Ohio Department of Health
Bureau of Radiation Protection

Annual Low-Level Radioactive Waste Management Report For 2002

The Ohio Department of Health (ODH), Bureau of Radiation Protection is releasing this report titled *Annual Low-Level Radioactive Waste Management Report for 2002*. The report is designed to keep the ODH management 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 by contacting the 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 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 generated, treated, stored and/or disposed of by generators within the state.

This report presents a summary of information on the generation and management of low-level radioactive waste (LLRW) in Ohio during 2002. The definition of LLRW does not include naturally occurring or accelerator-produced radioactive material waste. This information is compiled from the annual reports submitted by the low-level radioactive waste generators to ODH.

Ohio's responsibility as Host State for the Midwest Interstate Low-Level Radioactive Waste Compact (Compact) was terminated by the Compact Commission in 1997. The compact is no longer involved in siting its own repository.

Radioactive waste generators use either the Barnwell (South Carolina) or Envirocare of Utah disposal facility for land disposal of radioactive waste. The Barnwell facility is currently decreasing the disposal volume available for out-of-compact radioactive waste generators, including Ohio generators. Therefore, the land disposal waste volumes are being shifted to the Envirocare facility for Class A low-level radioactive waste that they accept.

The Ohio Department of Health, Bureau of Radiation Protection

The Ohio Department of Health (ODH) is authorized by Ohio Revised Code (ORC) 3748 to be the radiation control agency for the state. The Bureau of Radiation Protection (BRP) performs the radiation control functions on behalf of the director of ODH.

Ohio became an agreement state with the U.S. Nuclear Regulatory Commission (NRC) for the regulation of byproduct, source and special nuclear radioactive materials effective Aug. 31, 1999. Being an agreement state means that the NRC has relinquished control and regulation of certain byproduct, source and special nuclear radioactive materials within the State of Ohio to ODH.

The director of ODH, through the BRP, collects and analyzes information on LLRW generators within the State of 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. The reports submitted by waste generators provide information on the management, storage, transportation and disposal of radioactive waste. Fees are collected from the LLRW generators to fund this activity.

After Ohio became a member of the Midwest compact, Ohio rules promulgated in Chapter 3701-77 of the Administrative Code (effective Dec. 23, 1987) required annual reporting of low-level radioactive waste generated in Ohio to the director of ODH. In the process of becoming an agreement state, the rules were inadvertently rescinded in 1997. In February 1999, the rules were reinstated under Chapter 3701:1-54 of the Ohio Administrative Code. The reporting requirements under the old 3701-77-02 and current 3701:1-54-02 rules are the same; the principal rule differences are in the fee structure associated with the waste generated and an added reporting exemption.

Low-Level Radioactive Waste

Low-level radioactive waste (LLRW) is defined in division 3748.01 of the Ohio Revised Code and rule 3701:1-54-01 of the Ohio Administrative Code. For the purposes of this report, the definition of LLRW is equivalent to Title 42 Section 2021(b) of the United States Code. The definition of LLRW does not include naturally occurring or accelerator-produced radioactive materials (NARM); spent fuel assemblies from commercial nuclear reactors; high-level radioactive waste (includes residue from reprocessing spent fuel, certain reactor

components and spent nuclear fuel); or uranium mining and milling waste. Low-level radioactive waste is waste containing radioactive material that meets the definition contained in Chapter 3748 and rule 3701:1-54-01 of the Ohio Administrative Code. Rule 3701:1-54-01 defines low-level radioactive waste as follows:

> 'Low-level radioactive waste' means, with regard to the disposal of low-level radioactive waste, radioactive waste that is not classified as high-level radioactive waste and that is class A, B, or C low-level radioactive waste as defined in 10 C.F.R. 61.55, as that section existed on January 26, 1983. In regard to regulatory control at locations for purposes other than a disposal facility, low-level radioactive waste has the same meaning as in 42 U.S.C.A. 2021 (b). Low-level radioactive waste does not include any such waste that is owned or generated by the United States department of energy; by the United States navy as a result of the decommissioning of its vessels; or as a result of any research, development, testing, or production of any atomic weapon.

LLRW includes a variety of materials that have a wide range of levels of radioactivity. LLRW includes items contaminated with radioactive material, for example, protective clothing, paper towels and laboratory equipment. 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. Low-level radioactive waste 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 rule 3701-39-02.1 Appendix C [specifically section 10 CFR 61.55] of the OAC, 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 low-level radioactive waste are:

- Class A waste, generally consisting of short-lived radionuclides (radionuclides with half-lives of less than 30 years) but also including low concentrations of some long-lived radionuclides. Disposed Class A waste must be isolated for at least 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 a structurally stable physical form for disposal or in a structurally stable container that will last for at least 300 years.

- Class C waste, including waste with the highest concentration of short- and long-lived radionuclides that states are responsible for managing. Disposal units for Class C LLRW must have barriers capable of preventing people in the 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 U.S. 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.

Additional forms of radioactive waste that require regulatory management and oversight are:

- "Mixed waste," which satisfies the definition of both low-level radioactive waste and hazardous waste in federal law,
- NARM and technologically enhanced, naturally occurring radioactive materials (TENORM) waste, while not considered by definition as LLRW, require disposal in a controlled manner due to the radiation hazards that exists with this waste.

The 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 non-industrial consumers, for example, pipe scale and water softener/filtration systems.

LLRW Generation and Management

Inventory of Generators

A LLRW generator report form is sent to all Ohio licensees and NRC licensees within Ohio annually. The inventory of generators is based on analysis of the 2002 annual generator reports that were completed and returned to the department. The department received 549 responses from licensees, of which 129 licensees generated waste and an additional four licensees did not generate LLRW but continued to store or disposed of LLRW in 2002. Only those licensees that generated, continued to store or disposed of LLRW in 2002 were required to submit a report.

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 since United States Enrichment Corporation (USEC) is regulated by the NRC as a private enterprise and has a unique waste stream. The blend of Academic/Medical was added since 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 classification 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 facilities.
- Medical facilities. Hospitals, physicians and clinics that are licensed to use radioactive materials as part of their services.

- 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 the teaching or research.
- Academic/Medical. A joint medical facility within an academic and research institution where each type of facility generates substantial waste, i.e., produce the activity typical of medical institutions and the volume typical of academic/research institutions.
- Government. NRC- and state-licensed governmental agencies within Ohio.
- Industrial. NRC- 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 commercial service providers that are licensed by the NRC and Ohio to conduct radioactive material distribution activities that generate low-level radioactive waste.
- Uranium enrichment. NRC-regulated activities for the processing of uranium and uranium ores for use in nuclear reactor fuel for nuclear power stations.

The assignment of generator classification is based on the generators self-identification. Commercial entities submitted under other classifications were entered under the Industrial classification.

Volume and Activity of LLRW Generated in 2002

For calendar year (CY) 2002, the BRP received 549 unique responses to the LLRW generator report form. Of the respondents, 129 generated LLRW that required reporting, two had terminated their radioactive materials license and the balance were either exempt from reporting or did not generate any radioactive waste.

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

The results of the responses were entered into a computer database. The computer program handled MBq and mCi activity conversions. Due to the wide range of data values for activity and volume, the data was manipulated in scientific notation with three significant digits. The implicit error introduced by using data in this format ranges from 0.1 per cent up to a 1 per cent error, which is significantly smaller than the acceptable error in the activity and volume estimates provided by the waste generators.

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

In accordance with rule 3701:1-54-02 of the Ohio Administrative Code, certain generators of LLRW were exempted from having to submit a LLRW generator report. A reporting exemption was granted to users of byproduct radioactive material provided that the only byproduct materials used had a half-life of less than one day. This exemption provides regulatory relief from filing to small clinics and physicians using short half-lived radioactive materials for medical diagnosis and imaging even though they did generate LLRW.

Generators of NARM waste are not designated as LLRW generators because NARM is not included in the definition of LLRW. These radionuclides include, but are not limited to, Germanium/Galium-68, Cobalt-57, Cobalt-58, Thallium-201, Sodium-22, Indium-111, Iodine-123 and Radium-226. (Note: Indium-111 can be a byproduct material instead if it is produced in a nuclear reactor.)

The decision of declaring radioactive material or contaminated items as radioactive waste is often a subjective call by individual generators. The greatest impact of the variability is noticed in the decay-in-storage (DIS) waste volumes and activities. However, regardless of when the specific material is declared waste, all must be reported in one reporting period or the next.

The volume and activity of the waste generated by each organization classification is listed in Table 1 “Organization Classification.”

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	42,201 (1.14)	0.04	2,153	2.13
Academic/medical	76,889 (2.08)	0.06	1,216	1.20
Government Office	1,172 (0.03)	<0.01	31	0.03
Industrial	59,608,845 (1,611)	49.45	7,310	7.22
Medical	24,694,383 (667)	20.48	8,524	8.42
Uranium Enrichment	6,023 (0.16)	<0.01	15,400	15.21
Utility	36,121,805 (976)	29.96	66,581	65.78
TOTAL	120,151,805 (3,247)	---	101,216	---

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 the majority of the activity and volume of waste generated.

Table 2 - Waste Generated by Waste Class

Class	Activity in MBq (Ci)	% of activity	Volume in ft^3	% of volume
A	88,615,397 (2,395)	73.51	100,455	99.25
B	29,907,840 (808)	24.81	460	0.45
C	2,028,081 (55)	1.68	301	0.30
Total	120,551,318 (3,258)	---	101,216	---

Trends of Generated LLRW

In 1998, a low-level radioactive waste generator report to report 1997 waste generation was not sent to generators. Factors included: the Midwest Compact Commission discontinuance of LLRW disposal facility siting in Ohio for which Ohio was to be the host state, the reassignment of LLRW staff and the replacement of LLRW generator rules as described earlier.

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

Classification/Year	1995	1996	1998	1999	2000	2001	2002
Academic	2.2	2.97	1.81	1.62	1.77	1.18	1.14
Academic/Medical	--	--	7.00	7.38	1.76	2.39	2.08
Government Office	0.39	--	0.36	0.07	0.15	0.12	0.03
Industrial	15.3	3.24	31.9	61.4	3,644	1,122	1,611
Medical	25.6	22.4	976	1,103	1,650	972	667
Uranium Enrichment	--	--	0.59	0.47	0.45	0.19	0.16
Utility	551	1,540	132	368	442	791	976
TOTAL	595	1,569	1,150	1,543	5,740	2,888	3,258

The volume and activity of LLRW produced by nuclear power plants are cyclical due to waste management and operating practices.

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

Classification/Year	1995	1996	1998	1999	2000	2001	2002
Academic	2,682	1,371	3,340	859	1,893	1,732	2,153
Academic/medical	--	--	4,200	3,897	3,189	1,885	1,216
Government Office	59	10	76	91	24	134	31
Industrial	11,055	2,792	7,640	35,308	510,664	21,311	7,310
Medical	26,082	22,351	25,300	80,921	8,853	8,638	8,524
Uranium Enrichment	--	--	62,400	41,521	42,388	18,013	15,400
Utility	11,244	14,641	17,000	30,140	29,259	73,255	66,581
TOTAL	51,122	41,165	120,000	192,736	596,271	124,969	101,216

The medical waste volume in 1999 was unusually high due to a single licensee reporting and confirming a one-time waste volume of approximately 70,000 cubic feet. Excluding the unique waste volume, the waste volume would have been approximately 11,000 cubic feet.

The large volume spike of industrial waste generated in 2000 was the result of a superfund site that included radioactive materials. That particular waste was disposed on site into disposal cells that had been previously approved by the NRC under decommissioning plans transferred to Ohio upon becoming an agreement state. Therefore, the waste does not show up in shipments or disposal at commercial disposal facilities.

The reduction of the remaining medical waste volumes is attributed to more licensees making use of an exemption from reporting. The reporting exemptions and the definition of LLRW will increase the variability of data submitted to ODH.

The volume and activity of LLRW produced by the Uranium Enrichment facility has declined significantly since 2000 because the Ohio facility is on standby mode instead of being in full operation. The waste produced is from maintenance and cleanup efforts at the facility.

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 that 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 decay in storage on site prior to disposal, which is a common form of waste treatment to dispose of or eliminate the radioactive component of the waste.

Treatment of LLRW

LLRW waste 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 characteristic of any low level radioactive waste in order to render the waste safer for transport or management, amenable to recovery, convertible to another usable material, or reducible in volume."

Decay-in-storage (DIS) is the most 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 indistinguishable from background, whichever is longer. After the radioactive materials have decayed, the remaining waste can be disposed of appropriately such as biohazardous, sharps, pathological, chemical or normal trash. The radionuclides held for DIS are short-lived with a half-life that is generally on the order of hours to days. Any radionuclide with a half-life of less than 120 days is usually held for decay in storage.

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 (including shredding and compaction),
- Supercompaction,
- Incineration,
- Commercial decay-in-storage,
- Thermal reduction.

Commercial LLRW processors used by Ohio generators are located outside of Ohio. Processors either returned only a small fraction of the LLRW to the originating facilities or disposed of the processed waste at a licensed disposal facility on behalf of the generator.

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

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 the 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 LLRW generated is broken down into two categories – DIS or non-DIS waste. By splitting the waste streams in this manner, not only can the volume and activity of the waste be differentiated, but also the constituent waste streams for the LLRW can be identified. This differentiation is of particular importance because LLRW held for DIS does not leave the site of the generator as a radioactive waste.

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 after treatment for DIS waste is the volume of waste that remains in storage at the end of the calendar year. Ultimately, the final volume of all DIS waste is zero.

The final volume and activity after treatment is in Table 11. This statistic is the volume and activity of radioactive waste disposed at the two low-level radioactive waste land disposal facilities.

Table 5 - DIS vs. non-DIS vs. USEC Waste Generated

Decay in Storage	Activity in MBq (Ci)	% of activity	Volume generated (ft^3)	% of volume generated	Final Volume (ft^3)	% of final volume
Yes	83,612,388 (2,260)	69.36	15,539	15.35	8,706	21.61
No*	36,932,907 (998)	30.64	70,277	69.43	16,317	40.50
USEC*	6,023 (0.16)	<0.01	15,400	15.21	15,264	37.89
Total	120,551,318 (3,258)	---	101,216	---	40,287	---

* USEC waste was segregated from the non-DIS waste for this table only

The waste type Biohazard/Pathological is now recorded and reported as a single waste type. Past reports did not clarify that the two categories had been combined and was listed in the table as Biohazard.

The waste type Dry Solid may combine several subcategories of solid waste into a single category. Examples of subcategories combined into 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. In this year's report, the resins/beads have been separated out from the "Dry Solid" waste stream; the two subcategories had been reported together in the past. These resins/beads (ion exchange) are used to clean water in the nuclear power plant reactor.

Table 6 - DIS vs. Non-DIS Waste Activity Generated by Waste Type

Waste Type	DIS Activity in MBq (Ci)	% of DIS Activity	Non-DIS Activity in MBq (Ci)	% of non-DIS Activity
Animal Carcass	---	---	32.3 (<0.01)	<0.01
Aqueous Liquid	13,190,277 (356)	15.78	801 (<0.01)	<0.01
Biohazard/ Pathological	7,158,442 (193)	8.56	3.7 (<0.01)	<0.01
Debris (HV-LLRW)	---	---	257 (<0.01)	<0.01
Dry Solid	58,662,994 (1,585)	70.16	2,607,185 (70)	7.06
Gas (Xe-133, Kr-85)	279,653 (7.6)	0.33	---	---
Generator Columns	4,289,780 (116)	5.13	---	---
Liquid Mixed Waste	86.58 (<0.01)	<0.01	58,740 (1.6)	0.16
Resin/beads (ion exchange)	---	---	33,552,710 (907)	90.83
Scintillation Vials	2,198 (0.06)	<0.01	4,332 (0.12)	0.01
Scintillation fluid - bulk	---	---	2.96 (<0.01)	<0.01
Sealed Sources	20,350 (0.55)	0.02	640,211 (17)	1.73
Sewer	8,670 (0.23)	0.01	74,655 (2.0)	0.20
TOTAL	83,612,388 (2,260)	---	36,938,930 (998)	---

Table 7 - DIS vs. Non-DIS Waste Volume Generated by Type

Waste Type	DIS Volume ft^3	% of DIS volume	Non-DIS volume ft^3	% of non-DIS volume
Animal Carcass	---	---	6	0.01
Aqueous Liquid	1,692	10.89	63	0.07
Biohazard/Pathological	932	6.00	6	0.01
Debris (HV-LLRW)	---	---	368	0.43
Dry Solid	12,709	81.79	81,696	95.35
Gas (Xe-133, Kr-85)	20	0.13	---	---
Generator Columns	1	0.01	---	---
Liquid Mixed Waste	0.63	<0.01	57	0.07
Resin/Beads (ion exchange)	---	---	2,915	3.40
Scintillation Vials	105	0.68	544	0.63
Scintillation Fluid - bulk	---	---	0.27	<0.01
Sealed Sources	3.5	0.02	16	0.02
Sewer	75.72	0.49	8	<0.01
TOTAL	15,539	---	85,677	---

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 to a licensed disposal 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.

Twenty-six licensees reported shipping LLRW in 2002.

Table 8 - LLRW Shipments by Waste Class

Waste Class	Activity in MBq (Ci)	% of activity	Volume (ft^3)	% of volume
A	803,326 (22)	5.43	69,267	99.12
B	8,854,840 (239)	59.80	239	0.34
C	5,149,364 (139)	34.78	375	0.54
Total	14,807,530 (400)	---	69,880	---

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

Table 9 - LLRW Waste Shipments by Disposal Destination

Destination	Activity in MBq (Ci)	% of activity	Volume (ft^3)	% of volume
ADCO for DIS	590 (0.02)	<0.01	170	0.24
Barnwell	5,642,263 (152)	38.10	1,157	1.66
DSSI (TN)	59,388 (1.6)	0.40	109	0.16
Envirocare of Utah	9,091,712 (246)	61.40	67,991	97.30
NSSI (TX)	10,732 (0.29)	0.07	49.16	0.07
Permafix	2,845 (0.07)	0.02	405	0.58
TOTAL	14,807,530 (400)	---	69,880	---

Barnwell is a LLRW disposal site in South Carolina that accepts class A, B and C radioactive wastes. It is in the process of phasing out waste acceptance from outside the Atlantic compact. Ohio LLRW generators will be losing site access by July 2008.

The Envirocare of Utah site accepts class A radioactive waste. This facility is the site of choice for large volumes of low-level wastes, generated in decommissioning activities.

Table 10 - LLRW Shipments by Year

Calendar Year	Activity in MBq (Ci)	Volume in ft^3
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

LLRW Land Disposal

Table 11 is a list of the activity and volume of radioactive waste received from Ohio licensees and disposed at the Barnwell, S.C., and Envirocare of Utah facilities of waste. The data presented in Table 11 are data values reported by the respective land disposal facilities.

Table 11 - LLRW Land Disposal – Disposal Site Reports

Disposal Site	Year	Activity in MBq (Ci)	Volume (ft^3)
Barnwell, SC	1998	3,626,000 (98)	1,544
	1999	1,480,000 (40)	1,577
	2000	12,617,000 (341)	2,230
	2001	5,069,000 (137)	1,358
	2002	44,881,000 (1,213)	729.9

Disposal Site	Year	Activity in MBq (Ci)	Volume (ft^3)
Envirocare of Utah	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

The volumes and activities of the radioactive waste presented here are what remain after the generated radioactive wastes have 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.

The activity and volume of radioactive waste disposed of at Barnwell will continue to decrease over time as access to that facility is phased out for Ohio generators.

The activity disposed at Envirocare of Utah will increase as more waste is shipped there. In 2002, Envirocare also received approval to dispose of containerized Class A waste that will allow higher activities of waste to be disposed. However, the volume increase of Class A waste will be negligible because the volume disposed at Barnwell is small compared to Envirocare.

LLRW Storage

Presently, few locations in Ohio store LLRW for extended periods. LLRW is stored on site for decay-in-storage, awaiting treatment options or accumulating for shipment. The NRC, by policy and license conditions, did not allow licensees to store LLRW for extended periods on site, other than decay-in-storage, if there were readily available treatment or disposal options. Ohio, which became an Agreement State on Aug. 31, 1999, maintains the same policy and licensing conditions.

Medical facilities commonly use decay-in-storage 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 in most cases. These facilities plan to continue to use these methods and are, therefore, able to avoid the costs associated with other methods of disposal.

The following tables provide information on waste still in storage as of Dec. 31, 2002, that had been placed into storage prior to 2002.

Table 12 is a subtotal of the waste activity and volume of LLRW that continued to be held in storage for more than one year, by the year in which the waste was generated.

In the column "Year generated," a "?" is used for one line. One generator under newer radiation safety management was unable to ascertain the year in which the older waste in storage was generated.

Two industrial users contributed 95 per cent of the activity in storage. The activity of the material is predominantly in the form of sealed sources or devices that were taken out of service and are awaiting disposal.

The uranium enrichment facility accounted for 83 per cent of the volume of waste remaining in storage for more than 12 months. This material is a high-volume, low-activity waste pending further treatment and disposal options.

Table 12 - Pre-2002 LLRW Remaining in Storage by Year Generated

Year generated	Activity in MBq (Ci)	% of total activity	Volume in ft^3	% of total volume
?	490 (0.01)	0.04	1.27	0.01
1987	74 (<0.01)	0.01	1	0.01
1991	25,900 (0.70)	2.08	1.55	0.01
1992	15 (<0.01)	<0.01	3.5	0.03
1993	53 (<0.01)	<0.01	158	1.35
1994	155 (<0.01)	0.01	369	3.15
1995	133 (<0.01)	0.01	47	0.40
1996	256 (<0.01)	0.02	1038	8.85
1997	1432 (0.04)	0.12	595	5.08
1998	3154 (0.09)	0.25	647	5.52
1999	2220 (0.06)	0.18	1458	12.43
2000	930,816 (25.16)	74.83	3545	30.23
2001	279,243 (7.55)	22.45	3864	32.95
TOTAL	1,243,941 (33.62)	---	11,727	---

Table 13 breaks down the waste held in storage for more than one year by the waste type. Dry solid waste is the overwhelming majority of the waste volume. Sealed sources and sealed source-like material, based on activity to volume ratio (listed under dry solid), constitute the largest activity of waste held in storage.

Table 13 - Pre-2002 LLRW Remaining in Storage by Waste Type

Waste Type	Activity in MBq (Ci)	% of Activity	Volume in ft^3	% of Volume
Biohazard/Pathological	27.57 (<0.01)	<0.01	1	0.01
Dry Solid	1,196,740 (32.3)	96.21	10,848	92.51
Debris (HV-LLRW)	3.26 (<0.01)	<0.01	528	4.5
Gas in Container	74 (<0.01)	0.01	1	0.01
Liquid - Aqueous	17,784 (0.48)	1.43	318	2.71
Scintillation Vials	29.6 (<0.01)	<0.01	25	0.21
Sealed Sources	29,283 (0.79)	2.35	6	0.05
TOTAL	1,243,941 (33.6)	---	11,727	---

Appendix A

Low-Level Radioactive Waste Generator Report

for Calendar Year 2002

2002 Low-Level Radioactive Waste Generator Report
Ohio Department of Health - Bureau of Radiation Protection

Licensee Information

Licensee Name _____
Street Address _____
_____
_____
Telephone number (_____) _____ - _____
Federal Tax ID number _____

Organization Classification
[__] Academic
[__] Industrial
[__] Medical
[__] Utility
[__] Government Office
[__] Uranium Enrichment
[__] Academic and Medical

[__] I/We did not generate, possess, or store any low-level radioactive waste in CY 2002.

----------Remainder for Generators Only ----------

Person completing LLRW annual report

Name _____ Title _____
Phone number (_____) _____ - _____

Radiation Safety Officer

Name (printed) _____ Title _____

RSO Signature _____ Date _____

ODH / NRC Radioactive Material License(s) _____
Address where LLRW is held for Decay-in-Storage
_____
_____

Generator Reporting Exemption

[__] This facility is exempt from low-level radioactive waste generator reporting requirements under 3701:1-54-02(E) since this facility exclusively uses radionuclides that are subject to reporting and whose half-life is of one day or less.

Table 1a - 2002 LLRW Generated and Not Placed in Storage

[3701:1-54-02(B)2, -02(F)]

Complete the following table for the types and amount of waste generated in CY 2002 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 10 CFR 61.55.
- 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 3701:1-54-02(D).
- Enter the predominant radionuclides (not more than five) 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 3701:1-54-01(J).
- In the column labeled "Type of Disposal," indicate the disposition of the waste as land burial, incineration, sewer, or commercial decay-in-storage (DIS).

[__] Does not apply - no data to report for this table.

Waste Class	Waste Type	Radionuclide (not more than five)	Activity [_] Ci [_] mCi [_] Bq [_] MBq	Volume Generated (cu ft)	Volume after Treatment (cu ft)	Type of Disposal

Table 1b - 2002 LLRW Generated and Placed into Storage

[3701:1-54-02(B)2, -02(B)3, -02(F)]

Complete the following table for the types and amount of waste generated in the CY 2002 and placed into storage. Summarize from your records, and subtotal based on the 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 10 CFR 61.55.
- 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 3701:1-54-02(D).
- Enter the predominant radionuclides (not more than five) 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 3701:1-54-01(J).
- In the column labeled "DIS" for Decay-In-Storage - indicate by yes/no if the waste was designated for decay-in-storage.

[__] Does not apply - no data to report for this table.

Waste Class	Waste Type	Radionuclide (not more than five)	Activity [_] Ci [_] mCi [_] Bq [_] MBq	Volume Generated (cu ft)	Volume after Treatment (cu ft)	DIS (y/n)

Pre-2002 LLRW Remaining in Storage

[3701:1-54-02(B)3]

Complete the following table for the types and amounts of LLRW that was placed in storage before Jan. 1, 2002, and continue to be held in storage as of Dec. 31, 2002. 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 10 CFR 61.55 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 3701:1-54-02(D).
- In the column "Radionuclide," enter the predominant radionuclides (no more than five) remaining in the waste as of Dec. 31, 2002.
- Enter the decay corrected activity of the waste remaining in storage as of Dec. 31, 2002, 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) (not more than five)	Activity (12/31) [_] Ci [_] mCi [_] Bq [_] MBq	Volume (cu ft)

LLRW Shipment Information

[3701:1-54-02(B)4]

Identify the types and amount of LLRW shipped in CY 2002, 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 10 CFR 61.55.
- 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 [10 CFR 20 Appendix G], *3701:1-50-05* [10 CFR 71.5])
- In the column "Radionuclide," enter the predominant radionuclides (not more than five) 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 (e.g. Barnwell). 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 (3701:1-50-05 [10 CFR 71.5])

[_] public highway [_] air [_] vessel [_] rail

Waste Class	Waste Type	Radionuclide	Activity [_] Ci [_] mCi [_] Bq [_] MBq	Volume (cu ft)

LLRW General Information

Was any additional LLRW stored or shipped in CY 2001 that was not reported in *last year's report*? [_] Yes [_] No [3701:1-54-02(B)5]

If yes, describe the amounts and types and amounts.

_____

_____

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

_____

_____

_____

_____

_____

_____

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

_____

_____

_____

_____

_____

_____

_____

Anticipated 2003 LLRW Generation

[3701:1-54-02(B)8]

If the anticipated types and amount of waste to be generated or placed in storage during CY 2003 will be approximately the same as CY 2002, check the box below. Otherwise, complete the table below estimating the type and amount of LLRW to be generated or placed in storage during CY 2003.

[_] Approximately the same as CY 2002.

Waste Class	Waste Type	Radionuclide	Activity [_] Ci [_] mCi [_] Bq [_] MBq	Volume (cu ft)

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

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 Returned or Disposed	Return Date