IMPROVING THE REGULATION AND MANAGEMENT OF LOW-ACTIVITY RADIOACTIVE WASTES

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ABSTRACT

This paper summarizes the first phase of a study in progress by a committee of the National Academies' Board on Radioactive Waste Management. The Board initiated the study after observing that statutes and regulations administered by the federal and state agencies that control low-activity radioactive wastes have developed as a patchwork over almost 60 years and usually reflect the enterprise or process that produced the waste rather than the waste's radiological hazard. Inconsistencies in the regulatory patchwork or its application may have led to overly restrictive controls for some low-activity wastes but the relative neglect of others. In the first phase of this study, the committee reviewed current low-activity waste inventories, regulations, and management practices. This led the committee to develop five categories that encompass the spectrum of low-activity wastes and serve to illustrate gaps and inconsistencies in current regulations and management practices. The committee completed its first phase with four findings that will lead into the final phase of the study. This paper is excerpted from the committee's interim report that was issued in October 2003.

INTRODUCTION

This study was initiated by the National Academies' Board on Radioactive Waste Management (the Board),[a] which observed that statutes and regulations administered by the federal and state agencies that control low-activity wastes have developed in an ad hoc manner over almost 60 years since passage of the Atomic Energy Act of 1946 (McMahon Act). These controls usually reflect the waste's origin—national defense, nuclear power, other industries, research, medicine, or natural sources—rather than its radiological hazard. In some cases, inconsistencies in the regulatory patchwork or its application may have led to overly restrictive regulation, resulting in excessive costs and other burdens on waste generators. In other cases, some wastes may present greater potential risks to the public than are generally recognized. To conduct the study, the Board obtained funding from five sponsors and nominated a study committee of independent, volunteer experts (see Acknowledgements section).[b] This paper is excerpted from the committee's interim report (NRC, 2003).

The Board intended the term "low-activity waste" to include the spectrum of low-activity materials declared as wastes.[c] These wastes generally contain lower levels of radioactive material and present less of a hazard to public and environmental health than spent nuclear fuel, high-level waste from chemical processing of spent fuel, or transuranic wastes—all of which are clearly defined in federal statutes and tightly regulated. However, low-activity wastes may contain long-lived radionuclides at well above background levels, and may represent a significant chronic (and, in some cases, an acute) hazard to public and environmental health.

FEDERAL AND STATE CONTROL OF LOW-ACTIVITY WASTES

The main federal statutes applicable to low-activity wastes include the Atomic Energy Act of 1954 (AEA), as amended, the Nuclear Waste Policy Act of 1982 (NWPA), as amended, the Low-Level Radioactive Waste Policy Act of 1980 (LLRWPA), as amended, and the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA). The committee noted that the AEA maintained the definitions introduced in the McMahon Act, which were established before the health hazards of radiation were fully appreciated and security of nuclear materials was the overriding concern. Much low-activity waste meets the definition of low-level waste given in the NWPA and LLRWPA.[d]

Low-level wastes generated or disposed in the commercial sector are regulated by the Nuclear Regulatory Commission (USNRC) under its authority to license nuclear facilities and the possession of nuclear materials. The Environmental Protection Agency (EPA) has authority to regulate environmental radiation exposure as well as hazardous chemical wastes. Wastes that contain both radionuclides and hazardous chemicals are referred to as "mixed wastes" and may be subject to regulation by both the USNRC and EPA. The Department of Energy (DOE) is self-regulating for defense wastes on its own sites. The Department of Transportation regulates the shipment of radioactive materials while the USNRC has the authority to regulate certain packages for transportation of nuclear materials.

Uranium- and thorium-contaminated wastes produced after UMTRCA was passed in 1978 must be disposed in USNRC-licensed radioactive waste facilities.[e] Other disposal options exist for essentially the same materials produced before UMTRCA. A large amount of pre-UMTRCA wastes were produced by the former Atomic Energy Commission and are now managed under the Formerly Utilized Sites Remedial Action Program (FUSRAP).

The states have several responsibilities with regard to low-activity wastes. The LLRWPA makes each state responsible for disposing of its own low-level waste and encourages the formation of state compacts (congressionally ratified agreements among groups of states) to provide disposal facilities. States may assume portions of the USNRC's regulatory authority by becoming a USNRC Agreement State.[f] In addition, the states regulate non-AEA wastes because these wastes are not covered by federal statutes. Especially important for the states is their regulation of naturally occurring radioactive materials (NORM) and technologically enhanced NORM (TENORM) from activities including mining, oil and gas production, and water treatment.

THE COMMITTEE'S CATEGORIZATION OF LOW-ACTIVITY WASTES

Given the spectrum of low-activity wastes and their patchwork of federal and state controls, the committee sought to develop a concise list of categories that would include essentially all low-activity wastes,[g] yet by focusing on their inherent radiological properties rather than their origins, emphasize gaps and inconsistencies between their current regulation and management and their actual radiological hazards. The committee agreed that five categories suffice to provide an instructive and inclusive categorization low-activity radioactive wastes in the United States.

The first three categories include wastes defined and regulated as "low-level wastes." Although their regulatory requirements are essentially the same, the wastes are very different in their radiological and physical characteristics.

- Wastes containing types and quantities of radioactive materials that fit well within the USNRC classification system for low-level waste, e.g., Class A, B, and C. These include wastes from nuclear utilities, other industries, medicine, and research that are disposed in USNRC-licensed, commercially operated facilities ("commercial low-level waste"), and similar wastes produced and disposed at DOE sites ("defense low-level waste").

- Slightly radioactive solid materials (SRSM)—debris, rubble, and contaminated soils from nuclear facility decommissioning and site cleanup.[h] They arise in very large volumes but produce very low or practically undetectable levels of radiation. They fall at the very bottom of USNRC Class A (the lowest of the classes).

- Discrete sources—out-of-service radiation sources and associated materials from industrial, medical, and research applications. Although they meet the statutory definition of low-level waste, they may emit high enough levels of radiation to cause acute effects in humans or serious contamination incidents.[i] Larger sources may exceed USNRC Class C (the highest of the classes).

Differences in the radiological hazards among wastes in these first three waste categories are not adequately recognized by the broad statutory definitions of low-level waste. At the low end, radioactivity in the very large volumes of debris, rubble, and soil is so low it is often difficult to measure. Recognizing this, the USNRC has initiated a rulemaking on alternative dispositions for SRSM. Both the EPA and USNRC are considering allowing the use of hazardous waste landfills for these materials.[j] At the opposite extreme, discrete sources declared as waste are often highly radioactive and have the potential to produce acute radiation effects and serious contamination incidents. The larger sources exceed USNRC Class C limits on near-surface disposal, and in the absence of a geological repository (e.g., Yucca Mountain if licensed and constructed) have no present means of disposal.

The last two categories illustrate wastes that are similar in their radiological and physical properties, but their regulation is very different.

- Uranium and thorium ore processing wastes. These wastes have been produced in large volumes from the recovery of uranium and thorium for nuclear applications and are therefore federally controlled under the AEA. Their radiological hazards arise not only from radioactive uranium and thorium isotopes, but also from their radioactive decay products, especially radium, which can migrate into drinking water, and radon, which is a gas.

- NORM and TENORM wastes. These wastes arise coincidentally from the recovery of natural resources (extraction of rare earth minerals and other mining operations, oil, and gas) and water treatment. Like uranium and thorium wastes, they arise in large volumes and their radiological hazards result from uranium, thorium, and their radioactive decay products, radium and radon. NORM and TENORM are not controlled by the AEA, but mainly by the individual states.

While the AEA wastes in the first four categories receive a great deal of public attention and concern, there appears to be little public recognition of potential radiological hazards of NORM and TENORM wastes. However, these materials may well be more radioactive than carefully regulated SRSM (see Sidebar I) or other AEA wastes.

LOW-ACTIVITY WASTE OVERVIEW

The committee used its categorization of low-activity waste as the framework for an overview of waste inventories and management practices in the United States. Among these wastes, low-level wastes from DOE and commercial nuclear facilities have received the most attention from regulators and the public.

Although similar in their characteristics, DOE "defense" low-level waste and commercial low-level waste are generally managed and regulated separately according to their respective origins in the DOE or private sector.

Tailings and other wastes from mining and processing uranium and thorium ores have been produced in very large quantities. Like low-level waste, uranium and thorium wastes are subject to the AEA, but concern about them has been limited mainly to populations living around mining and milling sites—including Native Americans. Equally large or larger volumes of

SIDEBAR I. NUCLEAR POWER WASTE VERSUS NORM

The Big Rock Point (BRP) nuclear power plant, located in northern Michigan is in the midst of decommissioning. In 2001, BRP officials approached the USNRC, seeking approval for disposing of large quantities of concrete rubble from the decommissioning project in a municipal landfill in northern Michigan.

They proposed a waste characterization and monitoring protocol that would assure that no concrete rubble would go to the landfill if any appreciable quantity of radioactivity were present. All surfaces would be scanned for contamination at predetermined release limits. Any contamination would be removed. Then, the concrete would be rubblized and bulk scanned. A 5 picocurie above background per gram of rubble cut-off value for approving or rejecting a particular load would be established. The USNRC approved the proposal under the authority of 10 CFR section 20.2002, which gives USNRC the authority to approve disposal for low-level waste other than in a licensed low-level waste facility. The plan also was approved by the Michigan Department of Environmental Quality

The BRP personnel worked closely with the landfill owner and the township board in the rural community where the landfill is located, to assure all that the disposal of their decommissioning waste would be fully protective of the environment and the public. In general, BRP efforts were fairly successful in assuaging public concerns, though some reluctance to taking nuclear power plant waste remains in the minds of some local community residents and township board members. Michigan Department of Environmental Quality representatives had pointed out that there are other things going into the landfill that contain more radioactive material than the rubble. In fact, the coal ash that is used as daily cover for the cells show radioactive material concentrations in the range of 13 picocuries of radium per gram of ash.

Recently, the landfill operator installed portal monitors at the landfill, in preparation for accepting the decommissioning rubble. However, the portal monitor alarm has been tripped when certain loads of oil- and gas-production sludges and coal ash have been brought to the landfill. This material has been coming to the landfill for years, without any recognition of its radiological content. The landfill operator is developing operational procedures for determining when to refuse a load, which has tripped the portal alarm. The Michigan Low-Level Waste Authority has requested, and the landfill operator has agreed, to keep a log of all shipments that trip the portal alarms to develop a better sense of radioactive materials entering the landfill.

Source: Michigan Department of Environmental Quality.

NORM and TENORM wastes, which are radiologically similar to uranium and thorium wastes, are produced in the recovery of natural resources for non-nuclear purposes (mining, oil and gas production) and water treatment. NORM and TENORM wastes are not subject to the AEA, there has been almost no public concern about them, and there is no consistent system for regulating them.

Commercial Low-level Waste

Commercial low-level waste comes from nuclear power facilities and other industrial, medical, and research applications. Typical examples include protective shoe coverings and clothing, mops, rags, equipment and tools, laboratory apparatus, process equipment, reactor water treatment residues, non-fuel-bearing hardware, and some decontamination and decommissioning wastes. Low-level radioactive wastes are produced in essentially every state. With a few exceptions, the radionuclides contained in commercial low-level waste are relatively short-lived fission products.

The 1978 revision of the AEA gave the USNRC authority to regulate wastes from the private sector. Defense low-level waste becomes subject to USNRC regulations if it is shipped for disposal in a commercial facility. In its regulations governing the disposal of commercial low-level waste, the USNRC defines three classes (A—the least hazardous—B, and C) based largely on the concentrations and half-lives of radionuclides in the waste. High or essentially unrestricted concentrations of radionuclides with half-lives less than 5 years are allowed, concentrations of some specific fission and activation products with longer half-lives are restricted, and concentrations of transuranic nuclides with half-lives greater than 5 years are limited to 100 nanocuries/gram (nCi/g). The vast majority of the volume of commercial low-level waste consists of USNRC Class A waste.

The Manifest Information Management System (MIMS) provides information on waste shipments to commercial disposal facilities (Barnwell, South Carolina; Clive, Utah; and Richland, Washington).[k] According to MIMS, approximately 600,000 cubic meters of waste containing almost 9 million curies of radioactivity were disposed from 1989 through 2001 (see Figures I and II). The vast majority of the waste, some 85 percent of the volume and the curies, came from nuclear utilities. Wastes from other industries amounted to about 7 percent of the volume and the curies. Wastes received from DOE sites made up most of the remainder. Wastes from medical and academic origins amounted to less than 1 percent of the volumes and curies disposed.

The trend toward volume reduction begun in the mid-1990s resulted from significant efforts to reduce waste production and to further reduce volume by compaction and super compaction of waste. The substantial volume increase beginning in 1998 reflects the large amounts of slightly contaminated soils, debris, and rubble that Envirocare of Utah began receiving in that year. The waste sent to Envirocare, however, contained less that 1 percent of the curies disposed.

DOE Defense Low-level Waste

Defense low-level waste has been generated in the course of producing or using special nuclear materials throughout the DOE complex, including fuel fabrication, reactor operation, and isotope separation and enrichment, and it continues to be produced in site cleanup work.[l] In general terms, DOE low-level waste is quite similar to commercial low-level waste except that some radionuclides specific to nuclear fuel reprocessing appear in higher quantities. For example, some DOE low-level waste contains transuranic isotopes, mainly plutonium, at concentrations between 10 and 100 nCi/g. DOE is self-regulating for wastes generated and disposed at its sites. Onsite wastes that do not fit into other waste categories defined by Order 435.1 are managed and disposed as low-level waste. DOE low-level waste shipped to commercial facilities is subject to the USNRC's or the Agreement State's commercial waste regulations.

Cumulatively through fiscal year (FY) 1999, DOE had disposed an estimated total volume of 5.8 million cubic meters of low-level waste and contaminated media containing almost 50 million curies. In FY-2000, DOE treated about 833,000 cubic meters of low-level waste and disposed about 40,000 cubic meters. DOE disposed another 29,000 cubic meters in commercial facilities. The treated and subsequently disposed waste volumes were about equal to new additions, so the beginning and year-end inventory remained almost constant at about 146,000 cubic meters. DOE estimates that another 2 million cubic meters will be disposed by 2070 (DOE, 2001; CID, 2003).

Slightly Radioactive Solid Materials

Nuclear facility decommissioning produces debris, rubble, and contaminated soil characterized by large volumes of materials having small quantities of radioactive contamination—including concrete, plastics, metals and other building materials, equipment, and packaging. A previous study (NRC, 2002) introduced the term "slightly radioactive solid materials" (SRSM) to describe these wastes. They are produced in both the DOE and commercial sectors.

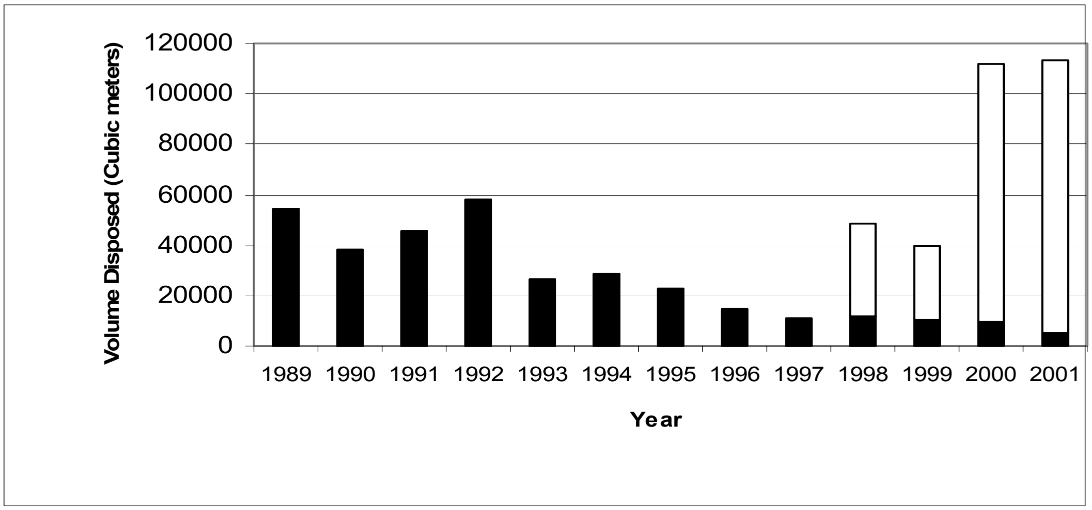

Fig. 1 Volumes of Low-Level Waste Disposed at Commercial Sites. Upper bars beginning in 1998 are very-low-level wastes received at Envirocare of Utah.
Source: MIMS, 2003.

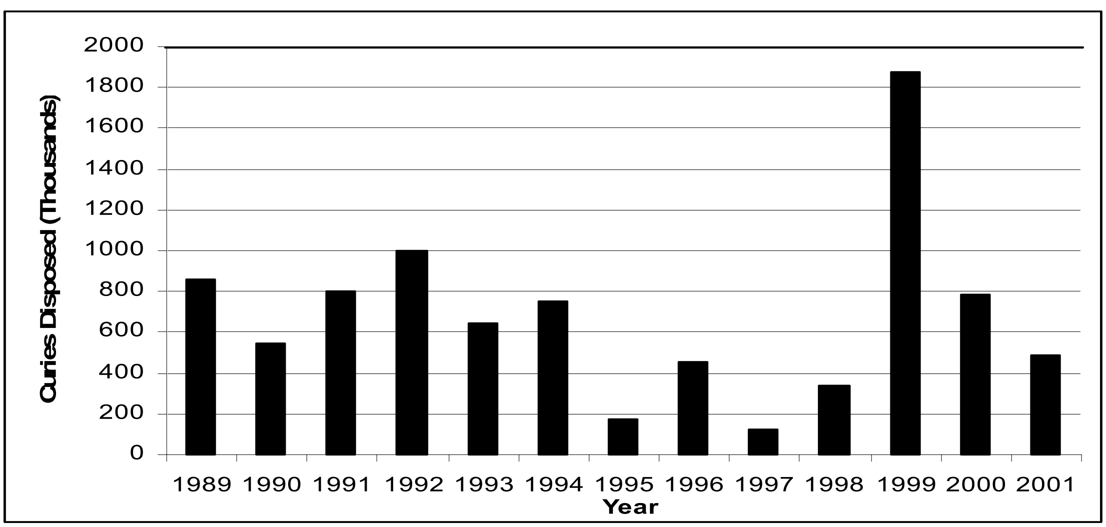

Fig. 2 Curies of Low-Level Waste Disposed at Commercial Sites.
Source: MIMS, 2003.

Decommissioning the existing commercial power reactor facilities may generate up to about 8 million cubic meters of SRSM, about 90 percent being concrete. These same facilities may also yield around million metric tons of metallic SRSM (NRC, 2002). DOE estimates that about 700 of its reactor and processing facilities will be fully decommissioned in the course of site cleanup (NRC, 1998). DOE also estimates that about 821,000 cubic meters of solid contaminated media may be excavated during its site cleanup activities between 2000 and 2010 (DOE, 2001).

Currently SRSM are regulated and disposed as USNRC Class A wastes, which means they must be disposed in USNRC licensed facilities (or their equivalent at DOE sites). However, these wastes usually contain very small amounts of radioactivity. Debris and rubble sent to Envirocare amounted to about 90 percent of the total low-level waste volume disposed in 2000, but amounted to only about 1 percent of the radioactivity (MIMS, 2003). The USNRC and its Agreement States have allowed alternative disposal pathways (e.g., in permitted landfills) on a case-by-case basis (USNRC, 2002). Both the EPA and USNRC are investigating alternative disposition options for these wastes.

Discrete Radiation Sources

Discrete radiation sources usually consist of a radioactive material in a leak-tight metal casing. The amount and type of radioactive material used (e.g., Co-60, Sr-90, Cs-137, Ir-192, Cf-252, Am-241) determine the type and intensity of emitted radiation. Sealed sources have essential uses in medical diagnostics and therapy, industry (radiography, well logging), and research. Over the course of time, radioactive decay may reduce their intensity below a useful level, or the application may become obsolete—such as the use of Ra-226 in medicine or Cs-137 irradiators. Unused radioactive sources are often referred to as "spent" sealed sources although they may continue to present a significant radiation hazard if not properly stored or disposed (IAEA, 2001).

Sealed sources in commercial use are licensed by the USNRC or an Agreement State. DOE controls sealed sources used at its sites. As a practical matter, however, the identifying marks and records on many sealed sources, especially older sources, are sometimes lost and the sources themselves may become lost or "orphaned." According to EPA estimates, there are over 30,000 orphan sources in the United States. In cooperation with the Conference of Radiation Control Program Directors (CRCPD), the EPA, USNRC, and DOE are funding a program to assist states to retrieve and securely dispose orphan sources.[m]

While many discrete sources clearly are not low-activity materials, they meet the NWPA definition of low-level waste. Their designation as low-level waste generally works in practice because the radionuclides in these sources typically have half-lives of a few decades or less,[n] and their small volume allows them to be safely stored in shielded containers. Regulatory authorities in most countries allow their disposal in near-surface facilities designed for low-level waste. Nonetheless, these sources represent the opposite extreme from the large volumes and low activities that characterize most other wastes considered in this report.

Uranium Mining and Processing Wastes

Beginning with the Manhattan Project in 1942, uranium and thorium ores were mined and processed on a massive industrial scale. Initial ore production was dedicated to the manufacture of material for nuclear weapons; subsequent production supported the nuclear power industry as well. The residues from recovering and processing uranium and thorium were stored in outdoor piles for later management or sometimes buried on site. Typical tailings piles range in size from tens of thousands to over three million cubic meters (DOE, 2003). In some cases tailings have been used inappropriately as construction materials (NRC, 1986).

The radiological hazards of these wastes arise from decay of naturally occurring uranium and thorium isotopes and their daughter isotopes. Beginning with Th-232, U-238, or U-235, radioactive decay produces a series of other radioisotopes (daughters) leading to the eventual formation of stable (non-radioactive) isotopes. The half-lives of the thorium and uranium parent isotopes are extremely long, so that the radioactivity associated with wastes containing these isotopes is low but persistent. Radon-222, a daughter product of U-238, is of particular concern because it is gaseous and can diffuse from tailings piles unless they are properly capped.

Uranium and thorium processing wastes are defined as byproduct material in section 11e.(2) of the AEA. In 1978 the Uranium Mill Tailings Radiation Control Act (UMTRCA) vested the EPA with overall responsibility for establishing health and environmental cleanup standards for uranium milling sites and associated properties, the USNRC with responsibility for licensing and regulating uranium production and related activities including decommissioning, and the DOE with responsibility for remediation of inactive mill tailings sites and long-term monitoring of all the decommissioned sites.

The USNRC has determined that it does not have authority to regulate uranium mining and processing wastes at facilities that were not under USNRC license at the time of passage of UMTRCA. Some of these wastes, generated between the start of the Manhattan Project and 1978 and related to the nation's early atomic weapons program, are managed under the Formerly Used Sites Remediation Action Program (FUSRAP) established under the AEA. FUSRAP cleanups are conducted by the Army Corps of Engineers. As noted earlier, there are different disposal options for UMTRCA and FUSRAP wastes. The DOE manages uranium-contaminated wastes on its sites.

NORM and TENORM Wastes

Naturally occurring radioactive materials (NORM) arise in many mineral extraction operations and are often discarded as wastes—examples include phosphate industry residues, scale and sludge from oil and gas production, non-uranium mining tailings, and coal ash residues (see Table 1). The materials are referred to as technologically enhanced NORM (TENORM) if their concentrations of radioactive materials are increased above naturally occurring levels. Sludge or filter media from water and wastewater treatment are good examples of TENORM waste. Estimates of the NORM and TENORM inventories from U.S. industries exceed 60 billion tons (NRC, 1999).

The radionuclides in NORM waste arise mainly from uranium and thorium series isotopes. NORM waste is therefore radiologically similar to uranium mining and milling wastes, although some radioisotope concentrations may differ. Unlike uranium and thorium wastes, NORM is not a byproduct of the production of nuclear materials and is not controlled by the AEA. Except for Department of Transportation regulations on transportation of radioactive materials, for the most part NORM is not regulated by federal agencies but rather by states.

There is considerable variation among states, which often regulate non-AEA materials collectively as naturally occurring and accelerator-produced radioactive materials (NARM). In Agreement States the same state agencies that have authority for AEA materials usually regulate NORM materials as well. States that regulate NORM specify concentrations of radium below which materials are exempt from regulation as waste, but the concentrations vary from state to state. Recognizing these disparities, the CRCPD has developed suggested state regulations for TENORM.[o]

Table I Domestic Processes that Generate NORM Waste

Process	Waste description	Radionuclide concentration (picocuries per gram)	Estimated waste generation (million metric tons per year)	Major generator locations
Soils in the United States	(Benchmark for typical background)	0.2 – 4.2		
Coal combustion	Fly ash	2 – 9.7	44	Midwestern and South Atlantic states
	Bottom ash and slag	1.6 – 7.7	17	
Geothermal energy production	Solids	10 – 250	0.05	California
Metal mining and processing	Slag, leachate and tailings from:			Mostly Midwestern and Western states
	-Large volume industries*	0.7 – 83	1000	
	-Special application metals	3.9 – 45	0.47	
	-Rare earth metals	5.7 – 3,200	0.002	
Municipal waste treatment	Sludge**	1.3 – 11,600 (picocuries per liter)	3	All, especially North Central and Atlantic Coastal Plain
Oil and natural gas production	Scale and sludge	Background to over 100,000	2.6	States where petroleum or natural gas is produced or processed
Phosphate mining and fertilizer production***	Ore tailings and phosphogypsum (calcium sulfate	7 – 55	48	Florida, Idaho, and other states in the West and Southeast

* Such as iron and copper mining.

** Filters typically have concentrations of 40,000 picocuries/gram but arise in much smaller volumes.

*** Phosphate fertilizer volumes are about one order of magnitude less, with the same concentrations of radionuclides.

Sources: DOE, 1997, and <http://www.tenorm.com>.

FINDINGS AND CONCLUSIONS

In general, the committee concluded that there is adequate statutory and institutional authority to ensure safe management of low-activity wastes, but the current patchwork of regulations is complex and inconsistent—which has led to instances of inefficient management practices and perhaps in some cases increased risk overall. Existing authorities have not been exercised consistently for some wastes. The system is likely to grow less efficient if the patchwork approach to regulation continues in the future. In its interim report (NRC, 2003) the committee developed the following findings:

Finding 1
Current statutes and regulations for low-activity radioactive wastes provide adequate authority for protection of workers and the public.

In its fact-finding meetings, site visits, and review of relevant literature, the committee found no instances where the legal and regulatory authority of federal and state agencies was inadequate to protect human health. This finding is consistent with that of previous studies by the National Academies and the National Council on Radiation Protection and Measurements (NCRP, 2002; NRC, 1999, 2002). Some states, however, have chosen not to exercise regulatory authority over NORM and TENORM wastes. The USNRC has determined not to regulate certain pre-1978 uranium and thorium wastes. The EPA has so far not exercised its authority under the Toxic Substance Control Act to regulate non-AEA radioactive wastes. In addition, some wastes have not been adequately controlled in spite of the existence of regulatory authority. The EPA estimates that some 30,000 "orphan" sealed radioactive sources have disappeared from regulatory control, and notes that since 1983 there have been 26 recorded meltings of sources that were inadvertently mixed with scrap steel. These incidents have been expensive, led to very conservative practices in the steel and nuclear industries, and fueled public distrust in the regulatory system (HPS, 2002; NRC, 2002; Turner, 2003).

Finding 2
The current system of managing and regulating low-activity waste is complex. It was developed under a patchwork system that has evolved based on the origins of low-activity waste.

In its information-gathering the committee received a clear message from agencies responsible for managing and regulating low-activity waste: A more consistent, simpler, performance-based and risk-informed approach to regulation is needed (see Sidebar II). Similarly, the NCRP found that the current waste classification systems "are not transparent or defensible" and that the "classification systems are becoming increasingly complex as additional waste streams are incorporated into the system" (NCRP, 2002, p. 65).

Findings 3 and 4
Certain categories of low-activity waste have not received consistent regulatory oversight and management.

Current regulations for low-activity waste are not based on a systematic consideration of risks.

SIDEBAR II. COMMENTS FROM REGULATORS AND MANAGERS

Radiation is radiation. Make decisions based on the radiation in the material and not based on the regulatory box of the material. **Southeast Compact Commission**

DOE would benefit from a more uniform approach to waste management, particularly when DOE uses commercial treatment and disposal. **Department of Energy**

Suggest improvements in management and oversight activities to achieve the greatest risk reductions with available resources. **Environmental Protection Agency**

Consistent, national standards for classifying radioactive materials such as pre-1978 ore processing residuals, oil and gas drilling wastes, and other NORM or TENORM, independent of pedigree... **Army Corps of Engineers**

Address more consistent and harmonized regulation of like materials that fall under different regulatory regimes; identify and address opportunities for more risk informed disposal of low-activity wastes. **Nuclear Regulatory Commission**

These comments were made by sponsors of this study at the first committee meeting.

Regulations focused on the wastes' origins have led to inconsistencies relative to their likely radiological risks. NORM and TENORM are not regulated by federal agencies because they do not fall under the Atomic Energy Act. State regulation of these wastes is inconsistent. Nevertheless, these wastes may have significant concentrations of radioactive materials compared to some highly regulated waste streams. For example, NORM wastes routinely accepted at a landfill triggered a radiation monitor intended to ensure that rubble from a decommissioned nuclear reactor meets very strict limits on its radioactivity (see Sidebar I).

Uranium mining and processing wastes, which are radiologically similar to NORM wastes, are regulated under federal authority by their status at the time UMTRCA was enacted. There are no federal regulations that prohibit ore processing residuals at facilities that were not under license by the USNRC in 1978 or thereafter from being disposed in hazardous waste facilities, but mill tailings regulated by the USNRC under UMTRCA, which may be radiologically identical to pre-1978 residuals, are prohibited from being disposed in such facilities.

In addition to inconsistencies in regulating the radiological risks, current low-activity waste regulations generally overlook trade-offs between radiological and non-radiological risks. Hundred-thousand-cubic-meter volumes of slightly contaminated soil and debris and very heavy reactor components are being transported long distances for disposal (St. Onge, 2003). In developing current requirements for how low-activity wastes are managed or disposed, worker risks in excavating, loading, and unloading large-volume wastes; risks of transportation accidents; and environmental risks and costs (e.g., consuming large amounts of fossil fuel) have not been analyzed and compared in a systematic way to radiological risks.

PUBLIC CONCERNS ABOUT LOW-ACTIVITY WASTE: AN ISSUE FOR THE FINAL REPORT

On beginning this study, the committee was aware that there is persistent and widespread public concern with all aspects of radioactive waste management and disposal (NRC 1996, 2001, 2002; GAO, 1999; Dunlap et al., 1993). During the committee's open sessions, members of the attending public expressed considerable lack of trust in the low-activity waste regulatory system due to its complexity, inflexibility, and inconsistency. These factors have apparently raised doubts about the system's capability for protecting public health. The key concerns raised in the open sessions—distrust of regulatory institutions and processes, the complexity of the problem, apprehension about risks, and the desire for greater stakeholder and public involvement—is consistent with a large and growing literature on public views of radioactive wastes and how to manage them (DOE, 1993; Dunlap et al., 1993; Slovic, 1993; Rosa and Clarke, 1999; Cvetkovich et al., 2002).

The task of the study committee in developing this interim report was to critically review the current regulatory and management practices for low-activity waste, and thus set the stage for the committee's final report, which will assess policy and technical options for improving the current practices. The assessments will include risk-informed options, and the committee strongly believes that issues of public trust and risk perception will be important considerations in the final report.

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FOOTNOTES

a The National Academies include the National Academy of Sciences (NAS), National Academy of Engineering, Institute of Medicine, and the National Research Council (NRC). Most National Academies studies, which are intended to advise the U. S. government and other decision makers, are conducted under the auspices of the NRC boards.

b `The Committee on Improving Practices for Regulating and Managing Low-Activity Radioactive Waste is referred \to as the "study committee" or more simply as the "committee" throughout this paper. Committee members are appointed by the Chair of the NRC, Dr. Bruce Alberts.

c `The Board intended the term "low-activity waste" to be more inclusive than "low-level waste," which is defined in the Nuclear Waste Policy Act. The term "low-activity waste" has sometimes been applied to the lower activity fractions DOE tank waste. The committee does not use the term in this sense.

d `Essentially low-level radioactive waste is defined by what it is not. Low-level waste is waste that is not otherwise defined as high-level waste, spent nuclear fuel, transuranic waste, or AEA byproduct material.

e `Strictly speaking, UMTRCA also applies to wastes at facilities licensed by the Nuclear Regulatory Commission before 1978.

f `Thirty-three states are Agreement States, including the three that currently host low-level waste disposal facilities (South Carolina, Utah, and Washington).

g `The committee did not include waste containing only short-lived radioactivity (on the order of a year or less), which simply decays away during storage. These wastes do not present long-term management or disposal challenges.

h `A previous study (NRC, 2002) introduced the term "slightly radioactive solid materials" (SRSM) to describe these wastes.

i `For completeness, radium sources and accelerator-produced material can be included in this category although they do not meet the statutory definition of low-level waste.

j `Landfills for chemically hazardous wastes must meet design and permitting requirements of the EPA, under authority of the Resource Conservation and Recovery Act (RCRA). States can set standards for acceptance of radioactive materials in RCRA landfills when the state has jurisdiction.

k `See <http://mims.apps.em.doe.gov>. DOE does not assure the quality of this information.

l `Department of Defense low-activity waste is not discussed in this report. This waste is managed and disposed by contractors as commercial waste regulated by the USNRC unless it is classified for security purposes. Classified waste is managed and disposed by DOE.

m `See <http://www.epa.gov/radiation/cleanmetals/orphan.htm> and <http://www.crcpd.org/PDF/Announcement.pdf>.

n Radium-226 and americium-241 are notable exceptions with half-lives of about 1600 and 460 years, respectively.

o See <http://www.crcpd.org/SSRCRs/N_4-99.PDF>.