Ohio Department of Health

Bureau of Radiation Protection

Annual Low-level Radioactive Waste

Management Report for 2012

The report is designed to keep Ohioans informed of low-level radioactive waste in the State of Ohio. The final report is designed and intended for distribution to interested members of the public. Copies of this report may be obtained from the ODH web site at http://www.odh.ohio.gov or by contacting Ohio Department of Health, Bureau of Radiation Protection at 614-644-2727.

Ohio Department of Health

Bureau of Radiation Protection

Annual Low-level Radioactive Waste Management Report

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Introduction

The Ohio Department of Health (ODH) Bureau of Radiation Protection (BRP) collects low-level waste generation information from both Ohio and the U.S. Nuclear Regulatory Commission (NRC) licensees in accordance with rule 3701:1-54-02 of the Ohio Administrative Code (OAC). The purpose of this rule is to provide ODH with information relating to the amount of low-level radioactive waste (LLRW) generated, treated, stored and/or disposed of by generators within the state. Fees are collected from the LLRW generators to help fund this activity.

This report presents a summary of information on the generation and management of LLRW in Ohio during 2012. The annual reports submitted by waste generators are compiled in this report and provide information on the management, storage, transport, and disposal of radioactive wastes.

In prior years, radioactive waste generators often used the Barnwell, S.C., or EnergySolutions (formerly Envirocare) of Utah disposal facilities for land disposal of radioactive waste. After July 2008, the Barnwell facility has closed out the disposal volume available for out-of-compact radioactive waste generators, which includes Ohio generators. As indicated by the data, land disposal volumes have shifted to the EnergySolutions facility for the Class A LLRW it accepts. In 2012, additional disposal capacity for class A, B, and C waste also became available in Texas.

The Ohio Department of Health, Bureau of Radiation Protection

ODH is authorized by Ohio Revised Code (ORC) 3748 to be the radiation control agency for the state. The BRP performs the radiation control functions in behalf of the director of ODH.

Ohio became an agreement state with the NRC for the regulation of byproduct, source and special nuclear materials effective Aug. 31, 1999. Being an agreement state means the NRC has relinquished control and regulation of certain byproduct, source and special nuclear materials within Ohio to ODH.

The director of ODH, through the BRP, collects and analyzes information on LLRW generators within Ohio. These activities are performed in response to the responsibilities given to the states in the Low Level Radioactive Waste Policy Act (LLRWPA) (1980) as amended in 1985 and codified in Title 42 Section 2021 of the United States Code (USC). This law also enabled states to enter into waste compacts for the purpose of establishing a LLRW disposal site for the collective states in the compact. Ohio is a member of the Midwest Compact and ceded its responsibility for a host repository in 1997. The Midwest Compact is no longer involved in siting its own repository.

The reporting requirements under OAC 3701:1-54-02 rules were revised in 2007. Under the current reporting rules, **LLRW reporting exemptions have expanded** to include all LLRW generated and disposed of in accordance with paragraphs (D) to (G) of OAC 3701:1-38-19 (Waste Disposal). Those wastes include:

1.) Licensed materials discharged into sanitary sewerage,

2.) Licensed material held for decay-in-storage (DIS),

3.) Licensed material disposed by incineration (at approved concentration limits), and

4.) Direct disposal of LLRW containing Carbon-14 and Hydrogen-3 (Tritium), at approved concentration limits.

As a consequence of these expanded reporting exemptions, LLRW generator volumes and activities reported are less than previous years.

Low- level Radioactive Waste

LLRW is defined in rule 3701:1-38-01(A) (94) of the OAC. For the purpose of this report, the definition of LLRW does not include NARM (Naturally Occurring or Accelerator Produced), transuranic waste, high-level radioactive waste, DOE generated or uranium mining and milling waste. LLRW is waste containing radioactive material that meets the definition contained in OAC rule 3701:1-38-01(A) (94). OAC rule 3701:1-38-01(A) (94) defines LLRW as follows:

"Low-level radioactive waste" or "LLRW," also "low-level waste," or "LLW" means radioactive waste which is not high-level radioactive waste, spent nuclear fuel, NARM, or byproduct material as defined in section 11 E. (2) of the Atomic Energy Act of 1954, as amended, but is radioactive material that the United States nuclear regulatory commission classifies as low-level radioactive waste.

LLRW includes a variety of materials that have a wide range of levels of radioactivity. This includes items contaminated with radioactive material, for example protective clothing, paper towels and laboratory equipment. Also included are some highly radioactive items, such as sealed sources, materials used to purify coolant in nuclear power plants and from equipment associated with nuclear reactors. LLRW is generated in the operation and maintenance of nuclear power plants as well as hospitals, universities, private research firms, industrial facilities and the military.

The classification system for LLRW, defined in OAC rule 3701:1-54-10 which is similar to Title 10 Code of Federal Regulations (CFR) 61.55, is designed to take into account the potential hazards of LLRW. The system is based on the concentration of the particular radionuclides in the waste and their half-life and is part of an overall regulatory system designed to control the potential human exposure to disposed radioactive waste. The classes of radioactive waste are:

Class A waste, generally consisting of short-lived radionuclides, less than 30 years, but also including low concentrations of some long-lived radionuclides. Disposed Class A waste must be isolated for 100 years.

Class B waste, including waste with higher concentrations of short-lived radionuclides than Class A waste and concentrations of long-lived radionuclides similar to Class A waste. Class B waste must be in structurally stable physical form for disposal or in a structurally stable container that will last for 300 years.

Class C waste, including waste with the highest concentrations of short-lived and long-lived radionuclides that states are responsible for managing. Disposal units for Class C LLRW must have barriers capable of preventing people in future years from accidentally encountering the waste for at least 500 years.

As previously noted, federal law makes each state responsible for providing disposal capacity for LLRW generated in the state. These federal laws however, do not make the states responsible for all LLRW generated within their borders. The federal government, specifically the Department of Energy (DOE), is responsible for LLRW from the following sources and types:

LLRW owned or generated by the DOE.

LLRW owned or generated by the U.S. Navy as the result of decommissioning Navy vessels.

LLRW owned or generated by the federal government as the result of any research, development, testing or production of nuclear weapons.

The primary source of “greater than Class C waste” is from the decommissioning of nuclear power plants and high-activity sealed sources. This class waste is generally not suited for shallow-land burial.

Additional forms of radioactive waste that require regulatory management and oversight are: "Mixed Waste," which satisfies the definition of both LLRW waste and hazardous waste in federal law.

While not considered by definition as LLRW, NARM and technologically enhanced naturally occurring radioactive materials (TENORM) require disposal in a controlled manner due to the radiation hazards that exist with this waste. Ohio rules on TENORM are found in OAC 3701:1-43.

The federal LLRWPA, ORC 3748 and Ohio rules do not address the collection of information on the activity and volume of NARM waste produced, although it is regulated to the same degree as LLRW. NARM waste is typically generated from medical, consumer and industrial sources. TENORM waste is typically generated as a byproduct from industrial processes and nonindustrial consumers, such as pipe scale and water treatment sludges.

LLRW Generation and Management

Inventory of generators

An LLRW generator report form is sent annually to select Ohio licensees and NRC licensees within Ohio. The inventory of generators is based on analysis of the 2012 annual generator reports that were completed and returned to the BRP. The BRP received 238 responses from generators, of which 37 reported billable waste. Only those licensees that generated, continued to store or disposed of LLRW in 2012 were required to submit a report. The remainder were either exempt or did not generate any LLRW.

ODH has provided seven separate classifications for generators instead of the standard five mentioned in national waste report statistics. The additional classifications are Uranium Enrichment and Academic/Medical. Uranium Enrichment was added because United States Enrichment Corporation (USEC) and its subsidiary American Centrifuge Operating, LLC. is currently regulated by the NRC as a private enterprise and has a unique waste stream. The U.S. DOE (Department of Energy) in 2012 has taken possession of all radioactive material at the USEC site thus rendering it exempt from future LLRW reporting. The blend of Academic/Medical was added because the facilities under this category are both medical institutions and universities, and as such, produce the activity typical of medical institutions and the volume typical of academic/research institutions.

The waste generator descriptions are:

Utilities – Public or private utilities that provide basic services within the state borders. The volume and activity in this category is almost exclusively from nuclear power plants. Other utilities use licensed radioactive material in the form of sealed sources for process measurements, typically for level and fill measurements in coal-fired utilities.

Medical Facilities – Hospitals, physicians and clinics licensed to use radioactive materials as part of their service.

Academic and Research Facilities – Licensed colleges, universities and research facilities within the state borders, including research reactors that use radioactive materials in the course of teaching or research.

Academic/Medical – A joint medical facility within an academic and research institution where the combined facility generates waste with activities and volumes characteristic of each.

Government – NRC-licensed and state-licensed government agencies within Ohio.

Industrial – NRC-licensed and Ohio-licensed sources within the State of Ohio. These licenses may include sealed sources and radioactive devices as well as commercial nuclear pharmacies or other service providers licensed by the NRC or Ohio to conduct radioactive material distribution activities that generate LLRW.

Uranium Enrichment – NRC-regulated activities for the processing of uranium and uranium ores for use as nuclear reactor fuel. This facility in Ohio is USEC through its subsidiary American Centrifuge Operating, LLC.

The assignment of generator classification is based on the generator's self-identification. Commercial entities submitted under other classifications were entered under the "industrial" classification.

Volume and Activity of LLRW generated in 2012

The LLRW generator report form sent to licensees (copy in appendix) requested information regarding the volume and activity of the LLRW generated. Additional information regarding the amount of LLRW stored at the end of the calendar year, the amount of LLRW shipped for disposal and the treatment of LLRW during the calendar year were also requested.

The results of the responses were entered into a computer database. The computer program handled MBq (Megabequerel) and Ci (Curie) activity conversions. Due to the wide range of data values for activity and volume, the data were manipulated in scientific notation with three significant digits. The implicit error introduced by using data in this format ranges from 0.1 percent to 1 percent error.

For general readability of the report, the volume terms were reported in cubic feet number formats and radionuclide activities are converted back to Curie units. Therefore, some rounding errors may be found.

In accordance with OAC rule 3701:1-54-02 (D), certain generators of LLRW were exempted from having to submit a LLRW generator report. A reporting exemption was granted to users of DIS byproduct radioactive material, provided the only byproduct materials used had a half-life of one hundred twenty days or less. This exemption provides regulatory relief from filing by small clinics and physicians using short half-life radioactive materials for medical diagnosis and imaging even though they did generate LLRW. Other licensees who generate LLRW may also benefit from the additional reporting exemptions referred to previously on page six of this report if they qualify.

Generators of NARM waste are not designated as LLRW generators because NARM is not included in the definition of LLRW. Examples of these radionuclides include, but are not limited to, Germanium/Gallium-68, Cobalt-57 and 58, Thallium-201, Sodium-22, Iodine-123, Radium-226 and Indium-111. Often the distinction must be traced to a manufacturer, as numerous radionuclides may also be produced in a reactor.

The volume and activity of the waste generated by waste class is listed in Table 2 "Waste Generated by Waste Class." Class A waste constitutes most of the volume of waste generated. Class C waste constitutes a majority of the activity, and for reporting year 2012 more than 90 percent of activity and volume reported originates from the nuclear utilities.

Table 1 – Waste Generator Classification

Waste Generator Classification	Activity in MBq (Ci)	% of total activity	Volume generated In ft^3	% of total volume generated
Academic	115,419.7 (3.1194)	0.54	235.22	0.73
Academic/medical	4,930.06 (0.13324)	0.02	12.9	0.04
Government office	86.32 (0.00233)	<0.01	1,169.5	3.5
Industrial	17,547.12 (0.474)	0.09	850.68	2.54
Medical	181.88 (0.00491)	<0.01	24.81	0.07
Uranium enrichment	-		-	
Utility	21,260,204.48 (574.6)	99.35	31,148.27	93.12
TOTAL	21,398,369.57 (578.334)	100	33,441.38	100

Table 2 – Waste Generated by Waste Class

	Activity in MBq (Ci)	% of Activity	Volume in ft3	% of Volume
A	545,169.57 (14.734)	2.55	33,270.93	99.49
B	6,312,200 (170.6)	29.5	0.45	<0.01
C	14,541,000 (393)	67.95	170	0.51
Total	21,398,369.57 (578.334)	100	33,441.38	100

Trends of Generated LLRW

In 1998, an LLRW generator's report to report 1997 waste generation was not sent to generators. Factors included: The Midwest Compact Commission discontinuance of LLRW disposal siting in Ohio for which Ohio was to become host state and the reassignment of LLRW staff.

Changes in the volume generated or shipped do not translate into a proportional change in the volume disposed in a licensed land disposal facility. One reason is some generators are using commercial service providers to segregate and decontaminate radioactive waste prior to disposal, therefore reducing the volume disposed. Several kinds of waste, especially in the medical arena, are held for DIS on site prior to disposal, which is a common form of waste treatment to dispose of or eliminate the radioactive component of the waste.

Table 3 – Activity Trend (in Ci) of Waste Generated

Class/ year	Academ	Acad / Med	Govern Office	Indust	Medic	Uranium Enrich	Utility	Total
1995	2.2	-	0.39	15.3	25.6	-	551	595
1996	2.97	-	-	3.24	22.4	-	1,540	1,569
1998	1.81	7.0	0.36	31.9	976	0.59	132	1,150
1999	1.62	7.38	0.07	61.4	1,103	0.47	368	1,153
2000	1.77	1.76	0.15	3,644	1,650	0.45	442	5,740
2001	1.18	2.39	0.12	1,122	972	0.19	791	2,888
2002	1.14	2.08	0.03	1,611	667	0.16	976	3,258
2003	30.6	1.39	-	2,840	1,831	1.16	396	5,100
2004	11.9	5.6	0.01	1,943	13,060	1.96	1,933	16,956
2005	12.9	3.3	0.01	18,733	2,425	1.5	94.8	21,272
2006	16.9	3.6	0.73	5,068	1,467	0.3	2,692	9,249.9
2007	300	0.1	300	48.6	0.62	3.15	39,860.15	40,215.72
2008	81.25	0.2	0.0002	164.95	0.013	0.66	5,718.57	5,965.66
2009	1.85	0.07	0.0002	75.73	0.004	0.99	125.05	203.7
2010	2.24	0.12	0.0002	7.33	2.41	0.669	742.957	755.74
2011	2.20	0.0985	0.00001	8.153	0.0126	3.3508	128.711	142.526
2012	3.11	0.13324	0.00233	0.474	0.0049	-	574.6	578.334

Table 4 - Volume Trend (in ft^3) of Waste Generated

Class Year	Academic	Acad/ Medical	Govern Office	Indust	Medical	Uranium Enrich	Utility	Total
1995	2,682	-	59	11,055	26,082	-	11,244	51,122
1996	1,371	-	10	2,792	22,351	-	14,641	41,165
1998	3,340	4,200	76	7,640	25,300	62,400	17,000	120,000
1999	859	3,897	91	35,308	80,921	41,521	30,140	192,736
2000	1,893	3,189	24	510,664	8,853	42,388	29,259	596,271
2001	1,732	1,885	134	21,311	8,638	18,013	73,255	124,969
2002	2,153	1,216	31	7,310	8,524	15,400	66,581	101,216
2003	2,017	1,319	5	23,291	21,393	6,001	86,793	140,820
2004	2,096	1,413	247	87,035	22,116	21,099	19,599	121,544
2005	2,093	1,558	29	23,937	7,791	19,074	51,582	106,065
2006	2,705	1,159	8	23,344	8,881	20,338	82,165	138,601
2007	288.6	549.2	164.3	6,321	301.6	9,442	81,958	99,024
2008	766	552	97	6,463	11.9	18,095	50,612	76,608
2009	1,029	42.7	20.5	6,734	27.7	36,062	6,891.6	50,808
2010	1,029	551	4.6	3,251	169	81,577	64,200	150,784
2011	200.14	43.3	8.0	676.2	17.9	117.81	30,407.1	31,470.45
2012	235.22	12.9	1,169.5	850.68	24.81	-	31,148.3	33,441.38

Treatment of LLRW

LLRW may be treated to reduce the waste volume, radionuclide activity or make the waste safer. As defined in rule 3701:1-54-01 of the OAC, "Treatment means any method, technique, or process, including storage for radioactive decay, that changes the physical, chemical, or biological characteristics or composition of any radioactive waste in order to render the waste safer for transport or management, amenable to recovery, convertible to another usable material, or reduced in volume."

DIS (Decay-in -Storage) is the most commonly used method for treating LLRW. To use DIS, the radioactive waste is held in a segregated container from other waste and stored for 10 half-lives or until the radioactivity from the waste is no longer distinguishable from background, whichever is longer. After the radioactive material has decayed, the remaining waste can be disposed of appropriately as biohazardous, sharps, pathological, chemical or normal trash.

LLRW is frequently processed off site to reduce the volume prior to disposal and/or achieve a more stable waste form for disposal. Waste volume reduction can be accomplished in a number of ways including:

- Decontamination.
- Compaction.
- Supercompaction.
- Incineration.
- Commercial DIS.
- Thermal reduction.

Commercial LLRW processors used by Ohio generators are located outside of Ohio. The vast majority of processors disposed of the processed waste at a licensed facility on behalf of the generator in lieu of returning the processed waste.

For nuclear power plants, there has been a shift from treating the waste on site, to having a commercial firm segregate the waste, then treat the remaining waste by incineration or other means. The processor, not the generator, is primarily responsible for the final volume reduction.

Use of Decay – in – Storage (DIS)

Medical and academic facilities are avid users of DIS because it is simple to implement and does not have any direct costs. Indirect costs include the use of secured space and personnel time for logging, tracking and surveying waste.

Unless identified otherwise, the volume and activities listed are for the waste generated, not the volume and activity for the LLRW after treatment.

The "final volume" is the generator-identified volume after treatment, either by the generator or a commercial processor. The radioactive waste generation fee can be reduced by declaring the reduced volume after treatment. The final volume and activity after treatment is in Table 9. This statistic is the volume and activity disposed at the EnergySolutions LLRW land disposal facility.

The waste type "Dry Solid" may combine several subcategories of solid waste into a single category. Examples of subcategories combined in the Dry Solid waste type include incinerator ash, sludges, filter media, contaminated equipment, stock vials and other solid waste containing trace quantities of free-standing liquids. Resins/beads are separated out from the "Dry Solid" waste stream as they constitute the majority proportion of the activity. Most of this waste stream results from the filtration of water in the nuclear power industry.

Table 5 – Waste Activity and Volume Generated by Waste Type

Waste Type	Activity MBq (Ci)	% of activity	Volume in ft^3	% of volume
Animal Carcass	51.8 (0.0014)	<0.01	0.25	<0.01
Aqueous Liquid	191,796.11 (5.183)	0.9	81.5	0.24
Biohazard/ Pathological	759.4 (0.0205)	<0.01	7.61	0.02
Dry Solid	300,002.35 (8.108)	1.4	31,660	94.67
Gas	7.03 (0.00019)	<0.01	-	-
Liquid Mixed Waste	430.16 (0.01162)	<0.01	67.4	0.2
Resin/Beads (ion exchange)	20,903,046.34 (564.947)	97.69	421.25	1.26
Scintillation Vials	406.27 (0.01098)	<0.01	39	0.12
Scintillation Fluid-bulk	692.64 (0.0187)	<0.01	-	-
Sealed Sources	1,091.36 (0.02949)	0.01	3.2	0.01
HV-LLRW High Vol. LLRW	83.59 (0.002259)	<0.01	1,160.5	3.47
Natural Uranium / Thorium	2.52 (0.000068)	<0.01	0.67	<0.01
Total	21,398,369.57 (578.334)	100	33,441.38	100

LLRW Shipments

The generalized flow of radioactive waste from generation to disposal can be simplified into the following sequence of events. (1) The waste is generated and recognized as a radioactive waste. (2) The radioactive waste is treated on site and packaged for shipment as appropriate for the waste stream. (3) The radioactive waste is shipped to a treatment, storage or disposal facility (TSDF). (4) The waste is treated to reduce volume and activity as appropriate by the TSDF. (5) The remaining radioactive waste is sent by the TSDF back to the generator or a licensed facility for burial on behalf of the generator.

For the purposes of the waste generator report, the return of contaminated syringes to a radiopharmacy was not considered either a waste shipment or disposal. Syringes and needles are used to inject patients with short-lived radionuclides. The syringe volumes and activities are incorporated in the nuclear pharmacy waste reports.

A total of 26 facilities reported shipping LLRW waste in 2012.

Table 6 – LLRW Shipments by Waste Class

Waste Class	Activity MBq (Ci)	% of activity	Volume (ft^3)	% of volume
A	524,732.93 (14.181)	7.67	120,624.54	99.86
B	6,312,200 (170.6)	92.33	172	0.14
C	-		-	
TOTAL	6,836,932.93 (184.781)	100	120,796.54	100

As can be seen in the data, Class A and B LLRW was reported being shipped in Ohio in 2012. Many generators are now able to remove higher activity inventories (Class B & C) if generated due to additional disposal capacity for these classes of LLRW in the state of Texas. For CY 2013, The Council of Radiation Control Program Director's (CRCPD), through its Source Collection and Threat Reduction (SCATR) program, is actively collecting obsolete sources in Ohio as part of a larger pilot program. This will be reflected in next year's annual LLRW report and includes class A, B, & C LLRW destined for disposal at either EnergySolutions (Clive, UT) or Waste Control Specialists (WCS) in Andrews, Texas.

The waste shipped was also broken down by the destination of the waste.

Table 7 – LLRW Shipments by Destination

Destination	Activity MBq (Ci)	% of activity	Volume (ft^3)	% of volume
East Chicago, IN	170.63 (0.0046)	<0.01	146.5	0.12
El Dorado, AR	0.14 3.7µCi	<0.01	7.3	<0.01
Clive, Utah	511,524.3 (13.8249)	7.45	119,390.41	98.85
Oak Ridge, TN	8,379.16 (0.226)	0.12	834.34	0.69
Gainesville, FL	377.79 (0.0102)	<0.01	76.64	0.06
Kingston, TN	3,589 (0.097)	0.05	7.35	<0.01
Sauget, IL	691.9 (0.0187)	0.1	162	0.13
Andrews, TX	6,312,200 (170.6)	92.28	172	0.14
TOTAL	6,836,932.93 (184.781)	100	120,796.54	100

Table 8 – Total LLRW Shipments by Year

Calendar Year	Activity in MBq (Ci)	Volume in ft³
1998	5,840,000 (158)	27,518
1999	15,900.000 (430)	92,310
2000	22,021,265 (595)	74,484
2001	30,323,124 (820)	105,899
2002	14,807,530 (400)	69,880
2003	3,005,880.1 (81.24)	62,253
2004	21,868,587.69 (591.04)	36,556
2005	5,233,693.71 (141.45)	59,631
2006	100,141,428 (2,706.5)	135,281
2007	1,674,096,043.22 (45,245.8)	103,525
2008	223,002,127.28 (6,027.08)	89,656.7
2009	8,996,184.89 (243.14)	133,989.6
2010	30,370,158.07 (820.815)	149,445.19
2011	5,124,205.59 (138.492)	175,683.12
2012	6,836,932.93 (184.781)	120,796.54

LLRW Land Disposal

Table 9 is a list of the activity and volume of radioactive waste received from Ohio licensees and disposed at the EnergySolutions facility in Clive, Utah. The 2012 data are values reported by Ohio generators at the respective land disposal facility.

Table 9 – LLRW Land Disposal - EnergySolutions Utah Site Reports

Year	Activity in MBq (Ci)	Volume (ft^3)
1998	24,383 (0.659)	4,240
1999	-	73,905
2000	72,520 (1.96)	62,091
2001	258,260 (6.98)	48,764
2002	202,760 (5.48)	14,329
2003	96,200 (2.6)	5,005
2004	781,762 (21.13)	215,883
2005	1,011,432 (27.34)	108,713
2006	10,815,100 (292.3)	103,638
2007	1,184,407 (32.011)	21,127
2008	21,635,852.83 (584.75)	86,016
2009	8,856,663.03 (239.37)	108,013
2010	21,799,819.19 (589.184)	83,593
2011	1,990,495.08 (53.797)	118,799
2012	511,524.3 (13.8249)	119,390

The volumes and activities of the radioactive waste presented here are what remain after the generated radioactive waste has been treated, segregated and reduced in volume prior to final disposal. There are some lag times between waste generation, to shipment and/or treatment and eventually disposal at a land disposal facility when appropriate.

Due to the closure of the Barnwell, S.C. site to Ohio generators, the activity and volume of LLRW going to EnergySolutions in Utah has increased. Disposal availability has also expanded in CY 2012 with the development of a new disposal site in Andrews, Texas.

LLRW Storage

Currently, few locations in Ohio store LLRW for extended periods. LLRW is stored on site for DIS awaiting treatment options or accumulating for shipment. The current policy and requirements for licensees storing LLRW beyond a five-year period may be found in OAC rule 3701:1-54-03, titled "Assured Isolation Facility." To date, no AIF license has been issued in Ohio. The NRC, by policy and license conditions, does not allow their licensees to store LLRW for extended periods on site, other than DIS, if there were readily available treatment or disposal options.

Medical facilities commonly use DIS or transfer their material back to the pharmaceutical vendor as the preferred method of waste management. The radionuclides in the LLRW held for DIS generally have short half-lives, six hours or less in many cases. These facilities plan to continue to use DIS and thus are able to avoid the reporting and costs associated with other disposal methods.

OAC 3701:1-54-02 (F) provides a fee exemption for LLRW first generated or stored prior to Jan. 1, 1998.

The following tables provide information on waste storage as of Dec. 31, 2011, placed into storage prior to 2012. There are 19 facilities who reported storing LLRW in 2012.

Table 10 – Pre – 2012 LLRW Remaining in Storage by Year Generated

Year Generated	Activity MBq (Ci)	% of total activity	Volume in ft³	% of total volume
2006	0.04 (1µCi)	<0.01	0.1	<0.01
2007	0.04 (1µCi)	<0.01	0.1	<0.01
2008	180.63 (0.00481)	0.62	10.54	0.68
2009	1,013.69 (0.02739)	3.41	774.8	49.69
2010	19,009.74 (0.513776)	64.02	330.54	21.2
2011	9,487.28 0.25646	31.95	443.25	28.43
TOTAL	29,691.42 (0.80247)	100	1,559.33	100

Table 11 breaks down the waste held in storage for more than one year by the waste type. Dry active waste represented the largest percentage activity and volume.

Table 11 – LLRW Remaining in Storage by Waste Type

Waste Type	Activity MBq (Ci)	% of activity	Volume ft³	% of volume
Dry active waste	20,639.38 (0.5578)	69.51	1,504.87	96.52
Liquid-aqueous	7,953.15 (0.2149)	26.79	19.25	1.23
Biohazard/Pathological	97.09 (0.002624)	0.33	14.09	0.9
Scintillation vials	8.48 (0.000229)	0.03	16.31	1.05
Sealed sources/special form	290.22 (0.00784)	0.98	0.01	<0.01
Mixed rad/hazardous	322.01 (0.0087)	1.08	3.5	0.22
Animal Carcass/ Tissue	381.1 (0.0103)	1.28	1.3	0.08
TOTAL	26,691.42 (0.80247)	100	1,559.33	100

Appendix

Low-level Radioactive Waste Generator Report Form

For Calendar Year 2012

Low- Level Radioactive Waste Generator Report for Reporting Year: _____
Ohio Department of Health - Bureau of Radiation Protection
Radioactive Materials License Number: _____

Licensee Information

Licensee Name	
Street Address	
Telephone ( )	Federal Tax ID number

Organization Classification

- ❑ Academic
- ❑ Industrial
- ❑ Medical
- ❑ Utility
- ❑ Government Office
- ❑ Uranium Enrichment
- ❑ Academic and Medical

Complete this report using data representing your facility's LLRW activities from the prior calendar year.
[Example: In 2011, you would enter data for LLRW reporting year 2010]

❑ I/We did not generate, possess, or store any low-level radioactive waste in this reporting year.

Remainder for Generators Only

Person completing LLRW annual report	
Name	Title
Telephone ( )	
Radiation Safety Officer	
Name (printed)	Title
RSO Signature	Date / /
Radioactive Material License Number	

Generator Reporting Exemption

❑ This facility is exempt from low- level radioactive waste generator reporting requirements under Ohio Administrative Code (OAC) rule 3701:1-54-02(D) since this facility exclusively generates and disposes of LLRW in accordance with paragraphs (D) to (G) of OAC rule 3701:1-38-19.

Table 1a - LLRW Generated and Not Placed in Storage
[OAC 3701:1-54-02(A)(2), - 02(E)]

Complete the following table for the types and amount of waste generated in the current reporting year and not placed into storage. Summarize from your records, and subtotal based on waste class and type, the information requested in the table below.

- In the column "Waste Class," enter the waste classification of A, B or C as defined in OAC 3701:1-54-10.
- In the column "Waste Type," enter the waste type as a generic description of the physical characteristics of the waste. Examples of generic descriptions are dry solid, aqueous liquid, scintillation vials, biological (animal carcasses) or high-volume, low-level radioactive waste (HV-LLRW) from decommissioning or decontamination. HV-LLRW is defined in OAC 3701:1-54-02(C).
- Enter the predominant radionuclides contained in each waste class and type in the column labeled "Radionuclide."
- Enter the total radionuclide activity for each waste class and type in the column labeled "Activity." Indicate by check mark the units of activity that are being used.
- In the column labeled "Volume Generated," enter the volume of waste generated in cubic feet before using waste treatment techniques.
- If the waste was treated, enter the volume of waste after treatment in cubic feet in the column labeled "Volume after Treatment." [Complete information on the processor in table "Generator Certification of Processed Waste" as applicable.]
- Treatment is defined in OAC 3701:1-54-01.
- In the column labeled "Type of Disposal," indicate the disposition of the waste as land burial, vitrification, etc.

☐ Does not apply - no data to report for this table.

Waste Class	Waste Type	Radionuclide	Activity ☐ Ci ☐ mCi ☐MBq	Volume Generated (cu ft)	Volume after treatment (cu ft)	Type of Disposal

Table 1b - LLRW Generated and Placed in Storage
[OAC 3701:1-54-02(A)(2), - 02(E)]

Complete the following table for the types and amount of waste generated in the current reporting year and placed into storage. Summarize from your records, and subtotal based on waste class and type, the information requested in the table below.

- In the column "Waste Class," enter the waste classification of A, B or C as defined in OAC 3701:1-54-10.
- In the column "Waste Type," enter the waste type as a generic description of the physical characteristics of the waste. Examples of generic descriptions include dry solid, aqueous liquid, scintillation vials, biological (animal carcasses) or high- volume, low- level radioactive waste (HV-LLRW) from decommissioning or decontamination. HV-LLRW is defined in OAC 3701:1-54-02(C).
- Enter the predominant radionuclides for the waste class and type in the column labeled "Radionuclide."
- Enter the total radionuclide activity for the waste class and type in the column labeled "Activity." Indicate by check mark the units of activity that are being used.
- In the column labeled "Volume Generated," enter the volume in cubic feet of waste generated before treating the waste.
- If the waste was treated, enter the volume of waste (in cubic feet) placed into storage after treatment in the column labeled "Volume After Treatment." [Complete information on the processor in table "Generator Certification of Processed Waste" as applicable.]
- Treatment is defined in OAC 3701:1-54-01.

☐ Does not apply - no data to report for this table.

Waste Class	Waste Type	Radionuclide	Activity ☐ Ci ☐ mCi ☐ MBq	Volume Generated (cu ft)	Volume after treatment (cu ft)

Prior Reporting Year LLRW Remaining in Storage
[OAC 3701:1-54-02(A)(3)]

- Complete the following table for the types and amounts of LLRW that was placed in storage before Jan. 1, of the current reporting year, and continued to be held in storage as of Dec. 31, of the current reporting year. Summarize from your records, subtotal based on the waste class and type by year, the information requested in the table below.
- In the column labeled "Year Generated," enter the year that the waste was placed into storage.
- Enter the waste classification of A, B or C as defined in OAC 3701:1-54-10 in the column labeled "Waste Class."
- Enter the waste type as a description of the physical characteristics of the waste in the column labeled "Waste Type." Examples of the generic descriptions include dry solid, aqueous liquid, scintillation vials, biological (animal carcasses) or high- volume, low-level radioactive waste (HV-LLRW) from decommissioning or decontamination. HV-LLRW is defined in OAC 3701:1-54-02(C).
- In the column "Radionuclide," enter the predominant radionuclides remaining in the waste as of December 31, of the current reporting year.
- Enter the decay corrected activity of the waste remaining in storage as of Dec. 31, of the current reporting year, in the column labeled "Activity." Indicate by check mark the units of activity that are being used.
- In the column "Volume," enter the volume (in cubic feet) of waste held in storage after any treatment techniques were used.

☐ Does not apply - no data to report for this table.

Year Generated	Waste Class	Waste Type	Radionuclide(s)	Activity (12/31) ☐ Ci ☐ mCi ☐MBq	Volume (cu ft)

LLRW Shipment Information
[OAC 3701:1-54-02(A)(4)]

Identify the types and amount of LLRW shipped in the current reporting year, including carrier or broker, shipment dates and modes of transportation. Provide a summary of the information from your individual waste manifest forms. The summaries may be subtotaled by carrier and destination for a shipment period in lieu of specifying individual dates. For example, a period may be a calendar quarter or a year. Make additional copies of this page if needed.

- In the column "Waste Class," enter the waste classification of A, B or C as defined in OAC 3701:1-54-10.
- In the column "Waste Type," enter the waste type as a generic description of the physical characteristics of the waste as entered on your waste manifest (ref. OAC 3701:1-38-19 Appendix A, OAC 3701:1-50-05).
- In the column "Radionuclide," enter the predominant radionuclides contained in each waste class and type.
- Enter the total radionuclide activity in the column labeled "Activity" for each waste class and type. Indicate by check mark the units of activity that are being used.
- In the column labeled "Volume," enter the volume of waste transported by the carrier/broker in cubic feet. (Note: there are 35.3 cu. ft. in a cubic meter.)
- Enter the final destination/disposal site (City, State / Facility name). List only one disposal site per table.
- Make as many copies of this page as needed.

☐ Does not apply - no data to report for this table.

Carrier/Broker	Shipment date(s)/period
Final Destination	Disposal Site
Mode of Transportation (OAC 3701:1-50-05) ☐ public highway ☐ air ☐ vessel ☐ rail	

Waste Class	Waste Type	Radionuclide	Activity ☐ Ci ☐ mCi ☐ MBq	Volume (cu ft)

LLRW General Information

Was any LLRW stored or shipped in the prior reporting year that was not reported in last year's report?

☐ Yes ☐ No [OAC 3701:1-54-02(A)(5)]

If yes, describe the types and amounts.

Describe the methods used to treat, store and dispose of LLRW.
[OAC 3701:1-54-02(A)(6)]

Describe actions taken, or planned to be taken, to reduce the LLRW volume or production
[OAC 3701:1-54-02(A)(7)]

Anticipated Next Reporting Year LLRW Generation
[OAC 3701:1-54-02(A)(8)]

If the anticipated types and amount of waste to be generated or placed in storage during the next reporting year will be approximately the same as the current reporting year check the box below. Otherwise, complete the table below estimating the type and amount of LLRW to be generated or placed in storage during the next reporting year.

❑ Approximately the same as the current reporting year.

Waste Class	Waste Type	Radionuclide	Activity ❑ Ci ❑ mCi ❑MBq	Volume (cu ft)

Low- Level Radioactive Waste Generator Report for Reporting Year: _____
Ohio Department of Health - Bureau of Radiation Protection
Radioactive Materials License Number: _____

Generator Certification of Processed Waste
[OAC 3701:1-54-02(E)]

Was any low-level radioactive waste sent to a processor for the purpose of treating the low-level radioactive waste, and either returning the waste to the generator or disposing of the waste on behalf of the generator?

☐ Yes ☐ No

If yes, complete the following table for low level radioactive waste that was sent out for volume reduction. The date is the date shipped. The volume shipped is the initial volume of the shipment being sent out for volume reduction. Indicate who the processor was and what treatment was used (e.g. compaction, incineration). Indicate for that particular shipment the volume of waste returned or disposed on behalf of the generator. If the waste was returned to the generator, include the date of the return by the processor.

Date	Volume Shipped	Processor	Process Technique	Volume Return or Disposed	Return Date

Supplemental Information to the LLRW Generators Report

Introduction

The attached forms consisting of questions and tables are provided on behalf of the director. Requested information is required for the annual LLRW report submission. Efforts were taken to minimize the required effort on the part of the waste generator while fulfilling the information collection requirements in accordance with Ohio Administrative Code (OAC) rule 3701:1-54-02.

An important distinction for LLRW generators to understand while completing the report is that the current reporting year is data from the last calendar year. For example: In 2011, you would enter 2010 data for LLRW reporting year 2010.

The contents of the annual LLRW report are:

- Licensee Information (with generator information)
- Table 1a - LLRW Generated and Not Placed in Storage
- Table 1b - LLRW Generated and Placed Into Storage
- Prior-Reporting Year LLRW Remaining in Storage
- LLRW Shipment Information
- LLRW General Information
- Anticipated Next Reporting Year LLRW Generation
- Generator Certification of Processed Waste

Each report page has its own instructions on how to complete the table for that page. If the table does not apply to your facility, mark the box indicating that you have no data to report. The following information is intended to clarify potential or common questions that generators may have when completing the reports. Address specific questions with the LLRW Generator Report to the Bureau of Radiation Protection, Decommissioning and Waste Management.

Who needs to file a LLRW generator report?

A LLRW generator report needs to be completed if:

- Any LLRW as defined in OAC 3701:1-38-01(93) was generated, possessed, stored, or shipped during the current reporting year.

Facilities may be exempted from low level radioactive waste generator reporting requirements under OAC 3701:1-54-02 if they exclusively generate and dispose of LLRW in accordance with paragraphs (D) to (G) of OAC 3701:1-38-19. Those wastes include decay in storage (DIS), sewerage, and incinerated wastes which were previously reportable.

Licensee Information

The organization classification is determined by the licensee. Licensees that are both medical and academic facilities can choose whether they want to identify themselves as academic or medical or both, depending on how they interpret their waste streams. All commercial facilities that do not have a general category are listed under "Industrial". Utilities can be any electrical power generator (including coal), and water and sewer treatment facilities.

LLRW Generation and Storage Information

NORM and NARM radioactive wastes **do not** meet the definition of LLRW and are not required to be reported, and should not be reported. Reporting of such wastes may artificially increase the volume of low-level radioactive waste generated. NARM and NORM radioactive materials are defined in OAC 3701:1-38-01. Examples of NORM/NARM material include F-18, Tl-201, Ga-68, Gd-153, and Ra-226.

Tables 1a and 1b request information on the activity and volumes of waste generated in the current reporting year and their final volume after treatment. The two tables segregate the listing of waste based on the disposition (storage vs. disposal) of the waste. Any waste listed in Table 1a should not be listed in Table 1b, or vice versa.

Table 1a is for LLRW generated and disposed in the current reporting year.

Table 1b is for LLRW generated and placed for storage awaiting disposal. LLRW held in storage more than forty-two months are subject to fees in accordance with OAC 3701:1-54-02 (B)(2). Licensees that continue to hold LLRW beyond five years may be subject to additional conditions as found in OAC 3701:1-54-03, the Assured Isolation Facility rule.

The table "Prior Reporting Year LLRW Remaining in Storage" requests information on the volume and activity of LLRW remaining in storage as of December 31, of the current reporting year, that was generated before January 1, of the current reporting year. The information is to be broken down by its waste class and waste type with the calculated radionuclide activity of the waste as of December 31, of the current reporting year, and subtotaled by the year that the waste was placed into storage.

LLRW class descriptions of Class A, B, and C may be referenced in OAC 3701:1-54-10.

All radioactive waste containing exclusively radionuclides with a half-life of less than five years is class A waste regardless of the activity.

Typical waste types include, but are not limited to; animal carcass; bulk aqueous liquid; bulk scintillation fluid; construction debris; dry/solid or dry active waste (less than 0.5% free standing liquid); liquid mixed waste (radioactive and hazardous); scintillation vials; sealed sources and devices; biological or pathological media; ion exchange resin and media; and contaminated soils.

The activity of the radioactive waste is the activity contained within the waste container when the container is segregated for disposal or it has been closed to preclude further additions of radioactive materials and waste.

Mixed hazardous waste is waste that contains radioactive and hazardous waste. Scintillation fluid and scintillation vials are a special category of mixed radioactive / hazardous that should be entered separately as bulk scintillation fluid or scintillation vials. (Note: mixed wastes must be maintained in accordance with EPA regulations and guidelines. Contact Ohio EPA for the current regulation and policy on handling mixed waste.)

The volume after commercial treatment may be estimated from the treatment of generated waste in prior years if this information is not available from the commercial facility at the time of reporting.

For the purposes of this report, the return of nuclear medicine radioactive materials to the originating pharmacy, or returning a sealed source or device to the manufacturer, is considered a transfer of radioactive material and not a waste generation or a waste shipment.

Questions regarding the accounting of satellite waste accumulation are occasionally raised. The radioactive waste at satellite accumulation sites **must** be accounted for and reported, but **when** it is accounted for and reported depends on the licensees operation. It is the responsibility of the licensee to verify that all the waste is accounted for, whether the waste is included in the current year's report or the following year's report. Therefore, if the satellite accumulation containers are partially filled, then the low-level radioactive waste does not need to be reported in the current year, if it will be reported in the following year when the waste container is closed and/or collected for disposal.

Supplemental Information to the LLRW Generators Report

LLRW Shipment Information

Calculate by carrier/broker and destination/disposal site the subtotals of the waste class and type shipped. Do not list more than one disposal location in a single table. List the final destination of the shipment (city, state) and also list the land disposal facility name.

A licensed land disposal facility available to most Ohio generators is EnergySolutions in Utah. The EnergySolutions Barnwell, S.C. facility closed to Ohio generators in July, 2008.

The LLRW shipments to be reported in this section are those that required completion of a manifest in accordance with OAC 3701:1-38-19 Appendix A when shipped for ultimate disposal.

LLRW General Information

Methods used to treat, or dispose of LLRW may include, but are not limited to, decay-in-storage; compaction; incineration; freeze dry; fuel blending; evaporation; distillation; vitrification; digestion; sewer disposal; decontamination; and solidification/ stabilization.

Methods used to store LLRW may include, but are not limited to, seal in steel drums; hold in waste container; hold in liquid waste container; hold in "structurally stable" high integrity container (HIC) for land disposal; keep frozen in a freezer.

Methods used to reduce the volume of LLRW requiring off-site disposal or production of LLRW may include, but are not limited to, reuse or recycle contaminated item; substitute use of radioactive with non-radioactive material; substitute longer-lived with shorter-lived radionuclides; decontamination; compaction; incineration; decay-in-storage; process changes. NCRP Report 143 "Management Techniques for Laboratories and Other Small Institutional Generators to Minimize Off-Site Disposal of Low-Level Radioactive Waste" may provide additional information of use to generators.

Generator Certification of Processed Waste

This section is for LLRW sent to a processor with the radioactive waste residue either returned to the generator or disposed of on behalf of the generator.

A common form of LLRW processing to be entered on this table includes incineration of LLRW at a commercial facility. For the fuel blending and incineration of scintillation vials, the final volume is normally zero. For the incineration of dry active waste, the final volume is the volume of the ash either returned to the generator or disposed on behalf of the generator.

If you have comments and/or suggestions on how to improve the report form, please contact the Decommissioning and Waste Management Section of the Bureau of Radiation Protection at 614-644-2727.