

Low-Level Radioactive Waste in Michigan

A Survey of Radioactive Waste Generators

State of Michigan
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Statutory Basis

Section 18(a) of the Low-Level Radioactive Waste Authority Act, 1987 PA 204, as amended (Act 204), requires generators of low-level radioactive waste (LLRW) to annually report to the Michigan Low-Level Radioactive Waste Authority (Authority) certain information on the volume, type, and activity of the LLRW produced. Based on a survey conducted in 2006, this report is a summary of the information submitted by generators for calendar year 2005.

Introduction

Commercial LLRW is a by-product of radioactive materials used in nuclear power plants, industry, and medical and research institutions. It comes in very diverse forms, including laboratory equipment, sealed radiation sources, wiping rags, protective clothing, hand tools, vials, needles, filter resins, and metallic reactor components.

Through the 1970s and 1980s, only three disposal facilities in the nation were licensed to accept commercial LLRW. The states in which these facilities were located (Nevada, South Carolina, and Washington) did not want to continually bear sole responsibility for the nation's LLRW and urged Congress to take action to avoid a disposal capacity crisis. The resulting federal Low-Level Radioactive Waste Policy Act of 1980, and the Policy Amendments Act of 1985, established the requirement that each state, acting alone or in cooperation with other states through an interstate "compact," is responsible for providing disposal capacity for the LLRW produced within its borders.

The Authority was established by Act 204 to fulfill the state's responsibility under federal law to provide for the careful isolation of the LLRW produced by Michigan's hospitals, universities, industry, and nuclear power plants.

From November 1990 through mid-1995, Michigan generators of LLRW were denied access to the nation's three operating LLRW disposal facilities. This access denial was imposed on Michigan generators because of the setbacks experienced in our efforts to site a disposal facility. In order to determine the problems and challenges that this forced on-site storage might present, in 1992 the Authority conducted an initial survey of waste generators to determine:

- The number of facilities producing and storing LLRW;
- The volume of waste produced annually;
- The volume of LLRW in storage;
- What capacity facilities had to continue to store LLRW;
- The characteristics of the waste in storage, including waste form, principle radionuclides, and activity level; and
- The impacts and costs associated with the need to provide on-site storage.

The 1992 survey was mailed to about 700 facilities that were licensed by the U.S. Nuclear Regulatory Commission (NRC) or registered by the State Radiological Protection Program, formerly within the Michigan Department of Public Health and currently within the Michigan Department of Environmental Quality (MDEQ). The survey results showed that while the use of radioactive materials is widespread, only a small portion of all licensees or registrants produce waste that must be disposed in an LLRW disposal facility.

In 1994 the Michigan Legislature enacted amendments to Act 204, requiring that generators report annually to the Authority on the volume of waste being produced and in storage and other information on the generation and management of LLRW. The Authority is required to provide a report to the Legislature summarizing the results of the data received from waste generators. The generator survey and this report fulfill the reporting requirements of Act 204.

Every several years, the survey is mailed to all entities that are either licensed with the NRC or registered with MDEQ's Radiological Protection Program. In the intervening years, the survey is sent only to those facilities that had indicated in the prior year's survey that they were generating LLRW or were storing LLRW that had been previously generated, along with newly licensed or registered facilities.

The survey conducted in 2006, seeking data on calendar year 2005 waste management practices and volumes, included only those 36 facilities identified in the last survey as waste generators or waste storers, along with a small number of new facilities that had not been licensed or registered during prior surveys. This report summarizes the findings for calendar year 2005.

This survey was conducted utilizing a Web-based survey form for the first time in 2006. This method was received well by survey recipients and appears to have expedited the return of survey information.

General Findings

For many years, the number of entities actually generating LLRW and the annual volumes of waste have been falling. From 1980 to the late 1990s, the volume of waste requiring burial in a licensed LLRW disposal facility decreased by about 90 percent both within Michigan and nationally. Ever-increasing disposal costs encouraged the development of improved materials management practices, and new waste treatment and processing technologies helped to bring about this volume reduction. The cost of disposal, along with the uncertainty of access to disposal facilities, caused some facilities to cease the use of radioactive materials in order to avoid the generation of LLRW. The first generator survey conducted by the Authority in 1992 identified 49 generators of LLRW in Michigan. The 2006 survey identified only 28 facilities that generated LLRW in calendar year 2005.¹ This reduction occurred in the ranks of hospitals, universities, and research and industrial entities (typically small-quantity waste generators).

The past few surveys have revealed an increase in waste volumes generated. However, this increase was not due to a general increase in waste generation rates, but rather due to special cleanup projects. The most significant of these is the decommissioning of the Big Rock Point Nuclear Power Plant near Charlevoix. The dismantlement of this plant resulted in the generation of significant quantities of material that must be treated as LLRW. A special discussion of waste management issues for the Big Rock Point decommissioning project is included at the end of this report.

¹ Some LLRW generators may be missed due to unreturned survey forms.

Survey Results

Michigan Waste Generators

The data presented in Table 1 summarize the responses of the 28 facilities that reported they generated LLRW in 2005, along with five other facilities that were still storing wastes previously generated, but not presently generating waste. Those facilities can be summarized as follows:

Table 1 – Summary of Responses by Facility Type

Type of Generator	Generating LLRW	Storing LLRW
Academic	6	4
Government	2	0
Industry	9	1
Medical	6	0
Utility	5	0
Total	28	5

Appendix A provides a listing of the facilities included in this Table.

Waste Generation in 2005

Skyrocketing disposal costs through the late 1980s and 1990s, along with uncertainty about the availability of disposal sites, led to the development and implementation of better waste management practices and to new waste treatment and processing techniques. Through this period, the volume of waste requiring licensed disposal following treatment or processing declined by about 90 percent. The dramatic decline in waste volumes has been experienced in Michigan and nationally.

Figure 1 shows that Michigan's annual waste generation rate declined steadily through 1997 but shows an increase in waste volumes beginning in 1999. This increase was not due to a general increase in waste generation. Rather, the increase is almost entirely due to two special waste projects. The shipment for disposal of two steam generators from the D.C. Cook Nuclear Power Plant in 1999 comprised nearly 15,000 cubic feet of waste.

The other major contributor to the increase in waste volumes since 1999 has been the decommissioning of the Big Rock Point Nuclear Power Plant. The dismantlement of the plant, near Charlevoix, resulted in the generation of significant quantities of material that must be treated as LLRW. A specific discussion of the Big Rock Point decommissioning project is presented at the end of this report.

Figure 1
Annual Waste Volumes for Michigan: 1980-2004
 (Data not available for all years)

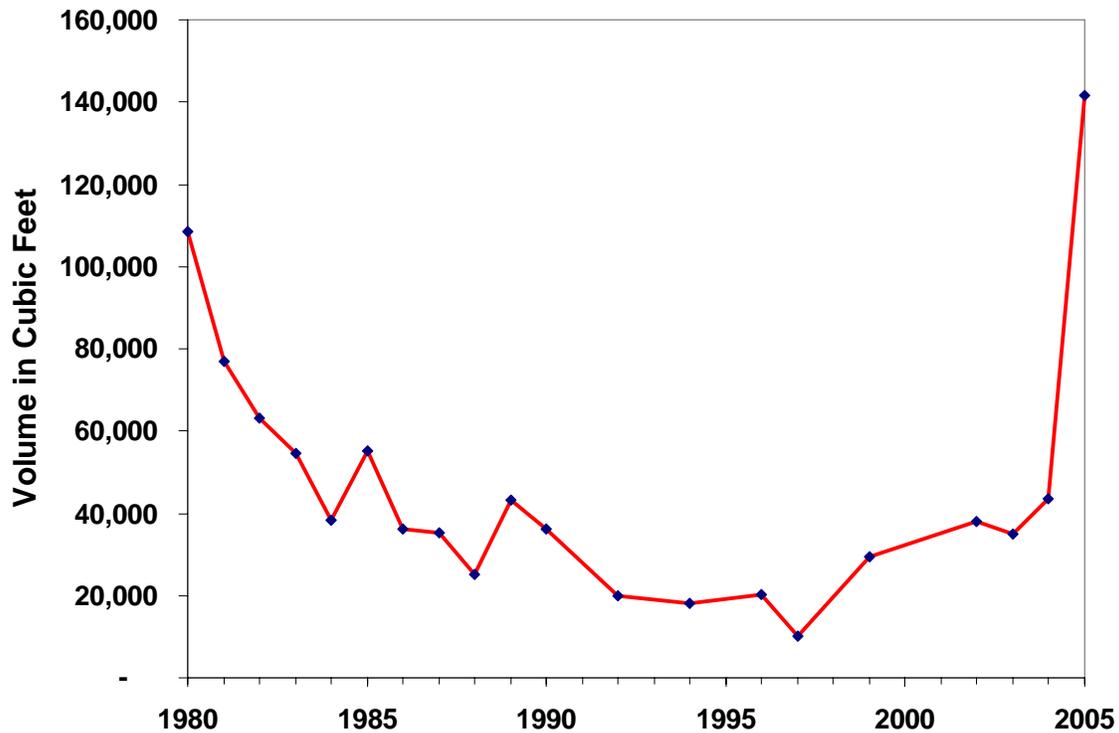


Table 2 indicates the volume of waste, by generator category and waste class, that was generated in 2005. The data show that nuclear utilities generate the majority of Michigan's LLRW.

Table 2 – LLRW Generated in Calendar Year 2005 Requiring Disposal in a Licensed Facility

Type of Generator	Number of Generators	Cubic Feet Produced in 2005	Percent	Class A Waste	Class B Waste	Class C Waste	Mixed Waste
Academic	6	1,759	1.2%	1,675	0	0	84
Government	2	13	<0.1%	13	0	0	0
Industry	9	2,558	1.8%	2,427	0	0	131
Medical	6	470	0.3%	470	0	0	0
Utility	5	136,861	96.6%	136,321	405	127	8
Total	28	141,661	100%	140,906	405	127	223

Trends in Generation Rates Over the Next Five Years

The survey asked respondents if they anticipated generating LLRW in future years. It is notable that eight respondents anticipated generating waste in future years, even though they did not generate any LLRW in calendar year 2005. Only one respondent who generated waste in 2005 did not anticipate future waste generation.

Table 3 reflects survey respondents' estimates of their annual waste generation rate for each of the next five years. The large increase in utility waste volume expected in 2006 is due to the demolition of concrete that housed the Big Rock Point reactor. Much of this rubble will have to be sent to a licensed LLRW disposal facility, in contrast to the volumes of rubble that have been disposed of through 2005 that were largely free of radioactive contaminants.

Table 3 – Volume of Waste (cubic feet)
shaded area represents generator estimates

Type of Generator	2005	2006	2007	2008	2009	2010
Academic	1,759	2,258	22,498	1,948	1,956	1,806
Government	13	8	8	4	4	4
Industry	2,558	8,456	1,682	1,682	1,682	1,682
Medical	470	77	82	87	92	97
Utility	136,861	780,162	42,661	15,425	17,450	16,425
Total	141,661	790,961	66,931	19,146	21,184	20,014

Volume in Storage

Generators were asked to identify the volume of waste currently in storage. Most generators will store waste for some period of time prior to disposal. Smaller waste generators may store waste for significant periods of time prior to shipping for disposal in order to have a quantity of waste that is economical to ship. Table 4 indicates, by generator category, the number of facilities reporting waste in storage and the volume of waste in storage.

Table 4 – Volume of Waste in Storage

Type of Generator	Facilities Reporting Waste in Storage	Cubic Feet LLRW in Storage	Class A Waste	Class B Waste	Class C Waste	Mixed Waste
Academic	7	355	350	0	0	5
Government	1	13	13	0	0	0
Industry	7	208	206	0	0	2
Medical	5	140	140	0	0	0
Utility	4	35,574	35,564	0	0	10
Total	24	36,290	36,273	0	0	17

The volumes of waste in storage cited above do not include waste volumes stored for decay. Decay in storage (DIS) is a management practice that can be used for wastes involving radionuclides that have relatively short half-lives (usually less than 90 days). Safely storing such wastes for a period of time equal to ten half-lives of the radionuclides results in a waste material that can be considered nonradioactive. Many clinics and other medical facilities practice DIS. However, because these wastes do not require disposal in a licensed LLRW facility, these facilities, and their wastes, are not included in this report.

Waste Streams

Survey respondents were asked to provide the volume and activity for the different types of wastes that were generated in 2005. Table 5 indicates the volume and activity for a variety of waste types or “streams.” A description of these waste streams is included in Appendix B.

Table 5 – Volumes and Activity by Waste Stream

Waste Stream	Volume (Cubic Feet)	Percent of Volume	Activity (Millicuries)	Percent of Total Activity
Dry Active Waste	23,522	16.6%	13,364	1.3%
Medical Generators	250	0.2%	0	0.0%
Aqueous Liquids	592	0.4%	208	<0.1%
Organic Liquids	93	<0.1%	12,925	1.3%
Oils	156	0.1%	701	<0.1%
Animal Carcasses	138	<0.1%	182	<0.1%
Biological Waste (Not Animal Carcasses)	0	0.0%	0	0.0%
Ash	10	<0.1%	30	<0.1%
Activated Equipment	205	0.1%	40	<0.1%
Contaminated Hazardous Material	8	<0.1%	0	0.0%
Rubble, Sand, and Soil	111,132	78.5%	147,000	14.8%
Sludge	725	0.5%	3,950	0.4%
Evaporator Concentrates	901	0.6%	7,730	0.8%
Air Filter Media, Cartridges	0	0.0%	0	0.0%
Liquid Filter Media, Cartridges	82	<0.1%	0	0.0%
Ion Exchange Resins	3,485	2.5%	797,656	80.5%
Sealed Sources	19	<0.1%	6,785	0.7%
TENORM	2	<0.1%	0	0.0%
Other	306	0.2%	3	<0.1%
Total	141,626	100%	990,574	100%

Volume of Waste Disposed in 2005

There are two licensed LLRW disposal facilities in the United States that accept LLRW from Michigan generators.² These facilities, now both owned and operated by EnergySolutions, are located in Barnwell, South Carolina, and 80 miles west of Salt Lake City, in Clive, Utah.

The Barnwell, South Carolina, facility serves as the regional disposal facility for the Atlantic Compact (comprised of Connecticut, New Jersey, and South Carolina). Under the terms of the Atlantic Compact, that facility will accept waste from states other than Atlantic Compact states only until 2008, with an ever-decreasing annual cap on non-Compact waste through that year. This facility accepts the full spectrum of LLRW – Class A, B, and C waste. It is the only disposal option for generators of Class B and C wastes in the majority of the states, including Michigan. The Barnwell facility accepted a total of about 43,000 cubic feet of waste and about 518,000 curies in 2005.³

The Clive, Utah, facility, formerly known as Envirocare, was established independent of the interstate compact structure but operates with some measure of oversight from the Northwest Compact (Utah is a member state). This facility can accept waste from generators in all states. The facility can accept all Class A waste, but it is not licensed to accept Class B and C waste. The Clive facility accepts much larger volumes of waste than the Barnwell facility, but a much smaller curie content. In 2005 this facility accepted more than 3.9 million cubic feet of waste with a curie content of 3,200 curies.³

Table 6 reflects, by generator category, the number of facilities that shipped waste for disposal during 2005, the waste volume as disposed, and the final destination of the waste. Small volumes of certain waste types were shipped to other facilities besides the two land disposal facilities. For instance, there are several companies that provide for the incineration of aqueous liquids.

The “as disposed” volume figures reflect the volume of waste actually placed in the land disposal facility. Many waste streams can be significantly reduced in volume through treatment and processing prior to burial. Thus, the volumes reflected in this table are smaller than the volumes generated.

Table 6 – Volume of Waste Disposed in 2005 (in Cubic Feet)

Type of Generator	Generators Shipping for Disposal in 2005	Volume of Waste Disposed	Volume Shipped to Barnwell	Volume Shipped to Clive	Other Facilities (or Site Not Identified)
Academic	4	278	25 (2)	28 (1)	225 (3)
Government	1	15	0 (0)	15 (1)	0 (0)
Industry	4	1,327	55 (1)	1,145 (2)	127 (2)
Medical	2	470	10 (1)	0 (0)	450 (1)
Utility	5	131,245	4,206 (3)	123,193 (5)	0 (0)
Total	16	133,335	4,296 (7)	124,381 (9)	802 (6)

* Numbers in parentheses indicate the number of generators that shipped to a particular site.

² A third licensed disposal facility, the U.S. Ecology site located near Richland, Washington, accepts waste only from the 11 states that comprise the Northwest Compact and the Rocky Mountain Compact.

³ Data from the U.S. Department of Energy's Manifest Information Management System.

Other Waste Management Methods

The survey asked respondents to identify the various waste management methods that were used at their facilities. Table 7 presents the results. It should be noted that many facilities indicate that more than one management method is used. A description of these waste management methods is included in Appendix B.

Table 7 – Waste Management Methods

Waste Management Methods	Number of Respondents
Decay to background	27
Return to manufacturer	22
On-site incineration	3
Off-site incineration	11
Controlled release off-site to air, water, or sanitary sewer pursuant to NRC regulations	15
Refrigerated or frozen awaiting licensed disposal facility	4
Noncompacted awaiting licensed disposal facility	17
Compacted awaiting licensed disposal facility	13
Solidified awaiting licensed disposal facility	6
Dewatered awaiting licensed disposal facility	4
Curtailment of LLRW generation (elimination or substitution of activities previously generating LLRW)	15
Off-site treatment with return for storage	0
Brokerage storage for decay	3
“Green is Clean”	5
Other	3

Brokerage Services

Survey respondents were asked whether or not a brokerage service was used to manage their LLRW. A brokerage service usually picks up waste from a variety of waste generators and then properly packages, manifests, and ships the waste for disposal. The brokerage service may also provide some waste treatment or processing or send it to a third party for processing prior to disposal.

Most LLRW generators made use of brokerage services. Of 28 waste generators, 22 indicated that a brokerage service was used for some portion of their overall waste management scheme.

Off-Site Waste Treatment and Processing

Generators were also asked to identify any commercial waste treatment or processing companies (separate from brokerage services) that were used to treat wastes prior to disposal. Nuclear power plants utilize waste treatment and processing more than other generators. The four nuclear power plants each indicated that a variety of commercial waste treatment and processing services were used to volume-reduce and stabilize their LLRW. Among the 22 nonutility generators, only 12 utilized commercial treatment or waste processing separate from brokerage services.

Table 8 indicates the number of facilities, by type of generator, that indicated employment of a waste brokerage and/or off-site waste processor to help manage LLRW.

Table 8 – Use of Waste Management Services

Type of Generator	Number of Generators Utilizing Brokerage Services	Number of Generators Utilizing Off-Site Waste Treatment
Academic	7	1
Government	2	0
Industry	6	4
Medical	4	3
Utility	3	4
Total	22	12

Big Rock Point Decommissioning Project

The Big Rock Point Nuclear Power Plant, operated by Consumers Energy near Charlevoix, permanently stopped generating electricity in August 1997 and began the process of decommissioning the plant shortly after shutdown. The goal of decommissioning is to completely dismantle the plant, remove all waste material and any contaminants, and return the site to unrestricted use.

The process of decommissioning creates large volumes of waste material. Much of the material is ordinary, uncontaminated building demolition material. Some hazardous waste is produced, such as asbestos and contaminated oils. Large volumes of LLRW must also be removed from the site and properly treated and disposed.

As an NRC licensee, Consumers Energy is required to consider virtually all decommissioning waste leaving Big Rock Point as LLRW, unless it can be shown that the material does not include any radioactivity above background levels. The volumes reflected in this report do not include a significant volume of concrete rubble that was generated in the decommissioning process, but that was deemed to be “nonimpacted” by radioactive contaminants and was disposed as ordinary demolition debris.

Some of this nonimpacted rubble was shipped to a Michigan Type II landfill as normal demolition debris, following on-site procedures to comprehensively assess the material and ensure that the rubble was free of radioactive contaminants. Consumers Energy had applied for, and received, approval from the NRC to dispose of this nonimpacted debris under Title 10 of the Code of Federal Regulations, Section 20.2002, Method for obtaining approval of proposed disposal procedures, allowing for an alternate disposal method. Under this provision, Consumers Energy was required to demonstrate that this disposal method would not adversely affect public health or the environment.

Another large volume of rubble was shipped to a radioactive waste treatment facility to undergo a waste evaluation process known as “Green is Clean.” This evaluation determines which material is free of radioactive contaminants and can, therefore, be disposed in an ordinary landfill. The remaining material is disposed as LLRW.

The decommissioning of Big Rock Point was completed in late 2006. One of the final stages of decommissioning, the removal of the base of the containment sphere, produced a very large volume of rubble. This material was shipped for "Green is Clean" evaluation, and this volume will be reflected in next year's survey.

The Future of LLRW Disposal

As noted earlier, there are only two facilities that accept Michigan LLRW for disposal. The facility in Barnwell, South Carolina, is the only facility that accepts Class B and C wastes from the majority of states, including Michigan. Under South Carolina law, the Barnwell facility will no longer accept LLRW from states other than the states of its three-state compact after June 2008.

The loss of access to the Barnwell facility may pose problems for generators across the country in the disposal of Class B and C wastes. Generators in Michigan and 35 other states may have to store such wastes or take steps to avoid generating them.

Class B and C wastes form only a small percentage of the overall LLRW waste stream. The generation of some Class B and C wastes, such as activated reactor hardware, cannot be avoided. Other wastes that sometimes fall within Class B or C limits can be avoided. For instance, a batch of filter resins used in nuclear power plants can become Class B or C waste if used over a significant time period. If replaced earlier, the material can meet Class A limits. While avoiding the creation of Class B or C wastes, such a strategy results in the creation of greater overall volumes of LLRW.

Survey respondents were asked if the loss of access to the Barnwell facility would impact their operations and what steps, if any, were being taken to address those possible impacts. Because most respondents do not generate Class B or C wastes, they indicated that there would be no impact. The nuclear power plants indicated that storage of Class B and C wastes would be necessary, and most indicated they were prepared to do so. The most significant impact might be felt by any facilities that will be decommissioning following this loss of access.

A 2004 report by the U.S. General Accounting Office recently reached the following conclusion regarding the management of Class B and C wastes: "If disposal conditions do not change...most states will not have a place to dispose of their Class B and C wastes after 2008. Nevertheless, any disposal shortfall that may arise is unlikely to pose an immediate problem because generators can minimize, process, and safely store wastes."⁴ The report does acknowledge that long-term storage of ever-increasing volumes of such wastes may result in increased safety and security risks.

No shortfall is foreseen in the availability of adequate disposal capacity for Class A wastes.

⁴ "Low-Level Radioactive Waste: Disposal Availability Adequate in the Short-term, but Oversight Needed to Identify Any Future Shortfalls," U.S. General Accounting Office; June 2004

Appendices

Appendix A

2005 Low-Level Radioactive Waste Generator Survey Respondents

<u>Colleges/Universities</u>	<u>County</u>	<u>Generating LLRW</u>	<u>Storing Only</u>	<u>Future Generating</u>
Alpena Community College	Alpena		x	
Kettering University	Genesee			x
Michigan Technological University	Houghton	x		x
Michigan State University	Ingham			x
Central Michigan University	Isabella		x	x
Western Michigan University	Kalamazoo		x	x
Calvin College	Kent	x		x
Northern Michigan University	Marquette		x	x
Oakland University	Oakland	x		x
Eastern Michigan University	Washtenaw	x		x
University of Michigan	Washtenaw	x		x
Wayne State University	Wayne	x		x
 <u>Government</u>				
U.S. Army TACOM LCMC	Macomb	x		x
U.S. Department of Commerce	Washtenaw	x		x
 <u>Hospitals/Medical Centers</u>				
Cardinal Health Nuclear Pharmacy Services	Kent	x		x
Henry Ford Bi-County Hospital	Macomb			x
Cardinal Health NPS	Oakland	x		x
William Beaumont Hospital	Oakland	x		x
VA Ann Arbor Healthcare System	Washtenaw	x		x
Children's Hospital of Michigan	Wayne			x
Henry Ford Hospital	Wayne	x		x
Henry Ford Wyandotte Hospital	Wayne			x
Karmanos Cancer Institute	Wayne	x		x
 <u>Industry</u>				
Kinnco, Inc.	Grand Traverse		x	
Pharmacia & Upjohn Company	Kalamazoo	x		x
General Motors Corporation	Macomb	x		x
Dana-Perfect Circle	Muskegon	x		x
The Dow Chemical Company	Midland	x		x
Aastrom Biosciences, Inc.	Washtenaw	x		x
Cayman Chemical Company	Washtenaw	x		x
Esperion Therapeutics, Inc.	Washtenaw	x		
MIR Preclinical Services	Washtenaw			x
Pfizer Global Research and Development	Washtenaw	x		x
TSRL	Washtenaw	x		x
 <u>Nuclear Power Plants</u>				
D.C. Cook	Berrien	x		x
Big Rock Point	Charlevoix	x		x
Detroit Edison - Fermi 1	Monroe	x		x
Detroit Edison - Fermi 2	Monroe	x		x
Palisades	Van Buren	x		x

Description of Waste Classes, Waste Streams, and Waste Management Methods

Waste Class

Class A: LLRW that has the largest volume but lowest concentrations of long-lived and/or short-lived radionuclides. Most Class A waste decays to a level that no longer poses a hazard within 100 years. Class A waste includes most LLRW from hospitals and universities and the majority of waste from nuclear power plants.

Class B: LLRW that has small volumes but intermediate concentrations of long-lived and/or short-lived radionuclides. Class B wastes must meet more rigorous waste form requirements than Class A to ensure stability. Most Class B waste decays to a level that no longer poses a hazard within 100 to 300 years. Class B waste can include certain radiopharmaceutical wastes, sealed sources, and some ion exchange resins from nuclear power plants.

Class C: LLRW that has the smallest volumes but the highest concentrations of long-lived and/or short-lived radionuclides. Class C wastes must meet more rigorous waste form requirements to ensure stability and must be disposed of at a depth of at least five meters below the surface or be disposed of with intruder barriers. Most Class C waste decays to a level that no longer poses a hazard within 500 years. Class C waste is limited almost exclusively to some ion exchange resins, some sealed sources, and activated metal components from nuclear power plants.

It is important to note that all of the waste classes can contain radionuclides with long half-lives. It is the concentration of the radionuclides within a waste material, more than the half-life of the radionuclides present, that often determines the class of waste.

Mixed Waste: Waste material that contains radioactive constituents, as defined under Title 10 of the Code of Federal Regulations, Part 61, Licensing Requirements for Land Disposal of Radioactive Waste, and hazardous constituents, as defined under federal hazardous waste rules in Title 40 of the Code of Federal Regulations, Part 261, Identification and Listing of Hazardous Waste. Both the radiological and chemical hazard of the mixed waste must be considered in the management and disposal of this waste.

Waste Streams

Activated Equipment (or Shielding): Tools, instruments, equipment, and lead shielding made radioactive by irradiation from a nuclear reactor or spent fuel pool.

Air Filter Media, Cartridges: Air filters or the media used within air filters, such as charcoal or cellulose fibers.

Animal Carcasses: Radioactivity contaminated animal carcasses or body parts usually resulting from animal research. Animal carcasses present a special storage problem in that they often require freezing to inhibit biological degradation.

Aqueous Liquids: Wastes that are dissolved in water. Liquid waste must be solidified before shipment to a disposal facility. Liquids cannot be accepted for land disposal.

Ash: Incinerating LLRW results in substantial volume reduction but most of the radioactivity is still present in the ash. Ash is often solidified with cement, asphalt, or other material prior to disposal or storage.

Biological Waste: Other biological waste may include animal bedding and excreta and laboratory culture media.

Contaminated Hazardous Material: Wastes that have hazardous constituents or properties as designated by U.S. Environmental Protection Agency or MDEQ regulations as well as contamination with radionuclides. This type of waste is also referred to as “mixed waste.”

Dry Active Waste (DAW): Solid waste that commonly consists of protective clothing, glassware, paper, cloth, and plastics that may have been contaminated with radioactive material. Some DAW can be compacted or incinerated.

Evaporator Concentrates: Evaporation of contaminated water is a common treatment method at nuclear power plants. The concentrated residue produced during the process is solidified before disposal.

Ion Exchange Resins: Organic polymer materials used to remove radioactive contaminants from circulating cooling water and used for other water treatment systems within nuclear power plants.

Liquid Filter Media, Cartridges: Filters or filter media used to remove radionuclides from water.

Medical Generators: A commercially available device used to create a short-lived radionuclide (to be used in a medical application) from a parent radionuclide. The most widely used medical generator is used to produce technetium-99m from a molybdenum source. The device is usually returned to the manufacturer at the end of its useful life.

Oils: Lubricating or machine oil that has become contaminated with radioactive materials.

Organic Liquids: Chemical compounds such as alcohols or solvents such as benzene, xylene, and toluene that have been contaminated with radioactive materials.

Rubble, Sand, and Soil: Concrete, gravel, soil, or other building rubble contaminated with radioactive materials. These wastes are usually generated in the process of decommissioning a licensed facility.

Sealed Sources: A radioactive source sealed in a container to prevent contact with, or dispersion of, the radioactive material during its use. Sealed sources are used in a wide variety of medical, research, industrial, and construction applications.

Sludge: Produced when filtering contaminants, sludges include powdered ion-exchange resins, diatomaceous earth, suspended solids, silica, and metal oxides.

TENORM: Technologically-Enhanced Naturally Occurring Radioactive Material results from naturally occurring radionuclides being concentrated by some man-made process. For example, radium scale can develop on oil and gas well piping.

Waste Management Methods

Decay to Background: Hospitals, universities, and research institutions often use radionuclides with relatively short half-lives. The NRC permits wastes containing radionuclides with half-lives of up to 90 days or less to be stored until the radioactivity has decayed to background--a period recognized as being equal to ten half-lives for any particular radionuclide. Almost all universities and medical facilities indicated that some wastes were stored for decay.

Return to Manufacturer: A “sealed source” is a radioactive material sealed in a container to prevent contact with, or dispersion of, the radioactive material. Sealed sources are used in a variety of different ways in medical treatment and in industrial and manufacturing processes. Examples include devices used

to examine welded joints, to test the thickness of paper, and to control fluid levels in bottling plants. Sealed sources are often returned to the manufacturer after the radionuclide source has decayed.

On-site Incineration: Facilities may be licensed to incinerate certain waste material under strict limits imposed by the NRC. Three licensees incinerate some of their LLRW on-site. The resulting ash is treated as LLRW.

Off-site Incineration: There are several commercial LLRW incinerators operating elsewhere in the country. The resulting ash is treated as LLRW. Ash may be solidified to avoid dispersal problems. Scintillation fluids (chemical solutions often used in biomedical research) are often incinerated, leaving no residual waste.

Controlled Release to Air, Water, or Sanitary Sewer: NRC regulations allow for the discharge of small concentrations of radionuclides to the air, water, or sanitary sewage systems. The concentration limits established by the NRC for such releases are very conservative. For instance, the concentrations for sewer release are set so that a person would get no more than 500 millirem of exposure in a year if the sewer discharge was the person's only source of drinking water.

Refrigerated or Frozen: Biological wastes, particularly animal carcasses used in laboratory experiments, are often frozen to forestall biological deterioration if disposal is not possible or delayed. Hospitals, universities, and research institutions may use this technique.

Noncompacted Awaiting Licensed Disposal: Many waste generators, particularly the small quantity generators, simply containerize their wastes in drums until disposal is available. The waste materials are dry solids.

Compacted Awaiting Licensed Disposal: Some waste generators use compactors to reduce the volume of dry solid wastes. Generators may have their own compactor or send waste to a commercial compactor for treatment and return.

Solidified Awaiting Licensed Disposal: Some liquid or wet wastes can be solidified by the use of concrete, asphalt, or epoxies. The resulting waste form is more stable; however, often the volume is increased substantially through the addition of the solidifying agent. Liquid wastes are not permitted in licensed LLRW land disposal facilities.

Dewatered Awaiting Licensed Disposal: Ion exchange resins used in nuclear power plants to remove radioactive contaminants from circulating cooling waste are often "dewatered" or dried prior to being placed into storage or sent for disposal.

Curtailed of LLRW Generation: Over the past decade, the volume of LLRW being generated has declined significantly, due to better waste management practices, new waste treatment technologies, and eliminating or substituting activities or procedures that would generate LLRW. Due to the uncertainty of disposal and the cost of both storage and disposal, most waste generators continue to search for ways to reduce the amounts of LLRW being produced.

Off-site Treatment with Return for Storage: During the years when disposal was not possible, Michigan generators were still able to send wastes out of state to commercial waste treatment or processing facilities. The waste was returned to the individual generator following compaction or incineration to await final disposal. Now that wastes can be disposed, no generators are having wastes treated and returned.

Brokerage Storage for Decay: Some wastes with radionuclides of short half-lives can be stored until decayed. If a generator has no space to store waste for decay, waste can be sent to a brokerage for storage. After the radionuclides have sufficiently decayed, the material can be disposed as nonradioactive waste.

**LOW-LEVEL RADIOACTIVE WASTE AUTHORITY
LOW-LEVEL RADIOACTIVE WASTE MANAGEMENT SURVEY**

For Calendar Year 2005

Under Section 18(a) of Act 434 (P.A. of 1994), generators of low-level radioactive waste (LLRW) are required to provide information to the Michigan Low-Level Radioactive Waste Authority on an annual basis, or as required by the Authority. Information requested includes waste volumes, curie content of the waste, and other data relevant to waste management and disposal. This survey will fulfill the generator's reporting requirements for calendar year 2005.

This survey is due September 30, 2006

If you have any questions concerning this survey, contact Thor Strong, Acting Commissioner of the Michigan Low-Level Radioactive Waste Authority, at 517-241-1252. (strongt@michigan.gov) or T.R. Wentworth at 517-241-1438 (wentwort@michigan.gov).

Please provide the following information (* required):

* Facility Name:

* Facility Address 1:

Facility Address 2:

* City:

* State:

* Zip Code:

* Contact Person:

Title:

* Daytime Phone:

E-mail:

If other facility locations are included in this responses, please list them in the spaces here:

1. If your facility has a U.S. Nuclear Regulatory Commission (NRC) License Number, please enter that here. If all radioactive materials are possessed under an NRC General License, indicate "GL":

2. Do you generate LLRW which, due to short half life of isotopes, may be stored for decay and eventually disposed as nonradioactive waste?

For all remaining questions, DO NOT include: 1) waste that is stored for decay which can then be disposed as nonradioactive waste; 2) sealed sources which can be returned to the manufacturer

3. A. In 2005, did your facility generate radioactive waste which requires disposal in a licensed LLRW disposal facility?
- B. Do you anticipate generating LLRW in the future?
- C. Is your facility storing any radioactive material or waste, generated prior to 2005, which is now awaiting disposal?

If you answered "NO" to 3A, 3B AND 3C, it is not necessary to complete the rest of the survey. Please click the "submit" button at the bottom of this page.

If you answered "YES" to 3A, 3B, OR 3C, please complete all remaining questions that are appropriate and applicable.

WASTE MANAGEMENT

4. A. Please estimate the volume of LLRW generated in calendar year 2005 that has been disposed, or will require disposal, in a licensed disposal facility. **Total Cubic Feet**
- B. If known, break down the total volume entered in 4A into waste classes. [Appendix 1](#) provides a description of waste classes.

Class A Class B Class C Mixed Don't Know

5. Use the following table to characterize the LLRW generated in calendar year 2005. Please indicate the volume, total activity and principle radionuclides for each waste stream that has been disposed or will require disposal in a licensed LLRW facility. The estimated volume for all waste streams reported should equal the total cubic feet volume reported in 4A.

A. Dry Active Waste	K. Rubble, sand, soil etc.
B. Medical Generators	L. Sludge
C. Aqueous Liquids	M. Evaporator Concentrates
D. Organic Liquids (not oils)	N. Air Filter Media, Cartridges
E. Oils	O. Liquid Filter Media, Cartridges
F. Animal Carcasses	P. Ion Exchange Resins
G. Biological Waste (exclude animal carcasses)	Q. Sealed Sources
H. Ash	R. TENORM
I. Activated Equipment or Shielding (radioactive by irradiation)	S. Other (describe)
J. Contaminated Hazardous Material	

Waste Stream	Estimated Volume (Cubic Feet)	Total Activity (millicuries)	Principle Radionuclides
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

6. Please estimate the volume (in cubic feet) of LLRW that your facility will generate in each of the next five years. If you are unsure of Waste Class, enter as Class A.

	2006	2007	2008	2009	2010
Class A	<input type="text"/>				
Class B	<input type="text"/>				
Class C	<input type="text"/>				
Mixed	<input type="text"/>				

7. Check each waste management method currently used, either by you at your facility, or by an off-site waste processor, to manage your LLRW

- | | |
|--|--|
| <input type="checkbox"/> Decay to background | <input type="checkbox"/> Curtailment of LLRW generation (elimination or substitution of activities previously generating LLRW) |
| <input type="checkbox"/> Return to manufacturer or supplier | |
| <input type="checkbox"/> On-site incineration | <input type="checkbox"/> Off-site treatment with return for storage |
| <input type="checkbox"/> Off-site incineration | <input type="checkbox"/> Brokerage storage for decay |
| <input type="checkbox"/> Controlled release pursuant to 10CFR20 | <input type="checkbox"/> "Green is clean" |
| <input type="checkbox"/> Refrigerated or frozen, prior to disposal | <input type="checkbox"/> Other (Please describe) |
| <input type="checkbox"/> Non-compacted prior to licensed disposal | <input type="text"/> |
| <input type="checkbox"/> Compacted prior to licensed disposal | |
| <input type="checkbox"/> Solidified prior to licensed disposal | |
| <input type="checkbox"/> Dewatered prior to licensed disposal | |

8. If your facility uses a waste brokerage service (a company which packages and collects waste) so that you do not have to deal with a disposal site directly, please provide the name of the company(s) and the state(s) where the broker(s) is located

9. If your facility shipped waste off-site for treatment or processing prior to disposal (incineration, compaction, etc.), identify the waste processor(s) and the state(s) where the processor(s) are located.

WASTE DISPOSAL

10. Please estimate the volume of waste shipped for disposal (either directly or through a broker or processor) at a licensed LLRW disposal facility in calendar year 2005. **Total Cubic Feet**

11. Please identify the volume (in cubic feet) of waste sent to the following disposal sites during calendar year 2005:

Duratek, Inc. (Barnwell, South Carolina)

Envirocare of Utah, Inc. (Clive, Utah)

U.S. Ecology (Richland, Washington)

Other (please identify)

Don't know

WASTE IN STORAGE

12. A. Please estimate the cubic feet of LLRW, currently in storage, that will require disposal in a licensed LLRW disposal facility.

Total Cubic Feet

B. If known, break down the total volume entered in 12A by waste class:

Class A

Class B

Class C

Mixed

Don't Know

C. What percentage of the waste in storage was generated in calendar year 2005?

 %

13. What difficulties, if any, are you experiencing in your effort to ship stored wastes for disposal? Please explain:

14. The Duratek, Inc. disposal facility in Barnwell, S.C. will cease accepting waste from Michigan generators in July, 2008. This facility is currently the only option for disposal of Michigan's Class B and C wastes. Please explain any impact this loss of access will have on your facility and any steps being taken to address the issue

15. Please provide any other comments or explanations that will assist us understand your responses to this survey.

Before submitting, please print a copy for your records using your internet browser print button.

_Submit Form	_Reset Form
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