2018

Annual Low-Level Radioactive Waste Program Report

to the
Pennsylvania General Assembly and the
Appalachian Compact Commission

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Commonwealth of Pennsylvania
Bureau of Radiation Protection

MESSAGE FROM THE SECRETARY

In 1980, the U.S. Congress enacted the Low-Level Radioactive Waste Policy Act. It made each state responsible for the disposal of such waste generated within its borders and encouraged states to enter into compacts with each other.

The Pennsylvania General Assembly responded to the federal act by enacting the Appalachian States Low-Level Waste Compact Act of 1985 (35 P.S. §§7125.1 – 7125.4). The Act permits Pennsylvania to establish a regional disposal site for the Appalachian Compact states of Delaware, Maryland, West Virginia, and Pennsylvania. Pennsylvania was selected as the initial host state because it generates the largest amount of low-level radioactive waste (LLRW) within the Appalachian Compact.

Since the Act was passed, the factors that drove the need for such a facility have changed dramatically. In December 1998, the Department of Environmental Protection (DEP) announced the suspension of efforts to site a LLRW facility in Pennsylvania. There is currently disposal capacity for LLRW at two out-of-state facilities.

While Pennsylvania suspended the siting process, it maintains the ability to restart it should circumstances again change. The work done under the state's voluntary siting and technical screening process would provide a solid foundation for future work if necessary.

To help assure the public that LLRW is disposed of properly, the Pennsylvania DEP's Bureau of Radiation Protection collects disposal data from the LLRW generators as well as from the U.S. Department of Energy's (DOE) national LLRW database and the Energy*Solutions* disposal facility in Clive, Utah, and the Waste Control Specialists disposal facility in Andrews, Texas.

The data is compiled and reported in this, the *Annual Low-Level Radioactive Waste Program Report to the Pennsylvania General Assembly and the Appalachian Compact Commission*. This report contains the LLRW generation data for calendar year 2018.

Sincerely,

Patrick McDonnell
Secretary

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SECTION 1
INTRODUCTION

This report is prepared for submission to the Pennsylvania General Assembly and the Appalachian Compact Commission (Commission). Its purpose is to fulfill the statutory requirements contained in Section 901 of the Pennsylvania Low-Level Radioactive Waste (LLRW) Disposal Act (35 P.S. § 7130.901) and Article 2 of the Act (35 P.S. §§ 7125.1).

Similar to the 2017 report, this report contains disposal information for Class A, Class B, and Class C wastes from the Appalachian Compact (Compact). As in past years, the majority of LLRW generated by volume in 2018 is Class A waste. Table C-1 and Chart C-1 illustrate the trend in volume of LLRW disposed by state and year. Most of this Class A LLRW was disposed of at the Energy*Solutions* facility in Clive, Utah. In addition, there is a small amount of Class C LLRW disposed from the Appalachian Compact generators. The 2013 opening of the Waste Control Specialists (WCS) disposal facility in Andrews, Texas, to LLRW generators outside of the Texas LLRW Disposal Compact (member states are Texas and Vermont) allows for Class B and Class C LLRW disposal from the Appalachian Compact generators.

Section 2 of this report contains activities of the Commission as well as the host state of Pennsylvania.

Section 3 contains a discussion of LLRW quantities generated in Pennsylvania and the Compact, waste minimization, and toxicity of LLRW.

Section 4 contains the financial statistics and expenditures for Pennsylvania (calendar year 2018) and the Commission (fiscal year 2017-2018), and a list of LLRW generators in the Compact for 2018.

Appendix A includes information on volume, curie content, waste class, radionuclides and waste toxicity of LLRW generated. The information was obtained from the Energy*Solutions* facility in Clive, Utah; the Waste Control Specialist's site in Andrews, Texas; and the Department of Energy's (DOE) national database contained in the Manifest Information Management System (MIMS).

Appendix B contains pertinent LLRW disposal tables and charts for Pennsylvania and the other member states of the Compact - Delaware, Maryland, and West Virginia.

Appendix C provides statistics related to volume and activity trends of LLRW during 1998 through 2018.

Appendix D includes the independent auditor's report of the Commission's financial accounts for fiscal year 2017-18.

SECTION 2
APPALACHIAN STATES COMPACT ACTIVITIES

The Commission was established under a compact entered into by Delaware, Maryland, West Virginia, and Pennsylvania. The U.S. Congress consented to the Compact in May 1988. The primary purpose of the Compact is to provide for the regional management and disposal of LLRW as required by the federal Low-Level Radioactive Waste Policy Act of 1980, as amended. Pennsylvania was designated as the initial host state to provide a site for a regional facility because it generates more LLRW than the other Compact members. Other important duties of the host state are to:

- Ensure, consistent with applicable state and federal law, the protection and preservation of public health, safety, and environmental quality in the siting, design, development, licensing, operation, closure, decommissioning, and long-term care for the institutional control period of the facility within the state.
- Prohibit the use of any shallow land burial and develop alternative means for treatment, storage, and disposal of LLRW.
- Establish requirements in law for financial responsibility. These requirements include purchase and maintenance of adequate insurance by generators, brokers, carriers, and regional facility operators and establish a long-term care fund to pay for preventative or corrective measures at the regional facility.
- Ensure that charges for disposal of LLRW at the regional facility are sufficient to fully fund the safe disposal and perpetual care of the regional facility, and that charges are assessed without discrimination based on the state of origin.
- Ensure and maintain a manifest system that documents all waste-related activities of generators, brokers, and carriers, and establish the chain of custody of waste from its initial generation to the end of its hazardous life.

Summary of the Host State Activities for Calendar Year 2018

The Department of Environmental Protection (DEP) continued to perform the administrative responsibilities and duties of the Commission. The Commission's powers and duties are specified in the Act.

In April, a representative from DEP's LLRW Program represented DEP at the Low-Level Waste Forum (Forum) meeting in San Francisco, California, as one of the Forum directors and a member of the Executive Committee. The Forum was established to facilitate state and compact implementation of the LLRW Policy Act and to promote the objectives of LLRW regional compacts.

In September, DEP held the annual meeting of the Low-Level Waste Advisory Committee (LLWAC). The primary purpose of the meeting was to discuss regional and national issues and recent developments.

In October, a representative from DEP's LLRW Program attended the regular meeting of the Forum in Richland, Washington.

In November, DEP's LLRW Program staff coordinated and attended the 2018 annual meeting of the Commission in Harrisburg.

A representative from DEP's LLRW Program staff continued to serve on the Forum's Disuse Sources Working Group (DSWG). At the request of the National Nuclear Security Administration (NNSA), the Forum formed the DSWG to solicit input from a broad range of stakeholders and to prepare a report. The DSWG is currently working on the implementation of the recommendations contained in the report.

A representative from DEP's LLRW Program staff continued to serve on the Forum's Working Group regarding the 10 CFR Part 61 proposed rulemaking. The Working Group provided extensive comments to the U.S. Nuclear Regulatory Commission (NRC) regarding the agency's proposed approach to revising LLRW regulations in Part 61.

DEP continued to monitor the generation of LLRW in Pennsylvania. By obtaining the appropriate disposal information directly from the national MIMS database, DEP has significantly reduced the regulated community's administrative LLRW reporting requirements.

Summary of Commission's Activities for Fiscal Year 2017-18

In July 2017, the Commission's Independent Auditor, Greenawalt & Company, P.C., conducted its annual audit of the Commission's financial statements for fiscal year (FY) 2016-17. The audit did not identify any instances of non-compliance that are required to be reported under the Government Auditing Standards.

In October 2017, the Commission held its annual meeting in Harrisburg. At this meeting, the Commission elected its chairman and vice-chairman, reviewed the audit report of the Commission's financial statements for FY 2016-17, reviewed and discussed the recent national developments involving LLRW management and disposal, reviewed the LLRW generation report for the Compact, approved a proposed budget for FY 2018-19, and reviewed recent NRC Low-Level Waste Program activities.

In October 2017, a representative of the Commission attended the Forum meeting in Alexandria, Virginia.

In April 2018, a representative from the Commission attended the Forum meeting in San Francisco, California.

The Commission continued to monitor the generation of LLRW in the Compact. The Commission also continued to monitor and assess national developments, including the activities of the NRC, for any potential impact on management and disposal of LLRW in the Compact.

SECTION 3
WASTE QUANTITIES GENERATED

Radioactive waste is radioactive material judged by the licensee as being no longer useful for its intended purpose. Radioactive waste can also be legacy waste resulting from past contamination of a facility. This legacy waste enters the waste stream after a facility is decontaminated. Radioactive waste can be generally categorized as high-level, low-level, byproduct material, special nuclear material and transuranics, or a combination of these. Radioactive waste can also be mixed with hazardous non-radioactive waste, which is generally referred to as a mixed waste.

LLRW is waste that satisfies the definition in the LLRW Policy Amendments Act (LLRWPAA) of 1985 (42 USC 2014). The LLRWPAA defines LLRW as, "radioactive material that (A) is not high-level radioactive waste, spent nuclear fuel or byproduct material as defined in Section 11e.2 of the Atomic Energy Act of 1954; and (B) which the NRC, consistent with existing law and in accordance with paragraph (A), classifies as low-level radioactive waste."

Any LLRW that requires disposal at a licensed facility is considered generated waste, and the institution or person that produces the waste is considered a generator. Since 1998, commercial LLRW is tabulated by date, in the MIMS system, for the date it was disposed of at the Barnwell or the Energy*Solutions* (formerly called Envirocare) LLRW disposal facilities. The LLRW disposed of at a DOE site is not included in this report.

Generators of LLRW can be categorized according to the type of operation or service they conduct. In the Compact, waste generator types are categorized as nuclear power plant (utility), medical, academic, government, or industrial.

Utilities include all the nuclear reactors that are used for generation of electricity in the Compact. Medical facilities include hospitals, clinics, and medical colleges where radioactive materials are used for medical applications. Academic facilities include universities and other institutions of higher learning that generate LLRW. Government facilities include federal, state, county and municipal operated institutions that generate LLRW. Industrial facilities may generate LLRW as part of the manufacturing process, research, waste-volume reduction, sample analysis, and facility or equipment decontamination.

Pennsylvania and Appalachian Compact LLRW Quantities

As of July 1, 2008, the Barnwell LLRW disposal site in South Carolina stopped accepting LLRW from outside of the Atlantic Compact (Connecticut, New Jersey, and South Carolina). Therefore, the LLRW generators within the Compact no longer had a disposal option for Class B and C wastes and certain types of Class A waste. Both Pennsylvania and the Commission were monitoring and tracking the generation of these types of wastes, which were stored by the LLRW generators in the Compact. As of 2013, WCS disposal facility in Andrews, Texas, has been accepting Class B and Class C LLRW from several utilities in the Compact.

Pennsylvania generators disposed of the largest volume and activity (radioactivity) of LLRW among the Compact states. Quantities and activity totals of LLRW by facility type and state for 2018 are listed in Tables and Charts B-1 and B-2.

The total volume of waste disposed of by the Compact LLRW generators in 2018 was about 344,184 cubic feet (ft^3). This amount was mainly due to waste from the government and industrial categories (see Table and Chart B-1). The largest volume of LLRW disposed of was from the government in the Compact. The large contribution of waste volume by the government category in 2018 is due to disposal of low- activity decontamination waste from the Environmental Protection Agency (EPA) Region 3 for its cleanup of the Safety Light site. The waste generated from this site is high in volume but low in activity.

The 2018 LLRW activity from the Compact is about 42,155 curies (Ci). The greatest contribution is from the nuclear utility sector (see Table and Chart B-2). The highest activity came from Talen Energy's Susquehanna Steam Electric Station due to shipment of resin and irradiated components. The disposal activity and volume tabulated in the aforementioned tables and charts include Class A, Class B, and Class C LLRW.

LLRW must be classified according to 10 CFR 61.55 before it can be shipped for disposal. In 2018, all of the LLRW disposed of at WCS from the Compact was Class B and Class C LLRW. Almost all Class A waste from the Compact was disposed of at the Energy*Solutions* site and a small quantity was disposed of at WCS.

Table B-3 contains information on the radioactive isotopes in the LLRW disposed of from the Compact's generators in 2018. The characterization and quantification of these isotopes are generally performed several months prior to disposal. Therefore, due to the short half-life of some listed isotopes and the in-growth of some others, the actual isotopic characterization and activity will be different at the time of disposal.

Table B-4 contains information on 2018 Compact LLRW disposal volume and activity by percentage of disposal at WCS and Energy*Solutions* LLRW sites.

Waste Minimization

Waste minimization can be accomplished by two different methods: source reduction and volume reduction. Source reduction is achieved by process modification, materials replacement, and segregation. Volume reduction is generally achieved by compaction or incineration. Appendix C discusses volume and activity trends from 1998 to 2018.

Toxicity of Low-Level Radioactive Waste

The toxicity of LLRW is a function of its constituent radionuclides. Toxicity is based on drinking water standards and expressed in two ways, as shown in Table A-2 of Appendix A.

Toxicity is first expressed as the annual concentration in picocuries per liter (pCi/L) of beta particle and photon radioactivity in drinking water that produces an annual dose equivalent to the total body or any internal organ of no more than 4 millirems (mrem) per year.[1] For gross alpha-emitting radionuclides, excluding radon and uranium, the maximum contaminant level (MCL) in drinking water is 15 pCi/L.[2] For combined radium-226 and radium-228, the MCL in drinking water is 5 pCi/L.[3] The second column of Table A-2 shows radionuclide concentrations in pCi/L in drinking water that would yield a risk equal to that from a dose rate of 4 mrem per year. Lower concentration quantity indicates higher toxicity.

The second mode of indicating toxicity is by comparing toxicity of each radionuclide to that of tritium (H-3) and expressing it as relative toxicity. Tritium is one of the least toxic of radionuclides and is assigned a value of 1. Relative toxicity of other radionuclides is calculated in column three of Table A-2, where higher numbers indicate higher toxicity. Radionuclides are listed without their half-lives in Table A-2; however, arrangement of radionuclides by their half-life ranges is provided in Table B-3, which is also arranged by nuclide and activity.

[1] Based on 40 CFR 141.16(a), and proposed revision to 40 CFR 141, published as Appendix C on Sept. 30, 1986, 51 FR 34859.
[2] 40 CFR 141.15(b)
[3] 40 CFR 141.15(a)

SECTION 4
FINANCIAL STATISTICS

The Pennsylvania LLRW Disposal Act (1988-12) requires the annual report to include financial statistics relating to all aspects of the Compact and the regional disposal facility. This chapter includes financial information on the host state of Pennsylvania and the Commission.

Pennsylvania law, in the form of the LLRW Disposal Act and the LLRW Disposal Regional Facility Act (Act 1990-107), established funds to pay the costs of developing an LLRW disposal facility in Pennsylvania. Funds were generated from mandatory contributions by utilities in Pennsylvania and voluntary contributions from a utility in Maryland. The maximum amount of money mandated for the Regional Facility Siting Fund was about $33 million.

Pennsylvania General Fund money was also appropriated for the LLRW program. The Acts state that funds used from the General Fund must be repaid to that fund within five years after the LLRW facility begins disposal operations. Repayments to the General Fund will be taken from surcharges on the waste during facility operation.

Expenditures of the Host State and the Appalachian Compact Commission

Table 4-1 contains the financial information of the host state, Pennsylvania, and the Commission for calendar year 2018 and fiscal year 2017-18, respectively.

TABLE 4-1
Pennsylvania and Appalachian Compact Commission Expenditures

EXPENDITURES	PENNSYLVANIA (HOST STATE) CY 2018	FY 2017-18 APPALACHIAN COMPACT COMMISSION
GRANTS	$0.00	$0.00
PERSONNEL	$32,343.69	$0.00
GENERAL EXPENSE	$0.00	$30,209.00
CONTRACTOR SERVICES	$0.00	$0.00
TOTAL	**$32,343.69**	**$30,209.00**

APPENDIX A

TABLE A-1
APPALACHIAN COMPACT LLRW DISPOSERS BY STATE AND COUNTY FOR 2018

Pennsylvania

County	Facility	Generator Type
Beaver	First Energy Nuclear Operating Co. - Beaver Valley	Utility
Butler	II-VI, Incorporated	Industry
Carbon	Joint Center for Therapeutic Oncology	Medical
Centre	Pennsylvania State University	Academic
Clinton	Air Parts of Lock Haven	Industry
Columbia	USEPA Region 3-Safety Light Superfund Site	Government
Cumberland	Dickinson College	Academic
Dauphin	Cardinal Health 414, LLC	Medical
	Exelon Corporation - TMI 1	Utility
Delaware	Cheyney University	Academic
	Villanova University	Academic
Erie	Associated Clinical Laboratory	Industry
Franklin	Knepper's Kleen Water	Industry
Indiana	Fluid Recovery Services	Industry
Lancaster	Franklin and Marshall College	Academic
Lawrence	Alaron Corporation	Industry
Luzerne	Talen Energy Corporation - SSES	Utility
Montgomery	Exelon Corporation - Limerick	Utility
	SmithKline Beecham - King of Prussia	Industry
	Janssen Research & Development	Industry
	Pet Net Pharmaceutical Services	Industry
	Unitech Services Group, Inc.	Industry
Philadelphia	City of Philadelphia Water Dept.	Government
	Drexel University	Academic
	Temple University	Academic
	Thomas Jefferson University	Academic
Westmoreland	Westinghouse Electric Company, LLC - Waltz Mill	Industry
York	Exelon Corporation - Peach Bottom	Utility

Maryland

County	Facility	Generator Type
Anne Arundel	Northrop Grumman	Industry
Baltimore	Johns Hopkins University/Asthma Allergy Center	Medical
	Plexus Corp.	Industry
	Sia Solutions, LLC	Industry
	United Iron and Metal	Industry
	University of Maryland	Academic
Calvert	Exelon Corporation - Calvert Cliffs	Utility

County	Facility	Generator Type
Frederick	CLYM Environmental Services	Industry
Howard	DSM Nutritional Products	Industry
	Ecology Services, Inc.	Industry
Montgomery	Food and Drug Administration	Government
	National Institute of Standards and Technology	Government
Prince George's	Radiation Service Organization	Industry
Washington	North Hagerstown High School	Academic

West Virginia

County	Facility	Generator Type
Monongalia	West Virginia University	Academic
Ohio	US EPA Region 3	Government

TABLE A-2
TOXICITY TABLE OF INDIVIDUAL RADIONUCLIDES

Radionuclides	Concentration[a] (pCi/L)	Relative[b] Toxicity	Radionuclides	Concentration[a] (pCi/L)	Relative[b] Toxicity
Tritium (H-3)	9.0E04	1.0	Europium-155	7.0E03	12.9
Americium-241	4.0E00	22,500.0	Gadolinium-153	1.0E04	9.0
Americium-23	1.5E01	6,000.0	Hafnium-181	3.0E03	30.0
Antimony-122	2.0E03	45.0	Iodine-125	1.0E03	90.0
Antimony-124	1.0E03	90.0	Iodine-129	1.0E02	900.0
Antimony-125	4.0E03	22.5	Iodine-131	7.0E02	128.6
Barium-131	7.0E03	12.9	Iodine-133	4.0E02	225.0
Barium-140	1.0E03	90.0	Iridium-192	2.0E03	45.0
Beryllium-7	1.0E05	0.9	Iron-55	1.0E04	9.0
Bismuth-207	2.0E03	45.0	Iron-59	1.0E03	90.0
Cadmium-109	5.0E02	180.0	Lanthanum-140	1.0E03	90.0
Calcium-45	2.0E03	45.0	Lead-203	1.0E04	9.0
Californium-252	1.5E01	6,000.0	Manganese-54	3.0E03	30.0
Carbon-14	3.0E03	30.0	Neptunium-237	1.5E01	6,000.0
Cerium-141	4.0E03	22.5	Nickel-59	3.0E04	3.0
Cesium-134	8.0E01	1,125.0	Nickel-63	1.0E04	9.0
Cesium-136	5.0E02	180.0	Niobium-95	5.0E03	18.0
Cesium-137	1.0E02	900.0	Phosphorus-32	7.0E02	128.6
Chlorine-36	2.0E03	45.0	Plutonium-238	1.5E01	6,000.0
Chromium-51	8.0E04	1.1	Plutonium-239	4.0E01	2,250.0
Cobalt-57	6.0E03	15.0	Plutonium-240	1.5E01	6,000.0
Cobalt-58	2.0E03	45.0	Plutonium-241	1.5E01	6,000.0
Cobalt-60	2.0E02	450.0	Plutonium-242	1.5E01	6,000.0
Curium-242	1.5E01	6,000.0	Polonium-210	1.5E01	6,000.0
Curium-243	1.5E01	6,000.0	Promethium-149	3.0E03	30.0
Curium-244	1.5E01	6,000.0	Protactinium-233	3.0E03	30.0
Europium-152	2.0E03	45.0	Radium-226	1.5E01	6,000.0
Europium-154	1.0E03	90.0	Rubidium-86	6.0E02	150.0
Ruthenium-103	4.0E03	22.5	Ruthenium-106	3.0E02	300.0
Scandium-46	2.0E03	45.0	Selenium-75	6.0E02	150.0
Silver-110M	7.0E02	128.6	Sodium-22	5.0E02	180.0
Sodium-24	4.0E03	22.5	Strontium-85	4.0E03	22.5
Strontium-89	9.0E02	100.0	Strontium-90	5.0E01	1,800.0
Sulfur-35	1.0E04	9.0	Tantalum-182	2.0E03	45.0
Technetium-99	5.0E03	18.0	Tellurium-125M	2.0E03	45.0
Thorium-228	1.5E01	6,000.0	Thorium-230	1.5E01	6,000.0
Thorium-232	1.5E01	6,000.0	Thallium-202	4.0E03	22.5
Thallium-204	2.0E03	45.0	Tin-113	4.0E03	22.5
Transuranics	1.5E01	6,000.0	Vanadium-48	2.0E03	45.0
Yttrium-90	1.0E03	90.0	Yttrium-91	1.0E03	90.0
Zinc-65	4.0E02	225.0	Zirconium-95	3.0E03	30.0

[a] Concentration of beta and photon radioactivity in drinking water yielding a risk equal to that from a dose rate of 4 mrem/year (proposed revision to 40 CFR 141, 51 FR 34859, Sept. 30, 1986).
[b] Toxicity of radionuclides compared to tritium, which has a value of 1.

APPENDIX B

TABLE B-1
Appalachian Compact 2018 Disposed LLRW Volume by State and Facility Type

Facility Type/State	WV	DE	MD	PA	Total
Academic	13.0	0	0.70	28.92	42.62
Government	4.0	0	615.40	219,321	219,941
Industry	0	0	1,907	72,479	74,386
Medical	0	0	10.0	9.73	19.73
Utility	0	0	2,966	46,830	49,796
Total	17.0	0	5,498	338,668	344,183

This data is for LLRW disposal at the Energy*Solutions* site in Clive, Utah, and the WCS site in Andrews, Texas. Volume is in cubic feet.

CHART B-1

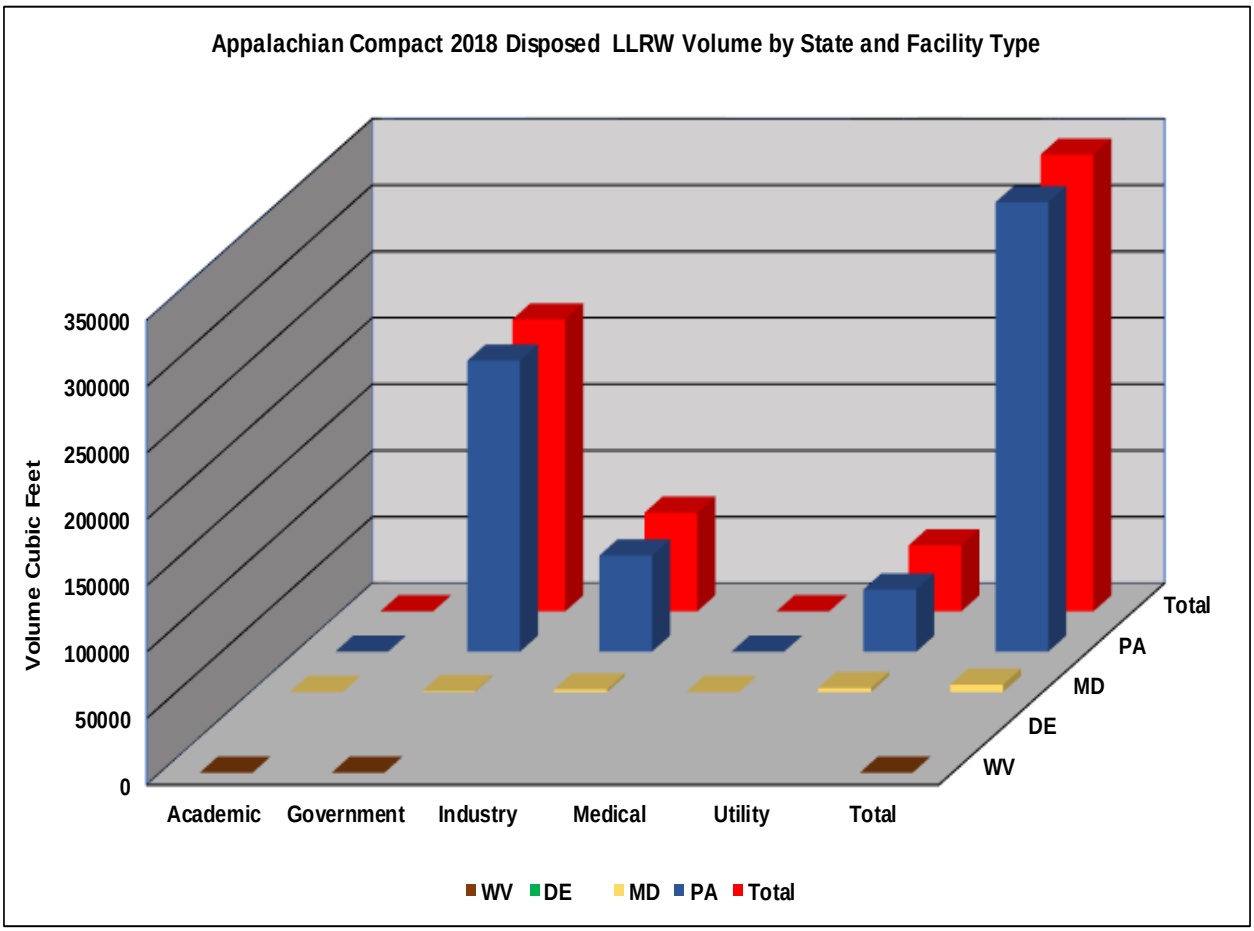


TABLE B-2
Appalachian Compact 2018 Disposed LLRW Activity by State and Facility Type

Facility Type/State	WV	DE	MD	PA	Total
Academic	0.01	0	0.00045	0.02	0.03
Government	0.00119	0	49.06	0.42	49.48
Industry	0	0	0.12	42.04	42.16
Medical	0	0	0.01	0.15	0.16
Utility	0	0	76.12	41,987	42,063
Total	0.01	0	125.31	42,029	42,155

This data is for LLRW disposal at the Energy*Solutions* site in Clive, Utah, and the WCS site in Andrews, Texas. Activity is in curies.

CHART B-2

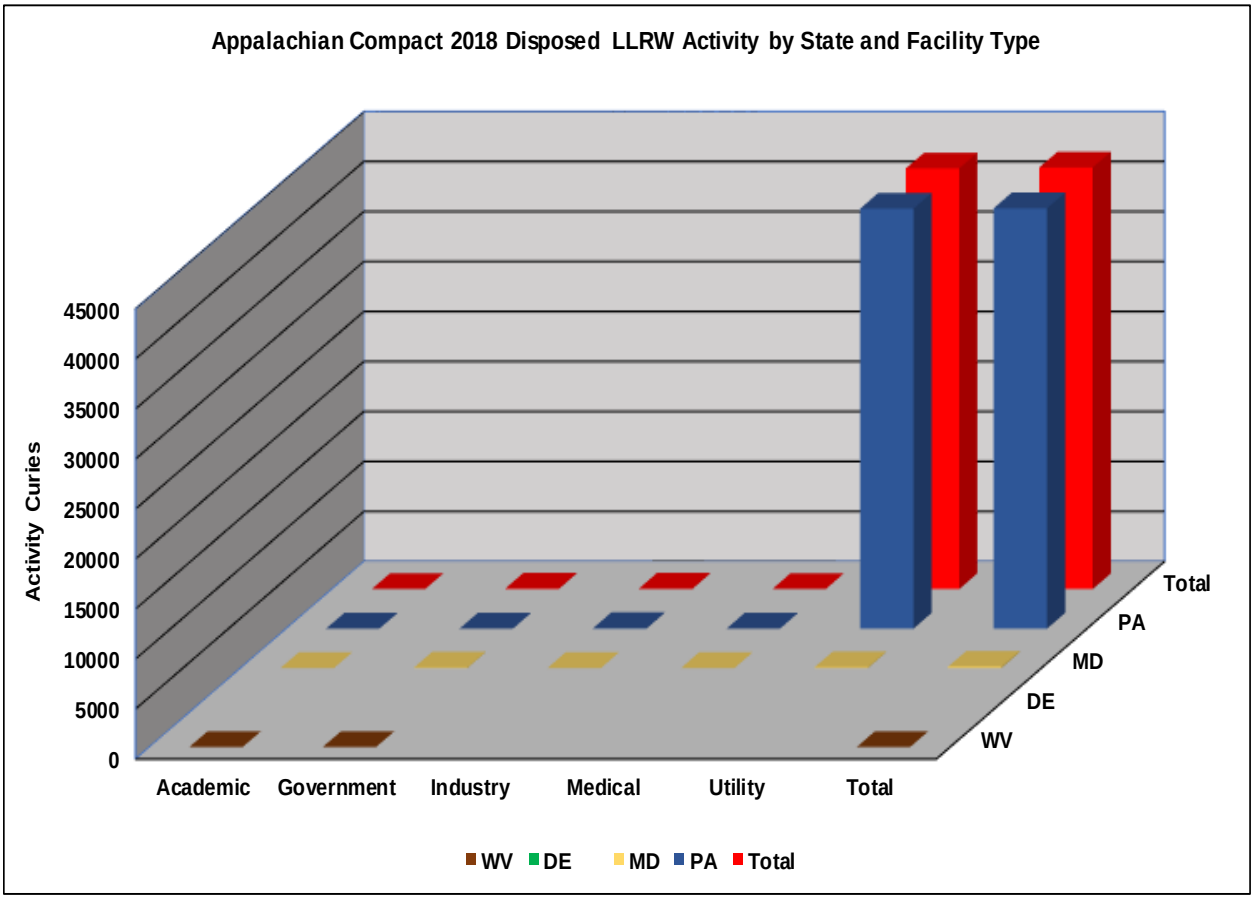
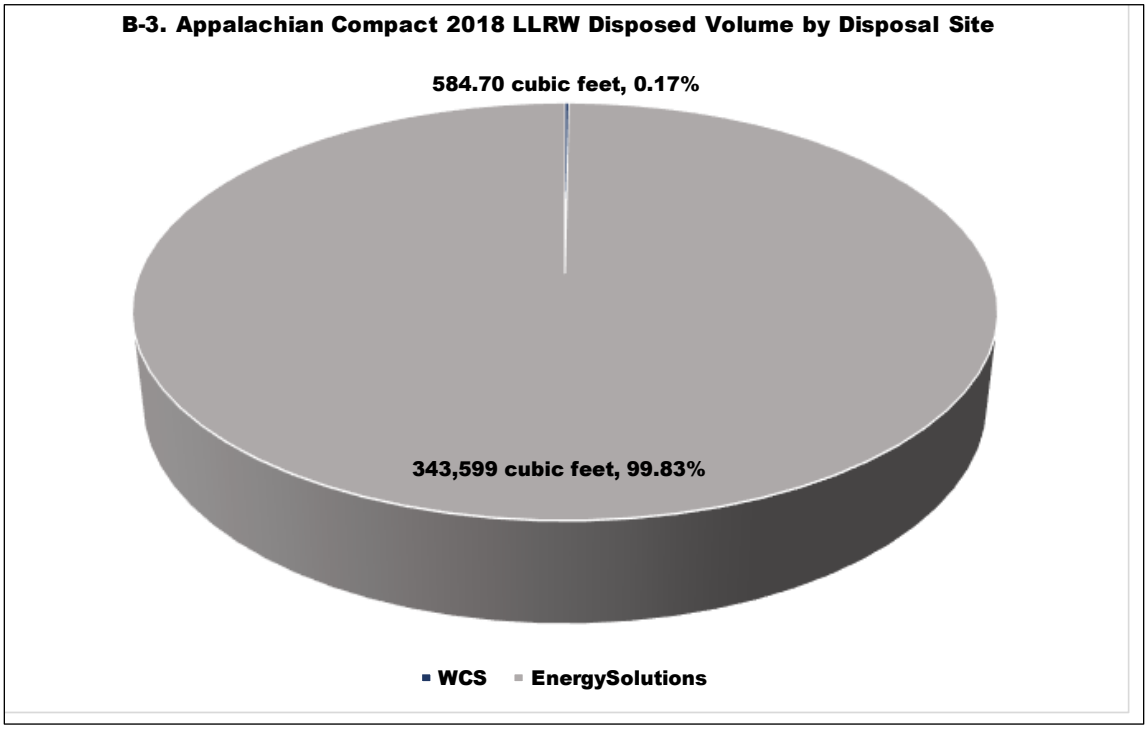
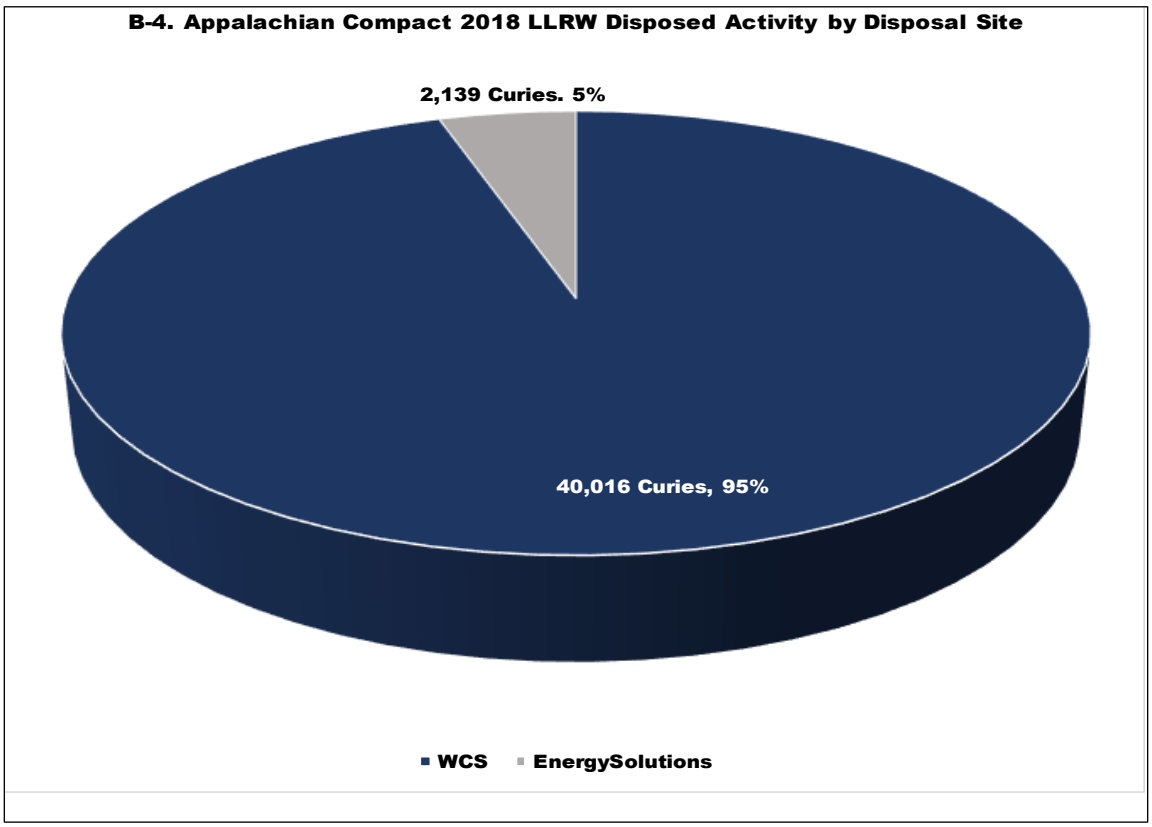


TABLE B-3
Appalachian Compact 2018 LLRW Isotopes Sorted by Isotope

Isotope	Element	Half-life Yr.	Curies
Ac-227	actinium	2.18E+01	0
Ag-108M	silver	1.27E+02	0
Ag-110M	silver	6.82E-01	1.29
Al-26	aluminum	7.16E+05	0
Am-241	americium	4.32E+02	0.05
Am-242M	americium	1.52E+00	0
Am-243	americium	7.37E+03	0
Ba-133	barium	1.05E+01	0.01
Ba-140	barium	3.50E-02	0
Be-7	beryllium	1.46E-01	0.17
Bi-207	bismuth	3.20E+01	0
Bi-210	bismuth	3.00E+06	0
C-14	carbon	5.73E+03	13.66
Ca-45	calcium	4.45E-01	0
Cd-109	cadmium	1.27E+00	2.81
Cd-113M	cadmium	1.36E+01	0
Ce-139	cerium	3.77E-01	0
Ce-141	cerium	8.90E-02	0
Ce-144	cerium	7.78E-01	1.19
Cf-252	californium	2.64E+00	0
Cl-36	chlorine	3.01E+05	0
Cm-242	curium	4.47E-01	0
Cm-243	curium	2.85E+01	0
Cm-244	curium	1.81E+01	0
Co-56	cobalt	2.16E-01	0
Co-57	cobalt	7.42E-01	0.26
Co-58	cobalt	1.94E-01	39.26
Co-60	cobalt	5.27E+00	24,009.12
Cr-51	chromium	7.59E-02	6.16
Cs-134	cesium	2.06E+00	1.51
Cs-137	cesium	3.02E+01	75.78
Eu-152	europium	1.36E+01	0
Eu-154	europium	8.80E+00	0
Eu-155	europium	4.96E+00	0
Fe-55	iron	2.70E+00	14,069.17
Fe-59	iron	1.22E-01	0.81
Gd-153	gadolinium	6.61E-01	0
Ge-68	germanium	7.89E-01	0
H-3	tritium	1.23E+01	66.91
Hf-181	hafnium	1.16E-01	0
Hg-203	mercury	1.28E-01	0
I-125	iodine	1.65E-01	0.07
I-129	iodine	1.57E+07	0
I-131	iodine	2.20E-02	0
In-114M	indium	1.36E-01	0
Ir-192	iridium	2.03E-01	0
K-40	potassium	1.28E+09	0.09
Kr-85	krypton	1.07E+01	0.22
La-140	lanthanum	4.59E-03	0
Mn-53	manganese	3.70E+06	0
Mn-54	manganese	8.56E-01	330.21
Na-22	sodium	2.60E+00	0
Nb-94	niobium	2.03E+04	0.25
Nb-95	niobium	9.60E-02	0.25
Nb-97	niobium	1.37E-04	0
Ni-59	nickel	7.50E+04	16.12
Ni-63	nickel	1.00E+02	3,345.25
Np-237	neptunium	2.14E+06	0
Pa-233	protactinium	7.39E-02	0
Pb-210	lead	2.23E+01	0.07
Pm-147	promethium	2.62E+00	0.08
Po-210	polonium	3.79E-01	0.01
Pu-238	plutonium	8.78E+01	0.06
Pu-239	plutonium	2.41E+04	0.01
Pu-240	plutonium	6.54E+03	0.01
Pu-241	plutonium	1.44E+01	0.24
Pu-242	plutonium	3.76E+05	0
Ra-226	radium	1.60E+03	1.87
Ra-228	radium	5.75E+00	0.15
Rb-83	rubidium	2.36E-01	0
Ru-103	ruthenium	1.08E-01	0
Ru-106	ruthenium	1.01E+00	0
S-35	sulfur	2.39E-01	0.02
Sb-122	antimony	7.39E-03	0
Sb-124	antimony	1.65E-01	0.03
Sb-125	antimony	2.77E+00	1.78
Sc-46	scandium	2.29E-01	0
Sm-151	samarium	9.00E+01	0.1
Sn-113	tin	3.15E-01	0
Sr-85	strontium	1.78E-01	0
Sr-89	strontium	1.38E-01	0.02
Sr-90	strontium	2.86E+01	0.86
Ta-182	tantalum	3.14E-01	0
Tc-99	technetium	2.13E+05	0.09
Te-123M	tellurium	3.28E-01	0
Th-228	thorium	1.91E+00	0.03
Th-229	thorium	7.34E+03	0
Th-230	thorium	7.70E+04	0.01
Th-231	thorium	2.91E-03	0
Th-232	thorium	1.41E+10	0.06
Th-234	thorium	6.60E-02	0
Th-NAT	natural thorium	1.41E+10	0
Tl-202	thallium	3.35E-02	0
Tl-204	thallium	3.78E+00	0
U-234	uranium	2.45E+05	0
U-235	uranium	7.04E+08	0
U-236	uranium	2.34E+07	0
U-238	uranium	4.47E+09	0
U-DEP	depleted uranium	4.47E+09	1.74
U-NAT	natural uranium	4.47E+09	0.03
W-181	tungsten	3.32E-01	0
Xe-127	xenon	9.98E-02	0
Xe-133	xenon	1.44E-02	0
Y-88	yttrium	2.92E-01	0
Zn-65	zinc	6.69E-01	166.75
Zn-88	zinc	2.28E-01	0

CHART B-3 and B-4
Appalachian Compact 2018 Percent Disposed LLRW Volume and Activity by Disposal Site





APPENDIX C

Discussion of Low-Level Radioactive Waste Trends in the Appalachian Compact

The DOE's National Low-Level Waste Management Program's MIMS has been collecting data on LLRW generated in Pennsylvania since 1986. MIMS data can be found on the DOE's website at: http://mims.doe.gov.

The total volume as calculated from the MIMS data for 2018 for the Compact LLRW generators is about 344,184 ft^3. The majority of 2018's LLRW volume was due to decommissioning of the Safety Light Superfund site within PA. During the last ten years, the LLRW volume from the Appalachian Compact has been consistent. However, there have been large increases in the volume of LLRW due to disposal of low activity waste and large decontamination and decommissioning (D&D) projects as in years 2000, 2001, 2016, and 2017. It is difficult to predict the volume of D&D waste because it depends on several factors, such as the timeframe designated for decommissioning activities and decisions made by corporate and regulatory authorities. (See Table and Chart C-1.)

The traditional volume-reduction methods are not effective for most D&D wastes, which generally consist of building debris and soil. On the other hand, most D&D wastes have extremely low radioactivity per volume (also known as low-specific activity). Most of the D&D waste produced in the United States is shipped to the Energy*Solutions* facility in Clive, Utah. Furthermore, most of this low-specific activity D&D waste would not have been disposed of at the proposed Pennsylvania LLRW site due to the proposed design and waste acceptance criteria of the facility.

The 2018 LLRW activity (radioactivity) from the Compact is about 42,155 Ci. The closure of the Barnwell facility to waste disposal from outside the Atlantic Compact has had a significant impact on the activity trend of LLRW in the Compact during the years 2009 through 2013. During these years, only the lower activity Class A waste was disposed of by the Compact's generators at the Energy*Solutions* LLRW site. This is the reason the reported activity of LLRW after 2008 is very low. However, the activity of the Compact's LLRW is trending up after 2013 due to Class B and Class C LLRW disposal access at the WCS site. Most of the Class C waste is contained in irradiated reactor components, which are being stored at the nuclear power plant sites due to high cost of disposal and the annual activity limit on the imported waste at the WCS facility. (See Table and Chart C-2.)

The DOE's MIMS database does not include LLRW disposed of at the Energy*Solutions* facility prior to 1998. This omission of historical data would affect waste generation trend information for volume but would not have a significant impact on the radioactivity of LLRW. This is because, historically, about 99 percent of the Compact's LLRW activity has been shipped to the Barnwell disposal site for burial. The MIMS database includes LLRW volume and activity data for the Barnwell disposal site from 1986 through 2008 for the Compact.

TABLE C-1
Appalachian Compact Disposed LLRW Volume from 1998 to 2018

Year	WV	DE	MD	PA	Total
1998	48.0	173.8	7,604.6	42,686.0	50,512.4
1999	158.7	80.6	8,406.8	143,043.7	151,689.8
2000	53.4	27.6	9,766.8	421,398.1	431,245.9
2001	44.1	76.2	10,759.9	534,429.4	545,309.6
2002	183.3	366.4	6,752.8	55,371.4	62,673.9
2003	151.8	73.5	3,703.1	74,901.0	78,829.4
2004	34.8	48.8	13,177.8	55,136.0	68,397.4
2005	2.4	74.2	107,956.4	91,292.6	199,325.6
2006	38.0	59.2	48,131.8	57,627.7	105,856.7
2007	48.7	42.7	21,015.6	78,454.5	99,561.5
2008	132.2	414.8	6,702.5	113,483.2	120,732.7
2009 *	134.1	431.2	21,451.3	103,666.9	125,683.5
2010 *	11.3	29.4	22,957.6	76,519.4	99,517.7
2011 *	19.1	1,061.0	10,568.7	155,508.5	167,157.3
2012 *	21.0	75.2	12,364.3	122,380.2	134,840.7
2013 *	44.8	339.5	23,597.2	72,066.9	96,048.4
2014**	24.8	42.7	72,334.3	56,040.4	128,442.2
2015**	19.0	45.2	18,202.9	91,222.9	109,490.0
2016**	1.8	4.5	7,349.0	237,858.3	245,213.6
2017**	0.68	34.13	6,588.0	489,265.90	495,888.71
2018**	17.0	0	5,498	338,668	344,184
Total 1998 to 2018	1,188.98	3,500.63	444,889.40	3,411,021.00	grand total 3,860,601.01

Volume is in cubic feet. * 2009 through 2013 LLRW volume only includes disposal at Energy*Solutions* in Clive, Utah. ** 2014 through 2018 volume includes disposal at Energy*Solutions* in Clive, Utah, and WCS in Andrews, Texas. Years 1998 to 2008 include disposal at Barnwell, South Carolina, and Energy*Solutions*, Clive, Utah.

CHART C-1

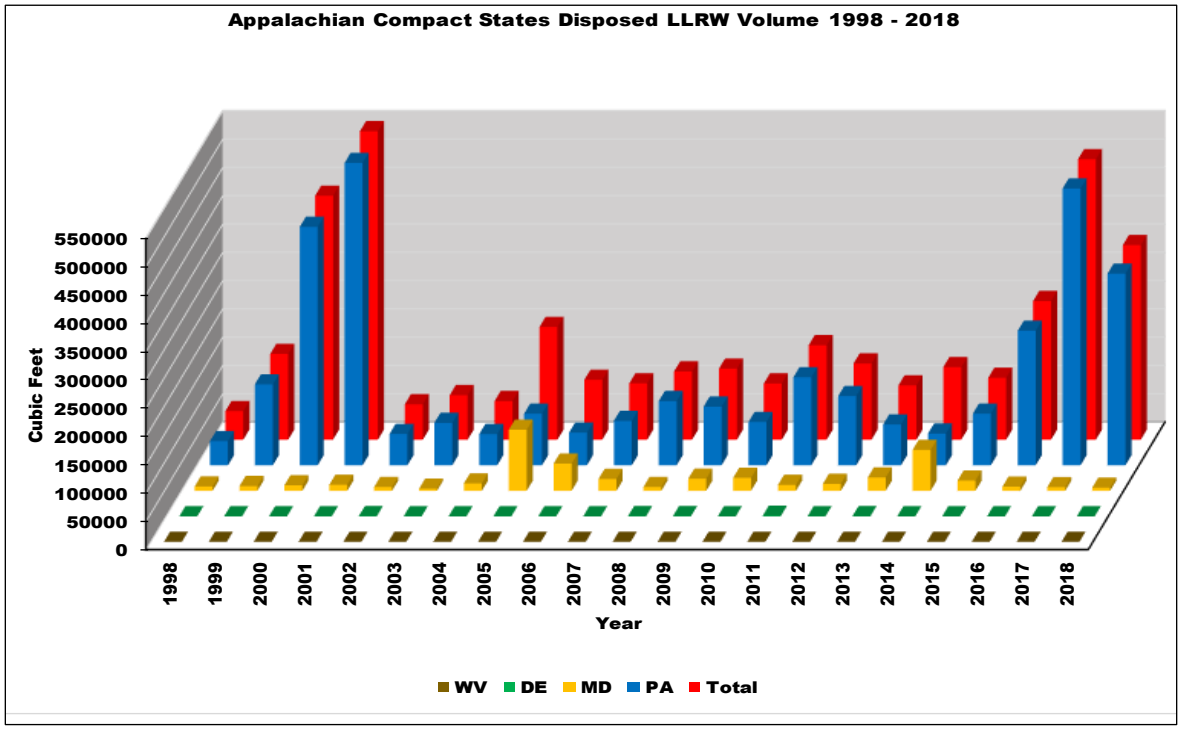
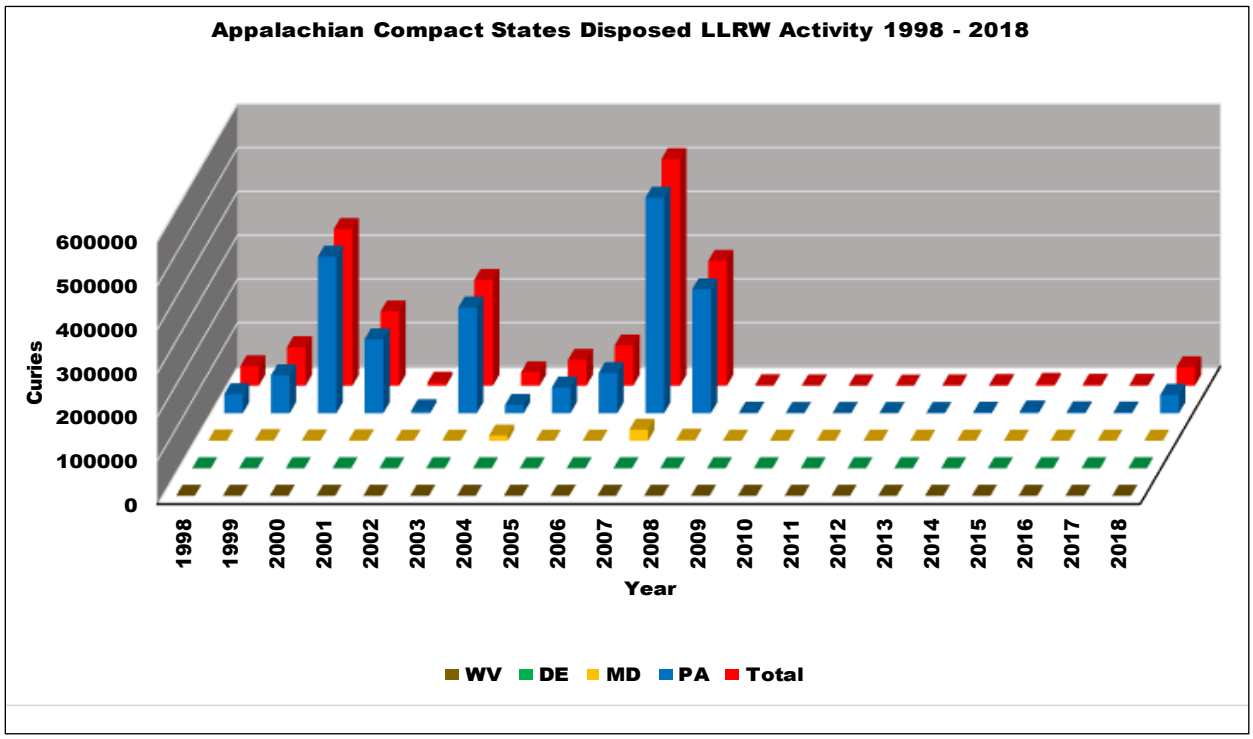


TABLE C-2
Appalachian Compact Disposed LLRW Activity from 1998 to 2018

Year	WV	DE	MD	PA	Total
1998	37.3	0.1	531.5	43,691.0	44,259.9
1999	0.5	0.1	1,335.7	86,618.0	87,954.3
2000	2.2	0.02	484.0	357,624.4	358,110.7
2001	0.03	0.03	903.3	168,919.6	169,822.9
2002	0.1	0.5	244.5	6,777.4	7,022.5
2003	0.2	24.7	166.3	241,649.8	241,840.9
2004	0.8	0.2	11,830.7	18,890.3	30,722.0
2005	0.7	31.3	156.8	58,786.2	58,974.9
2006	0.03	11.9	60.1	91,719.1	91,791.1
2007	0.2	12.9	25,304.7	492,579.3	517,897.0
2008	0.1	12.2	2,181.5	283,328.8	285,522.6
2009 *	0.02	0.5	4.7	1,001.4	1,006.6
2010 *	0.01	0.03	1.4	656.8	658.2
2011 *	0.02	1.0	1.8	492.6	495.5
2012 *	0.003	0.01	2.1	449.3	451.4
2013 *	0.01	45.3	15.7	458.5	519.5
2014**	0.002	0.01	260.7	1,212.8	1,473.5
2015**	0.02	0.007	27.8	4,147.3	4,175.2
2016**	0.35	0.014	209	2,020.93	2,230.29
2017**	0.00001	0.0017	178.52	1,714.26	1,892.78
2018**	0.01	0	125.31	42,029.35	42,155.0
Total 1998 to 2018	42.61	140.82	44,026.13	1,904,767.14	grand total 1,948,976.77

Activity is in curies. * 2009 through 2013 LLRW activity only includes disposal at Energy*Solutions* in Clive, Utah. ** 2014 and 2018 activity includes disposal at Energy*Solutions* in Clive, Utah, and WCS in Andrews, Texas. Years 1998 to 2008 includes disposal at Barnwell, South Carolina, and Energy*Solutions*, Clive, Utah.

CHART C-2



APPENDIX D

Appalachian States Low-Level Radioactive Waste Commission
Financial Statements

APPALACHIAN STATES LOW-LEVEL RADIOACTIVE WASTE COMMISSION

FINANCIAL STATEMENTS

YEARS ENDED JUNE 30, 2018 AND 2017

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INDEPENDENT AUDITOR'S REPORT

Commission Members
Appalachian States Low-Level
Radioactive Waste Commission
Harrisburg, Pennsylvania

Report on the Financial Statements

We have audited the accompanying financial statements of the governmental activities and each major fund of Appalachian States Low-Level Radioactive Waste Commission as of and for the years ended June 30, 2018 and 2017, and the related notes to the financial statements, which collectively comprise the Commission's basic financial statements as listed in the table of contents.

Management's Responsibility for the Financial Statements

Management is responsible for the preparation and fair presentation of these financial statements in accordance with accounting principles generally accepted in the United States of America; this includes the design, implementation, and maintenance of internal control relevant to the preparation and fair presentation of financial statements that are free from material misstatement, whether due to fraud or error.

Auditor's Responsibility

Our responsibility is to express opinions on these financial statements based on our audit. We conducted our audit in accordance with auditing standards generally accepted in the United States of America and the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. Accordingly, we express no such opinion. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of significant accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinions.

400 West Main Street • Mechanicsburg, PA 17055 • 717.766.4763 • Fax 717.766.2731
62 West Pomfret Street • Carlisle, PA 17013 • 717.243.4822 • Fax 717.258.9372
www.greenawalt.cc

Commission Members
Appalachian States Low-Level
Radioactive Waste Commission

Opinions

In our opinion, the financial statements referred to above present fairly, in all material respects, the respective financial position of the governmental activities and each major fund of Appalachian States Low-Level Radioactive Waste Commission as of June 30, 2018 and 2017, and the respective changes in financial position for the years then ended in accordance with accounting principles generally accepted in the United States of America.

Other Matters

Required Supplementary Information

Accounting principles generally accepted in the United States of America require that management's discussion and analysis on pages MDA-1 and MDA-2 and budgetary comparison information on page ORSI-1 be presented to supplement the basic financial statements. Such information, although not a part of the basic financial statements, is required by the Governmental Accounting Standards Board, who considers it to be an essential part of financial reporting for placing the basic financial statements in an appropriate operational, economic, or historical context. We have applied certain limited procedures to the required supplementary information in accordance with auditing standards generally accepted in the United States of America, which consisted of inquiries of management about the methods of preparing the information and comparing the information for consistency with management's responses to our inquiries, the basic financial statements, and other knowledge we obtained during our audit of the basic financial statements. We do not express an opinion or provide any assurance on the information because the limited procedures do not provide us with sufficient evidence to express an opinion or provide any assurance.

Other Reporting Required by *Government Auditing Standards*

In accordance with *Government Auditing Standards*, we have also issued our report dated August 20, 2018, on our consideration of the Commission's internal control over financial reporting and on our tests of its compliance with certain provisions of laws, regulations, contracts and other matters. The purpose of that report is solely to describe the scope of our testing of internal control over financial reporting and compliance and the results of that testing, and not to provide an opinion on the effectiveness of the Commission's internal control over financial reporting or compliance. That report is an integral part of an audit performed in accordance with *Government Auditing Standards* in considering the Commission's internal control over financial reporting and compliance.

Greenawalt & Company, P.C.

GREENAWALT & COMPANY, P.C.

August 20, 2018

Mechanicsburg, Pennsylvania

APPALACHIAN STATES LOW-LEVEL RADIOACTIVE WASTE COMMISSION

MANAGEMENT'S DISCUSSION AND ANALYSIS

JUNE 30, 2018

The General Assembly of the Commonwealth of Pennsylvania created the Appalachian States Low-Level Radioactive Waste Commission (Commission) by enacting the Appalachian States Low-Level Radioactive Waste Compact Act, 1985-120. Under the authority of this act, the states of Delaware, Maryland, West Virginia and the Commonwealth of Pennsylvania formed a compact to provide for the regional management and disposal of Low-Level Radioactive Waste (LLRW). Congress consented to the Appalachian States Low-Level Radioactive Waste Compact in 1988.

The Commission consists of ten members; four members from Pennsylvania and two members from each of the other party states of Maryland, Delaware and West Virginia. The Commission members are appointed according to the laws of each party state. Each party state determined the length of term for which its Members and Alternates are appointed.

The Commission provides for representation of the compact party states throughout the siting process and LLRW disposal facility development and operations. Pennsylvania has been designated as the initial host state for the regional LLRW disposal facility because it generates the largest amount of LLRW in the compact.

In December of 1998, the Pennsylvania Department of Environmental Protection (DEP) suspended the LLRW siting process due to the current availability of out-of-state LLRW disposal facilities and the diminished volume of LLRW that would have been disposed of at the regional LLRW disposal facility in Pennsylvania. As a result, the Commission amended certain provisions of its bylaws to facilitate its continued operations without a business office and transferred the duties and responsibilities of the executive director to the chairman of the Commission. The vice chairman acts as secretary and treasurer of the Commission.

The Commission continues to incur certain expenditures, which are included in the Commission's budget. The budget is reviewed and approved by the Commission at its annual meeting. The Commission's annual expenditures presently exceed its annual interest income from the Operating Fund. The Operating Fund accounts for the general operations of the Commission and is managed by the Pennsylvania Department of Treasury's INVEST Program. At the current level of expenditures, the Operating Fund would be adequate to provide for continued funding of the Commission's expenditures for approximately 5 years. As of June 30, 2018, the Operating Fund had a fund balance of approximately $ 108,000. The Commission's actual expenditures for this period were approximately $ 30,000.

The Commission's annual budget is not expected to vary significantly in the foreseeable future. However, the interest income from the INVEST Program may vary due to economic conditions.

Article II of act 1985-120 allows the Commission to collect fees from the four compact party states for the purpose of continuing its duties and responsibilities. The Act requires that the payments by the party states be made directly to the Commission in quarterly installments during the fiscal year. In 1998, the Commission decided to suspend the collection of the fees due to the suspension of the LLRW siting process and the subsequent closure of its business office. However, the option continues to be available to the Commission should the need arise.

The Commission is not presently involved in any litigation that would have a material adverse effect on the financial position of the Commission. Also, the Commission is tax exempt under the Internal Revenue Code and, accordingly, there is no provision for income taxes in the Commission's financial statements.

As required by Article II of Act 1985-120 and Article VIII of the Commission Bylaws, the Commission prepares and publishes an annual report. The report summarizes the activities of the Commission during the preceding fiscal year, and includes the Independent Auditor's Report on the Commission's basic financial statements.

APPALACHIAN STATES LOW-LEVEL RADIOACTIVE WASTE COMMISSION

STATEMENTS OF NET POSITION
JUNE 30, 2018 AND 2017

	2018	2017
Assets		
Cash	$ 10,951	$ 11,160
Investments	2,820,175	2,825,234
Total assets	2,831,126	2,836,394
Liabilities - none	-	-
Net position		
Unappropriated	10,951	11,160
Appropriated	97,478	126,016
Restricted	2,722,697	2,699,218
Total net position	$ 2,831,126	$ 2,836,394

The accompanying notes are an integral part of these financial statements.

APPALACHIAN STATES LOW-LEVEL RADIOACTIVE WASTE COMMISSION

STATEMENTS OF ACTIVITIES
YEARS ENDED JUNE 30, 2018 AND 2017

	2018	2017
Direct expenses		
Legal services	$ 10,000	$ 10,000
Membership fee	9,500	9,500
Meeting expenses	1,308	1,197
Audit	3,000	3,000
Travel	5,635	3,607
Insurance	200	200
Advertising	566	453
	30,209	27,957
Revenue		
Investment earnings	24,941	11,114
	24,941	11,114
Change in net position	(5,268)	(16,843)
Net position - beginning of the year	2,836,394	2,853,237
Net position - end of the year	$ 2,831,126	$ 2,836,394

The accompanying notes are an integral part of these financial statements.

APPALACHIAN STATES LOW-LEVEL
RADIOACTIVE WASTE COMMISSION
STATEMENTS OF REVENUE, EXPENDITURES
AND CHANGES IN FUND BALANCES - GOVERNMENTAL FUNDS
YEARS ENDED JUNE 30, 2018 AND 2017

	2018			2017		
	Operating Fund	Surcharge Fund	Total	Operating Fund	Surcharge Fund	Total
Revenue						
Investment earnings	$ 1,462	$ 23,479	$ 24,941	$ 837	$ 10,277	$ 11,114
Expenditures						
Legal services	10,000	-	10,000	10,000	-	10,000
Membership fee	9,500	-	9,500	9,500	-	9,500
Meeting expenses	1,308	-	1,308	1,197	-	1,197
Audit	3,000	-	3,000	3,000	-	3,000
Travel	5,635	-	5,635	3,607	-	3,607
Insurance	200	-	200	200	-	200
Advertising	566	-	566	453	-	453
	30,209	-	30,209	27,957	-	27,957
Excess (deficiency) of revenues over expenditures	(28,747)	23,479	(5,268)	(27,120)	10,277	(16,843)
Fund balance - beginning of the year	137,176	2,699,218	2,836,394	164,296	2,688,941	2,853,237
Fund balance - ending of the year	$ 108,429	$ 2,722,697	$ 2,831,126	$ 137,176	$ 2,699,218	$ 2,836,394

The accompanying notes are an integral part of these financial statements.

REPORTING ENTITY

The Appalachian States Low-Level Radioactive Waste Commission was established to meet state responsibilities outlined in the federal Low-Level Radioactive Waste Policy Act of 1980 (P.L. 96-573) and the Low-Level Radioactive Waste Policy Amendments Act of 1985 (P.L. 99-240).

The reporting entity consists of all funds over which the Commission exercises oversight responsibility. Oversight responsibility is determined on the basis of financial interdependency, selection of governing authority, designation of management, ability to significantly influence operations and accountability for fiscal matters and scope of public service. The Commission is not a component unit of any of the Party States and is not included in any of the Party State's financial statements. Additionally, no other component units exist.

SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

Basis of presentation

Entity-wide financial statements (i.e., the statement of net position and the statement of activities) report information on all activities of the Commission.

The statement of activities demonstrates the degree to which the direct expenses are offset by revenues.

Fund financial statements are also presented to show revenues and expenditures of each fund.

Fund accounting

The accounts of the Commission are organized on the basis of funds, each of which is considered a separate accounting entity. The operations of each fund are accounted for with a separate set of self-balancing accounts that comprise its assets, liabilities, fund balance, revenues, and expenditures. Resources are allocated to and accounted for in individual funds based upon the purposes for which they are to be spent and the means by which spending activities are controlled. The Commission has the following funds:

Operating Fund - This fund accounts for the general operations of the Commission.

Surcharge Fund - This fund accounts for the surcharge payments received by the Commission.

Surcharge payments

Surcharge payments came from a disposal surcharge levied by the Federal government on generators of low-level waste. This surcharge was mandated by the 1985 Low-Level Radioactive Waste Policy Amendments Act. The surcharge was to serve as an incentive to regions and states to meet federally set milestones in the development of their own disposal facilities.

SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (Cont'd.)

Income tax

The Commission is exempt under the Internal Revenue Code and, accordingly, there is no provision for income taxes in the accompanying financial statements.

Subsequent events

Management has considered the disclosure of subsequent events through August 20, 2018, and there are no items requiring disclosure.

CASH AND INVESTMENTS

All of the Commission's cash deposits are FDIC insured up to $ 250,000. The Commission does not have a formal policy regarding cash deposits.

All of the Commission's investments are with the Pennsylvania Treasurer's INVEST Program. These amounts are invested directly in a portfolio of securities which are held by third-party custodians. Since the INVEST Program acts in a fiduciary capacity for the Commission and recognizes the Commission as the pledgee of the collateral securities, these investments are considered to be held by the third-party custodians in the Commission's name.

APPROPRIATED NET POSITION

The Commission has appropriated a portion of June 30 net position as follows:

	2018	2017
Fiscal Stabilization Fund	$ 87,478	$ 116,016
Legal Fund	10,000	10,000
	$ 97,478	$ 126,016

Fiscal Stabilization Fund is the money available in the Commission's Operating Fund to replenish the checking account.

Legal Fund is the money allocated for legal services provided by the Commission's independent counsel.

LEGAL SERVICES

Legal services are primarily to assist the Commission in fulfilling its activity as disclosed in the Reporting Entity Note. In the opinion of management, the Commission is not involved in any litigation that would have a material adverse effect on the financial position of the Commission.

OTHER REQUIRED SUPPLEMENTARY INFORMATION

APPALACHIAN STATES LOW-LEVEL RADIOACTIVE WASTE COMMISSION

BUDGETARY COMPARISON INFORMATION - OPERATING FUND
YEAR ENDED JUNE 30, 2018

	Actual	Original Budget	Variance Over (under) Budget
Revenue - Investment earnings	$ 1,462	$ 100	$ 1,362
Expenditures			
Legal services	10,000	10,000	-
Membership fee	9,500	9,500	-
Meeting expenses	1,308	2,000	(692)
Audit	3,000	3,000	-
Travel	5,635	5,000	635
Insurance	200	200	-
Advertising	566	500	66
	30,209	30,200	9
Excess (deficiency) of revenues over expenditures	$ (28,747)	$ (30,100)	$ 1,353

Greenawalt & Company, P.C.

CERTIFIED PUBLIC ACCOUNTANTS

Since 1955

Deborah J. Kelly
Scott J. Christ
Ronald S. Morgan

James E. Lyons
Howard R. Greenawalt

Independent Auditor's Report on Internal Control Over Financial Reporting and on Compliance and Other Matters Based on an Audit of Financial Statements Performed in Accordance With *Government Auditing Standards*

Commission Members
Appalachian States Low-Level
Radioactive Waste Commission
Harrisburg, Pennsylvania

We have audited, in accordance with auditing standards generally accepted in the United States of America and the standards applicable to financial audits contained in *Government Auditing Standards* issued by the Comptroller General of the United States, the financial statements of the governmental activities and each major fund of Appalachian States Low-Level Radioactive Waste Commission, as of and for the year ended June 30, 2018, and the related notes to the financial statements, which collectively comprise the Commission's basic financial statements, and have issued our report thereon dated August 20, 2018.

Internal Control Over Financial Reporting

In planning and performing our audit of the financial statements, we considered the Commission's internal control over financial reporting (internal control) to determine the audit procedures that are appropriate in the circumstances for the purpose of expressing our opinions on the financial statements, but not for the purpose of expressing an opinion on the effectiveness of the Commission's internal control. Accordingly, we do not express an opinion on the effectiveness of the Commission's internal control.

A deficiency in internal control exists when the design or operation of a control does not allow management or employees, in the normal course of performing their assigned functions, to prevent, or detect and correct, misstatements on a timely basis. A material weakness is a deficiency, or combination of deficiencies, in internal control, such that there is a reasonable possibility that a material misstatement of the entity's financial statements will not be prevented, or detected and corrected on a timely basis. A significant deficiency is a deficiency, or a combination of deficiencies, in internal control that is less severe than a material weakness, yet important enough to merit attention by those charged with governance.

Our consideration of internal control was for the limited purpose described in the first paragraph of this section and was not designed to identify all deficiencies in internal control that might be material weaknesses or significant deficiencies. Given these limitations, during our audit we did not identify any deficiencies in internal control that we consider to be material weaknesses. However, material weaknesses may exist that have not been identified.

400 West Main Street • Mechanicsburg, PA 17055 • 717.766.4763 • Fax 717.766.2731
62 West Pomfret Street • Carlisle, PA 17013 • 717.243.4822 • Fax 717.258.9372
www.greenawalt.cc

Independent Auditor's Report on Internal Control Over Financial Reporting and on Compliance and Other Matters Based on an Audit of Financial Statements Performed in Accordance With *Government Auditing Standards* (Cont'd.)

Compliance and Other Matters

As part of obtaining reasonable assurance about whether the Commission's financial statements are free from material misstatement, we performed tests of its compliance with certain provisions of laws, regulations, contracts, noncompliance with which could have a direct and material effect on the determination of financial statement amounts. However, providing an opinion on compliance with those provisions was not an objective of our audit, and accordingly, we do not express such an opinion. The results of our tests disclosed no instances of noncompliance or other matters that are required to be reported under *Government Auditing Standards*.

Purpose of this Report

The purpose of this report is solely to describe the scope of our testing of internal control and compliance and the results of that testing, and not to provide an opinion on the effectiveness of the entity's internal control or on compliance. This report is an integral part of an audit performed in accordance with *Government Auditing Standards* in considering the entity's internal control and compliance. Accordingly, this communication is not suitable for any other purpose.

Greenawalt & Company, P.C.

GREENAWALT & COMPANY, P.C.

August 20, 2018

Mechanicsburg, Pennsylvania

Greenawalt & Company, P.C.

CERTIFIED PUBLIC ACCOUNTANTS

Since 1955

Deborah J. Kelly
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August 20, 2018

Commission Members
Appalachian States Low-Level
Radioactive Waste Commission
Harrisburg, Pennsylvania

We have audited the financial statements of the governmental activities and each major fund of the Appalachian States Low-Level Radioactive Waste Commission for the year ended June 30, 2018. Professional standards require that we provide you with information about our responsibilities under generally accepted auditing standards (and, if applicable, *Government Auditing Standards* and the Uniform Guidance), as well as certain information related to the planned scope and timing of our audit. We have communicated such information in our letter to you dated May 29, 2018. Professional standards also require that we communicate to you the following information related to our audit.

Significant Audit Findings

Qualitative Aspects of Accounting Practices

Management is responsible for the selection and use of appropriate accounting policies. The significant accounting policies used by the Commission are described in the Summary of Significant Accounting Policies note to the financial statements. No new accounting policies were adopted and the application of existing policies was not changed during the year ended June 30, 2018. We noted no transactions entered into by the Commission during the year for which there is a lack of authoritative guidance or consensus. All significant transactions have been recognized in the financial statements in the proper period.

Accounting estimates are an integral part of the financial statements prepared by management and are based on management's knowledge and experience about past and current events and assumptions about future events. Certain accounting estimates are particularly sensitive because of their significance to the financial statements and because of the possibility that future events affecting them may differ significantly from those expected. We noted no items requiring significant accounting estimates.

The financial statement disclosures are neutral, consistent, and clear.

Difficulties Encountered in Performing the Audit

We encountered no significant difficulties in dealing with management in performing and completing our audit.

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Corrected and Uncorrected Misstatements

Professional standards require us to accumulate all known and likely misstatements identified during the audit, other than those that are clearly trivial, and communicate them to the appropriate level of management. Management has corrected all such misstatements. In addition, none of the misstatements detected as a result of audit procedures and corrected by management were material, either individually or in the aggregate, to the financial statements taken as a whole.

Disagreements with Management

For purposes of this letter, a disagreement with management is a financial accounting, reporting, or auditing matter, whether or not resolved to our satisfaction, that could be significant to the financial statements or the auditor's report. We are pleased to report that no such disagreements arose during the course of our audit.

Management Representations

We have requested certain representations from management that are included in the management representation letter dated August 20, 2018.

Management Consultations with Other Independent Accountants

In some cases, management may decide to consult with other accountants about auditing and accounting matters, similar to obtaining a "second opinion" on certain situations. If a consultation involves application of an accounting principle to the Commission's financial statements or a determination of the type of auditor's opinion that may be expressed on those statements, our professional standards require the consulting accountant to check with us to determine that the consultant has all the relevant facts. To our knowledge, there were no such consultations with other accountants.

Other Audit Findings or Issues

We generally discuss a variety of matters, including the application of accounting principles and auditing standards, with management each year prior to retention as the Commission's auditors. However, these discussions occurred in the normal course of our professional relationship and our responses were not a condition to our retention.

Other Matters

We applied certain limited procedures to the budgetary comparison information - operating fund, which is required supplementary information (RSI) that supplements the basic financial statements. Our procedures consisted of inquiries of management regarding the methods of preparing the information and comparing the information for consistency with management's responses to our inquiries, the basic financial statements, and other knowledge we obtained during our audit of the basic financial statements. We did not audit the RSI and do not express an opinion or provide any assurance on the RSI.

Restriction on Use

This information is intended solely for the information and use of Commission Members and Management, and is not intended to be, and should not be, used by anyone other than these specified parties.

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GLOSSARY OF COMMON RADIOACTIVE WASTE TERMS

Glossary of Common Radioactive Waste Terms

Atomic Energy Act (AEA) – This 1954 Act created the federal Atomic Energy Commission (AEC). The AEC later split into the Nuclear Regulatory Commission (NRC) and the Energy Research and Development Administration (ERDA). ERDA then became part of the U.S. Department of Energy (DOE) in 1977. This Act encouraged the development and use of nuclear energy and research for the general welfare and the common defense and security of the United States. It is the basis of authority for the NRC, the DOE, and the U.S. Environmental Protection Agency (EPA) in regulating radioactive materials defined in the AEA. NARM is not defined under this act and, therefore, is not subject to its requirements. (See Glossary entry for "NARM.")

By-product Material – There are three types of by-product materials: (1) any radioactive material (except special nuclear material) yielded in or made radioactive by exposure incident to the process of producing or utilizing special nuclear material; (2) the tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes (underground ore bodies depleted by these solution extraction operations do not constitute "by-product material" within this definition); and (3) the Energy Policy Act in 2005 added discrete Ra-226 sources to the by-product definition. Also included is any other naturally occurring radioactive material made into a discrete source that would pose a similar hazard to an Ra-226 discrete source.

CERCLA (Superfund) – Passed in 1980, the Comprehensive Environmental Response, Compensation and Liability Act (also known as Superfund) addresses immediate and long-term threats to the public's health and the environment from abandoned or active sites contaminated with hazardous or radioactive materials. Under the Superfund program, EPA has the authority to clean up the nation's worst hazardous waste sites using money from a trust fund supported primarily from a tax on chemical feed stocks used by manufacturers. Companies or individuals responsible for the wastes are identified by EPA, if possible, and made to pay for the cleanups. The Superfund Amendments and Reauthorization Act (SARA) of 1986 authorized CERCLA to continue cleanup activities around the country. Several site-specific amendments, definitions, clarifications, and technical requirements were added to the legislation, including additional enforcement authorities. Title III of SARA also authorized the Emergency Planning and Community Right-to-Know Act (EPCRA).

CFR – Code of Federal Regulations.

Class A Waste – Waste that is usually segregated from other waste classes at the disposal site. The physical form and characteristics of Class A waste must meet the minimum requirements set forth in 10 CFR 61.56(a). If Class A waste also meets the stability requirements set forth in 10 CFR 61.56(b), it is not necessary to segregate the waste for disposal.

Class B Waste – Waste that must meet more rigorous requirements on waste form to ensure stability after disposal. The physical form and characteristics of Class B waste must meet both the minimum and stability requirements set forth in 10 CFR 61.56.

Class C Waste – Waste that not only must meet more rigorous requirements on waste form to ensure stability but also requires additional measures at the disposal facility to protect against inadvertent intrusion. The physical form and characteristics of Class C waste must meet both the minimum and stability requirements set forth in 10 CFR 61.56.

Curie (Ci) – Radioactive atoms are unstable and break down by disintegrating into other atoms. A curie is the unit of radioactivity equal to 3.7×10^{10} disintegrations per second or 3.7×10^{10} becquerel (Bq). A common unit used in environmental measurements is the picocurie (pCi), which is equal to 10^{-12} Ci or disintegrations per second or 0.037 Bq.

Department of Energy (DOE) – This federal agency's mission is to achieve efficiency in energy use, diversity in energy sources, a more productive and competitive economy, improved environmental quality,

and a secure national defense. DOE was created on Oct. 1, 1977, out of the Energy Research and Development Agency, as well as various aspects of non-nuclear federal energy policy and programs. The DOE complex, which is located across 22 states, produced and tested nuclear weapons. For more information, visit DOE's website at www.doe.gov.

Energy*Solutions* – A company that operates a LLRW disposal facility in Clive, Utah.

Environmental Protection Agency (EPA) – Created in 1970, the federal EPA is responsible for working with state and local governments to control and prevent pollution in areas of solid and hazardous waste, pesticides, water, air, drinking water, and toxic and radioactive substances.

Federal Facilities Compliance Act (FFCA or FFCAct) – An amendment to Resource Conservation and Recovery Act (RCRA), the FFCA waives immunity for DOE and other federal agencies, allowing states and the EPA to impose penalties for non-compliance, and requires DOE to develop plans for treating hazardous components of radioactive wastes subject to RCRA requirements.

Half-Life – The half-life of a radioactive material is the time it takes for half of the material to radiate energetic particles and rays and transform into new materials. For example, the half-life of cesium (Cs-137) is 30 years, after which time half of it decays to a non-radioactive stable nuclide, barium (Ba-137). If one starts with 100 Kg of Cs-137, 50 Kg of Cs-137 remain after 30 years.

Hazardous Waste – A subset of solid wastes that poses substantial or potential threats to public health or the environment and meets any of the following criteria identified in 40 CFR Parts 260 and 261:

- Is specifically listed as a hazardous waste by EPA;
- Exhibits one or more of the characteristics of hazardous waste (ignitability, corrosivity, reactivity, and/or toxicity); or
- Is generated by the treatment of hazardous waste or is contained in a hazardous waste.

Hazardous and Solid Waste Amendments (HSWA) – This 1984 Act amended RCRA and required the phasing out of land disposal of untreated hazardous waste by more stringent hazardous waste management standards (broken down into thirds with a timetable for each third). Some of the other mandates of this law include increased enforcement authority for EPA and a program requiring corrective action.

High-Level Radioactive Waste (HLW) – The radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly from reprocessing, and any solid waste derived from the liquid that contains a combination of transuranic and fission product nuclides in quantities that require permanent isolation. HLW is also a mixed waste because it has highly corrosive components or has organics or heavy metals that are regulated under RCRA. HLW may include other highly radioactive material that NRC determines by rule, consistent with existing law, requires permanent isolation.

Heavy Metal (RCRA Metals) – This is a common hazardous waste that can damage organisms at low concentrations and tends to accumulate in the food chain. Examples are lead, chromium, cadmium, and mercury.

Land Disposal Restrictions (LDR) – These restrictions were mandated by the 1984 HSWA amendments to RCRA. They prohibit the disposal of hazardous wastes into or on the land unless the waste meets treatability standards of lower toxicity.

Liquid Scintillation Cocktail (LSC) – A common fluid used in medical laboratories to analyze DNA and proteins. It often uses radioactive tracers and RCRA-listed hazardous materials such as Toluene and Xylene. The combinations of the two make it a mixed waste. By volume, it is the most common form of commercially generated (non-DOE) mixed waste (71 percent in a 1990 national study).

Low-Level Mixed Waste (LLMW) – LLMW is waste that contains LLRW and hazardous waste.

Low-Level Radioactive Waste (LLRW or LLW) – LLRW is waste that satisfies the definition of LLRW in the Low-Level Radioactive Waste Policy Amendments Act (LLRWPAA) of 1985. The LLRWPAA defines LLRW as "radioactive material that (A) is not high-level radioactive waste, spent nuclear fuel, or byproduct material as defined in Section 11e.2 of the Atomic Energy Act of 1954; and (B) which the NRC, consistent with existing law and in accordance with paragraph (A), classifies as low-level radioactive waste."

Manifest Information Management System (**MIMS**) **–** It is a database used to monitor the management of commercial low-level radioactive waste (LLW) in the United States and is operated by the U.S. Department of Energy.

Mixed Transuranic Waste (MTRU) – MTRU contains both transuranic (TRU) and hazardous wastes. Approximately 55 percent of DOE's TRU is MTRU.

Mixed Waste (MW) – MW contains both hazardous waste (as defined by RCRA and its amendments) and radioactive waste (as defined by AEA and its amendments). The NRC or the NRC's agreement states and EPA or EPA's RCRA authorized states jointly regulate mixed waste. The fundamental and most comprehensive statutory definition is found in the Federal Facilities Compliance Act (FFCA), where Section 1004(41) was added to RCRA: "The term 'mixed waste' means waste that contains both hazardous waste and source, special nuclear or byproduct material subject to the Atomic Energy Act of 1954."

Naturally Occurring or Accelerator-Produced Radioactive Materials (NARM) – Radioactive materials not covered under the AEA that are naturally occurring or produced by an accelerator. Accelerators are used in sub-atomic particle physics research. These materials have been traditionally regulated by the states. A subset of NARM is NORM. NARM waste with more than 2 nCi/g of Ra-226 or equivalent is commonly referred to as discrete NARM waste; below this threshold the waste is referred to as diffuse NARM waste. Naturally occurring radionuclides made into sources (discrete NARM) may be classified as by-product material under the Energy Policy Act of 2005.

Naturally Occurring Radioactive Material (**NORM) –** Naturally occurring radioactive material is a radioisotope that is radioactive in its natural physical state, not man-made, but does not include source or special nuclear material.

Nuclear Regulatory Commission (NRC) – NRC is an independent regulatory agency created out of the Atomic Energy Commission in 1975 to regulate the civilian uses of nuclear material. Specifically, the NRC is responsible for ensuring that activities associated with the operation of nuclear power plants and fuel cycle plants, and medical, industrial, and research applications are carried out with adequate protection of the public health and safety, environment, and national security. At full complement, the NRC has five commissioners nominated by the President and confirmed by the Senate. The President designates one of the commissioners as Chairman. NRC regulates all commercial AEA materials. Except in a few cases, NRC does not regulate DOE. NRC does not regulate NARM. This site (http://www.nrc.gov) will link you to NRC's home page.

Resource Conservation and Recovery Act (RCRA) – RCRA gave EPA authority to control hazardous waste from "cradle-to-grave." This includes the minimization, generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes. RCRA focuses only on active and future facilities and does not address abandoned or historical sites (see CERCLA).

Rad (Radiation Absorbed Dose) – One rad is defined as the absorption of 100 ergs per gram of material. The unit rad can be used for any type of radiation. The rad is a unit used to measure a quantity called absorbed dose. This relates to the amount of energy absorbed in some material and is used for any type of radiation and any material.

Radiation – Ionizing radiation is comprised of highly energetic and penetrating X-rays and gamma rays and lesser penetrating particles. Beta particles are simply energetic electrons, and alpha particles are helium nuclei both arising from the nucleus of a decaying atom. The alpha particle is the easiest of these radiations to stop and the gamma rays are the most difficult to shield against. A piece of paper can stop an alpha particle, but it may take as much as many inches of lead shielding to stop most of the X-rays or gamma rays in a beam. Depending on the dose, kind of radiation, and observed endpoint, the biological effects of radiation can differ widely. Ionizing radiation has been proven to cause cancer at high doses and is assumed to cause cancer and other deleterious health effects at low doses.

Rem (Roentgen Equivalent Man) – The rem is a unit used to derive a quantity called equivalent dose. This relates the absorbed dose in human tissue to the effective biological damage of the radiation. Equivalent dose is often expressed in terms of thousandths of a rem or mrem.

Solid Waste – As defined under RCRA, any solid, semi-solid, liquid, or contained gaseous materials discarded from industrial, commercial, mining, agricultural operations and from community activities. Solid waste includes garbage, construction debris, commercial refuse, sludge from water supply or waste treatment plants, or air pollution control facilities and other discarded materials. Solid waste does not include solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits under Section 402 of the Clean Water Act or source, special nuclear, or byproduct material as defined by the AEA.

Source Material – Source material is the uranium or thorium ores mined from the earth. Source material is defined in 10 CFR 20.1003 as "(1) uranium or thorium or any combination of uranium and thorium in any physical or chemical form; or (2) ores that contain, by weight, one-twentieth of one percent (0.05 percent) or more of uranium, thorium, or any combination of uranium and thorium. Source material does not include special nuclear material."

Special Nuclear Material (SNM) – SNM is defined in 10 CFR 20.1003 as "(1) plutonium, uranium-233, uranium enriched in the isotope 233 or in isotope 235, and any other material that the NRC, pursuant to the provisions of Section 51 of the AEA, determines to be SNM, but does not include source material; (2) or any material artificially enriched by any of the foregoing but does not include source material." SNM is important in the fabrication of weapons-grade materials and, as such, has strict licensing and handling controls.

Specific Activity – The amount of radioactivity per unit weight or volume.

Spent Nuclear Fuel (SNF) – Fuel is withdrawn from a nuclear reactor following irradiation and has undergone at least one year's decay since being used as a source of energy in a power reactor. SNF has not been chemically separated from its constituent elements by reprocessing. SNF includes the special nuclear material, byproduct material, source material, and other radioactive materials associated with fuel assemblies. See 10 CFR 72.3 for more details.

Superfund - See "CERCLA."

Storage-in-Decay – Radioactive elements will break down and yield energetic gamma rays, X-rays, and particles. After enough time has elapsed (usually ten half-lives), the material has decayed to a point where a radiation survey meter cannot distinguish between it and natural background radiation levels.

TENORM – Technologically enhanced naturally occurring radioactive materials. It is naturally occurring radioactive material not specifically subject to regulation under the laws of the Commonwealth or Atomic Energy Act (Public Law 83-703, 68 Stat. 921, 42 U.S.C. § 2015 et seq.), but whose radionuclide concentrations or potential for human exposure have been increased above levels encountered in the undisturbed natural environment by human activities.

Transuranic Radioactive Waste (TRU) – TRU waste contains more than 100 nanocuries of alpha-emitting transuranic isotopes with half-lives greater than 20 years per gram of waste except for

(1) high-level radioactive waste; (2) wastes that DOE has determined, with the concurrence of EPA, do not need the degree of isolation required by EPA's high-level waste rule (40 CFR 191); or (3) waste that has been approved for disposal on a case-by-case basis in accordance with NRC's radioactive land disposal regulation (10 CFR Part 61). TRU is not generally found outside the DOE complex and is mainly produced from the reprocessing of spent nuclear fuel, nuclear weapons production, and reactor fuel assembly. TRU wastes mainly emit alpha particles as they break down. DOE is currently proceeding with plans for TRU waste disposal at a geologic repository called the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. DOE categorizes TRU as either contact handled (CH) or remote handled (RH) with RH being the more radioactive of the two.

Vitrification – Vitrification is the process of converting materials into a glass-like substance, typically through a thermal process. Radionuclides and other inorganics are chemically bonded in the glass matrix. Consequently, vitrified materials generally perform very well in leach tests. EPA has specified, under the land disposal restrictions, vitrification to be the treatment technology for high-level waste (55 FR 22627, June 1, 1990).

Waste Control Specialists LLC (WCS) – A company that operates a LLRW, byproducts and hazardous waste disposal facility in Andrews, Texas. The facility is within the jurisdiction of the Texas Low-Level Radioactive Waste Disposal Compact (member states are Texas and Vermont).

Waste Isolation Pilot Plant (WIPP) – The WIPP, which is managed by the DOE, is a geologic disposal facility for TRU radioactive waste generated as by-products from DOE's nuclear weapons production. The WIPP is located underground in excavated, natural salt formations near Carlsbad, New Mexico.

Commonwealth of Pennsylvania
Department of Environmental Protection
Bureau of Radiation Protection
P.O. Box 8469
Harrisburg, PA 17105-8469
717-787-2480

Low-Level Radioactive Waste Hot Line (within PA)
800-232-2786

For more information, visit www.dep.pa.gov

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

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