428	100	8	1	0	960
S	46	529	278	125	32	3	0	1013
SSW	34	676	101	17	2	0	0	830
SW	38	912	98	12	1	0	0	1061
WSW	19	827	214	13	0	1	0	1074
W	19	797	342	150	22	2	0	1332
WNW	21	640	396	144	36	0	0	1237
NW	21	601	577	148	29	1	0	1377
NNW	27	407	711	239	49	3	1	1437
TOTALS	509	6666	3732	1019	195	11	1	12133

Table 5F

Five Year Aggregate 35-foot
PASQUILL F

	Class 1 Calms	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	
Wind mph	0.95	3	7	12	18	24	>24	TOTAL
N	8	78	12	0	0	0	0	98
NNE	7	31	3	0	0	0	0	41
NE	5	25	0	0	0	0	0	30
ENE	5	27	1	0	0	0	0	33
E	6	27	5	0	0	0	0	38
ESE	14	26	7	0	0	0	0	47
SE	17	75	13	0	0	0	0	105
SSE	19	136	39	1	1	0	0	196
S	30	344	59	1	0	0	0	434
SSW	50	501	56	0	0	0	0	607
SW	36	1061	68	0	0	0	0	1165
WSW	29	990	47	1	0	0	0	1067
W	11	677	78	1	0	0	0	767
WNW	12	349	69	2	0	0	0	432
NW	13	198	84	2	0	1	0	298
NNW	23	94	70	6	0	0	0	193
TOTALS	285	4639	611	14	1	1	0	5551

Table 5G

Five Year Aggregate 35-foot
PASQUILL G

	Class 1 Calms	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	
Wind mph	0.95	3	7	12	18	24	>24	TOTAL
N	7	36	4	0	0	1	0	48
NNE	11	18	1	0	0	0	0	30
NE	4	16	0	0	0	0	0	20
ENE	1	10	0	0	0	0	0	11
E	6	22	0	0	0	0	0	28
ESE	10	22	5	0	0	0	0	37
SE	10	27	2	0	0	0	0	39
SSE	10	52	6	0	0	0	0	68
S	22	96	12	0	0	0	0	130
SSW	21	133	15	0	0	0	0	169
SW	7	198	28	0	0	0	0	233
WSW	8	205	8	0	0	0	0	221
W	4	140	17	1	0	0	0	162
WNW	7	90	15	0	0	0	0	112
NW	6	57	26	2	0	0	0	91
NNW	5	38	25	3	0	0	0	71
TOTALS	139	1160	164	6	0	1	0	1470

Tables 6A-6G - Frequency Distribution Tables for Elevated Releases

Table 6A

Five Year Aggregate 297-foot
PASQUILL A

	Class 1 Calms	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	
Wind mph	0.95	3	7	12	18	24	>24	TOTAL
N	11	1	1	6	0	0	0	19
NNE	1	5	1	1	0	0	0	8
NE	0	1	1	1	0	0	0	3
ENE	0	1	2	0	0	0	0	3
E	0	1	0	0	0	0	0	1
ESE	0	3	2	3	1	0	0	9
SE	0	2	5	1	0	0	0	8
SSE	0	4	4	1	2	0	0	11
S	0	1	2	0	0	0	0	3
SSW	0	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0	0
WSW	0	0	0	1	0	0	0	1
W	0	1	0	0	2	0	0	3
WNW	0	0	2	0	0	0	0	2
NW	0	1	0	3	0	0	0	4
NNW	1	2	3	3	3	0	0	12
TOTALS	13	23	23	20	8	0	0	87

Table 6B

Five Year Aggregate 297-foot
PASQUILL B

	Class 1 Calms	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	
Wind mph	0.95	3	7	12	18	24	>24	TOTAL
N	0	1	8	14	2	0	0	25
NNE	0	0	2	5	2	0	0	9
NE	0	1	1	6	0	0	0	8
ENE	0	0	2	3	0	0	0	5
E	0	1	1	3	1	0	0	6
ESE	1	4	13	26	4	0	0	48
SE	0	3	6	5	3	0	0	17
SSE	0	1	1	3	2	0	0	7
S	0	0	0	0	5	0	0	5
SSW	0	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0	0
WSW	0	0	0	1	1	0	0	2
W	0	0	0	3	1	1	0	5
WNW	0	0	3	0	2	2	3	10
NW	0	1	1	2	2	0	0	6
NNW	0	3	9	24	18	9	4	67
TOTALS	1	15	47	95	43	12	7	220

Table 6C

Five Year Aggregate 297-foot
PASQUILL C

	Class 1 Calms	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	
Wind mph	0.95	3	7	12	18	24	>24	TOTAL
N	0	6	25	36	26	1	0	94
NNE	0	2	11	16	4	0	0	33
NE	0	2	7	7	2	0	0	18
ENE	0	3	14	8	0	0	0	25
E	0	4	16	9	1	0	0	30
ESE	0	7	51	47	3	0	0	108
SE	0	9	21	31	7	1	0	69
SSE	0	4	2	38	13	0	0	57
S	1	1	3	9	14	7	2	37
SSW	0	0	0	0	0	1	0	1
SW	0	0	1	4	0	0	0	5
WSW	0	0	1	2	3	0	0	6
W	0	0	0	5	3	9	1	18
WNW	0	0	2	7	7	8	0	24
NW	1	1	10	11	15	8	2	48
NNW	0	3	31	71	62	47	11	225
TOTALS	2	42	195	301	160	82	16	798

Table 6D

Five Year Aggregate 297-foot
PASQUILL D

	Class 1 Calms	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	
Wind mph	0.95	3	7	12	18	24	>24	TOTAL
N	18	269	442	565	426	131	10	1861
NNE	3	182	145	127	55	4	1	517
NE	2	191	125	62	21	1	2	404
ENE	2	186	131	32	5	0	0	356
E	8	238	251	66	18	3	0	584
ESE	7	271	505	192	47	3	0	1025
SE	17	355	878	458	57	10	1	1776
SSE	10	243	811	1092	206	24	3	2389
S	13	102	395	1047	628	136	18	2339
SSW	5	72	124	220	71	8	1	501
SW	7	43	93	171	57	1	0	372
WSW	11	50	73	216	92	7	2	451
W	16	53	101	623	695	175	12	1675
WNW	3	82	138	689	901	285	28	2126
NW	2	173	344	430	564	229	52	1794
NNW	54	358	1172	1527	1240	512	153	5016
TOTALS	178	2868	5728	7517	5083	1529	283	23186

Table 6E

Five Year Aggregate 297-foot
PASQUILL E

	Class 1 Calms	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	
Wind mph	0.95	3	7	12	18	24	>24	TOTAL
N	27	524	467	222	46	7	0	1293
NNE	8	354	66	27	5	0	0	460
NE	9	294	41	2	0	0	1	347
ENE	5	282	33	1	0	2	0	323
E	9	397	70	8	0	0	0	484
ESE	15	457	226	27	3	0	0	728
SE	25	474	747	171	6	1	0	1424
SSE	10	277	718	372	30	4	2	1413
S	6	160	281	306	144	23	3	923
SSW	2	90	118	114	40	8	0	372
SW	3	61	87	63	16	0	0	230
WSW	2	61	111	109	20	2	0	305
W	4	57	132	299	186	9	1	688
WNW	4	97	146	284	108	12	1	652
NW	1	206	361	258	83	13	1	923
NNW	21	441	1536	944	305	58	10	3315
TOTALS	151	4232	5140	3207	992	139	19	13880

Table 6F

Five Year Aggregate 297-foot
PASQUILL F

	Class 1 Calms	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	
Wind mph	0.95	3	7	12	18	24	>24	TOTAL
N	9	217	176	19	6	0	0	427
NNE	2	161	24	3	0	0	0	190
NE	2	130	6	0	0	0	0	138
ENE	3	115	16	2	0	0	0	136
E	7	165	42	0	0	0	0	214
ESE	5	140	125	14	0	0	0	284
SE	8	188	343	81	0	0	0	620
SSE	5	149	296	79	0	1	0	530
S	2	76	172	51	8	0	0	309
SSW	3	63	60	29	4	0	0	159
SW	1	52	73	19	2	0	0	147
WSW	0	40	67	20	1	0	0	128
W	1	44	81	70	7	0	0	203
WNW	2	66	91	64	3	0	0	226
NW	2	115	154	40	4	0	0	315
NNW	3	167	429	184	9	0	0	792
TOTALS	55	1888	2155	675	44	1	0	4818

Table 6G

Five Year Aggregate 297-foot
PASQUILL G

	Class 1 Calms	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	
Wind mph	0.95	3	7	12	18	24	>24	TOTAL
N	0	18	19	3	1	0	0	41
NNE	0	6	2	0	0	0	0	8
NE	0	10	3	0	0	0	0	13
ENE	0	9	2	0	0	0	0	11
E	1	9	3	0	0	0	0	13
ESE	0	12	7	2	0	0	0	21
SE	0	19	48	19	0	0	0	86
SSE	0	19	50	18	0	0	0	87
S	1	14	39	14	4	1	0	73
SSW	0	8	19	12	2	0	0	41
SW	0	11	22	17	0	0	0	50
WSW	0	15	29	15	0	0	0	59
W	0	8	32	26	2	0	0	68
WNW	0	11	24	25	3	0	0	63
NW	1	20	23	20	0	0	0	64
NNW	0	21	37	19	0	0	0	77
TOTALS	3	210	359	190	12	1	0	775

APPENDIX A – SUPPLEMENTAL INFORMATION

1. MEASUREMENTS AND APPROXIMATIONS OF TOTAL RADIOACTIVITY

Provided below are the methods used to measure or approximate the total radioactivity in effluents and the methods used to determine radionuclide composition.

Tritium

ODCM Table 4.3.1 requires that a continuous sample of stack effluents be collected for H-3 and analyzed monthly. The error involved in this sample is approximately ±18 percent.

Particulates

ODCM Table 4.3.1 requires that a continuous sample of stack effluents be collected and analyzed weekly for principal gamma emitters. The error involved in this sample is approximately ±18 percent.

2. BATCH RELEASES

There were no routine liquid or gaseous batch releases during the reporting period.

3. ABNORMAL RELEASES

a. Liquid

VY has installed 32 groundwater wells to monitor the 2010 leak event or to monitor additional at-risk structures, systems or components (SSCs) that could cause a release of licensed material to the groundwater. One well (GZ-08) has been dry since installation and no samples were collected from it in 2020. A second well, GZ-24 was compromised by excavation activity in 2014 and is no longer able to be sampled. A new well was drilled at GZ-02 in 2020 and the original well has been abandoned. GZ-16 has been found and samples have recommenced at this location as of November 2020. Sample locations GZ-10 and GZ-20 were not sampled in 2020 due to demolition activities associated with the Auxiliary Off-Gas Building. A summary of the sample results for the remaining wells are presented in Table A-1. There are only two (2) wells that had detectable activity (>MDC) in 2020 and all of these sample results are well below the EPA limit of 20,000 pCi/L for drinking water. None of the wells in this program supply drinking water, and no drinking water wells on site or adjacent to VY have shown tritium at detectable levels in regular surveillance samples.

b. Gaseous

There were no non-routine gaseous releases (measured) during the reporting period.

Table A-1: VY Groundwater Tritium Summary - 2020

Groundwater well Sampled	Number of analyses performed	Mean Concentration[1]	Concentration Range[1]	
			Min	Max
GZ-01	1	< 665	< 665	< 665
GZ-02	1	< 658	< 658	< 658
GZ-03	2	< 656	< 637	< 675
GZ-04	2	< 654	< 639	< 669
GZ-05	1	< 669	< 669	< 669
GZ-06	1	< 665	< 665	< 665
GZ-07	1	< 633	< 633	< 633
GZ-09	1	< 1710	< 1710	< 1710
GZ-10	0	**	**	**
GZ-11	2	< 651	< 634	< 667
GZ-12	2	< 650	< 634	< 666
GZ-12D	4	< 647	< 612	< 692
GZ-13	1	< 679	< 679	< 679
GZ-13D	2	< 649	< 632	< 665
GZ-14	4	< 653	< 627	< 699
GZ-14D	4	**1140**	**944**	**1640**
GZ-15	4	< 651	< 613	< 701
GZ-16	1	< 678	< 678	< 678
GZ-17	1	< 659	< 659	< 659
GZ-18	1	< 665	< 665	< 665
GZ-18D	1	< 668	< 668	< 668
GZ-19	1	< 658	< 658	< 658
GZ-19D	1	< 656	< 656	< 656
GZ-20	0	**	**	**
GZ-21	1	< 634	< 634	< 634
GZ-22D	12	**1660**	**709**	**2270**
GZ-23	12	< 634	< 611	< 691
GZ-25	2	< 668	< 668	< 668
GZ-26	2	< 657	< 657	< 657
GZ-27	2	< 667	< 667	< 667

Notes:

1. All concentrations are in units of pCi/L
2. Required LLD for tritium = 2,000 pCi/L
3. "<" denotes minimum detectable value for the analytical period
4. **Bold** values denote positive results (greater than minimum detectable values)

APPENDIX B – LIQUID HOLDUP TANKS

Requirement	With the quantity of radioactive material in any outside tank exceeding the limit of Section 4 of the Decommissioning Safety Analysis Report, describe the events leading to this condition in the next Radioactive Effluent Release Report.
Response	The limits for any outside tank were not exceeded during this reporting period.

APPENDIX C - RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

The requirements for radioactive liquid effluent monitoring instrumentation channels in ODCM Table 3.1.1 were removed in ODCM Revision 40.

APPENDIX D - RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

Requirement	Radioactive gaseous effluent monitoring instrumentation channels are required to be functional in accordance with ODCM Table 3.1.2. If a non-functional, gaseous effluent monitoring instrumentation is not returned to functional status within 30 days pursuant to Note 5 of Table 3.1.2, an explanation in the next annual Radioactive Effluent Release Report of the reason(s) for the delay in correcting the inoperability is required per ODCM Section 10.1.
Response	There were no issues related to the radioactive gaseous effluent monitoring instrumentation for this reporting period.

APPENDIX E – RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

This Appendix is no longer required by the ODCM Revision 40. This Appendix is retained as a placeholder to allow this report to be consistent with previous reports.

APPENDIX F – LAND USE CENSUS

Requirement	A land use census is conducted in accordance with ODCM Control 3/4.5.2. With a land use census identifying a location(s) that yields at least a 20 percent greater dose or dose commitment than the values currently being calculated pursuant to ODCM Control 4.3.3, the new location(s) must be identified in the next Annual Radioactive Effluent Release Report.
Response	The Land Use Census was completed during the third quarter of 2020. No locations were identified which yielded a 20 percent greater dose or dose commitment than the values currently being calculated pursuant to ODCM Control 4.3.3. See Table 4C for a listing of nearest residents in the site area as determined in the 2020 Land Use Census.

APPENDIX G – PROCESS CONTROL PROGRAM

Requirement	ODCM Section 10.1 requires that licensee-initiated changes to the Process Control Program (PCP) be submitted to the Commission in the annual Radioactive Effluent Release Report for the period in which the change(s) was made.
Response	There were minor editorial changes made to the Process Control Program during this reporting period.

APPENDIX H – OFF-SITE DOSE CALCULATION MANUAL

Requirement	ODCM Section 10.1 requires that licensee-initiated changes to the Off-Site Dose Calculation Manual (ODCM) be submitted to the Commission in the annual Radioactive Effluent Release Report for the period in which the change(s).
Response	There were no changes to the Offsite Dose Calculation Manual (ODCM) during 2020.

APPENDIX I – RADIOACTIVE LIQUID, GASEOUS, AND SOLID WASTE TREATMENT SYSTEMS

Requirement	ODCM Section 10.5 requires that licensee-initiated major changes to the radioactive waste systems (liquid, gaseous, and solid) be reported to the Commission in the annual Radioactive Effluent Release Report for the period in which the evaluation was reviewed by the Independent Safety Review Committee.
Response	There were no licensee-initiated major changes to the radioactive waste systems during this reporting period.

APPENDIX J – ON-SITE DISPOSAL OF SEPTIC/SILT/SOIL WASTE

Requirement	Off-Site Dose Calculation Manual, Appendices B, F and I require that the dose impact due to on-site disposal of septic waste, cooling tower silt, and sand/soil type materials during the reporting year and from previous years be reported to the Nuclear Regulatory Commission in the Annual Radioactive Effluent Release Report if disposals occur during the reporting year. Vermont Yankee will report in the Annual Radioactive Effluent Release Report a list of the radionuclides present and the total radioactivity associated with the disposal activities on the Vermont Yankee site.
Response	There was no on-site disposal spreading during 2020.