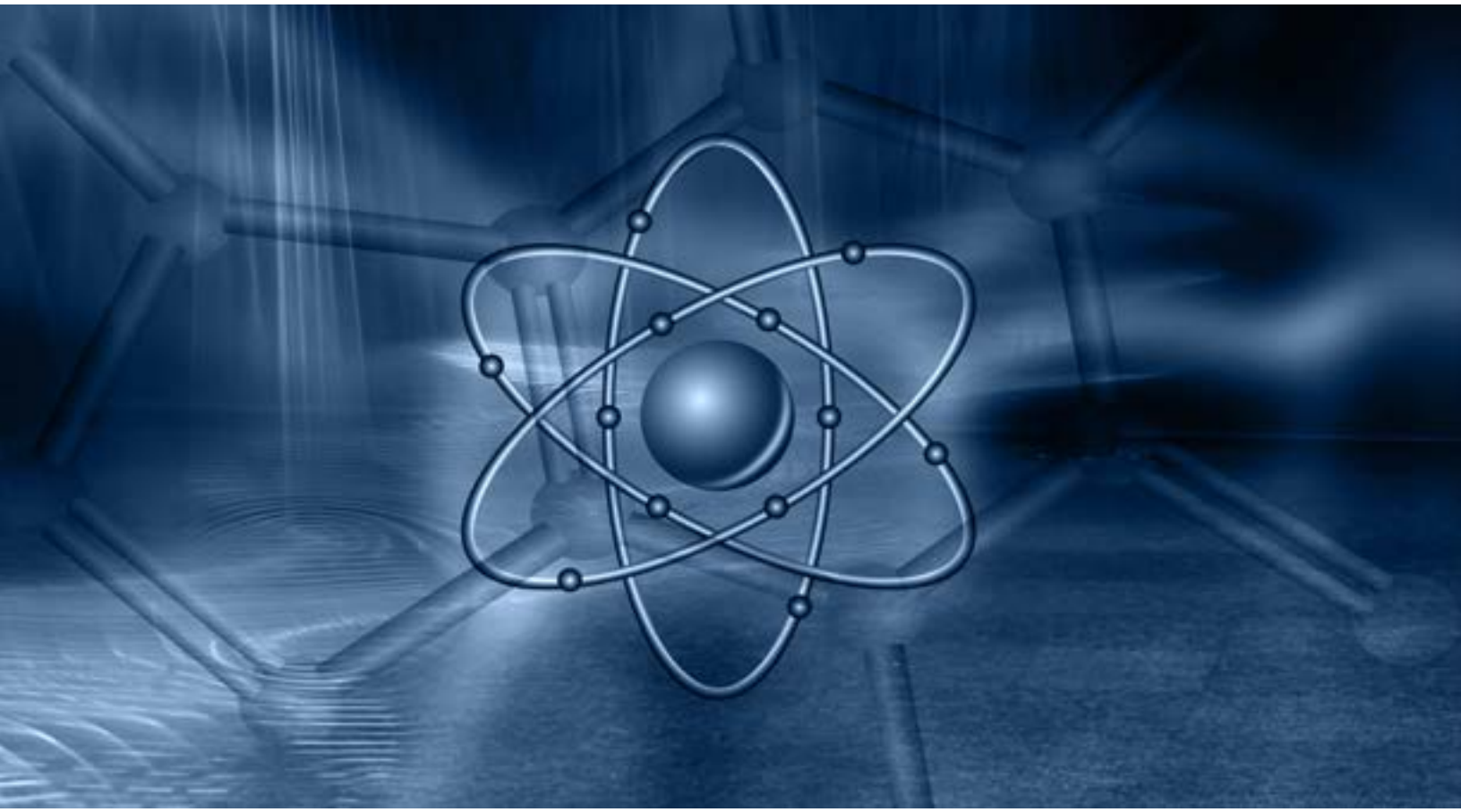
New York State Low-Level Radioactive Waste Status Report for 2020

Final Report | July 2021



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Our Mission:

Advance clean energy innovation and investments to combat climate change, improving the health, resiliency, and prosperity of New Yorkers and delivering benefits equitably to all.

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New York State Low-Level Radioactive Waste Status Report for 2020

Final Report

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July 1, 2021

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1 Introduction

This report summarizes data on low-level radioactive waste (LLRW)[1] generated in New York State.[2] It is based on reports from generators[3] that file annually with the New York State Energy Research and Development Authority (NYSERDA). The New York State Low-Level Radioactive Waste Management Act[4] (State Act) requires LLRW generators in the State to submit annual reports to NYSERDA that provide detailed information on waste generated, stored, and disposed. To facilitate compliance, NYSERDA developed report forms available on its website. Generators without internet access are provided paper copies upon request. This is the 35th year that generators have submitted such reports to NYSERDA.

The State Act requires NYSERDA to prepare an annual report summarizing—by type of generator and county—the nature, characteristics, and quantities of LLRW generated in the State. This report is designed to meet that requirement and summarizes the most recent year's data in a series of tables and figures. Section 2 reports volume, radioactivity,[5] and other characteristics of waste disposed in 2020. Section 3 summarizes volume, radioactivity, and other characteristics of waste held in storage pending future disposal as of December 31, 2020. Section 3 also summarizes the volume of waste held in storage for decay and subsequent disposal as nonradioactive waste as of December 31, 2020. Such waste may still be subject to special disposal requirements due to other hazardous characteristics (e.g., regulated medical waste). Section 4 shows historical LLRW generation data and includes generators' projections of waste quantities for the next five years.

In this report, volume is presented in cubic meters and radioactivity is presented in gigabecquerels (GBq) or megabecquerels (MBq). These units have been adopted to be consistent with U.S. Nuclear Regulatory Commission uniform national LLRW manifest requirements. Information for converting the data to cubic feet and curies is provided in footnotes throughout the report and the conversion tables in Appendix A.

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[1] Low-level radioactive waste is one category of waste produced through processes using radioactive materials. In the U.S., radioactive wastes are classified according to a number of different categories by federal law and U.S. Nuclear Regulatory Commission (NRC) regulations.

[2] Waste generated by certain federal installations and programs, such as the Brookhaven National Laboratory, the Knolls Atomic Power Laboratory, and West Valley Demonstration Project, are not included in this report nor in the requirements for generator reporting to NYSERDA. Under the federal Low-Level Radioactive Waste Policy Act, as amended in 1985 (Public Law 99-240), the federal government is responsible for disposal of LLRW owned and generated by the United States Department of Energy (DOE), the U.S. Navy, as a result of decommissioning vessels, and the federal government, as a result of research, development, testing, and production of nuclear weapons.

[3] "Generator" is defined in 21 NYCRR Part 502.2(e) as "A person who by his actions within New York, or through the actions within New York of any agent, employee, or independent contractor, generates low-level radioactive waste."

[4] New York Public Authorities Law. §1854-d(1) (McKinney's Consolidated Laws of New York, 2000).

[5] Radioactivity is the measure of a material's propensity to emit radiation, or the number of radiation-emitting events occurring each second.

2 Low-Level Radioactive Waste Disposed by New York State Generators in 2020

This section summarizes data reported by LLRW generators in the State on waste transferred to licensed LLRW disposal facilities in Clive, Utah (Energy Solutions); Richland, Washington (U.S. Ecology); and Andrews, Texas (Waste Control Specialists) during 2020. LLRW is categorized as Class A, B, or C. These categories were established originally by the U.S. Nuclear Regulatory Commission in Title 10 of the Code of Federal Regulations, Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste" and have since been adopted by the New York State Department of Environmental Conservation in 6 NYCRR Part 382, "Regulations for Low-Level Radioactive Waste Disposal Facilities." Class A contains the lowest concentration of short- and long-lived radioactive materials and represents the largest class by volume produced in the State. On the other end of the spectrum, Class C waste contains the greatest concentration of long-lived radioactive material, and although normally the smallest in terms of volume generated, usually contains the greatest amount of radioactivity. Class B, as the name suggests, is an intermediate category.

The Clive facility can accept most Class A waste, but cannot accept Class B or C waste. The Clive facility can also accept, treat, and dispose of most solid, mixed waste (i.e., LLRW that also contains other hazardous constituents) that meets the site's radioactivity concentration limits. The Richland facility is authorized to accept limited volumes of LLRW containing small quantities of naturally occurring radioactive material (e.g., radium, uranium, and thorium) from State generators. The Andrews facility accepts Class A, B, and C waste.

In 2020, generators in the State reported disposing 892 cubic meters (31,497 cubic feet) of LLRW containing 9,046 GBq (244 curies) of radioactivity. About 98.9% of the volume, containing 70.1% of the radioactivity, was shipped to the Clive facility. The Andrews facility received about 1.1% of the volume, containing 29.9% of the radioactivity. The Richland facility received less than 0.1% of the total volume and activity.

In general, variability in volume and activity of LLRW disposed is primarily a function of refueling and maintenance activities at nuclear power plants. The increase in disposal in 2015 and 2016 can be attributed to three separate disposal actions: decommissioning of a university research reactor, disposal of both irradiated hardware, and a large volume of resin from one of the nuclear power plants.

Individual entries in the following tables are rounded using standard practices as described. The totals shown represent the sum of the rounded entries; therefore, they may vary from one table to another and not always equal 100%. Waste volumes are rounded to the nearest tenth of a cubic meter. In most cases, radioactivity is rounded to the nearest 10,000th of a GBq. Percentages are rounded to the nearest tenth of a percent in the table and figures.

Table 1. Generators Reporting and Disposing Waste[6]

Generator Type	Number Reporting	Number Disposing
Medical		
Government	5	2
Private	134	7
College	14	10
Other	12	3
Total Medical	**165**	**22**
Industrial		
Manufacturing	7	6
Research and Development	2	0
Other	1	1
Total Industrial	**10**	**7**
Academic (nonmedical)		
College or University	25	13
Other	3	1
Total Academic	**28**	**14**
Government (nonmedical)		
New York State	4	2
Other	2	1
Total Government	**6**	**3**
Total Nonpower Plant	**209**	**46**
Nuclear Power Plant	**6**	**6**
Total	**215**	**52**

[6] Disposal refers to generators that reported transferring any class of LLRW directly or via brokers or processors to one of the able licensed LLRW disposal facilities. LLRW generators that did not dispose waste are either storing waste for future disposal or storing waste for decay and subsequent disposal as non-radioactive waste. Section 3 addresses storage in detail.

Table 2. Volume and Radioactivity of Waste Disposed[7]

Generator Type	Volume[8] (m^3)	% of Total	Radioactivity[8] (GBq)	% of Total
Medical				
Government	0.1		8.6555	
Private	8.6		40.0483	
College	4.2		17.4695	
Other	0.6		18.9973	
Total Medical	**13.5**	**1.5**	**85.1706**	**0.9**
Industrial				
Manufacturing	1.9		0.1818	
Research and Development	0.0		0.0000	
Other	*		41.5980	
Total Industrial	**1.9**	**0.2**	**41.7798**	**0.5**
Academic (nonmedical)				
College or University	4.0		24.7760	
Other	0.6		0.0100	
Total Academic	**4.6**	**0.5**	**24.7860**	**0.3**
Government (nonmedical)				
New York State	2.4		20.9638	
Other	*		27.0345	
Total Government	**2.4**	**0.3**	**47.9983**	**0.5**
Total Nonpower Plant	**22.4**	**2.5**	**199.7347**	**2.2**
Nuclear Power Plant	**869.6**	**97.5**	**8,846.0062**	**97.8**
Total	**892.0**	**100.0**	**9,045.7409**	**100.0**
	(31,497 ft^3)		**(244 curies)**	

[7] Refers to all classes of LLRW transferred either directly or via broker or processor to one of the available licensed LLRW disposal facilities.

[8] To obtain volume in cubic feet (ft^3), multiply the number of cubic meters (m^3) by 35.31. To obtain radioactivity in curies, divide the number of gigabecquerels (GBq) by 37.

* Less than 0.1% or 0.1 cubic meters.

Table 3. Waste Disposed[9] by Class[10] and Generator Type

	Class A		Class B		Class C	
Generator Type	**Volume[11] (m^3)**	**Radioactivity[11] (GBq)**	**Volume[11] (m^3)**	**Radioactivity[11] (GBq)**	**Volume[11] (m^3)**	**Radioactivity[11] (GBq)**
Medical	13.3	49.4952	0.0	0.0000	0.2	35.6754
Industrial	1.9	41.7798	0.0	0.0000	0.0	0.0000
Academic	4.6	18.4189	0.0	0.0000	*	6.3671
Government	2.4	20.9638	0.0	0.0000	*	27.0345
Nuclear Power Plant	869.1	6,264.5064	0.5	2,581.4998	0.0	0.0000
Total	**891.3**	**6,395.1641**	**0.5**	**2,581.4998**	**0.2**	**69.0770**
	(31,472 ft^3)	**(173 curies)**	**(18 ft^3)**	**(70 curies)**	**(7 ft^3)**	**(2 curies)**

[9] Refers to LLRW transferred either directly, via brokers, or processors to one of the available licensed LLRW disposal facilities.

[10] Classes A, B, and C are waste-classification categories established by the U.S. Nuclear Regulatory Commission (NRC) in Title 10 of the Code of Federal Regulations, Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," and adopted by the New York State Department of Environmental Conservation in 6 NYCRR Part 382, "Regulations for Low-Level Radioactive Waste Disposal Facilities."

[11] To obtain volume in cubic feet (ft^3), multiply the number of cubic meters (m^3) by 35.31. To obtain radioactivity in curies, divide the number of gigabecquerels (GBq) by 37.

* Less than 0.1 cubic meters, 0.0001 gigabecquerels, 0.1 curies, or 0.1%.

Table 4. Distribution of Waste Among Disposal Facilities[12]

Disposal Facility	Volume[13] (m^3)	% of Total	Radioactivity[13] (GBq)	% of Total
Andrews, Texas	9.4	1.1	2,703.9438	29.9
Clive, Utah	882.5	98.9	6,341.7967	70.1
Richland, Washington	0.1	*	0.0004	*
Total	**892.0**	**100.0**	**9,045.7409**	**100.0**
	(31,497 ft^3)		**(244 curies)**	

[12] Refers to all classes of LLRW transferred either directly or via a broker or processor to the respective disposal facility.

[13] To obtain volume in cubic feet (ft^3), multiply the number of cubic meters (m^3) by 35.31. To obtain radioactivity in curies, divide the number of gigabecquerels (GBq) by 37.

* Less than 0.1% or 0.1 cubic meters.

Table 5. Waste Disposed by County of Origin

County	Number of Generators Reporting	Number of Generators Disposing LLRW[14]	Volume[15] (m^3)	% of Total	Radioactivity[15] (GBq)	% of Total
Albany	11	2	2.4	0.2	20.9638	0.2
Allegany	0	0	0.0	0.0	0.0000	0.0
Bronx	5	2	0.3	*	0.4385	*
Broome	4	1	0.1	*	0.5767	*
Cattaraugus	1	0	0.0	0.0	0.0000	0.0
Cayuga	0	0	0.0	0.0	0.0000	0.0
Chautauqua	1	0	0.0	0.0	0.0000	0.0
Chemung	1	1	0.8	0.1	0.0625	*
Chenango	1	0	0.0	0.0	0.0000	0.0
Clinton	0	0	0.0	0.0	0.0000	0.0
Columbia	0	0	0.0	0.0	0.0000	0.0
Cortland	1	0	0.0	0.0	0.0000	0.0
Delaware	0	0	0.0	0.0	0.0000	0.0
Dutchess	8	2	0.3	*	0.0255	*
Erie	17	3	1.0	0.1	0.5831	*
Essex	0	0	0.0	0.0	0.0000	0.0
Franklin	1	0	0.0	0.0	0.0000	0.0
Fulton	1	0	0.0	0.0	0.0000	0.0
Genesee	1	0	0.0	0.0	0.0000	0.0
Greene	0	0	0.0	0.0	0.0000	0.0
Hamilton	0	0	0.0	0.0	0.0000	0.0
Herkimer	0	0	0.0	0.0	0.0000	0.0
Jefferson	2	0	0.0	0.0	0.0000	0.0
Kings	11	1	0.1	*	0.0010	*
Lewis	0	0	0.0	0.0	0.0000	0.0
Livingston	2	0	0.0	0.0	0.0000	0.0
Madison	0	0	0.0	0.0	0.0000	0.0
Monroe	8	3	0.5	*	10.0166	0.1
Montgomery	0	0	0.0	0.0	0.0000	0.0
Nassau	24	3	5.7	0.6	0.9560	*
New York	18	13	4.7	0.5	47.4524	0.5
Niagara	2	0	0.0	0.0	0.0000	0.0
Oneida	0	0	0.0	0.0	0.0000	0.0
Onondaga	13	3	2.1	0.2	19.0661	0.2

Table 5 continued

County	Number of Generators Reporting	Number of Generators Disposing LLRW[14]	Volume[15] (m^3)	% of Total	Radioactivity[15] (GBq)	% of Total
Ontario	1	0	0.0	0.0	0.0000	0.0
Orange	7	0	0.0	0.0	0.0000	0.0
Orleans	0	0	0.0	0.0	0.0000	0.0
Oswego	4	3	517.1	58.0	3,304.5769	36.5
Otsego	1	1	0.8	0.1	0.0086	*
Putnam	2	0	0.0	0.0	0.0000	0.0
Queens	8	2	0.4	*	41.6304	0.5
Rensselaer	4	0	0.0	0.0	0.0000	0.0
Richmond	4	0	0.0	0.0	0.0000	0.0
Rockland	2	1	*	*	9.6550	0.1
St. Lawrence	0	0	0.0	0.0	0.0000	0.0
Saratoga	1	0	0.0	0.0	0.0000	0.0
Schenectady	3	1	*	*	0.0006	*
Schoharie	0	0	0.0	0.0	0.0000	0.0
Schuyler	0	0	0.0	0.0	0.0000	0.0
Seneca	0	0	0.0	0.0	0.0000	0.0
Steuben	1	1	0.4	*	0.0772	*
Suffolk	21	2	0.1	*	35.6874	0.4
Sullivan	0	0	0.0	0.0	0.0000	0.0
Tioga	0	0	0.0	0.0	0.0000	0.0
Tompkins	5	2	0.5	0.1	2.9525	*
Ulster	2	0	0.0	0.0	0.0000	0.0
Warren	2	0	0.0	0.0	0.0000	0.0
Washington	0	0	0.0	0.0	0.0000	0.0
Wayne	2	1	39.3	4.4	30.8161	0.3
Westchester	12	4	315.4	35.4	5,520.1940	61.0
Wyoming	0	0	0.0	0.0	0.0000	0.0
Yates	0	0	0.0	0.0	0.0000	0.0
Totals	**215**	**52**	**892.0**		**9,045.7409**	
			(31,497 ft^3)		**(244 curies)**	

[14] Refers to the number of generators that reported transferring all classes of LLRW, either directly or via a broker or processor, to one of the available licensed LLRW disposal facilities.

[15] To obtain volume in cubic feet (ft^3), multiply the number of cubic meters (m^3) by 35.31. To obtain radioactivity in curies, divide the number of gigabecquerels (GBq) by 37.

* Less than 0.1 cubic meter, 0.1%, or 0.0001 GBq.

Table 6. Radionuclide Content of Waste Disposed[16,17] (MBq)

Radionuclide	Half-Life[18]	Academic	Government	Industrial	Medical	Nuclear Power Plants	Total
Ag-110m	249.8 d			0.098		1,744.924	1.7 E3
Al-26	7.2 E5 y			0.098			9.8 E-2
Am-241	432.7 y	111.000	0.120	0.259		285.632	4.0 E2
Ba-133	12.8 d				253.095		2.5 E2
Ba-140	12.8 d					5.365	5.4 E0
Be-7	53.3 d			0.053			5.3 E-2
C-14	5.7 E3 y	330.209	209.257		1,663.009	83,339.831	8.5 E4
Ca-45	162.7 d	0.500					5.0 E-1
Cd-109	461.0 d			18.277			1.8 E1
Ce-144	284.6 d				4.985	1,884.454	1.9 E3
Cl-36	3.0 E5 y	0.074	0.002		0.370		4.5 E-1
Cm-242	162.8 d					7.596	7.6 E0
Cm-243	29.1 y					29.699	2.9 E1
Cm-244	29.1 y					17.310	1.7 E1
Co-57	271.8 d			51.829	4,754.409	3,374.486	8.2 E3
Co-58	70.9 d			0.933	11.100	53,223.139	5.3 E4
Co-60	5.3 y	0.001	0.740		89.627	2,955,086.862	3.0 E6
Cr-51	27.7 d	110.737		0.019		5,221.514	5.3 E3
Cs-134	2.1 y					5,028.641	5.0 E3
Cs-137	30.1 y	13,353.302	30,319.328		58,048.947	668,959.749	7.7 E5
Eu-152	13.5 y				0.160		1.6 E-1
Fe-55	2.7 y	126.527				815,105.384	8.2 E5
Fe-59	44.5 d					1,234.667	1.2 E3
Gd-153	241.6 d				308.713		3.1 E2
Ge-68	270.8 d				50.027		5.0 E1
H-3	12.3 y	1,710.623	17,399.132	41,600.849	16,277.346	66,764.561	1.4 E5
I-125	59.4 d	0.107			2,057.644		2.1 E3
1-129	1.6 E7 y		0.858		0.408	19.911	2.1 E1
Kr-85	10.8 y				27.380		2.7 E1
La-140	1.7 d					3.371	3.4 E0
Mn 54	312.1 d	2.960		4.182	2.393	165,836.258	1.7 E5
Na-22	2.6 y				12.084		1.2 E1
Nb-94	2.0 E4 y			0.999		643.989	6.4 E2
Nb-95	35.0 d					555.745	5.6 E2
Ni-59	7.6 E4 y					25,673.999	2.6 E4
Ni-63	101 y	2,740.588		14.700	0.370	3,777,115.084	3.8 E6
P-32	14.3 d	1.863					1.9 E0
Pb-210	22.3 y				0.992		9.9 E-1

Table 6 continued

Radionuclide	Half-Life[18]	Academic	Government	Industrial	Medical	Nuclear Power Plants	Total
Po-210	138.4 d		12.543		0.001		1.3 E1
Pu-238	87.7 y					119.242	1.2 E2
Pu-239	2.4 E4 y		0.289			68.713	6.9 E1
Pu-240	2.4 E4 y					64.047	6.4 E1
Pu-241	14.4 y					3,238.037	3.2 E3
Ra-226	1.6 E3 y	373.924	0.696		14.584		3.9 E2
Re-184	38.0 d			0.274			2.7 E-1
S-35	87.2 d	199.672					2.0 E2
Sb-124	60.2 d				3.996	869.701	8.7 E2
Sb-125	2.8 y				170.200	80,001.132	8.0 E4
Sn-113	115.1 d					2,730.031	2.7 E3
Sn-117 m	13.6 d					5.180	5.2 E0
Sr-89	50.5 d					5,433.017	5.4 E3
Sr-90	28.8 y	5,700.000	53.604		1,326.113	11,847.325	1.9 E4
Ta-182	114.4 d			0.208			2.1 E-1
Tc-99m	6.0 h		0.021		0.433	146.801	1.5 E2
Te-123m	119.7 d					9.774	9.8 E0
Th-232	1.4 E10 y	2.040		24.106	0.037		2.6 E1
Tl-204	3.8 y	0.001					1.0 E-3
U-233	1.6 E5 y			0.186			1.9 E-1
U-234	2.4 E5 y			60.064			6.0 E1
U-235	7.0 E8 y			1.939			1.9 E0
U-236	2.3 E7 y			0.246			2.5 E-1
U-238	4.5 E9 y	20.023	1.704	0.018	9.950		3.2 E1
W-187	23.7 h				0.036		3.6 E-2
Y-88	106.7 d				0.004		3.5 E-3
Zn-65	243.8 d	2.135		0.340	49.580	110,049.378	1.1 E5
Zr-89	78.4 h				0.059		5.9 E-2
Zr-95	64 d					261.704	2.6 E2
Zr-98	83.4 d				32.560		3.2 E1
Others[19]	---	---	---	---	---	---	---
	Total	**24,786.286**	**47,998.294**	**41,779.677**	**85,170.612**	**8,846,006.253**	**9.0 E6**

[16] Some generator facilities have reported radionuclides with half-lives of less than 90 days in LLRW disposed. In the majority of these cases, these radionuclides cannot be separated readily from longer-lived radionuclides in the waste.The sum of individual radionuclide radioactivities frequently will not match the overall radioactivity totals reported for waste disposed due to rounding and other approximation techniques. Every effort is made to identify and resolve significant discrepancies.

[17] To obtain radioactivity in curies, divide the number of megabecquerels (MBq) by 37,000.

[18] Source: Chart of the Nuclides, General Electric Company under the direction of Naval Reactors, U.S. DOE; 16th edition, revised to 2002. NB: y=years, m=months, d=days, h=hours.

[19] In certain cases, LLRW generators are permitted by manifest to report a single activity for a group of radionuclides without assigning a value to each; those data are reported here.

Table 7. Number of Facilities Disposing Various Waste Types[20]

Waste Type[21]	Medical	Industrial	Academic	Government	Nuclear Power Plants	Total
Activated Material	1	0	0	0	0	1
Aqueous Liquids	2	1	2	0	0	5
Animal Carcasses	0	0	1	0	0	1
Anion Exchange Media	0	0	0	0	1	1
Biological Material (except animal carcasses)	2	0	0	0	0	2
Cation Exchange Medias	0	0	0	0	1	1
Charcoal	0	0	0	0	0	0
Compacted Trash	7	3	4	1	2	17
Contaminated Equipment	0	0	0	2	0	2
Demolition Rubble	0	0	0	0	0	0
Evaporator Bottoms/ Sludges/Concentrates	0	0	0	0	2	2
Filter Media	0	1	0	0	2	3
Filter (Mechanical)	0	0	0	0	0	0
Glassware/Labware	2	0	1	0	0	3
Incinerator Ash	0	0	0	0	0	0
Material to be Incinerated	1	0	1	0	0	2
Mixed Bed Ion-Exchange Media	0	0	0	0	2	2
Non-Compacted Trash	3	1	0	0	2	6
Oil	0	0	0	0	1	1
Organic Liquids (excluding oil)	1	0	1	0	0	2
Paint or Plating	0	1	0	0	1	2
Sealed Source/Device	6	2	1	3	0	12
Soil	0	0	0	0	1	1
Other[22]	2	0	2	2	0	6

[20] Refers to the number of generators that reported transferring any class of LLRW directly and via brokers and processors to one of the available licensed LLRW disposal facilities.

[21] Waste types listed are as defined by the U.S. Nuclear Regulatory Commission (NRC) Uniform Manifest. Generators frequently report disposal of several types of waste.

[22] In certain cases, generators reported disposing waste that did not fit into any of the categories listed. Those data are reported here.

3 Low-Level Radioactive Waste in Storage (as of December 31, 2020)

This section provides information on LLRW stored by generators.

Many generators store LLRW to allow its radioactivity to diminish to levels that permit disposal as nonradioactive waste (i.e., storage for decay). In general, the regulatory agencies with jurisdiction over LLRW in the State allow storage for decay only where the waste contains radionuclides with half-lives of less than 90 days. LLRW in storage for decay is normally held for 10 half-lives or until radioactivity has diminished to a level where it is indistinguishable from background radiation. Most generators hold LLRW in storage for decay at their own facilities, although approved off-site facilities may be used.

Generators also regularly store waste pending future transfer to a licensed LLRW disposal facility (i.e., storage pending disposal). Storage pending disposal can occur for extended periods, as when the Barnwell LLRW disposal facility in South Carolina no longer accepted waste from generators in New York State from June 30, 1994 to June 30, 1995. The Barnwell facility again closed to New York State as of July 1, 2008, increasing storage needs until the Andrews, Texas facility opened in 2012. Such storage may also occur when the LLRW has a particular characteristic that makes it unacceptable at the available disposal facilities (e.g., contains chemically hazardous components).

For those cases where access to licensed disposal facilities is not available, most generators will store LLRW at their own sites, although approved off-site storage facilities may be used. In addition, most generators routinely store LLRW at their facilities for short periods as a normal part of operation or staging while accumulating a sufficient quantity for transfer to a waste broker or a treatment or disposal facility. Post-storage treatment or processing may significantly reduce the volume of waste requiring final disposal.

Individual entries in the following tables are rounded using standard procedures as described. The totals shown represent the sum of the rounded entries; therefore, they may vary slightly from one table to another and not always equal 100%. Waste volumes are rounded to the nearest tenth of a cubic meter. In most cases, radioactivity is rounded to the nearest 10,000th of a GBq. Percentages are rounded to the nearest tenth of a percent in the tables and figures.

Table 8. Generators Reporting and Storing Waste Pending Disposal[23]

Generator Type	Number Reporting	Number Storing
Medical		
Government	5	2
Private	134	3
College	14	4
Other	12	1
Total Medical	**165**	**10**
Industrial		
Manufacturing	7	2
Research and Development	2	2
Other	1	1
Total Industrial	**10**	**5**
Academic (nonmedical)		
College or University	25	14
Other	3	2
Total Academic	**28**	**16**
Government (nonmedical)		
New York State	4	2
Other	2	1
Total Government	**6**	**3**
Total Nonpower Plant	**209**	**34**
Nuclear Power Plant	**6**	**1**
Total	**215**	**35**

[23] Includes any class of LLRW reported in storage at generator sites or an approved off-site location pending transfer to a licensed LLRW facility as of December 31, 2020. Does not include LLRW held in storage for decay.

Table 9. Volume and Radioactivity of Waste Stored Pending Disposal[24]

Generator Type	Volume[25] (m^3)	% of Total	Radioactivity[25] (GBq)	% of Total
Medical				
Government	0.4		0.0501	
Private	1.1		0.0803	
College	2.3		3.0759	
Other	0.5		0.0022	
Total Medical	**4.3**	**10.1**	**3.2085**	**0.3**
Industrial				
Manufacturing	21.2		333.7088	
Research and Development	0.1		0.7578	
Other	0.1		32.9303	
Total Industrial	**21.4**	**50.0**	**367.3969**	**39.1**
Academic (nonmedical)				
College or University	10.2		155.5346	
Other	0.3		0.0140	
Total Academic	**10.5**	**24.5**	**155.5486**	**16.6**
Government (nonmedical)				
New York State	1.4		0.0208	
Other	0.2		0.0314	
Total Government	**1.6**	**3.7**	**0.0522**	*
Total Nonpower Plant	**37.8**	**88.3**	**526.2062**	**56.1**
Nuclear Power Plant	**5.0**	**11.7**	**412.4994**	**43.9**
Total	**42.8 (1,511 ft^3)**	**100.0**	**938.7056 (25 curies)**	**100.0**

[24] Includes all classes of LLRW reported in storage at generator sites or an approved off-site location pending transfer to a licensed LLRW facility as of December 31, 2020. Does not include LLRW held in storage for decay.

[25] To obtain volume in cubic feet (ft^3), multiply the number of cubic meters (m^3) by 35.31. To obtain radioactivity in curies, divide the number of gigabecquerels (GBq) by 37.

* Less than 0.1% or 0.1 cubic meters.

Table 10. Waste in Storage Pending Disposal by Class and Generator Type[26, 27]

	Class A		Class B		Class C	
Generator Type	**Volume[28] (m^3)**	**Radioactivity[28] (GBq)**	**Volume[28] (m^3)**	**Radioactivity[28] (GBq)**	**Volume[28] (m^3)**	**Radioactivity[28] (GBq)**
Medical	4.3	3.2085	0.0	0.0000	0.0	0.0000
Industrial	21.4	367.3969	0.0	0.0000	0.0	0.0000
Academic	10.5	155.5486	0.0	0.0000	0.0	0.0000
Government	1.6	0.0522	0.0	0.0000	0.0	0.0000
Nuclear Power Plant	0.0	0.0000	5.0	412.4994	0.0	0.0000
Total	**37.8**	**526.2062**	**5.0**	**412.4994**	**0.0**	**0.0000**
	(1,335 ft^3)	**(14 curies)**	**(176 ft^3)**	**(11 curies)**	**(0.0 ft^3)**	**(0.0000 curies)**

[26] Classes A, B, and C are waste-classification categories established by the U.S. Nuclear Regulatory Commission (NRC) in Title 10 of the Code of Federal Regulations, Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," and adopted by the New York State Department of Environmental Conservation in 6 NYCRR Part 382, "Regulations for Low-Level Radioactive Waste Disposal Facilities."

[27] Refers to LLRW in storage at generator sites or an approved off-site location pending transfer to a licensed LLRW facility as of December 31, 2020. Does not include LLRW held in storage for decay.

[28] To obtain volume in cubic feet (ft^3), multiply the number of cubic meters (m^3) by 35.31. To obtain radioactivity in curies, divide the number of gigabecquerels (GBq) by 37.

* Less than 0.1% or 0.1 cubic meters.

Table 11. Number of Facilities Reporting Storage of Various Waste Types Pending Disposal

Waste Type[29]	Medical	Industrial	Academic	Government	Nuclear Power Plants	Total
Activated Material	1	0	0	0	0	1
Animal Carcasses	0	0	0	0	0	0
Anion Exchange Media	0	0	0	0	0	0
Aqueous Liquids	2	0	1	1	0	4
Biological Material (Except Animal Carcasses)	0	0	0	0	0	0
Cation Exchange Media	0	0	0	0	0	0
Contaminated Equipment	0	0	0	0	0	0
Compacted Trash	2	2	2	1	0	7
Demolition Rubble	0	0	0	0	0	0
Evaporator Bottoms/Sludge	0	0	0	0	1	1
Filter Media	0	0	0	0	0	0
Filter Media (Mechanical)	0	0	0	0	0	0
Glassware/Labware	1	1	1	1	0	4
Incinerator Ash	0	0	0	0	0	0
Material that will be Incinerated	1	0	0	0	0	1
Mixed Bed Ion-Exchange Media	0	0	0	0	0	0
Non-Compactible Trash	1	1	1	2	0	5
Organic Liquids (excluding oil)	0	0	1	0	0	1
Paint or Plating	0	0	0	0	0	0
Sealed Source/Device	0	1	1	1	0	3
Soil	0	0	0	0	0	0
Other[30]	0	0	1	0	0	1

[29] Waste types listed are as defined by the U.S. Nuclear Regulatory Commission (NRC) Uniform Manifest. Generators frequently report storage of several types of waste.

[30] In certain cases, generators reported storage of waste that did not fit into any of the categories listed. Those data are reported here.

Table 12. Waste in Storage[31] Pending Disposal by County of Origin

County	Number of Generators Reporting	Number of Generators Storing LLRW[32]	Volume[33] (m^3)	% of Total	Radioactivity[33] (GBq)	% of Total
Albany	11	4	0.9	2.1	0.0386	*
Allegany	0	0	0.0	0.0	0.0000	0.0
Bronx	5	2	0.8	1.9	0.0316	*
Broome	4	1	*	*	0.5550	*
Cattaraugus	1	1	1.3	3.0	0.0208	*
Cayuga	0	0	0.0	0.0	0.0000	0.0
Chautauqua	1	1	*	*	0.0001	*
Chemung	1	0	0.0	0.0	0.0000	0.0
Chenango	1	0	0.0	0.0	0.0000	0.0
Clinton	0	0	0.0	0.0	0.0000	0.0
Columbia	0	0	0.0	0.0	0.0000	0.0
Cortland	1	0	0.0	0.0	0.0000	0.0
Delaware	0	0	0.0	0.0	0.0000	0.0
Dutchess	8	1	0.4	0.9	0.0001	*
Erie	17	4	21.8	50.9	327.4556	34.9
Essex	0	0	0.0	0.0	0.0000	0.0
Franklin	1	1	0.1	0.2	0.0100	*
Fulton	1	0	0.0	0.0	0.0000	0.0
Genesee	1	0	0.0	0.0	0.0000	0.0
Greene	0	0	0.0	0.0	0.0000	0.0
Hamilton	0	0	0.0	0.0	0.0000	0.0
Herkimer	0	0	0.0	0.0	0.0000	0.0
Jefferson	2	0	0.0	0.0	0.0000	0.0
Kings	11	1	0.1	0.2	1.8500	0.2
Lewis	0	0	0.0	0.0	0.0000	0.0
Livingston	2	1	0.2	0.5	0.0008	*
Madison	0	0	0.0	0.0	0.0000	0.0
Monroe	8	1	*	*	0.0353	*
Montgomery	0	0	0.0	0.0	0.0000	0.0
Nassau	24	0	0.0	0.0	0.0000	0.0
New York	18	5	2.5	5.8	3.1804	0.3
Niagara	2	0	0.0	0.0	0.0000	0.0
Oneida	0	0	0.0	0.0	0.0000	0.0
Onondaga	13	2	*	*	7.6138	0.8
Ontario	1	0	0.0	0.0	0.0000	0.0

Table 12 continued

County	Number of Generators Reporting	Number of Generators Storing LLRW[32]	Volume[33] (m^3)	% of Total	Radioactivity[33] (GBq)	% of Total
Orange	7	0	0.0	0.0	0.0000	0.0
Orleans	0	0	0.0	0.0	0.0000	0.0
Oswego	4	1	5.0	11.7	412.4994	43.9
Otsego	1	0	0.0	0.0	0.0000	0.0
Putnam	2	1	0.5	1.2	0.0400	*
Queens	8	2	1.4	3.3	34.5916	3.7
Rensselaer	4	1	0.8	1.9	2.3941	0.2
Richmond	4	0	0.0	0.0	0.0000	0.0
Rockland	2	0	0.0	0.0	0.0000	0.0
St. Lawrence	0	0	0.0	0.0	0.0000	0.0
Saratoga	1	0	0.0	0.0	0.0000	0.0
Schenectady	3	0	0.0	0.0	0.0000	0.0
Schoharie	0	0	0.0	0.0	0.0000	0.0
Schuyler	0	0	0.0	0.0	0.0000	0.0
Seneca	0	0	0.0	0.0	0.0000	0.0
Steuben	1	0	0.0	0.0	0.0000	0.0
Suffolk	21	1	1.2	2.8	0.3548	*
Sullivan	0	0	0.0	0.0	0.0000	0.0
Tioga	0	0	0.0	0.0	0.0000	0.0
Tompkins	5	2	0.5	1.2	0.0022	*
Ulster	2	0	0.0	0.0	0.0000	0.0
Warren	2	0	0.0	0.0	0.0000	0.0
Washington	0	0	0.0	0.0	0.0000	0.0
Wayne	2	0	0.0	0.0	0.0000	0.0
Westchester	12	2	5.2	12.1	148.0314	15.8
Wyoming	0	0	0.0	0.0	0.0000	0.0
Yates	0	0	0.0	0.0	0.0000	0.0
Totals	**215**	**35**	**42.8 (1,511 ft^3)**		**938.7056 (25 curies)**	

[31] Includes LLRW in storage at generator sites or an approved off-site location pending transfer to a licensed LLRW facility, as of December 31, 2020. Does not include LLRW held in storage for decay.

[32] Refers to the number of generators who reported LLRW in storage pending disposal as of December 31, 2020.

[33] To obtain volume in cubic feet (ft^3), multiply the number of cubic meters (m^3) by 35.31. To obtain radioactivity in curies, divide the number of gigabecquerels (GBq) by 37.

* Less than 0.1 cubic meter, or 0.1%, or 0.0001 GBq.

Table 13. Radionuclide Content of Waste[34] in Storage Pending Disposal[35] (MBq)

Radionuclide	Half-Life[36]	Academic	Government	Industrial	Medical	Nuclear Power Plants	Total
Am-241	432.7 y		0.185	61.816		0.644	6.3 E1
Ba-133	10.5 y	0.011					1.1 E-2
C-14	5.7 E3 y	1,611.425	0.343		49.147		1.7 E3
Ce-144	284.6 d					0.001	1.0 E-3
Cl-36	3.0 E5 y	0.300					3.0 E-1
Cm-243	29.1 y					3.050	3.1 E0
Co-56	77.3 d				0.429		4.3 E-1
Co-57	271.8 d		0.001		1.592		1.6 E0
Co-58	70.9 d				1.268		1.3 E0
Co-60	5.3 y	0.004			0.163	143,930.000	1.4 E5
Cr-51	27.7 d				40.000		4.0 E1
Cs-134	2.1 y					267.510	2.7 E2
Cs-137	30.1 y	148,004.000	0.751			61,050.000	2.1 E5
Eu-154	8.6 y				0.024		2.4 E-2
Eu-155	4.8 y				0.004		4.0 E-2
Fe-55	2.7 y					115,810.000	1.1 E5
H-3	12.3 y	3,382.803	45.260	36,260.370	2,816.560	521.700	4.3 E4
I-125	59.4 d				35.261		3.5 E1
I-129	1.6 E7 y		3.480				3.5 E0
Kr-85	10.8 y	487.730					4.9 E2
Lu-177	6.6 d				0.407		4.1 E-1
Mn-54	312.1 d	3.700			0.726	1.761	6.2 E0
Na-22	2.6 y	20.400			0.166		2.1 E1
Ni-63	101 y	2,019.240		331,052.606		84,730.000	4.2 E5
Np-237	2.1 E6 y	6.290					6.3 E0
Po-210	138.4 d y			21.989			2.2 E1
Pu-238	87.7 y					4.144	4.1 E0
Pu-239	2.4 E4 y					1.528	1.5 E0

Table 13 continued

Radionuclide	Half-Life[36]	Academic	Government	Industrial	Medical	Nuclear Power Plants	Total
Ra-226	1.6 E3 y		0.370				3.7 E-1
Ra-228	5.8 y		0.037				3.7 E-2
S-35	87.2 d	6.341			262.093		2.7 E2
Sr-90	28.8 y	0.019	0.803			6,179.000	6.2 E3
Tc-99m	6.0 h		0.005				5.0 E-3
Th-230	7.5 E4 y			0.056			5.6 E-2
Th-232	1.4 E10 y	0.119	0.800	0.056			9.7 E-1
U-238	4.5 E9 y	6.260	0.185	0.056			6.5 E0
Zn-65	243.8 d				0.672	0.030	7.0 E-1
Others[37]	---	---	---	---	---	---	---
	Total	**155,548.642**	**52.220**	**367,396.949**	**3,208.512**	**412,499.368**	**9.4 E5**

[34] Some generator facilities have reported radionuclides with half-lives of less than 90 days in LLRW stored. In the majority of these cases, the shorter-lived radionuclides reported cannot be separated readily from longer-lived radionuclides in the waste. The sum of individual radionuclide radioactivities will frequently not match the overall radioactivity totals reported for waste stored due to rounding and other approximation techniques. Every effort is made to identify and resolve significant discrepancies with the affected generators.

[35] To obtain radioactivity in curies, divide the number of megabecquerels (MBq) by 37,000.

[36] Source: Chart of the Nuclides, General Electric Company under the direction of Naval Reactors, U.S. DOE; 16th edition, revised to 2002. NB: y=years, m=months, d=days, h=hours.

[37] In certain cases, LLRW generators are permitted by manifest to report a single activity for a group of radionuclides without assigning a value to each; those data are reported here.

Table 14. Waste Reported in Storage for Decay[38] by Generator Type

Generator Type	Number of Generators Reporting	Number of Generators Reporting Storage for Decay[39]	Number of Generators Reporting Only Storage for Decay	Estimated Maximum Volume in Storage for Decay at Any Time[40] (m^3)
Medical	165	156	135	1,045
Industrial	10	1	0	1
Academic	28	16	2	187
Government	6	1	0	3
Nuclear Power Plant	6	0	0	0
Total	**215**	**174**	**137**	**1,236 (43,643 ft^3)**

[38] Storage for decay means holding the LLRW until the level of radioactivity has diminished to the point where it can be disposed of as non-radioactive waste. Normally, such LLRW is held for 10 half-lives, or until the radioactivity is at a level that is undetectable above background radiation.Typical radionuclides held for decay, with their respective half-lives, include Iodine-123 (13.1 hours), Iodine-125 (59.4 days), Iodine-131 (8.0 days), Technetium-99m (6.0 hours), Phosphorous-32 (14.3 days), Gallium-67 (3.3 days), and Sulfur-35 (87.2 days).

[39] Some generators that store for decay also may have transferred other LLRW to one of the licensed LLRW disposal facilities or may be storing LLRW pending disposal.

[40] To obtain volume in cubic feet (ft^3), multiply the number of cubic meters (m^3) by 35.31.

4 Historic Data and Projections for Low-Level Radioactive Waste Generation in New York State

This section provides historic data on the volume and radioactivity of LLRW shipped for disposal, based on generator data reported to NYSERDA for years 2011 through 2020.

This section also provides a summary, based on information supplied in the 2020 generator reports, of generator projections of the volume and radioactivity of LLRW that require disposal in a licensed LLRW facility for the years 2021 through 2025.

Volume projections are rounded to the nearest tenth of a cubic meter, and radioactivity projections to the nearest gigabecquerels (GBq).

Table 15. Historic Overview of Waste Disposal by Volume[41, 42] (in m^3)

Generator Type	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Nonpower Plant	98	60	46	40	380	79	15	20	51	22
Nuclear Power Plant	1,239	713	1,420	818	1,464	2,487	1,065	1,353	868	870
Total	**1,337**	**773**	**1,466**	**858**	**1,844**	**2,566**	**1,080**	**1,373**	**919**	**892**

Table 16. Historic overview of Waste Disposal by Radioactivity[41, 42] (in GBq)

Generator Type	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Nonpower Plant	1,064	196	33	524	41	126	34	974	315	200
Nuclear Power Plant	13,205	178,962	128,112	15,533	1,066,628	20,432	75,602	210,454	81,602	8,846
Total	**14,269**	**179,158**	**128,145**	**16,057**	**1,066,669**	**20,558**	**75,636**	**211,428**	**81,917**	**9,046**

[41] Data are based on reports that must be filed annually with NYSERDA.

[42] To obtain volume in cubic feet, multiply the number of cubic meters by 35.31. To obtain radioactivity in curies, divide the number of gigabecquerels (GBq) by 37.

Figure 1: Historic Overview of Waste Disposal, by Volume[43]

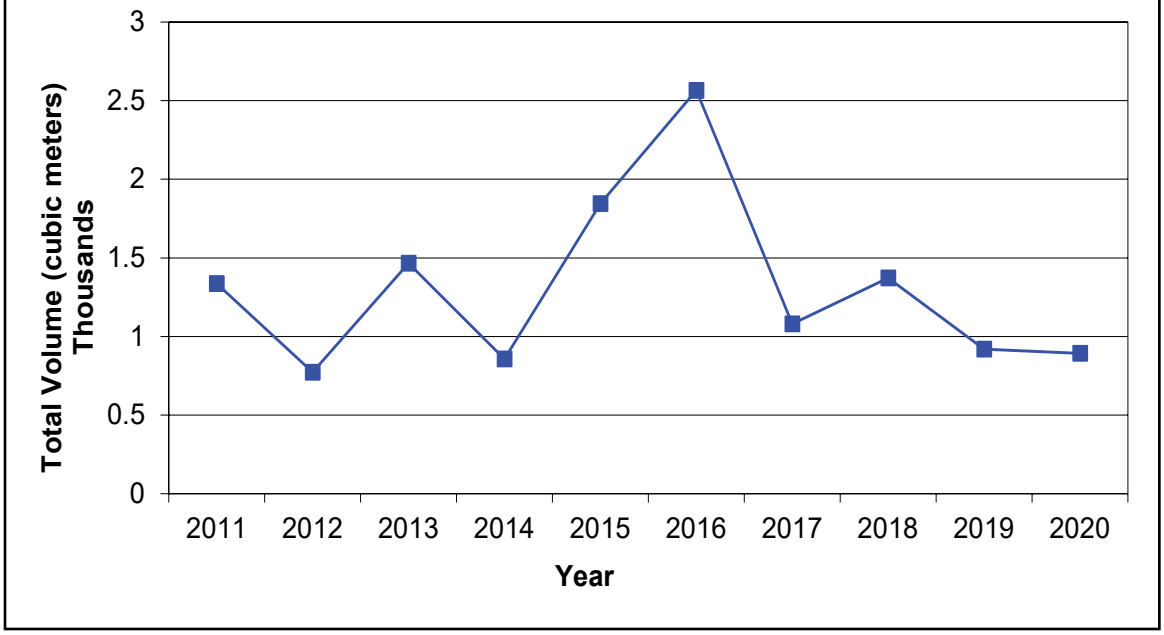
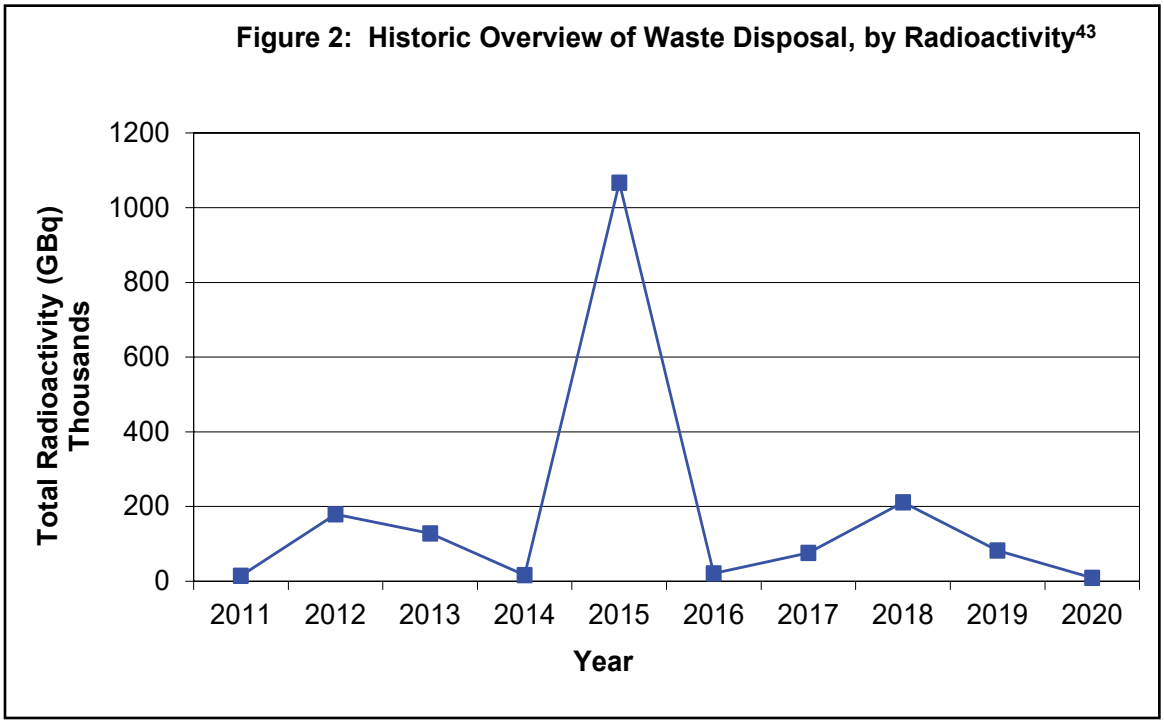


Figure 2: Historic Overview of Waste Disposal, by Radioactivity[43]



[43] In general, the radioactive content of the LLRW disposed continues to be a function of refueling and maintenance activities at New York State's six nuclear power plants, and shows little or no correlation to overall volume. The increase in disposal in 2015 and 2016 can be attributed to three separate disposal actions: decommissioning of a university research reactor, disposal of both irradiated hardware and a large volume of resin from one of the nuclear power plants.

Table 17. Generators' Five-Year Projections of Waste by Volume (m^3)[44, 45]

Generator Type	2021	2022	2023	2024	2025
Medical	61.1	61.5	61.5	60.5	60.5
Industrial	17.9	17.6	16.9	16.7	16.7
Academic	32.7	32.1	22.2	22.1	22.2
Government	0.9	0.5	0.5	0.5	0.5
Total Nonpower Plant	**112.6**	**111.7**	**101.1**	**99.8**	**99.9**
Nuclear Power Plant	**1,307.0**	**1,307.0**	**1,307.0**	**1,307.0**	**1,307.0**
Total	**1,419.6**	**1,418.7**	**1,408.1**	**1,406.8**	**1,406.9**

Table 18. Generators' Five-Year Projections of Waste[44, 45] by Radioactivity (GBq)

Generator Type	2021	2022	2023	2024	2025
Medical	64.1	54.2	56.9	59.7	60.3
Industrial	1,045.8	1,045.1	1,045.0	1,045.0	1,045.0
Academic	17.5	5.4	12.9	2.9	12.8
Government	0.2	0.2	0.2	0.2	0.2
Total Nonpower Plant	**1,127.6**	**1,104.9**	**1,115.0**	**1,107.8**	**1,118.3**
Nuclear Power Plant	**65,790.0**	**65,790.0**	**65,565.0**	**65,565.0**	**65,790.0**
Total	**66,917.6**	**66,894.9**	**66,680.0**	**66,672.8**	**66,908.3**

[44] Refers to all classes of LLRW projected by generators to require disposal in a licensed LLRW facility.

[45] To obtain volume in cubic feet (ft^3), multiply the number of cubic meters (m^3) by 35.31. To obtain radioactivity in curies, divide the number of gigabecquerels (GBq) by 37.

Appendix A: Conversions for Units

The metric system is the standard set of measurement units used in science and technology today. Metric or SI system (Systeme International d'Unites) units have been incorporated into the U.S. Nuclear Regulatory Commission's Uniform Waste Manifest.

Volume is presented in cubic meters and radioactivity is presented in gigabecquerels (GBq) and megabecquerels (MBq). These units have been adopted for this report to be consistent with the uniform national LLRW manifest requirements. Some conversions for SI units to the previously used units of cubic feet and curies are provided in the following tables.

Conversions for Units				
Measurement	**SI Unit**	**Previously Used Unit**	**Value of Conventional Unit in SI Units**	**Conversional Factors**
Radioactivity	**Gigabecquerel (GBq) Megabecquerel (MBq)**	**Curie (Ci) milliCurie (mCi)**	**1 Ci = 37 GBq 1 Ci = 37,000 MBq**	**Ci × 37 = GBq Ci × 37,000 = MBq GBq / 37 = Ci MBq / 37,000 = Ci**
Volume	**cubic meters (m^3)**	**cubic feet (ft^3)**	**1 ft^3 = 0.028 m^3**	**ft^3 × 0.028 = m^3 m^3 × 35.31 = ft^3**

Radioactivity Conversions		
mCi	**MBq**	**GBq**
500	**18,500**	**18.500**
200	**7,400**	**7.400**
100	**3,700**	**3.700**
50	**1,850**	**1.850**
20	**740**	**0.740**
10	**370**	**0.370**
5	**185**	**0.185**
2	**74**	**0.074**
1	**37**	**0.037**

Volume Conversions	
ft^3	**m^3**
11.9 (89 gallon drum)	**0.33**
11.1 (83 gallon drum)	**0.31**
7.5 (55 gallon drum)	**0.21**
4.01 (30 gallon drum)	**0.11**
0.67 (5 gallon pail)	**0.019**

NYSERDA, a public benefit corporation, offers objective information and analysis, innovative programs, Technical expertise, and support to help New Yorkers increase energy efficiency, save money, use renewable energy, and reduce reliance on fossil fuels. NYSERDA professionals work to protect the environment and create clean-energy jobs. NYSERDA has been developing partnerships to advance innovative energy solutions in New York State since 1975.

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EEA-LLRW-2021-r-1-v1 7/21