
Ohio Department of Health
Bureau of Radiation Protection

# Annual Low-Level Radioactive Waste Management Report For 2001

The Ohio Department of Health, Bureau of Radiation Protection is releasing this report entitled “Annual Low-Level Radioactive Waste Management Report for 2001”. The report is designed to keep the ODH management informed of low-level radioactive waste in the State of Ohio. The final report was also 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.


Ohio Department of Health

Bureau of Radiation Protection

# Annual Low-Level Radioactive Waste Management Report

Prepared by: Karl Von Ahn, Health Physicist
Bureau of Radiation Protection
Ohio Department of Health
35 East Chestnut
Columbus, OH 43216

Approved by: _____ Date: _____

Robert Owen, Manager of Technical Services

Approved by: _____ Date: _____

Roger Suppes, Chief of Bureau of Radiation Protection

Ohio Department of Health
Bureau of Radiation Protection

**Table of Contents**

Ohio Department of Health

Bureau of Radiation Protection

**List of Tables**

## Introduction

The Ohio Department of Health (ODH) Bureau of Radiation Protection collected low-level waste generation information from both Ohio and NRC licensees in accordance with Ohio Administrative Code (OAC) 3701:1-54-02. The purpose of this rule was to provide the Department of Health 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 2001. The definition of LLRW does not include naturally occurring or accelerator produced radioactive material waste. The information presented here was 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. For the past several years, most generators have been using the Barnwell SC LLRW disposal facility for burial of their LLRW. Envirocare of Utah is available for some Class A LLRW for disposal.

## The Ohio Department of Health, Bureau of Radiation Protection

The Ohio Department of Health is authorized by Ohio Revised Code (ORC) 3748 to be the Radiation Control Agency for the state and is divided into multiple Divisions. The Divisions are further subdivided into Bureaus. The Bureau of Radiation Protection (BRP) performs this function on behalf of the Director of the Department of Health.

Ohio became an Agreement State with the NRC for the regulation of byproduct, source, and special nuclear radioactive materials effective August 31, 1999. This means that the NRC

has relinquished control and regulation of certain byproduct, source, and special nuclear radioactive materials within the state of Ohio to the Ohio Department of Heath.

The 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.

**Low Level Radioactive Waste**

Low level radioactive waste is defined in ORC Chapter 3748.01 and OAC 3701:1-54-01. 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 NARM radionuclides, or 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 therefore, is waste containing radioactive material that meets the definition contained in ORC 3748 and OAC 3701:1-54-01.

Low-level radioactive waste includes a variety of materials that have a wide range of levels of radioactivity. It includes items contaminated with radioactive material, for example, protective clothing, paper towels and laboratory equipment. It also includes some very radioactive items, such as materials used to purify coolant in nuclear power plants and used equipment from equipment inside 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 NRC classification system for LLRW 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 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, which generally consists of short-lived radionuclides (radionuclides with half-lives of less than 30 years) but also includes low concentrations of some long-lived radionuclides. Disposal of Class A waste must be isolated for at least 100 years.
- Class B waste, which includes 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, which includes 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 DOE, is responsible for LLRW from the following sources and types:

- LLRW owned or generated by the DOE,
- LLRW owned or generated by the US Navy as the result of decommissioning Navy vessels,
- LLRW owned or generated by the Federal government as a result of any research, development, testing, or production of nuclear weapons.

The primary source of “greater than Class C” waste will be from the decommissioning of nuclear power plants and high activity sealed sources.

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

- "Mixed waste" which satisfies the definition of both low level radioactive waste and hazardous waste in federal law. Therefore, mixed waste is LLRW which is also chemically hazardous; and
- NARM waste – while not considered by definition as LLRW, requires disposal in a controlled manner due to the inherent radiation hazards that exists with this waste.

The LLRWPA, ORC 3748, and Ohio rules adopted thereunder, 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.

**LLRW generation and management**

*Inventory of generators*

A generator report form is sent to all Ohio licensees and NRC licensees within Ohio. The inventory of generators is based on analysis of the 2001 annual generator reports that were completed and returned to the Department. The Department received 522 responses from licensees, of which 154 licensees generated, continued to store, or disposed of LLRW in 2001. Only those licensees that generated, continued to store, or disposed of LLRW in 2001 were required to submit a response.

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, whereas they used to be a DOE facility. 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 almost exclusively in the form of sealed sources for process measurements.
- Medical Sources – NRC and state licensed hospitals, physicians and blood services that utilize radioactive materials as part of their services.
- Academic and Research Facilities – NRC and state licensed colleges, universities and research facilities within the state borders, including research reactors and limited medical research facilities.
- 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.
- Governmental sources – NRC and state licensed governmental agencies within Ohio.
- Industrial sources – NRC and Ohio licensed sources within the state of Ohio. These licenses may include sealed sources and radioactive devices as well as commercial pharmacies 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 rods for nuclear power stations.

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

*Volume and Activity of LLRW Generated in 2001*

For Calendar Year (CY) 2001, the BRP received 522 unique responses to the LLRW generator report form. Of the respondents, 154 generated LLRW that required reporting, 1 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 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 was also requested. Appendix A is the generator report sent to licensees.

The results of the responses were entered into a new 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 is manipulated in scientific notation with three significant digits. The implicit error introduced by using data in this format ranges from 0.1% up to a 1% 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 also converted to Curie units. Therefore some rounding errors may be found.

In accordance with OAC 3701:1-54-02, 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 provides a regulatory relief to small clinics and physicians using short half-lived radioactive materials for medical diagnosis and imaging.

Generators of NARM waste, while generators of radioactive waste, were not LLRW generators since NARM is not included in the definition of LLRW.

The declaration of radioactive material or contaminated items as radioactive waste is frequently a subjective call by individual generators. The greatest impact of the variability will be noticed in the DIS waste volumes and activities.

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

Table 1 - Waste Generator Classification

| # in group | Waste Generator Classification | Activity in MBq (Ci) | % of total activity | Volume generated in cu ft | % of total volume generated |
|---|---|---|---|---|---|
| 17 | Academic | 43,700 (1.18) | 0.04 | 1,732 | 1.39 |
| 2 | Academic/medical | 88,314 (2.39) | 0.08 | 1,885 | 1.51 |
| 1 | Government Office | 4,419 (0.12) | <0.01 | 134 | 0.11 |
| 22 | Industrial | 41,497,209 (1,122) | 38.83 | 21,311 | 17.05 |
| 109 | Medical | 35,946,876 (972) | 33.64 | 8,638 | 6.91 |
| 1 | Uranium Enrichment | 7,036 (0.19) | 0.01 | 18,013 | 14.41 |
| 2 | Utility | 29,284,390 (791) | 27.40 | 73,255 | 58.62 |
| 154 | TOTAL | 106,871,945 (2,888) | --- | 124,969 | --- |

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 almost all of the activity and volume of waste generated.

Table 2 - Waste Generated by Waste Class

| Class | Activity in MBq (Ci) | % of activity | Volume in cu ft | % of volume |
|---|---|---|---|---|
| A | 85,306,534 (2,306) | 79.82 | 124,603 | 99.71 |
| B | 12,139,275 (328) | 11.37 | 103 | 0.08 |
| C | 9,426,136 (255) | 8.83 | 263 | 0.21 |
| Total | 106,871,944 (2,888) | --- | 124,969 | --- |

*Trends of Generated LLRW*

There are no trends of LLRW generation with respect to activity or volume. Overall, LLRW minimization procedures have been used by most licensees for many years. There are significant variations in volume and activity produced amongst most of the categories. This is a reflection of (1) the business environment, (2) the number of sites undergoing decommissioning or decontamination, and (3) waste generation accounting and reporting.

In 1998, a low level radioactive waste generator report was not sent to generators to report 1997 waste generation. That was the result of several factors including 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.

Table 3 - Activity Trend (in Ci) of waste generated

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

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

The volume and activity of waste generated by USEC has been tapering down since they have started shutting down the NRC controlled production activities at the Portsmouth facility.

The large variations of the industrial waste was from decommissioning activities under an NRC approved decommissioning plan with a single licensee.

Table 4 - Volume Trend (in cu ft) of waste generated

| Classification/Year | 1995 | 1996 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
| Academic | 2,682 | 1,371 | 3,340 | 859 | 1,893 | 1,732 |
| Academic/medical | -- | -- | 4,200 | 3,897 | 3,189 | 1,885 |
| Government Office | 59 | 10 | 76 | 91 | 24 | 134 |
| Industrial | 11,055 | 2,792 | 7,640 | 35,308 | 510,664 | 21,311 |
| Medical | 26,082 | 22,351 | 25,300 | 80,921 | ~~79,352~~ 8,853 | 8,638 |
| Uranium Enrichment | -- | -- | 62,400 | 41,521 | 42,388 | 18,013 |
| Utility | 11,244 | 14,641 | 17,000 | 30,140 | 29,259 | 73,255 |
| TOTAL | 51,122 | 41,165 | 120,000 | 192,736 | ~~666,770~~ 596,271 | 124,969 |

The medical waste volume in 1999 was unusually high due to one licensee reporting 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 reduction of the remaining medical waste volumes is attributed to more licensees taking use of an exemption from reporting. The reporting exemptions, and the definition of LLRW, will increase the variability of data submitted to the Department.

The medical waste volume for CY 2000 was reduced from 79,352 to 8,853 cubic feet based on a corrected waste report received after the last annual report was issued.

The increase in the volume generated does not translate into a proportional increase in the volume ultimately disposed in a licensed land disposal facility. The reason is that more generators are using commercial disposal facilities to segregate their wastes, then treat the remaining radioactive waste by volume reduction techniques such as incineration prior to ultimate transfer and disposal at a licensed land disposal facility.

*Treatment of LLRW*

LLRW waste may be treated to reduce the waste volume, radionuclide activity, or make the waste safer. As defined in OAC 3701:1-54-01, "'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 often 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. Frequently more than one method of processing is used to gain additional volume reduction. Waste reduction can be accomplished in a number of ways including:

- Decontamination
- Compaction (including shredding and compaction)
- Supercompaction
- Incineration – this methodology frequently provides the greatest reduction ratios
- Commercial decay-in-storage
- Thermal Reduction

All 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 of treating the waste on site, to having a commercial firm segregate the waste, then treat it by incineration. 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 since it is very simple to implement and does not have any direct costs. (Indirect costs include the use of secured space, 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 was broken down into two categories – DIS vs 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 is of particular importance in that 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 by either themselves or a commercial processor. 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 USEC facility in Piketon, Ohio plans on shutting down its NRC regulated operations, but continue its DOE operations. Future waste streams from the facility are unpredictable at this time.

Table 5 - DIS vs non-DIS vs USEC waste generated

| Decay in Storage | Activity in MBq (Ci) | % of activity | Volume generated (cu ft) | % of volume generated | Final Volume (cu ft) | % of final volume |
|---|---|---|---|---|---|---|
| Yes | 75,168,823 (2,032) | 70.34 | 17,095 | 13.68 | 3,464 | 7.52 |
| No | 31,703,122 (857) | 29.66 | 89,860 | 71.91 | 25,617 | 55.59 |
| USEC | 7,036 (0.19) | <0.01 | 18,013 | 14.41 | 16,998 | 36.89 |
| Total | 106,871,945 (2,888) | --- | 124,969 | --- | 46,079 | --- |

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 | --- | --- | 587 (0.02) | <0.01 |
| Aqueous Liquid | 21,666,076 (585) | 28.82 | 17,060 (0.46) | 0.05 |
| Biohazard/ Pathological | 4,648,135 (126) | 6.18 | 4,303 (0.12) | 0.01 |
| Debris (HV-LLRW) | --- | --- | 4,965 (0.13) | 0.02 |
| Dry Solid | 48,799,826 (1,319) | 64.92 | 29,995,277 (811) | 94.61 |
| Gas (Xe-133, Kr-85) | 34,336 (0.93) | 0.05 | 74 (<0.01) | <0.01 |
| Generator Columns | 72 (<0.01) | <0.01 | --- | --- |
| Liquid Mixed Waste | 556 (0.02) | <0.01 | 87,469 (2.4) | 0.28 |
| Scintillation Vials | 372 (0.01) | <0.01 | 8,596 (0.23) | 0.03 |
| Sealed Sources | 19,425 (0.53) | 0.03 | 1,547,698 (42) | 4.88 |
| Sewer | --- | --- | 37,143 (1.00) | 0.12 |
| Stock vials | 25 (<0.01) | <0.01 | --- | --- |
| TOTAL | 75,168,823 (2,888) | --- | 31,703,122 (857) | --- |

The waste type "Biohazard/Pathological" is 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".

For additional clarification, the waste type "Dry Solid" combines several subcategories of solid waste into a single category. Examples of subcatergories combined into the "Dry solid" waste type include dewatered resins (ion exchange media), incinerator ash, sludges, filter media, and contaminated equipment.

Table 7 - DIS vs non-DIS Waste Volume Generated By Type

| Waste Type | DIS Volume in cu ft | % of DIS volume | Non-DIS volume in cu ft | % of non-DIS cu ft |
|---|---|---|---|---|
| Animal Carcass | --- | --- | 410 | 0.38 |
| Aqueous Liquid | 885 | 5.18 | 85 | 0.08 |
| Biohazard/ Pathological | 869 | 5.08 | 111 | 0.10 |
| Debris (HV-LLRW) | --- | --- | 11,732 | 10.88 |
| Dry Solid | 15,210 | 88.97 | 94,462 | 87.57 |
| Gas (Xe-133, Kr-85) | 27 | 0.16 | 1 | <0.01 |
| Generator Columns | 0.5 | <0.01 | --- | --- |
| Liquid Mixed Waste | 1.08 | 0.01 | 86 | 0.08 |
| Scintillation Vials | 80.5 | 0.47 | 908 | 0.84 |
| Sealed Sources | 20 | 0.12 | 30 | <0.03 |
| Sewer | --- | --- | 48 | 0.04 |
| Stock vials | 2.5 | 0.01 | --- | --- |
| TOTAL | 17,096 | --- | 107,873 | --- |

*LLRW Shipments*

The generalized flow of radioactive waste from the time it is generated until it is ultimately disposed of can be simplified into the following sequence of events. First, the waste is generated and recognized as a radioactive waste. Second, the radioactive waste is treated onsite and packaged for shipment as appropriate for the waste stream. Third, the radioactive waste is shipped to a Treatment, Storage or Disposal Facility (TSDF). Fourth, the waste is treated to reduce volume and activity as appropriate by the TSDF. Fifth, 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 syringes to a radiopharmacy was not considered either a waste shipment or disposal. These are the remaining contaminated

syringes and needles after injecting patients with short-lived radionuclides. The syringe volumes and activities are incorporated in the nuclear pharmacy waste reports.

Table 8 - LLRW Shipments by Waste Class

| Waste Class | Activity in MBq (Ci) | % of activity | Volume (cu ft) | % of volume |
|---|---|---|---|---|
| A | 10,217,345 (276) | 33.69 | 105,553 | 99.67 |
| B | 12,139,275 (328) | 40.03 | 103 | 0.10 |
| C | 7,966,505 (215) | 26.27 | 293 | 0.23 |
| Total | 30,323,124 (820) | --- | 105,899 | --- |

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

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, which means that Ohio LLRW generators will be losing site access by July 2008.

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

Table 9 - LLRW Waste Shipments by Disposal Destination

| Destination | Activity in MBq (Ci) | % of activity | Volume (cu ft) | % of volume |
|---|---|---|---|---|
| ADCO for DIS | 581 (0.02) | <0.01 | 113 | 0.11 |
| Barnwell | 29,563,067 (799) | 97.49 | 57,984 | 54.75 |
| DSSI (TN) | 752 (0.02) | <0.01 | 128 | 0.12 |
| ENSCO (AR) | 96 (<0.01) | <0.01 | 36 | 0.03 |
| Envirocare of Utah | 147,767 (3.99) | 0.49 | 46,843 | 44.23 |
| Permafix | 156,502 (4.23) | 0.52 | 425 | 0.40 |
| Richland, WA | 454,360 (12.28) | 1.5 | 370 | 0.35 |
| TOTAL | 30,323,124 (820) | --- | 105,899 | --- |

*LLRW Land Disposal*

Table 10 - LLRW Land Disposal – Disposal Site Reports

| Disposal Site | Year | Activity in MBq (Ci) | Volume (cu ft) |
|---|---|---|---|
| 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 |
| 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 |

The activity and volume of waste generated, shipped, and disposed by burial are all different due to treatment techniques used on the waste and lag times in a calendar year from waste generation, shipment, treatment, and ultimate disposal.

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. Envirocare also received approval to dispose of containerized "Class A" waste which will allow higher activities of waste to be disposed of there in the future. The volume increase of waste will be negligible since the volume of waste disposed at Barnwell is small compared to the volume disposed at Envirocare.

*LLRW Storage*

Presently, few locations in the state store LLRW for extended periods of time. 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 of time on site (i.e. other than decay-in-storage) if there were readily available treatment or disposal options. Ohio, which became an Agreement State on August 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. This is due to the generally short half-lives of the radionuclides used, which is 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 majority of the volume stored by medical facilities is held for less than 30 days to allow radionuclides to decay to background prior to disposal as non-radioactive trash. For medical facilities this means that they can then dispose of the biohazardous waste (waste containing

needles, blood or bodily fluid contaminated products) or pathogenic waste as appropriate for the remaining non-radioactive hazards.

The following tables provide information on waste still in storage as of December 31, 2001 that had been placed into storage prior to 2001.

Table 11 - Pre-2001 LLRW Remaining in Storage by Year Generated

| Year generated | Activity in MBq (Ci) | % of total activity | Volume in cu ft | % of total volume |
|---|---|---|---|---|
| 1991 | 25,900 (0.7) | 17.13 | 1.55 | 0.01 |
| 1992 | 0.37 (<0.01) | <0.01 | 1.5 | 0.01 |
| 1993 | 91 (<0.01) | 0.06 | 270 | 2.61 |
| 1994 | 231 (<0.01) | 0.15 | 617 | 5.96 |
| 1995 | 24 (<0.01) | 0.02 | 74. | 0.72 |
| 1996 | 220 (<0.01) | 0.15 | 985 | 9.51 |
| 1997 | 13,566 (0.37) | 8.97 | 646 | 6.24 |
| 1998 | 3,192 (0.09) | 2.11 | 732 | 7.06 |
| 1999 | 4,133 (0.11) | 2.73 | 1,694 | 16.35 |
| 2000 | 103,877 (2.81) | 68.69 | 5,336 | 51.52 |
| TOTAL | 151,236 (4.09) | --- | 10,356 | --- |

Table 11 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.

Table 12 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 constitute the largest activity of waste held.

Table 12 - Pre-2001 LLRW Remaining in Storage by Waste Type

| Waste Type | Activity in MBq (Ci) | % of Activity | Volume in cu ft | % of Volume |
|---|---|---|---|---|
| Biohazard/ Pathological | 9,133 (0.25) | 6.04 | 15 | 0.14 |
| Dry Solid | 59,320 (1.61) | 39.22 | 9,483 | 91.56 |
| Debris (HV-LLRW) | 4 (<0.01) | <0.01 | 528 | 5.10 |
| Liquid - Aqueous | 4,356 (0.12) | 2.88 | 306 | 2.95 |
| Scintillation Vials | 51 (<0.01) | 0.03 | 24 | 0.23 |
| Sealed Sources | 78,373 (2.12) | 51.82 | 1 | 0.01 |
| TOTAL | 151,236 (4.09) | --- | 10,356 | --- |


Appendix A

# Low-Level Radioactive Waste Generator Report

for Calendar Year 2001

2001 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

[__] I/We did not generate, possess, or store any low-level radioactive waste in CY 2001.

----------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 - 2001 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 2001 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 5) 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 - 2001 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 2001 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 5) 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-2001 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 January 1, 2001, and continue to be held in storage as of December 31, 2001. 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 5) remaining in the waste as of December 31, 2001.
- Enter the decay corrected activity of the waste remaining in storage as of December 31, 2001 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 2001, 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], 10 CFR 71.5)
- In the column "Radionuclide" enter the predominant radionuclides (not more than 5) 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.
- Enter the 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:_____

Destination: _____Disposal Site: _____

Mode of Transportation (10 CFR 71.5) [_] public highway [_] air [_] vessel [_] rail

| Waste Class | Waste Type | Radionuclide | Activity<br>[_] Ci [_] mCi<br>[_] Bq [_] MBq | Volume<br>(cu ft) |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## LLRW General Information

Was any additional LLRW stored or shipped in CY 2000 that was not reported in 2001?
[_] 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
[3701:1-54-02(B)7]

_____

_____

_____

_____

_____

_____

_____

## Anticipated 2002 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 2002 will be approximately the same as CY 2001, 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 2002.

[_] Approximately the same as CY 2001.

| Waste Class | Waste Type | Radionuclide | Activity<br>[_] Ci [_] mCi<br>[_] Bq [_] MBq | Volume<br>(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 |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |