

Environmental Surveillance of Vermont Yankee

Vermont Nuclear Decommissioning Citizens Advisory Panel

11 December 2023

William Irwin, ScD, CHP

Radiological Sciences Program Chief

Vermont Department of Health

Surveillance2020

Vermont Yankee Nuclear Power Station

Report on Public Health Monitoring



108 Cherry Street, PO Box 70
Burlington, VT 05402

healthvermont.gov

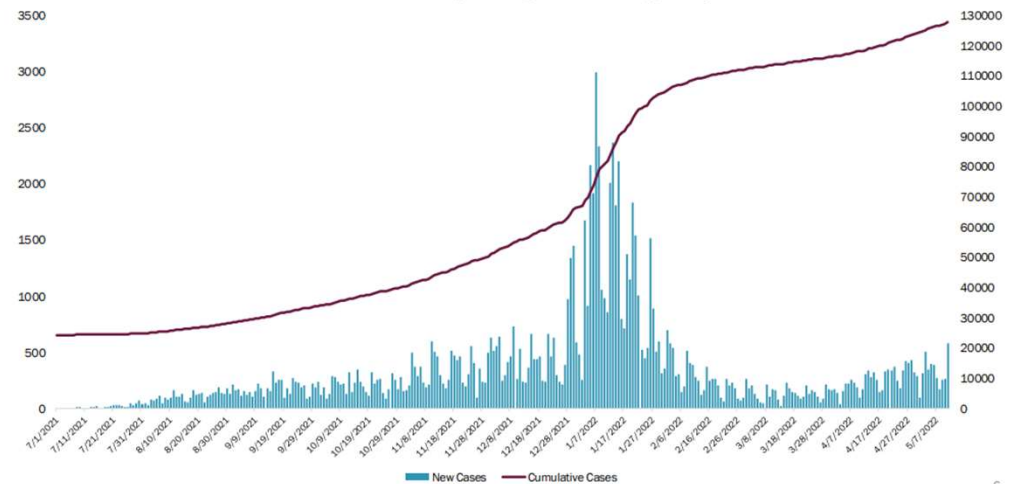
Historical Perspective

- The Health Department has been conducting environmental surveillance around Vermont Yankee since before initial criticality.
- Background radiation levels were measured between 1970 and 1972.
- Annual Environmental Surveillance Reports have been published since 1972.
- Paper versions were distributed to Vermont libraries
- Electronic versions were first published on the Internet in 2006; the latest is from 2020; all are at: <https://www.healthvermont.gov/environment/radiological/vermont-yankee>.

A 30-Month Reduction in Service for the COVID Pandemic March 2020 through October 2022

- The manager of VY environmental surveillance helped lead state-wide COVID testing and vaccinations.
- The Brattleboro District Office specialist who collects VY environmental samples helped run COVID testing and vaccination sites in the Brattleboro area.
- The Public Health Laboratory stopped nearly all other analyses to focus on running and reporting COVID-related tests.
- The Radiological Health laboratory analyst who reviewed test results prior to publication worked COVID at the Public Health Laboratory.

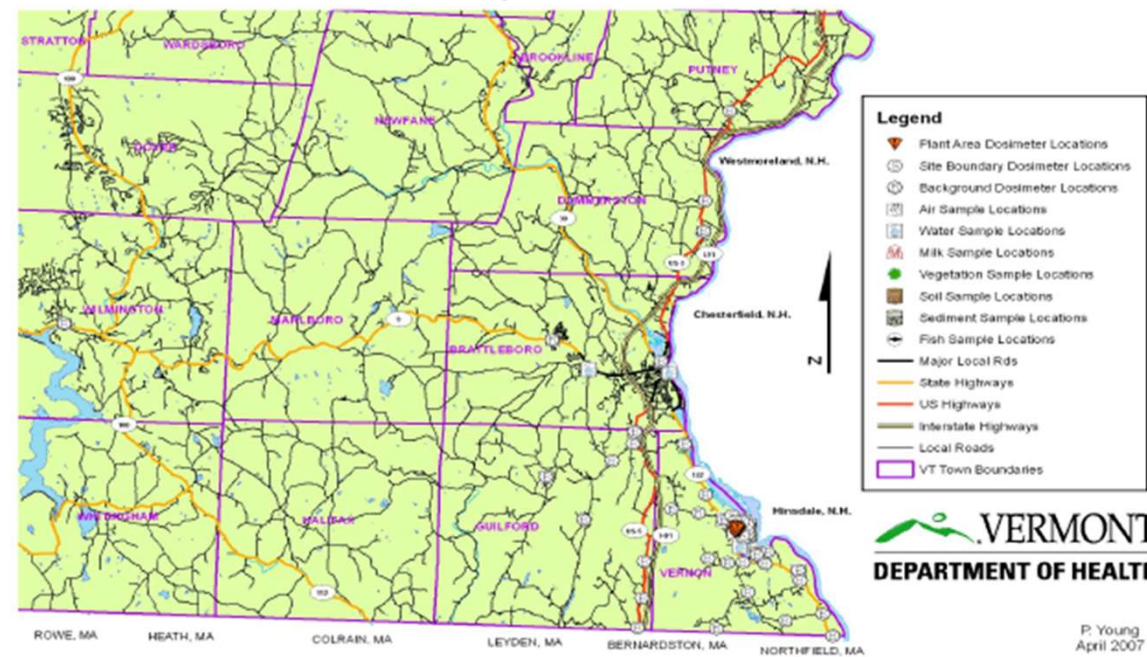
The proportion of Vermont cases of the Delta variant began to increase in early July, resulting in steady daily case growth between August and December 2021. In December, the Omicron variant arrived in Vermont and further increased daily case growth through May 2022.



A Restart in Late 2022

- VDH staff were able to restart sampling, testing, and sample analysis over the second half of 2022.
- Publication of 2023 results will begin after the final 2023 results are received in the first quarter of 2024.
- Health Department staff have reviewed about 350 reports of the 2023 results as reported from the Public Health Lab.
- No results since sampling restarted are indicative of environmental or public health impacts.

Environmental Radiation Surveillance Stations
Sample Locations



What is Sampled?



- Water from the Connecticut River upstream and downstream of Vermont Yankee, the public drinking water supply for Brattleboro, and well water from the Vernon Elementary School.
- Milk from two Vernon farms.
- The air from eight air sampling stations in Vernon, Guilford, Brattleboro, Dummerston and Wilmington.

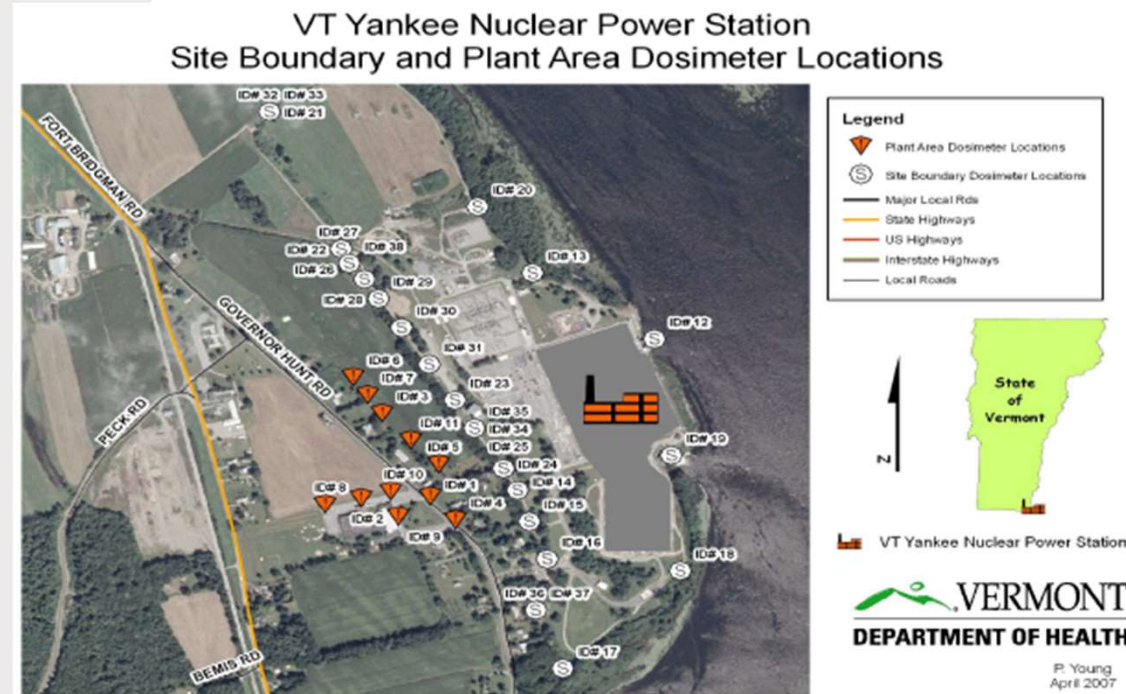
Table 1. 2020 Summary of Samples, Tests and Results

Sample Type	Sites	Number of Tests	Test Type	Results
Direct Gamma Radiation	68	199	Thermoluminescent dosimeters	Less than 20 milliroentgen per year at the land site boundary; no single quarter exceeded 10 milliroentgen.
Air: Particulates, Gases and Vapors	9	44	Total Alpha Radioactivity	Alpha radioactivity within the historical range. No increase observed as a result of operations at Vermont Yankee.
		44	Total Beta Radioactivity	Beta radioactivity within the historical range. No increase observed as a result of operations at Vermont Yankee.
		44	Iodine-131	No iodine-131 was detected in air samples.
		44	Gamma (gas/vapors) Radioactivity	Gamma radioactivity detected was of natural origin.
		2 (quarterly composites)	Gamma (particulates) Radioactivity	Gamma radioactivity detected was of natural origin.
Water	15	67	Total Alpha Radioactivity	Alpha radioactivity within the historical range. No increase observed as a result of operations at Vermont Yankee.
		67	Total Beta Radioactivity	Beta radioactivity within the historical range. No increase observed as a result of operations at Vermont Yankee.
	21	110	Tritium	All samples less than the lower limit of detection except one on-site groundwater monitoring well.
		110	Gamma Radioactivity	All detected gamma radioactivity of natural origin.
Milk	2	10	Iodine-131	All samples less than the lower limit of detection.
		10	Gamma Radioactivity	All gamma radioactivity detected was of natural origin.
Sediments	18	36	Gamma Radioactivity	Gamma radioactivity detected attributable to natural, Chernobyl, Fukushima, or above-ground nuclear weapons testing origin.
Fish	2	4	Gamma Radioactivity	Gamma radioactivity detected attributable to natural, Chernobyl, Fukushima, or above-ground nuclear weapons testing origin.
Total number of tests		791		

Eight air sampling stations – Transmission line crossing of Connecticut River downstream, Vernon Elementary School, D&E Tree, Guilford town highway garage, Brattleboro Courthouse, West Brattleboro, Wilmington VTrans garage, Dummerston VTrans garage.

Gamma Radiation Was Always Measured

- Environmental radiation dosimeters were in place and measuring site boundary dose throughout COVID.
- As they have been since 1970, the dosimeters were changed out periodically by the Health Department and processed by our dosimetry vendor.
- No direct gamma radiation emitted from the structures, systems and components remaining at Vermont Yankee through the decommissioning work has exceeded the limits established in the Health Department regulations.



Health Department Regulations

- The Health Department regulations may be found here:
<https://www.healthvermont.gov/sites/default/files/document/Radiological%20Health%20Rule.Final%20Adopted.April%202023.pdf>.
- Throughout the decommissioning, we have been using the discharge limitations of Part C, Section 2.1.1 for:
 - Liquid effluents,
 - Radioactive particulates in air, and
 - Direct gamma radiation.
- The five millirem per year related to each pathway is used for the fifteen millirem per year limit described in the Decommissioning Memorandum of Understanding between Vermont and NorthStar.
- From our measurements, NorthStar has not exceeded any limits through the decommissioning.
- We expect to use these limits after the release of the site for unrestricted use by the U.S. Nuclear Regulatory Commission.

Table 10. 2020 Thermoluminescent Dosimeter Exposure Measurements and Net Gamma Radiation: Station Area & Site Boundary Locations

2020 Site Boundary and Station Area Dosimeter Exposure (milliroentgen)																					
Location	Map ID #	Half1 Gross	1SD Error	Avg Blgrd	Half1 Net	Net H1 >=0	2SD Error	Qtr3 Gross	1SD Error	Avg Blgrd	Qtr3 Net	Net Q3 >=0	2SD Error	Qtr4 Gross	1SD Error	Avg Blgrd	Qtr4 Net	Net Q4 >=0	2SD Error	Annual Net	2SD Error
Gov Hunt Road #39	1	13.87	0.59	13.3	0.6	0.6	1.2	14.97	0.67	14.3	0.6	0.6	1.3	14.45	0.84	14.3	0.2	0.2	1.6	1.4	2.4
VDH DR06	2	13.63	0.75	13.3	0.4	0.4	1.5	14.75	1.09	14.3	0.4	0.4	2.1	14.11	0.75	14.3	-0.2	0.0	1.5	0.8	3.0
VDH DR51A	3	13.88	0.68	13.3	0.6	0.6	1.3	15.17	0.91	14.3	0.8	0.8	1.8	14.93	1.11	14.3	0.7	0.7	2.2	2.1	3.1
VDH DR52A	4	14.37	0.49	13.3	1.1	1.1	1.0	15.12	0.78	14.3	0.8	0.8	1.5	15.68	0.83	14.3	1.4	1.4	1.6	3.3	2.4
VDH DR53A	5	14.27	0.53	13.3	1.0	1.0	1.0	15.72	1.06	14.3	1.4	1.4	2.1	15.55	0.65	14.3	1.3	1.3	1.3	3.7	2.6
VDH T07A	6	13.50	0.68	13.3	0.2	0.2	1.3	15.58	0.70	14.3	1.2	1.2	1.4	14.80	0.96	14.3	0.5	0.5	1.9	2.0	2.7
VDH T07B	7	13.34	0.44	13.3	0.1	0.1	0.9	15.82	0.87	14.3	1.5	1.5	1.7	14.81	0.82	14.3	0.5	0.5	1.6	2.1	2.5
Vernon School (air sampler)	8	13.55	0.53	13.3	0.3	0.3	1.0	14.89	1.12	14.3	0.5	0.5	2.2	14.72	1.23	14.3	0.4	0.4	2.4	1.3	3.4
Vernon School Nurse	9	15.84	0.59	13.3	2.6	2.6	1.2	16.42	0.75	14.3	2.1	2.1	1.5	16.33	1.00	14.3	2.1	2.1	2.0	6.7	2.7
Vernon School Pole	10	13.78	0.68	13.3	0.5	0.5	1.3	14.51	0.83	14.3	0.2	0.2	1.6	13.99	0.86	14.3	-0.3	0.0	1.7	0.7	2.7
VY Parking Lot A	11	15.83	0.61	13.3	2.6	2.6	1.2	16.77	0.86	14.3	2.4	2.4	1.7	15.71	0.71	14.3	1.4	1.4	1.4	6.4	2.5
VDH DR45	12	24.16	1.08	13.3	10.9	10.9	2.1	21.24	1.01	14.3	6.9	6.9	2.0	20.96	1.15	14.3	6.7	6.7	2.3	24.5	3.7
VDH DR46	13	13.79	0.75	13.3	0.5	0.5	1.5	14.80	0.81	14.3	0.5	0.5	1.6	14.33	0.58	14.3	0.1	0.1	1.1	1.0	2.4
VDH DR08	15	14.10	0.48	13.3	0.8	0.8	0.9	14.83	0.72	14.3	0.5	0.5	1.4	14.24	0.63	14.3	0.0	0.0	1.2	1.3	2.1
VDH DR41	16	13.77	0.51	13.3	0.5	0.5	1.0	14.97	0.67	14.3	0.6	0.6	1.3	14.20	0.71	14.3	-0.1	0.0	1.4	1.1	2.2
VDH DR42	17	13.65	0.57	13.3	0.4	0.4	1.1	15.55	0.80	14.3	1.2	1.2	1.6	14.61	0.76	14.3	0.3	0.3	1.5	1.9	2.4
VDH DR43	18	15.70	0.66	13.3	2.4	2.4	1.3	17.20	1.00	14.3	2.9	2.9	2.0	16.65	0.83	14.3	2.4	2.4	1.6	7.7	2.9
VDH DR44	19	15.37	0.71	13.3	2.1	2.1	1.4	13.68	0.77	14.3	-0.7	0.0	1.5	13.81	0.93	14.3	-0.5	0.0	1.8	2.1	2.7
VDH DR47	20	13.95	0.70	13.3	0.7	0.7	1.4	15.06	0.73	14.3	0.7	0.7	1.4	14.93	1.19	14.3	0.7	0.7	2.3	2.1	3.1
VDH DR48	21	11.15	0.54	13.3	-2.1	0.0	1.1	12.28	0.81	14.3	-2.1	0.0	1.6	12.67	0.57	14.3	-1.6	0.0	1.1	0.0	2.2
VDH T01	22	13.54	0.74	13.3	0.3	0.3	1.5	14.69	0.84	14.3	0.3	0.3	1.6	14.47	0.84	14.3	0.2	0.2	1.6	0.8	2.7
VDH DR49	22	12.75	0.62	13.3	-0.5	0.0	1.2	13.79	0.69	14.3	-0.6	0.0	1.4	13.68	0.85	14.3	-0.6	0.0	1.7	0.0	2.5
VDH DR51	23	14.22	0.69	13.3	1.0	1.0	1.4	15.86	0.80	14.3	1.5	1.5	1.6	15.56	1.22	14.3	1.3	1.3	2.4	3.8	3.2
VDH DR52	24	14.52	0.84	13.3	1.3	1.3	1.6	16.01	0.91	14.3	1.7	1.7	1.8	15.23	0.78	14.3	1.0	1.0	1.5	3.9	2.9
VDH DR53	25	15.34	0.81	13.3	2.1	2.1	1.6	16.08	0.69	14.3	1.7	1.7	1.4	16.18	0.77	14.3	1.9	1.9	1.5	5.7	2.6
VDH T03	26	13.78	0.91	13.3	0.5	0.5	1.8	14.90	0.90	14.3	0.6	0.6	1.8	14.42	0.85	14.3	0.1	0.1	1.7	1.2	3.0

Site boundary dosimeter measurements are bolded.

In 2020, the reactor was shutdown and very little of the reactor had been removed.



Dosimeters around the site showed doses between 0.0 millirem and 6.7 millirem per year above background.



Doses from air and water discharges are calculated to be less than 1.0 millirem per year each.



We anticipate the dose limit of 15 millirem per year from all pathways is unlikely to be exceeded under normal circumstances after decommissioning.

2021 and 2022 Dosimetry Results

- The dose limit from air particulates, liquid effluents and gamma radiation is 15 milliroentgen above background for decommissioning.
- Doses from air particulates and liquid effluents are less than 1 millirem per year.
- Combined, doses from air particulates, liquid effluents and gamma radiation will be below 15 milliroentgen annually.

Year	Average Background in milliroentgen per year	Maximum in milliroentgen per year at site boundary	Exposure rate above background
2021	56 from 30 dosimeters at locations miles away	64 between 394 and 422 Governor Hunt Road	8 milliroentgen per year
2022	53 from 30 dosimeters at locations miles away	62 between 394 and 422 Governor Hunt Road	9 milliroentgen per year

Other Health Department Activities

- Attend twice monthly calls with NorthStar, the Agency of Natural Resources and the Department of Public Safety.
- Quarterly site visits to observe progress and/or to exchange radiation dosimeters.
- Receipt, review and distribution of low-level radioactive waste shipping notices.
- Train the Vermont Hazardous Materials Response Team, the VDH Radiological Health staff and the Public Health Lab staff twice annually on Vermont Yankee emergency response.

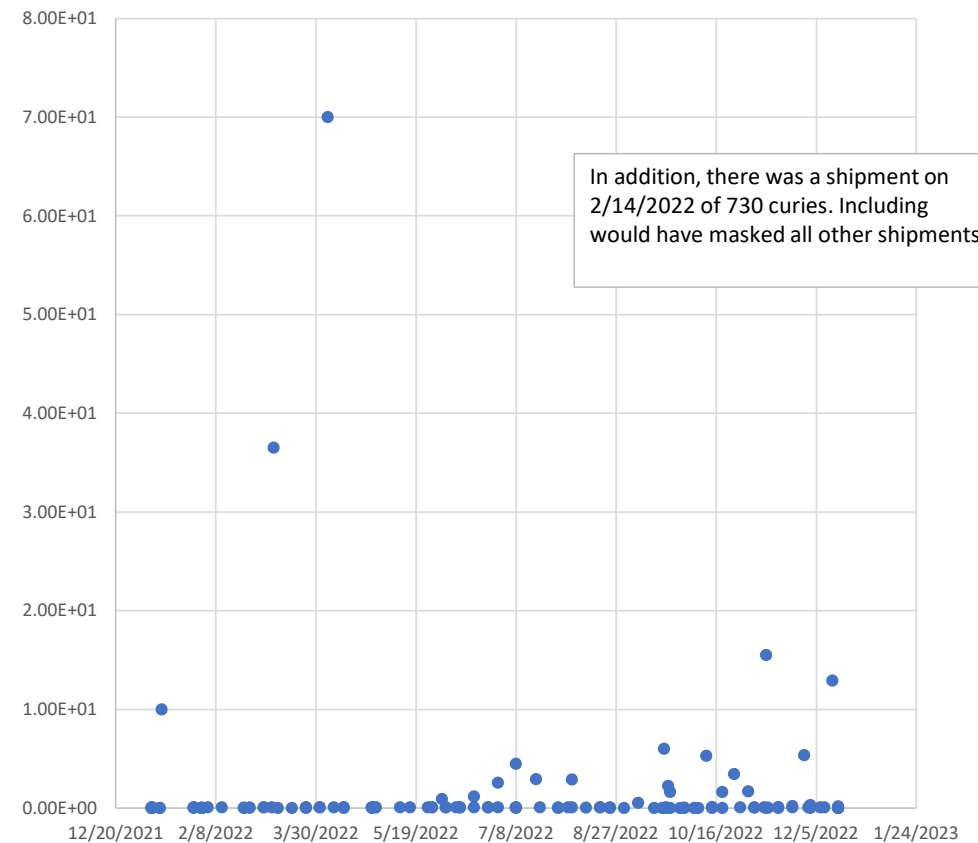


Photo by William Irwin, ScD, CHP with permission of NorthStar Vermont Yankee

Tracking Low-Level Radioactive Waste

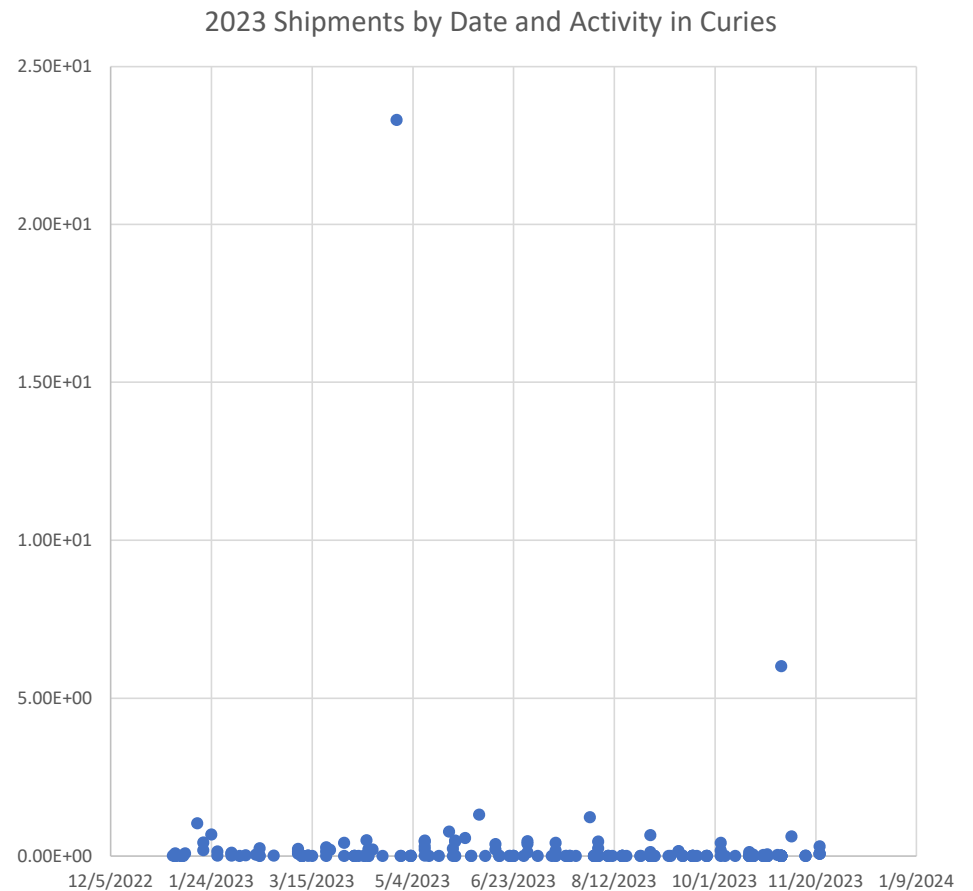
- NorthStar disposed of 7,480 curies in 126 shipments in 2022.
- The bulk was one shipment of 7,290 curies.

2022 Shipments by Date and Activity in Curies



Tracking Low-Level Radioactive Waste

- NorthStar disposed of 48 curies in 222 shipments through Thanksgiving, for a total of 48 curies.
- One shipment of 23.3 curies made up the most activity.



The Next Two Years Are Important

- While NorthStar and Orano have been effective decontaminating and disassembling the structures, systems and components for disposal as low-level radioactive waste, the history of nuclear power plant decommissioning usually includes unearthing something unexpected in the final years at every plant.
- We hope the last days of Vermont Yankee's decommissioning will be like its last years of operations when it went breaker-to-breaker between multiple refueling outages – exceptionally better than most other nuclear power plants in the nation.

AOG Pipe Tunnel Excavation



From the Vermont Department of Health Groundwater Release Investigation at <https://www.healthvermont.gov/environment/reports-responses-special-projects/tritium-contamination-vt-yankee-2010-12>.



The excavation images are as viewed from the north end. The piping that runs through the center of the excavation includes two emergency diesel generator fuel lines. The lines required special precautions during the excavation, as did the electrical duct for the emergency diesel generators (the concrete structure on the right). Image 2 shows workers removing soils from the excavation. Samples of these soils have been analyzed for radioactivity. Samples near the AOG pipe tunnel included radioactive metals, indicating the leakage pathway from the tunnel into the environment.



Photo credit: Paul Franz



Thank you.

William.Irwin@vermont.gov