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Long-Term Federal Management of Uranium Mill Tailings: Background and Issues for Congress

August 22, 2019

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SUMMARY

R45880

August 22, 2019

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Long-Term Federal Management of Uranium Mill Tailings: Background and Issues for Congress

In the wake of increasing concerns in the 1970s about human health and environmental risks posed by inactive uranium mill tailings, Congress enacted the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA). Uranium milling operations generate uranium concentrate, also known as *yellowcake* uranium, and waste material, called *tailings*, which can harbor and liberate radioactive and nonradioactive constituents.

Title I of UMTRCA authorized a remedial action program for uranium mill tailings sites that were inactive prior to 1978, which produced uranium concentrate under federal procurement contracts primarily for nuclear weapons and other defense purposes. Title II of UMTRCA authorized the regulation of uranium mills and tailings sites that were operating on or after the law's enactment, which largely produced uranium concentrate for civilian nuclear power plants. UMTRCA does not provide regulatory authority over uranium mining (the physical removal of uranium ore from the earth), waste material produced from uranium mining, or remediation of inactive uranium mine sites. The Department of Energy (DOE) is the federal agency responsible for implementing the remedial action program and administering long-term federal management of the tailings.

The site remediation costs have exceeded costs originally envisioned by Congress, the agencies, and the licensees due to an evolving understanding of the complexities and risks posed by unintended releases of contaminants from uranium mill tailings. As part of the remediation action, the uranium mill tailings are enclosed in engineered repositories, located at disposal sites, which are designed to prevent unintended release of potentially hazardous constituents for hundreds of years. DOE's authority to perform surface remediation at Title I sites expired on September 30, 1998. Groundwater contamination has compounded the technical complexity and timeline of remedial actions at certain sites. Congress amended UMTRCA in 1988 to authorize DOE to perform groundwater remediation without expiration under the Uranium Mill Tailings Remedial Action Amendments Act (UMTRA).

UMTRCA requires the transfer of both Title I and Title II disposal sites to long-term federal management. As of FY2019, the Department of Energy, Office of Legacy Management (DOE-LM) administers long-term federal management at 31 Title I sites, excluding the site at Moab, UT. Title II sites are regulated by the U.S. Nuclear Regulatory Commission (NRC) or an NRC agreement state and transferred to DOE-LM for long-term federal management when NRC, or the state, determines that applicable standards have been met. As of FY2019, 6 of 29 Title II sites have transferred to DOE-LM, and 23 Title II sites remain privately owned under an NRC or an agreement state license. DOE-LM expects to take long-term management responsibilities of the 23 remaining Title II sites by 2048.

Under UMTRCA, Congress established that the federal government pay for long-term monitoring and maintenance costs at Title I sites, subject to annual appropriations to DOE-LM. For Title II sites, Congress intended that the licensee would pay for any long-term management costs with a one-time long-term surveillance charge (LTSC). In the event that the LTSCs are not sufficient to cover annual monitoring and maintenance costs, DOE-LM would be responsible to carry out long-term management responsibilities, subject to availability of annual appropriations.

The long-term management efforts to stabilize tailings and monitor groundwater have proven more challenging, and expensive, than originally expected. The federal government will be responsible for long-term management of all UMTRCA sites once transferred to DOE-LM. Potential oversight issues for Congress may include understanding the decommissioning and transfer status of the remaining Title II sites, the adequacy of funding to complete decommissioning at certain sites if the licensee is unable to fulfill its obligations, and the adequacy of LTSCs to meet future management needs.

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Introduction

Congress passed the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA, P.L. 95-604) in the wake of environmental and public health concerns about exposures to radiological and nonradiological waste material originating from Cold War-era uranium mill tailing sites. Title I of UMTRCA authorized a remedial action program for uranium mill tailing sites that were inactive prior to the law's enactment in 1978. Under Title I of UMTRCA, the federal government was mostly responsible for financing the remediation and decommissioning of Title I sites, most of which produced uranium for nuclear weapons and other defense purposes. Title II of UMTRCA authorized federal agencies to regulate uranium mill tailings produced at commercially licensed facilities still operating on or after 1978. For Title II sites, Congress intended that commercial uranium mill operators, not the federal government, pay for site decommissioning and tailings stabilization activities.

The federal government assumes responsibility for both Title I and Title II uranium mill sites transferred to *long-term federal management* after site decommissioning has been completed. As of FY2019, the Department of Energy Office of Legacy Management (DOE-LM) administers long-term federal management at 31 Title I sites and 6 Title II sites. DOE-LM manages surface tailings and groundwater monitoring programs at sites under long-term federal management in an effort to minimize any unintended release of potentially radiological or nonradiological material. Long-term monitoring and maintenance activities may include stabilization of the engineered repository of uranium mill tailings and groundwater remediation or monitoring, if necessary.

As of FY2019, 23 Title II sites remain owned by commercial operators, who are permitted to operate under the Nuclear Regulatory Commission (NRC) or an NRC agreement state license. When the Title II site operator has completed all site decommissioning requirements, the license is to be transferred to DOE for long-term federal management.

This report presents the historical context for the law, the status of implementation since enactment, and selected issues for Congress. UMTRCA does not authorize the regulation of uranium mining—the process of physically removing uranium ore from the earth—or the disposal of waste material produced by uranium mining. The regulation of uranium mining and the remediation of abandoned uranium mines are not discussed in this report.

Uranium Mill Tailings

Uranium milling is the process of converting mined uranium ore to uranium concentrate, also known as yellowcake uranium.[1] Milling is common to a number of mineral extraction industries and refers to the physical and chemical processes necessary to concentrate minerals from mined ore. Uranium milling operations use a series of physical (crushing and grinding the mined ore) and chemical processes (acid or alkaline solutions, ion exchange) to concentrate the mineralized uranium ore into yellowcake uranium.[2] Heap leaching, a specific type of uranium milling operation, involves sprinkling sulfuric acid or another solvent directly over the ore in large earthen collection pits. The acidic stream trickles through the ore and dissolves uranium and that stream is collected and processed. Yellowcake uranium produced from the milling process is subsequently converted and enriched for civilian nuclear power production (**Figure 1**).

[1] Uranium concentrate is also commonly referred to as *uranium oxide* or U_3O_8.

[2] See NRC, "Conventional Uranium Mills," May 15, 2017, https://www.nrc.gov/materials/uranium-recovery/extraction-methods/conventional-mills.html.

Tailings are the waste material produced from milling operations. The milling process produces tailings initially as a slurry material, which is disposed of in a settling pond. The slurry tailings material dries, resulting in a sand-like material. Milling operations produce a large quantity of tailings relative to the amount of uranium concentrate produced. NRC estimated that 2.4 pounds of yellowcake uranium oxide is produced from 2,000 pounds of uranium ore.[3]

Public health and environmental concerns from uranium milling have been associated with various aspects of historical operations and tailings disposal. The U.S. Environmental Protection Agency (EPA) has identified four health exposure routes from uranium mill tailings:[4]

1. Increased risk of lung cancer from the diffusion of radon gas indoors if tailings material is used for construction material,
2. Inhalation of radon gas or ingestion of small particles directly emitted from the mill piles into the atmosphere,
3. Exposure to gamma radiation produced by radioactive decay products within the tailings, and
4. Wind and water erosion and mobilization of radioactive and other constituents into surface and groundwater.

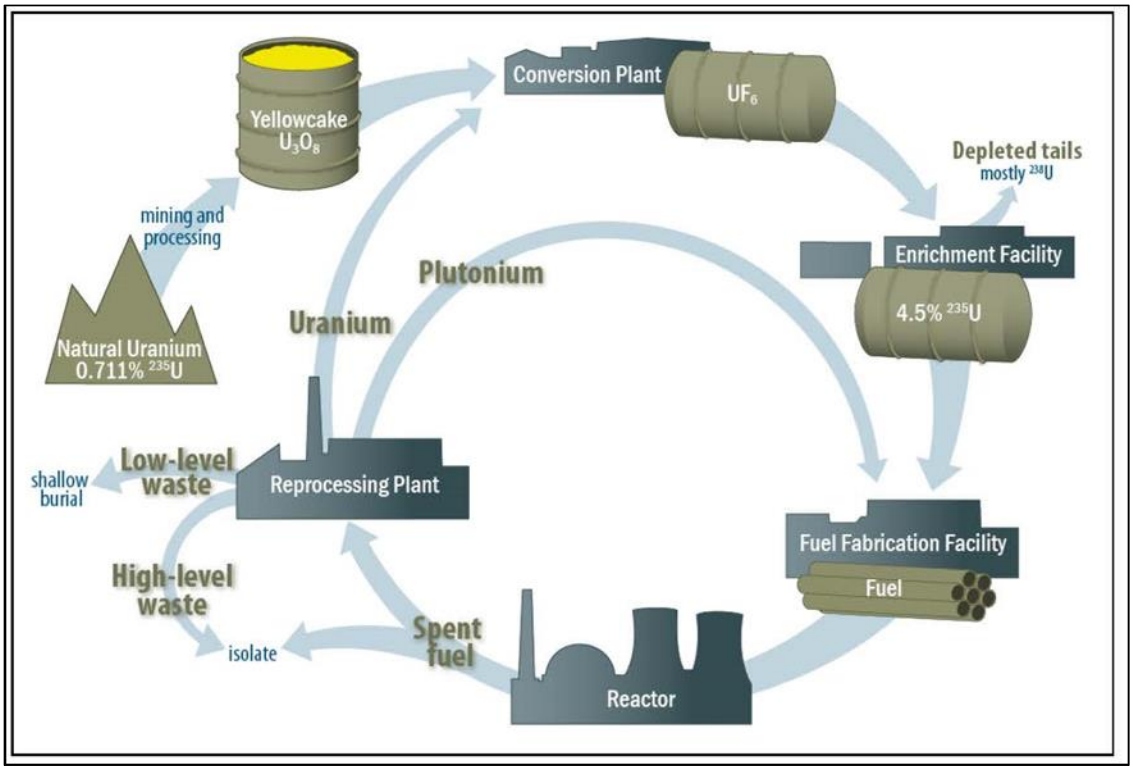
Physical and geochemical mechanisms can liberate trace metals and radionuclides within the tailings into groundwater or surface water. The hazards associated with the release of various radiological and nonradiological constituents from uranium tailings may persist for hundreds or thousands of years.[5]

[3] See NRC, "Final Generic Environmental Impact Statement on Uranium Milling," September 1980, pp. 3-14, 15.

[4] U.S. Environmental Protection Agency, *Radioactive Waste Disposal, an Environmental Perspective*, Air and Radiation (6602J), 1994, p. 7.

[5] See for example, U.S. Congress, House Committee on Interior and Insular Affairs, Subcommittee Energy and the Environment, *Uranium Mill Tailings Control*, 95th Cong., 2nd sess., June 26, 1978, 95-30, p. 76. In 1978, NRC chairman Joseph M. Hendrie stated, "The radioactive decay of these elements leads to production of radon, a radioactive gas with a half-life of about 4 days, which can diffuse from a tailings pile into the atmosphere and subsequently expose persons to radiation far away from the pile. The increased exposure compared to exposure from radon already in the atmosphere from other sources is exceedingly slight, but this increase is in effect permanent. This is because radon production in mill tailings continues for times on the order of 100,000 years, so the tailings pile becomes a perpetual source injecting a small amount of radon into the atmosphere, unless some action is taken to keep the radon from escaping."

Figure 1. UMTRCA and the Nuclear Fuel Cycle



Source: CRS Report RL34234, *Managing the Nuclear Fuel Cycle: Policy Implications of Expanding Global Access to Nuclear Power*, coordinated by Mary Beth D. Nikitin.

Notes: The dashed box highlights UMTRCA authority over uranium milling and mill tailings relative to the nuclear fuel cycle.

Brief History of Uranium Milling in the United States

During the 1950s and 1960s, the U.S. Atomic Energy Commission, a predecessor federal agency to DOE and NRC, procured uranium concentrate by funding domestic uranium ore mining exploration and development, entering into private purchasing contracts with domestic milling companies, and purchasing foreign-produced uranium concentrate.[6] The majority of domestic uranium concentrate production prior to 1971 primarily supported the development of nuclear weapons and naval reactors. From 1947 to 1971, annual domestic uranium concentrate production ranged from 20 million pounds to 35 million pounds (**Figure 2**).

After 1971, uranium mill operators produced uranium concentrate primarily for the production of civilian nuclear power. The 1970s were a period of growth for the U.S. nuclear power industry, as 59 nuclear reactors were first connected to the electricity grid between 1970 and 1979.[7] NRC

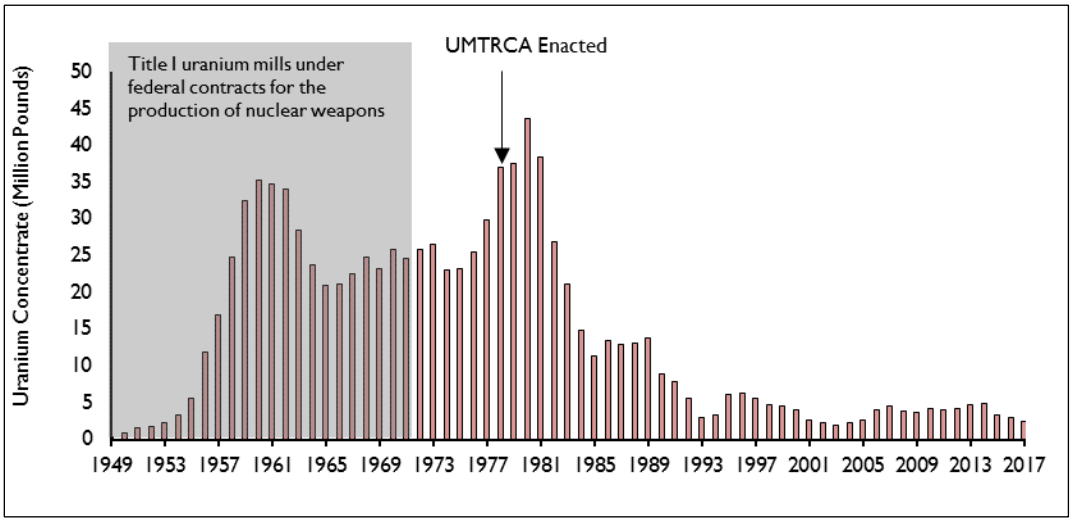
[6] U.S. Department of Energy, Office of Environmental Management (DOE-EM), "Linking Legacies, Connecting the Cold War Nuclear Weapons Production Processes to Their Environmental Consequences," January 1997, p. 51.

[7] See International Atomic Energy Agency, Power Reactor Information System: United States, updated February 13, 2019, https://pris.iaea.org/PRIS/CountryStatistics/CountryDetails.aspx?current=US.

estimated in 1978 that over 109 uranium mills would be required by the year 2000 to support the fuel requirements of the growing reactor fleet.[8] However, domestic uranium concentrate production in the United States decreased by roughly 92% from 1978 to 1993 (**Figure 2**). By 2000, one active U.S. uranium mill, two partially active U.S. uranium mills, and three *in-situ* recovery (ISR) facilities[9] combined to produce 4 million pounds of uranium concentrate.[10]

Continued growth by the domestic civilian nuclear power industry did not materialize as anticipated in 1978. Numerous factors led to a decrease of domestic uranium production.[11] In particular, U.S. nuclear power growth was far less than envisioned by Congress and federal agencies in 1978, as U.S. nuclear plant orders virtually halted after that year and dozens of previous orders were canceled. While the number of operational uranium mills was less than originally envisioned, potential risks from the uranium mills that did operate continue to present technical and regulatory challenges. The awareness of the technical and economic challenges posed during the decommissioning and long-term management of uranium mill tailings has increased since 1978. As of the second quarter of 2018, the U.S. uranium concentrate facilities consisted of one uranium mill and six ISR facilities in operation.[12]

Figure 2. Domestic Uranium Concentrate Production (1949-2017)



Source: CRS prepared the above figure using data from U.S. Energy Information Administration, *Annual Energy Review*, Table 9.3: Uranium Overview 1949-2011, September 2012; U.S. Energy Information Administration,

[8] Statement by Monte Canfield, Director, Energy and Minerals Division, U.S. General Accounting Office, in U.S. Congress, House Committee on Interstate and Foreign Commerce, Subcommittee on Energy and Power, *Uranium Mill Tailings Control Act Of 1978*, 95th Cong., 2nd sess., June 19, 1978.

[9] ISR or *in-situ* leach refers to nonconventional uranium recovery where uranium ore is dissolved by injecting a solution directly into an aquifer and removing the "pregnant" solution for processing. Since UMTRCA, ISR facilities have become the preferred uranium recovery process in the United States. This report will address only policy and oversight issues associated with conventional uranium mills.

[10] U.S. Energy Information Administration, *Uranium Industry Annual 2000*, May 2001, p. 11, https://www.eia.gov/uranium/marketing/archive/04782000.pdf.

[11] A detailed discussion of the factors that contributed the decline of the U.S. domestic uranium production industry is beyond the scope of this report. For further discussion, see CRS Report R44715, *Financial Challenges of Operating Nuclear Power Plants in the United States*, by Phillip Brown and Mark Holt.

[12] U.S. Energy Information Administration, *Domestic Uranium Production Report - Quarterly*, Second-Quarter 2018, August 10, 2018, https://www.eia.gov/uranium/production/quarterly/.

Domestic Uranium Production Report—Annual, Table 3: U.S. Uranium Concentrate Production, Shipments, and Sales, 2003-2017, May 2018.

Notes: The shaded area shows the range of years associated with Title I uranium mills under federal procurement contracts. UMTRCA was enacted in 1978.

Uranium Mill Tailings Radiation Control Act of 1978

The Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA; P.L. 95-604) includes three titles:

- Title I authorized the remediation of uranium mill tailings inactive prior to the law's enactment in 1978.
- Title II authorized the regulation of commercial uranium mills operating on or after 1978.
- Title III directed the NRC to consult with the state of New Mexico to study and designate two mill tailings sites in New Mexico.

By 1998, DOE completed site decommissioning for all Title I sites, with the exception of the site located at Moab, UT.[13] Legislation to authorize cleanup at Moab was enacted subsequent to UMTRCA. Title I provisions do not authorize remedial actions for sites in operation on or after 1978, which are addressed under Title II. Provisions under Title III have been resolved.

Title I—Remedial Action Program for Inactive Uranium Mill Sites

Title I was enacted to address the environmental and public health risks associated with residual radioactive material produced at "inactive"[14] uranium mill sites generated in support of the federal uranium procurement program during the mid-1940s through the 1970s. The majority of the uranium concentrate produced during this time period was for the development of nuclear weapons, nuclear fuel production, and other Atomic Energy Commission programs.[15] After the federal procurement contracts ended in the early 1970s, operations at some uranium mills ceased and licenses were terminated with few environmental remediation requirements.

Prior to 1978, federal agencies lacked legal authority to regulate uranium mill tailings.[16] In 1966, federal agencies issued a "Joint Federal Agency Position Regarding Control of Uranium Mill Tailings" urging planning management and stabilization of the mill tailings as the responsibility

[13] Moab remediation remains ongoing by DOE-EM.

[14] UMTRCA uses the term *inactive* to describe the conditions of uranium mill tailings sites under Title I. While the term *inactive* may imply that the sites may have become "active," the operators of Title I sites mostly ceased operations a decade or more before the enactment of UMTRCA. There are other references to conditions of uranium mill tailings at Title I sites as "abandoned" in the legislative history and similar legislation introduced at that time.

[15] DOE-EM, "Linking Legacies."

[16] U.S. Congress, House Committee on Interstate and Foreign Commerce, Energy and Power, *Uranium Mill Tailings Control Act of 1978*, 95th Cong., 2nd sess., June 1978, HRG-1978-FCH-0047, p. 216 (Washington: GPO, 1979). As the NRC testified in 1978: "Historically, the NRC and its predecessor agency have not had regulatory jurisdiction over uranium mill tailings after mill operations are terminated because the tailings are not themselves licensable material. Regulatory control over tailings is exerted indirectly as part of the Commission's licensing of ongoing milling operations pursuant to licensing authority over source materials. Therefore, after operations had ceased at the 22 inactive sites being considered and all licensable quantities of source material removed, the regulatory staff had no further role."

of the individual owners.[17] Yet without a legally binding regulatory program, DOE subsequently noted that actions resulting from the Joint Position were "far from satisfactory."[18]

Multiple communities used uranium mill tailings as construction material for civilian building projects. The characteristically "sandy" uranium tailings were attractive to construct roads, sewers, farmlands, foundations in office buildings, schools, homes, and other structures.[19] These sites became known as *vicinity properties*. In one instance, DOE reported that a uranium mill operator left a front-end loader on site for members of the public to take as much uranium tailings material as they could handle.[20] NRC stated that 270,000 metric tons of uranium tailings at Grand Junction were used for building materials.[21]

In 1972, growing concerns about environmental and public health risks from uranium mill tailings used as construction material led to Congress appropriating funds for remedial action of contaminated sites near Grand Junction, CO. Section 201 of the 1972 Atomic Energy Commission Appropriation Authorization (P.L. 92-314) "assumes the compassionate responsibility of the United States to provide to the state of Colorado financial assistance to undertake remedial action to limit the exposure of individuals to radiation emanating from uranium mill tailings which have been used as a construction related material in the area of Grand Junction, Colorado." The legislation addressing issues at Grand Junction served as the template for the remedial action program authorized under Title I of UMTRCA.

Definitions, Scope of Remedial Actions, and Site Inventory

Section 101 of UMTRCA defines key terms and identifies federal agencies authorized to implement UMTRCA. A *processing site* is defined as "(A) any site, including the mill, containing residual radioactive materials at which all or substantially all of the uranium was produced for sale to any Federal agency prior to January 1, 1971 under a contract with any Federal agency … and (B) any other real property or improvement thereon which (i) is in the vicinity of such site,

[17] As presented in U.S. Congress, House Committee on Interstate and Foreign Commerce, *Uranium Mill Tailings Radiation Control Act of 1978*, 95th Cong., 2nd sess., September 30, 1978, H. Rept. 95-1480, Part 2, p. 27. "The Federal Water Pollution Control Administration, the Public Health Service, and the Atomic Energy Commission agree that inactive tailings piles resulting from uranium milling operations should be structurally stabilized and contained to prevent water and wind erosion. Active tailings piles should be managed to minimize such erosion during use. Planning, management, stabilization and containment of tailings piles are viewed as being the responsibility of the individual mill owners. Mill owners should develop, without undue delay, specific plans for accomplishing such management, stabilization and containment, and submit such plans through the appropriate state regulatory agencies for approval. The staffs of the Federal Water Pollution Control Administration, the Public Health Service, and the Atomic Energy Commission will be available to the state regulatory agencies, upon request, to provide advice and assistance regarding the development of pile stabilization and containment objectives and measures for achieving them. Compliance by mill owners with approved plans for stabilization and containment should be recognized as constituting fulfillment of mill owner responsibility with regard to such tailings piles. Obtaining and enforcement of tailings piles stabilization and containment plans should rest initially with the states concerned."

[18] U.S. Congress, House Committee on Interstate and Foreign Commerce, *Uranium Mill Tailings Radiation Control Act of 1978*, 95th Cong., 2nd sess., September 30, 1978, H. Rept. 95-1480.

[19] Elisa J. Grammer, "The Uranium Mill Tailings Radiation Control Act of 1978 and NRC's Agreement State Program," *Natural Resources Lawyer*, vol. 13, no. 3 (1981), p. 478.

[20] David E. Mathes, DOE-EM, "Lessons Learned from the 20-Year Uranium Mill Tailings Remedial Action Surface Project," March 4, 1999, pp. 5-6.

[21] NRC, "Final Generic Environmental Impact Statement on Uranium Milling," vol. 1, p. 2-2.

and (ii) is determined by the Secretary [of Energy], in consultation with the [NRC], to be contaminated with residual radioactive materials derived from such site."[22]

Vicinity properties are off-site properties where uranium mill tailings were used as construction material prior to the law's enactment. A lesser amount of vicinity properties were adjacent sites contaminated by wind-borne dispersion of mill tailings particles. By 1999, DOE reported that it had remediated 5,300 vicinity properties.[23] DOE's authority to perform surface remedial actions at Title I UMTRCA sites, including vicinity properties, expired on September 30, 1998.[24]

Residual radioactive material is defined under Section 101 as "waste (which the Secretary determines to be radioactive) in the form of tailings resulting from the processing of ores for the extraction of uranium and other valuable constituents of the ores; and other waste (which the Secretary determines to be radioactive) at a processing site which relate to such processing, including any residual stock of unprocessed ores or low-grade materials."[25] *Tailings* are defined as "the remaining portion of a metal-bearing ore after some or all of such metal, such as uranium, has been extracted."[26]

DOE's remedial action efforts aimed to permanently isolate the residual radioactive material from the environment. Residual radioactive material was enclosed in engineered repositories consisting of multiple layers of relatively nonpermeable materials and capped with rip-rap.[27] These layers are intended to prevent the release of radon gas, limit downward infiltration and water seepage through the tailings piles, and minimize the erosion of the repository by natural wind and water. The repository is designed to stabilize residual radioactive material for at least 200 years and up to 1,000 years.[28]

A *disposal site* identifies the location where the engineered tailings repository is sited, which is either at the original processing site or an alternative location. *Disposal site* is not explicitly defined by statute under Title I. However, EPA regulations define *disposal site* as "the region within the smallest perimeter of residual radioactive material (excluding cover materials) following completion of control."[29] The distinction between a processing site and disposal site has bearing on long-term federal management obligations.

Under UMTRCA, DOE is required to consult with the EPA to prioritize which sites pose a potential health hazard.[30] However, DOE is not bound by EPA's site priority evaluation, and nothing in the statute precludes DOE from proceeding with remedial actions on lower-priority sites. UMTRCA instructed DOE to consult with NRC to develop site-specific boundaries. Site designations under this section are not subject to judicial review.[31]

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[22] 42 U.S.C. §7911(6).

[23] Mathes, "Lessons Learned," pp. 5-6.

[24] 42 U.S.C. §7922.

[25] 42 U.S.C. §7911(7).

[26] 42 U.S.C. §7911(8).

[27] "Rip-rap" is typically coarse rocks structured to prevent the erosion of underlying, relatively finer grain, layers.

[28] 40 C.F.R. §192.02(a).

[29] 40 C.F.R. §192.00. "Disposal site means the region within the smallest perimeter of residual radioactive material (excluding cover materials) following completion of control."

[30] 42 U.S.C. §7912(b).

[31] 42 U.S.C. §7912(d).

Section 102 lists 22 processing sites originally designated under Title I.[32] The number of Title I and Title II sites has expanded, and a full inventory of UMTRCA sites is presented in **Table A-1** and **Table A-2**.

Cooperative Agreements

Section 103 authorized DOE to enter into cooperative agreements with states or tribes to perform remedial actions at inactive uranium mill tailing sites.[33] Cooperative agreements between DOE-LM and states are subject to NRC concurrence. Under Section 103, any cooperative agreements between DOE and states are conditional on the site owner releasing DOE of liability associated with any issues occurring during remedial actions. Section 103 authorizes DOE, NRC, and EPA access to any site for inspection and enforcement subject to the establishment of a cooperative agreement.[34] Section 105 authorizes cooperative agreements between DOE and Indian tribes in consultation with the Department of the Interior's Bureau of Land Management (BLM), similar to provisions in Section 103, when processing sites are located on Indian lands.[35]

Land Acquisition and Transfer

Generally, DOE remediated the inactive uranium mill tailings and constructed a repository at the original processing site location. However, Congress was aware of instances where inactive uranium mill tailings were located on a floodplain or directly adjacent to a stream or river. In those instances, designing, constructing, and maintaining an engineered repository for the uranium mill tailings located next to a stream may have been technically infeasible.

UMTRCA authorizes agencies to determine whether an alternative disposal site is necessary to protect human health and the environment. Section 104 authorizes the state, under a cooperative agreement with DOE, to purchase surface and subsurface rights and transport tailings materials to an alternative disposal site.

When NRC and DOE determined that an alternative disposal site was necessary, DOE constructed repositories that were separate from the original inactive uranium mill tailings. The management of the original processing site was returned to the state. Section 104 outlines four options for the state to manage the processing site: (1) sell the land,[36] (2) retain the land, (3) donate the land for public or recreational purposes, or (4) transfer the land to the federal government.[37] The state provides appropriate documentation of remedial actions on the processing site to future purchasers.

DOE manages Title I disposal sites under a general NRC license.[38] UMTRCA authorized DOE to obtain the surface and subsurface mineral rights for the disposal site. The acquisition of subsurface interests was required conditional to a cooperative agreement. Congress intended to

[32] 42 U.S.C. §7912. Two processing sites—Rifle, CO, and Slick Rock, NM—are listed as "Two Sites" that are included in the original inventory of 22 sites.

[33] 42 U.S.C. §7913.

[34] 42 U.S.C. §7913(d).

[35] 42 U.S.C. §7915.

[36] UMTRCA provides the previous owner first right of refusal for purchasing the land at fair market value.

[37] 42 U.S.C. §7914(e).

[38] 42 U.S.C. §7914(f)(2).

avoid situations where the extraction of underlying minerals by subsurface mineral rights owners could disrupt the stabilized tailings.[39]

Under UMTRCA, inactive uranium mill tailings located on federal public lands are transferred to DOE as a public land withdrawal. Section 104(h) authorizes BLM to sell or lease rights to federal lands located within the disposal site boundary.[40] BLM is required to follow all applicable U.S. laws to sell or lease and provide assurances that the stabilized residual radioactive materials will not be disturbed by mineral development activities. Any prospective mineral developer is subject to licensing.[41] If the stabilized site is disturbed, the private operator must perform site remediation at no cost to the federal government.

Section 106 authorizes the purchase of land to develop a consolidated disposal site.[42] The section discourages use of any National Park System, National Wildlife Refuge System, and National Forest System lands. If land is acquired in a state where uranium milling has not occurred, the acquisition is subject to state concurrence.

Financial Responsibility

During the debate leading to the enactment of UMTRCA, Congress recognized that no clear entity was responsible for the cleanup of inactive uranium mill tailings among the federal government, states, and private site operators. In 1978, the U.S. General Accounting Office (now the Government Accountability Office, GAO) proposed that the federal government was most responsible to fund a cleanup program, as the majority of the uranium produced for the generation of uranium mill tailings was purchased at that time under federal supply contracts for the Manhattan Engineering District and other defense programs.[43]

In drafting UMTRCA, Congress decided that the federal government should be responsible for most of the remedial action costs at Title I sites and that the states where the Title I sites are located should share a portion of the costs. Section 107 establishes the financial responsibilities for remedial actions for the federal government and the cooperative states.[44] Under Section 107, the federal government is responsible for 90% of the remediation costs, including costs for land acquisition and cleanup of buildings and structures in the vicinity. Under a cooperative agreement, a state commits the remaining 10% share of the remediation costs. The federal government was responsible for all remedial action costs at processing sites located on Indian lands pursuant to cooperative agreements under Section 105.

Development of Remediation Standards

Congress authorized EPA to promulgate health and environmental standards for uranium mill tailing sites. Section 108 directed DOE to perform remedial actions in accordance with general health and environmental standards promulgated by the EPA pursuant to Section 275 of the

[39] U.S. Congress, House Committee on Interstate and Foreign Commerce, *Uranium Mill Tailings Radiation Control Act of 1978*, 95th Cong., 2nd sess., September 30, 1978, H. Rept. 95-1480, Part 2, p. 38. "The committee believes that the acquisition must include subsurface interests to prevent the creation of future hazards to the public through disruption of the tailings in an attempt to recover underlying minerals."

[40] 42 U.S.C. §7914(h).

[41] 42 U.S.C. §7914(h).

[42] 42 U.S.C. §7916.

[43] GAO, *The Uranium Mill Tailings Cleanup: Federal Leadership At Last?*, EMD-78-90, June 20, 1978.

[44] 42 U.S.C. §7917.

Atomic Energy Act of 1954 (AEA, P.L. 83-703), amended by Section 206 under UMTRCA.[45] EPA finalized standards for Title I sites, under 40 C.F.R. Part 192, Subparts A, B, C, on January 11, 1995.[46]

UMTRA Amendments of 1988

DOE identified groundwater contamination at UMTRCA sites during implementation. Groundwater contamination remains an ongoing issue at several sites. In the late 1980s, DOE expressed concern that groundwater contamination issues could not be resolved in a specified period of time.[47] Congress enacted the Uranium Mill Tailings Remedial Action Amendments Act of 1988 (UMTRA,[48] P.L. 100-616), which amended Section 112 of UMTRCA to extend indefinitely DOE's authority to perform groundwater remediation.[49] UMTRA provides DOE groundwater remedial authority for Title I sites only.

Title II—Regulation of Uranium Mills, 1978 and After

Title II of UMTRCA amended the AEA to authorize the regulation of licensed commercial uranium mills on or after the enactment of UMTRCA. Title II includes provisions authorizing the mechanism for transfer of land and mill tailings to the federal government; establishing regulatory roles of the states and federal agencies; and authorizing agencies to enter into bonding, surety, or other financial arrangements with a licensee to cover the costs of a federal agency administering long-term federal management.

Byproduct Material and Site Transfer

Section 201 amended Subsection 11e of the AEA to include mill tailings under the definition of *byproduct material*. Under Section 201, *byproduct material* is defined as "the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content."[50]

Section 202 amended the AEA by adding Section 83 authorizing the federal government to retain the byproduct material where the tailings are disposed of for long-term management.[51] UMTRCA allows for the state, at its discretion, to retain the site under long-term management, but no state has elected to do so. Pursuant to Section 202, any license issued that "results in the production of any byproduct material" must comply with NRC decommissioning standards, and byproduct material and the land where it was disposed of must be transferred to long-term federal

[45] 42 U.S.C. §7918.

[46] EPA, "Groundwater Standards for Remedial Actions at Inactive Uranium Processing Sites," 60 *Federal Register* 2854, January 11, 1995.

[47] U.S. Congress, Senate Committee on Energy and Natural Resources, *Uranium Mill Tailings Remedial Action Amendments Act of 1988*, 100th Cong., 2nd sess., September 23, 1988, S.Rept.100-543, p. 4. "Based on the draft EPA standards, the Department of Energy believes that groundwater restoration activities will take significantly more time that originally planned to perform, possibly decades. There will be additional costs associated with the groundwater restoration, but any estimates of these costs prior to the promulgation of the final standards would be speculative. Hence, given the uncertainties surrounding the groundwater restoration problem, it does not seem prudent to restrict the Secretary's authority to conduct groundwater restoration activities."

[48] UMTRA is commonly referred to as the UMTRA program or UMTRAP.

[49] 42 U.S.C. §7922(a)(1)(A).

[50] 42 U.S.C. §2014(e)(2).

[51] 42 U.S.C. §2113.

management.[52] The site is transferred to long-term federal management when NRC, or the state, determines that the site decommissioning has met all applicable requirements.

Unlike Title I sites, UMTRCA does not authorize DOE to perform remedial actions at Title II sites under long-term federal management. Section 202 authorizes DOE, as the custodial agency, to "carry out maintenance, monitoring, and emergency measures, but shall take no other action pursuant to such license, rule or order, with respect to such property and materials unless expressly authorized by Congress after the date of the enactment of this Act."[53]

NRC may exempt the requirement for long-term federal management prior to the termination of the license if long-term federal management is found "not necessary or desirable to protect the public health, safety, or welfare or to minimize or eliminate danger to life or property."[54]

The process to transfer a Title II site from an NRC license to long-term federal management is described in regulation and guidance.[55] For Title II sites transferring federal public lands to long-term federal management under DOE, "DOE must apply to BLM for permanent withdrawal of federal land and minerals from BLM's inventory."[56] Any transfer of BLM lands is subject to National Environmental Policy Act review. The U.S. Army Corps of Engineers, state governments, and local governments may become involved with the land transfer depending on the location of the site and the land ownership.

In the majority of UMTRCA public land withdrawals, DOE maintains full regulatory jurisdiction of surface and subsurface interests associated with the disposal site. More recently, there has been interest in alternative uses at federally managed disposal sites. As a result, BLM and DOE have proposed a "partial-jurisdiction" regulatory structure at certain sites.[57] The DOE would regulate the mill tailings repository and ensure that statutory maintenance and monitoring requirements are met. BLM would lease surface and subsurface rights for alternative uses of the land (grazing, recreational, etc.) and mineral development (oil and gas, uranium, etc.).

Federal Regulatory Authority

Section 205 of UMTRCA amended Section 84 of the AEA authorizing NRC as the principle federal regulator of Title II sites through issuance and enforcement of source and byproduct material licenses. Section 205 directs NRC to manage byproduct materials in a manner that protects public health and the environment from radiological and nonradiological hazards associated with the processing, possession, and transfer of byproduct materials.[58] In establishing license conditions that would achieve protectiveness, Section 205 also allows NRC to consider costs and other factors. NRC and agreement states are also responsible for ensuring that licensees

[52] 42 U.S.C. §2113(a).

[53] 42 U.S.C. §2113(b).

[54] 42 U.S.C. §2113(b)(1)(A).

[55] For more information, see DOE, "Process for Transition of Uranium Mill Tailings Radiation Control Act Title II Disposal Sites to the U.S. Department of Energy Office of Legacy Management for Long-Term Surveillance and Maintenance," April 2016; NRC, "Standard Review Plan for the Review of a Reclamation Plan for Mill Tailings Sites Under Title II of the Uranium Mill Tailings Radiation Control Act of 1978," June 2003; 10 C.F.R. §40 Appendix A.

[56] DOE, "Process for Transition of Uranium Mill Tailings Radiation Control Act Title II Disposal Sites," p. 8.

[57] DOE-LM noted four Title II sites in Wyoming where a portion of the site boundary may overlap with federal public lands managed by the Forest Service or BLM. See David S. Shafer et al., "Transfer and Transition: Interagency Coordination for Managing Public Lands at UMTRCA Title II Sites in Wyoming—16614," March 6-10, 2016.

[58] 42 U.S.C. §2114.

manage byproduct material in a manner that conforms to generally applicable standards promulgated by EPA.

Section 206 of UMTRCA amended Section 275 of the AEA authorizing EPA to set generally applicable environmental and health standards. Congress intended standards to be consistent (to the maximum extent practicable) with the standards required under Subtitle C of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976 (RCRA).[59] Congress did not intend EPA standards to be site-specific in order to provide the agencies flexibility to address surface and groundwater issues at a broad range of sites.[60] UMTRCA authorizes EPA to revise these standards periodically. On October 7, 1983, EPA published the final rule for applicable standards for Title II uranium mill tailings sites.[61]

The NRC determines whether the licensee has fulfilled all applicable decommissioning standards and license requirements prior to termination of the license and transfer of the site to long-term federal management. The NRC may delegate regulatory authority to an agreement state for issuing and enforcing byproduct material licenses in a manner that conforms to NRC requirements.[62] NRC retains oversight authority over agreement states, and the state ensures that the licensee remains in federal regulatory compliance.

Four UMTRCA Title II sites[63] are listed on the National Priorities List under the Comprehensive Environmental Response, Compensation, and Liability Act (P.L. 96-510),[64] which authorizes remediation and enforcement actions against the releases of hazardous substances into the environment.[65] At these four sites, NRC, EPA, and the state regulate remediation efforts by operating under a signed memorandum of agreement, which identifies the various agencies' responsibilities.

Congress authorized DOE to implement remedial action programs under Title I and designated DOE as the federal agency responsible for long-term federal management of UMTRCA sites.[66] DOE-LM was established in 2003 and manages environmental contamination at sites associated with legacy activities during World War II and the Cold War.[67]

As of FY2019, DOE-LM manages 19 Title I disposal sites,[68] 12 Title I processing sites, and 6 of 29 Title II disposal sites.[69] DOE-LM anticipates that it will assume custody of 17 additional Title

[59] 42 U.S.C. §2022.

[60] 42 U.S.C. §2022.

[61] 40 C.F.R. Part 192, Subparts D, E.

[62] 42 U.S.C. §2021(b).

[63] UMTRCA sites listed on the National Priorities List are Uravan, CO (COD007063274); Church Rock, NM (NMD030443303); Grants, NM (NMD007860935); and Canon City, CO (COD042167858).

[64] 42 U.S.C. §§9601-9675.

[65] CRS Report R41039, *Comprehensive Environmental Response, Compensation, and Liability Act: A Summary of Superfund Cleanup Authorities and Related Provisions of the Act*, by David M. Bearden.

[66] UMTRCA provides for other federal agencies to manage Title I sites. For other federal agencies to manage UMTRCA sites, specific designation by the President would be required. See 42 U.S.C. §7914(f)(2).

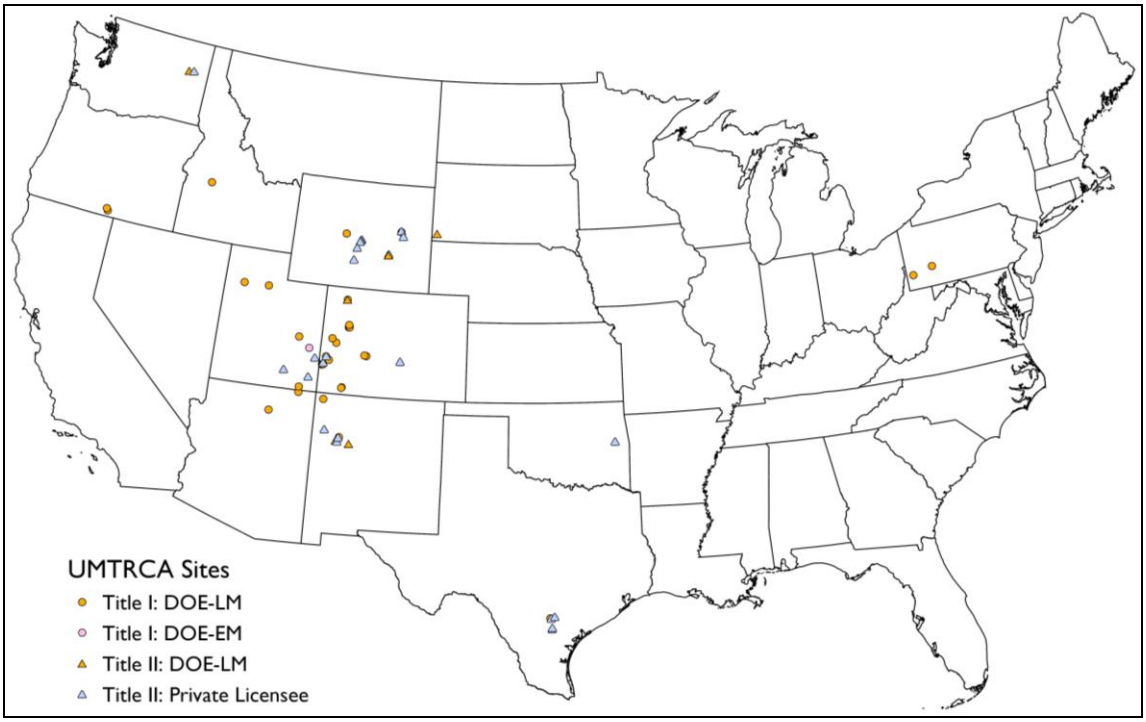
[67] DOE-LM, "About Us," https://www.energy.gov/lm/about-us.

[68] DOE-LM, "2017 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title I Disposal Sites," March 2018.

[69] DOE-LM, "2017 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title II Disposal Sites," December 2017.

II disposal sites over the next decade.[70] UMTRCA processing and disposal sites are located in 12 states (**Figure 3**). Site names and title descriptions are presented in the appendix (**Table A-1**).

Figure 3. Locations of UMTRCA Sites



Source: CRS compiled the locations of UMTRCA sites from multiple publicly available data sources including U.S. Department of Energy, Geospatial Environmental Mapping System, https://gems.lm.doe.gov/; technical reports; and satellite imagery. Locations for Title II sites in Texas were approximated based on NRC and DOE site location descriptions and satellite imagery.

Notes: "Title I: DOE-LM" sites include processing and disposal sites. "Title I: DOE-EM" includes only the Moab Site in Utah, where remedial action remains ongoing. "Title II: DOE-LM" sites are under long-term federal management by DOE-LM. "Title II: Private Licensee" sites are commercially owned and operated sites that are regulated by NRC or an NRC agreeement state. See **Table A-1** and **Table A-2** for site names and descriptions. No UMTRCA sites are located in Alaska or Hawaii.

State Regulatory Authority

Section 204 of UMTRCA amended Section 274b of the AEA authorizing NRC to enter into agreements with states allowing the states to regulate uranium milling operations through the issuance and enforcement of radioactive material licenses. Such *agreement states* retain the primary regulatory authority over licenses for radioactive materials on the determination that their regulations are as stringent as those of NRC.[71] The agreement state is responsible for issuing and enforcing the license to ensure that the licensee manages byproduct material in a manner that conforms to federal requirements. Section 204 of UMTRCA includes requirements for procedures for rulemaking, environmental analysis, and judicial review. NRC oversees agreement state

[70] Shafer et al., "Transfer and Transition."

[71] 42 U.S.C. §2021.

programs through inspections, training, and varying degrees of participation in rulemakings or other administrative activities.[72]

Financial Arrangements

Congress intended the NRC to regulate licenses in a manner such that decommissioning requirements would be so stringent as to minimize the need for long-term maintenance and monitoring activities. Section 203 amended Section 161 of the AEA authorizing NRC to enter into short- and long-term bonding, surety, or other financial arrangements with uranium mill licensees.[73] Short-term financial arrangements pay any remaining decommissioning costs if the operator becomes insolvent or otherwise incapable of completing all NRC decommissioning requirements. Long-term financial arrangements pay for the costs for DOE to perform long-term maintenance and monitoring after the license has been transferred to long-term federal management.

Status of Implementation

The legislative history suggests that public health and environmental concerns at the time were generally focused on preventing exposure to radiological emissions released into the air, such as radon gas.[74] Many in Congress also expressed concern about potential exposure risks associated with the unrestricted use of radioactive tailings material as fill material for buildings and other construction projects. Less understood at the time of UMTRCA's original enactment was the dispersion and migration of radiological and nonradiological contaminants in groundwater, which has been an issue at some UMTRCA sites.

DOE's surface remedial authority expired in 1998 for Title I sites. DOE continues to administer groundwater remediation and monitoring programs at Title I sites under long-term federal management. The Moab processing site in Utah is the only Title I site that has not transferred to long-term federal management.

Disposal Site Tailings Stabilization

Prior to UMTRCA, federal regulatory agencies had little authority to regulate tailings, and methods were not required under federal law to mitigate the erosion of tailings. Inactive uranium mill tailings piles were often susceptible to natural dispersal by wind, water, and human disturbances associated with unintended access to the tailings material. Under Title I of UMTRCA, state and federal agencies designed disposal sites as engineered repositories, which are intended to stabilize inactive uranium mill tailings for hundreds of years. As of 1994, the GAO reported for Title I remedial actions that "DOE spent $2 billion on surface cleanup activities through fiscal year 1994 and expects to spend about $300 million more through 1998."[75] Since 1998, when DOE's surface remedial authority expired, expenditures at Title I sites have been for groundwater remediation, disposal site stabilization, and monitoring activities.

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[72] NRC, "Agreement State Program," updated August 31, 2017, https://www.nrc.gov/about-nrc/state-tribal/agreement-states.html.

[73] 42 U.S.C. §2201.

[74] For information on potential risks of exposure to radon, see EPA, "Radon," January 30, 2019, https://www.epa.gov/radon.

[75] U.S. Congress, House Committee on Commerce, Subcommittee on Energy and Power, *Authorization of the Uranium Mill Tailings Radiation Control Act*, 104th Cong., 2nd sess., February 28, 1996, p. 11.

For Title II sites, private licensees are required to fund site decommissioning to all applicable requirements. After decommissioning of the site by the licensee, the disposal site is transferred to DOE-LM for long-term federal management. So far, six Title II sites have transferred to DOE-LM, while the decommissioning of the remaining Title II sites remains ongoing. Given the groundwater, stabilization, and erosion management issues experienced at Title I sites, DOE-LM may encounter similar challenges at Title II disposal sites once they are transferred to long-term federal management.

The DOE-LM efforts to stabilize Title I and Title II disposal sites present continuing challenges. Natural factors—such as wind erosion, intense rainfall and precipitation, and droughts—can deteriorate the physical integrity of the disposal site and potentially cause the unintended release of contaminants.[76] Vegetation can aid in stabilizing tailings and minimizing erosion. Annual monitoring and maintenance costs may vary from year to year depending on the variability in climatic events.

Groundwater Contamination and Monitoring

Some uranium mill operations have resulted in groundwater contamination from unlined surface tailings ponds, leach pads, and dissolution of hazardous constituents from water seepage through the tailings piles. Radiological and nonradiological contaminants may migrate if uncontrolled, remain in appreciable quantities, or naturally decrease in the aquifer depending upon site-specific geological characteristics. NRC has characterized groundwater contaminant plumes at some UMTRCA sites as up to three miles long.[77] As such, off-site migration of groundwater contamination has been an issue at some UMTRCA sites.[78]

DOE has applied active and passive groundwater remediation strategies at UMTRCA sites. Active groundwater restoration methods—such as pump-and-treat—have been used with varying results.[79] DOE has implemented natural flushing, a passive treatment method, to manage groundwater contamination. Natural flushing relies upon monitoring to characterize the movement rate and distribution of the contaminant plume. DOE-LM often applies *institutional controls* at UMTRCA sites in conjunction with groundwater remediation programs.[80] Institutional controls—which include providing alternative water sources, site use restrictions, drilling restrictions, fencing, and signs—are intended to minimize risks associated with exposures to impacted groundwater. For example, issues with persistent groundwater contamination at the Riverton, WY, Title I processing site prompted DOE to develop institutional controls at that site to minimize residents' groundwater use. DOE's institutional controls included certain restrictions

[76] April Gil et al., "Post-Closure Challenges of U.S. Department of Energy Sites in Desert Environments of the Southwestern United States," DOE-LM, February 26, 2012.

[77] C. F. Jove Colon et al., "Historical Case Analysis of Uranium Plume Attenuation," NRC, September 2000.

[78] For example, see the groundwater plume described at the Monument Valley Title I processing sites. DOE, "Monument Valley, Arizona, Processing Site," November 2018, https://www.lm.doe.gov/MonValley/Fact_Sheet_Monument_Valley.pdf.

[79] For example, in 2014 the pump-and-treat system at Tuba City, Arizona, was discontinued, and DOE-LM stated that the program was "ineffective at achieving the remediation goals after 10 years of operation." DOE, "U.S. Department of Energy, Office of Legacy Management's (DOE-LM) Groundwater Treatment Plan for Tuba City, Arizona, Uranium Mill Tailings Radiation Control Act, Title I, Disposal Site," November 5, 2014.

[80] For examples, see DOE-LM, "2017 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title I Disposal Sites," March 2018; and DOE-LM, "2017 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title II Disposal Sites," December 2017.

and notifications for developing new water wells and arranging alternative sources of water within the control boundary.[81]

DOE-LM administers groundwater monitoring programs at several UMTRCA sites.[82] DOE develops a long-term surveillance plan as part of the NRC general license requirements. Included in the long-term surveillance plan are detailed site-specific groundwater monitoring requirements. Groundwater monitoring requirements include the types of groundwater constituents sampled, the frequency of groundwater sampling, and the location and number of monitoring wells necessary to characterize the groundwater contamination.

For Title I sites, the 1988 UMTRA amendment authorized DOE to perform groundwater remediation indefinitely. However, DOE is not authorized to perform groundwater remediation at Title II sites under long-term federal management. At Title II sites under long-term federal management, DOE is authorized to perform maintenance and monitoring and to take emergency measures when necessary to protect public health.[83] In the debate leading to the enactment of UMTRCA, some Members expressed the intent to prevent "additional and costly remedial action" unless appropriated by Congress through legislative action.[84] The annual funding needs for UMTRCA sites under long-term federal management are dependent on the degree of site-specific monitoring and maintenance requirements and, for Title I sites, groundwater remediation costs.

Moab Processing Site, Utah

By the late 1990s, Title I disposal sites were constructed and transferred to long-term federal management, with the exception of the Moab site in Utah.[85] DOE-EM administers the Moab site remediation. The Moab site was originally designated as a Title II site under UMTRCA. The enactment of the Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001 (P.L. 106-398) in October 2000 redesignated Moab from a Title II site to a Title I site.[86] In designating Moab as a Title I site, Congress terminated the specific license under Title II and transferred the ownership to DOE and the remaining decommissioning costs to the federal government.

Uranium mill tailings at the Moab site are located on the north bank of the Colorado River. DOE-EM constructed a railway specifically for this project to transport the tailings to a disposal site, Crescent Junction, located approximately 30 miles to the north.[87] DOE transports tailings and

[81] DOE, "Long-Term Management Plan for the Riverton, Wyoming, Processing Site," September 2009, p.4.

[82] DOE, "Summary of Annual Site Environmental Reports," Calendar Year 2017, September 2018, p. A-9.

[83] 42 U.S.C. §7914(f)(2).

[84] Rep. John Dingell, House concurred in Senate amendment with amendments, *Congressional Record*, October 14, 1978.

[85] Uranium Reduction Company operated the Moab processing site from 1956 until 1962, when Atlas Minerals Corporation purchased it and operated the site until 1984. Uranium concentrate was produced at the mill and purchased by the U.S. government until 1970 and by private utilities thereafter. Atlas Minerals Corporation decommissioned the site from 1988 to 1995. In 1998, Atlas declared bankruptcy, and NRC appointed PricewaterhouseCoopers as the trustee. DOE, "Overview of the Moab UMTRA Project," May 2018.

[86] 42 U.S.C. §7912(f).

[87] DOE, "Overview of the Moab UMTRA Project."

performs groundwater remediation at the site.[88] DOE-EM reports that it had transported 59% of the roughly 16 million tons of uranium mill tailings by the end of December 2018.[89]

DOE-EM anticipates project completion by 2034.[90] DOE had incurred costs of $527 million by the end of FY2018 and estimated the total lifecycle costs to range from $1.186 billion to $1.197 billion.[91] Funding for Moab is appropriated annually in the Energy and Water Development and Related Agencies appropriations bill under the Non-Defense Environmental Cleanup account.

Selected Issues for Congress

Site remediation costs and time frames have exceeded amounts originally envisioned by Congress, the agencies, and the licensees due to an evolving understanding of the complexities and risks posed by unintended releases of contaminants from uranium mill tailings. In 1995, the GAO reported that DOE's total surface remediation costs were $2.3 billion, exceeding original 1982 estimates by $621 million.[92] Additionally, long-term federal costs to manage disposal sites and persistent groundwater contamination remain uncertain due to unforeseen challenges and site-specific monitoring and maintenance needs.

For Title II sites, six sites have been transferred to DOE-LM as of FY2019. Licensees of remaining Title II sites continue to decommission and transfer their sites to DOE-LM. Prior to long-term federal management, UMTRCA directs federal and state regulatory agencies to apply the stringency of decommissioning requirements on a licensee so that the degree of long-term monitoring and maintenance requirements is minimized. DOE-LM manages a Title II site once the NRC or the state transfers the license from the licensee following decommissioning.

In certain instances, NRC, DOE-LM, state agencies, and licensees have disagreed about the adequacy of decommissioning, the degree of long-term monitoring, and the amount of funding needed to perform long-term federal management requirements. In some instances, differences in views among the agencies have affected the timing of decommissioning and license transfers to DOE-LM. In other instances, licensees have lacked adequate funding to complete decommissioning. The following sections describe selected issues regarding proposed legislation, site-specific issues decommissioning, and long-term financial assurance.

Cheney Disposal Cell Reauthorization

DOE and residents continue to discover and excavate contaminated material at vicinity properties (i.e., buildings, roads, and sidewalks) around Grand Junction, CO, where uranium mill tailings were used as construction material prior to the enactment of UMTRCA. Discovered byproduct material from vicinity properties is disposed in the Cheney disposal cell,[93] located 15 miles southeast of the Grand Junction processing site. DOE constructed the Cheney disposal cell in

[88] For more information about the status of the remediation of the Moab site, see DOE, "Moab UMTRA Project," https://www.gjem.energy.gov/moab/.

[89] DOE, *FY2020 Congressional Budget Request*, Environmental Management, March 2019, p. 415, https://www.energy.gov/sites/prod/files/2019/04/f61/doe-fy2020-budget-volume-5_0.pdf.

[90] DOE, *FY2020 Congressional Budget Request*, Environmental Management, p. 41.

[91] DOE, *FY2019 Congressional Budget Request*, Environmental Management, March 2018, p. 91.

[92] GAO, *Uranium Mill Tailings, Cleanup Continues, but Future Costs Are Uncertain*, GAO/RCED-96-37, December 1995.

[93] The "Cheney disposal cell" is the name of the engineered repository, which is located within the Grand Junction disposal site boundary.

1990 to accept residual radioactive material from the Title I Grand Junction processing site and vicinity properties contaminated by the use of uranium tailings as building materials.

Under Section 112 of UMTRCA, DOE's authority to accept byproduct material at the Cheney disposal cell is scheduled to expire at the end FY2023 or when the cell reaches capacity,[94] whichever comes first.[95] DOE would be prohibited to operate the Cheney disposal cell after FY2023 absent the enactment of reauthorizing legislation.

In the 116th Congress, the House passed H.R. 347 authorizing DOE to dispose of residual radioactive material from processing sites and byproduct material from vicinity sites in the Cheney disposal cell through FY2031. Similar versions of this legislation were introduced in the 115th Congress.[96]

Title II Uranium Reimbursements

Thirteen Title II uranium mills produced uranium concentrate under both federal procurement contracts and commercial civilian nuclear power production. Title X of the Energy Policy Act of 1992 (P.L. 102-486) authorized reimbursements to pay Title II licensees for remedial costs proportional to the quantity of byproduct material produced under federal procurement contracts.[97] Reimbursement payments under Title X do not absolve the licensees from completing site decommissioning.

DOE-EM administers reimbursement payments to eligible Title II sites with funds appropriated from the Uranium Enrichment Decontamination and Decommissioning Fund, established under Title XI of the Energy Policy Act of 1992, to support remediation of federal uranium enrichment facilities.[98] Title X reimbursements are subject to annual appropriations in the Energy and Water Development and Related Agencies appropriations bill.

In 2000, eight years after the authorization of Title X reimbursements, the 106th Congress recognized that the implementation of decommissioning by licensees was more costly and taking longer than originally envisioned.[99] As of 2019, Title II licensees eligible for Title X continue to face similar decommissioning challenges. For example, committee report language in the FY2019 Energy and Water Development and Related Agencies appropriations bill directs DOE to use funds to "reimburse licensees for approved claim balances in a timely manner and to avoid

[94] DOE-LM estimates that 86 years of storage capacity remains in the Cheney disposal cell at the current rate of disposal. U.S. Congress, House Committee on Energy and Commerce, *Responsible Disposal Reauthorization Act of 2018*, 115th Cong., 2nd sess., September 7, 2018, H.Rept. 115-925, p. 3.

[95] 42 U.S.C. §7922(a). When UMTRCA was enacted, DOE's remedial authority under Section 112 expired seven years following the enactment of the law. In 1996, Section 112(a) was amended (P.L. 104-259) extending DOE's authority to receive byproduct material at the Cheney disposal cell until the end of FY2023.

[96] In the 115th Congress, the House passed H.R. 2278, which would have extended DOE's authority to accept byproduct material at the Cheney disposal cell until the end of FY2030. A similar bill (S. 1059) reported out of the Senate Committee on Energy and Natural Resources would have extended DOE's authority until the end of FY2048.

[97] 42 U.S.C. §2296.

[98] 42 U.S.C. §2297g.

[99] U.S. Congress, House Committee of the Whole House on the State of the Union, *Date Extensions*, 106th Cong., 2nd sess., September 25, 2000, H.Rept. 106-886, pp. 3-4. "The actual cleanup of these uranium and thorium processing sites is proving to be more costly and time consuming than originally envisioned in title X. As of April 2000, only two of the original 14 sites qualifying for title X reimbursement have been completed (i.e., the TVA site at Edgewater, South Dakota, and the ARCO Bluewater site at Grants, NM). Significant work at a majority of sites will continue after 2002. One of the primary factors driving these increases is the need for extensive groundwater remediation at several of the processing sites."

accumulating balances and liabilities."[100] From FY1994 to FY2018, DOE reported that $355 million was reimbursed to 13 licensees.[101] According to DOE, there were $26 million in approved but unpaid claims as of FY2018, and estimated remaining program liability was $99 million for the remaining sites eligible for reimbursements.[102]

Transfer Status and Funding

Various technical, financial, and regulatory issues have affected the timing of the transfer of Title II sites to long-term federal management. NRC's statutory responsibility is to regulate uranium mills and tailings for Title II sites in a manner that allows a licensee to complete site decommissioning in a manner so stringent that little long-term maintenance and monitoring would be required. Congress intended NRC to mitigate financial burdens to the licensees while requiring that all decommissioning requirements be fully met.[103]

The transfer of the remaining Title II sites to DOE-LM for long-term federal management would remain pending until NRC determines that the licensee has completed all decommissioning requirements. NRC estimates specific dates for some Title II sites, while others are listed as "to be determined."[104] **Table A-1** identifies Title I and Title II sites that have transferred to long-term federal management, and **Table A-2** identifies Title I and Title II sites that have not yet transferred to long-term federal management.

DOE-LM would become responsible for long-term federal management of Title II sites currently licensed by NRC or an NRC agreement state upon the completion of decommissioning and site transfer. For some Title II sites, DOE-LM and NRC have reached differing conclusions regarding the adequacy of decommissioning, the degree and type of long-term monitoring requirements, and the funds needed to pay for long-term monitoring and maintenance costs.

Section 203 of UMTRCA authorized NRC to collect a bond or other financial arrangement to pay for the costs in the event that a licensee was unable to fulfill all of their decommissioning requirements. UMTRCA does not authorize the use of federal funding to pay for the

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[100] U.S. Congress, House Committee on Appropriations, *Energy and Water Development Appropriations Bill, 2019*, H.Rept. 115-697, 115th Cong., 2nd sess., May 21, 2018, p. 98. "The Committee recommends $32,959,000 to reimburse private licensees for the cost of cleaning up uranium and thorium processing sites in accordance with Title X of the Energy Policy Act of 1992. The Committee expects the Department to reimburse licensees for all previous expenses, including costs related to remediation, restoration, and oversight of these programs, and to ensure all impacted communities are made whole. Fulfilling the obligation to fully reimburse licensees is important to the health and safety of the impacted communities. The Committee expects the Department to provide sufficient resources within future budget requests to reimburse licensees for approved claim balances in a timely manner and to avoid accumulating balances and liabilities."

[101] Three Title II licenses have been transferred under DOE custody, including Moab, UT, which Congress reassigned as a Title I site (P.L. 106-398). After reassignment, the Moab site no longer receives funding from Title X reimbursements. DOE, *FY2020 Congressional Budget Request*, Environmental Management, p. 441.

[102] DOE, *FY2020 Congressional Budget Request*, Environmental Management.

[103] U.S. Congress, House Committee on Interstate and Foreign Commerce, *Uranium Mill Tailings Radiation Control Act of 1978*, 95th Cong., 2nd sess., September 30, 1978, H. Rept. 95-1480, Part 2. "The committee believes and expects that these purposes should be met without causing mill closings and putting people out of work. At the same time, the committee recognizes that, despite past efforts by a licensee, the control and stabilization may not be adequate to meet the requirements of these amendments to the 1954 act."

[104] The status of Title II sites under NRC and agreement state licenses are listed on NRC's website. The website provides a brief site summary, major regulatory or technical issues, and NRC's expected closure date. See links at NRC, "Locations of Uranium Recovery Sites Undergoing Decommissioning," August 23, 2018, https://www.nrc.gov/info-finder/decommissioning/uranium/.

decommissioning of Title II sites.[105] In the event that the bond were insufficient to pay for the full decommissioning costs, UMTRCA provides no additional mechanism for funding to complete decommissioning. In some instances, Title II licensees have lacked adequate financial resources to complete NRC's decommissioning requirements.[106] If left unreclaimed, exposure risks from releases of radiological and nonradiological contaminants may present issues to affected communities. The magnitude of public health and environmental risks posed by unreclaimed tailings may vary among individual sites.

Long-Term Financial Assurance

For sites that have transferred to long-term federal management, DOE-LM administers Title I and Title II sites under an NRC general license. UMTRCA authorized long-term monitoring and maintenance costs at Title I sites to be paid by the federal government. For Title II sites, Congress intended that the licensee would pay for any necessary long-term monitoring and maintenance costs using a one-time long-time surveillance charge (LTSC). Annual costs are largely dependent on the extent of site-specific groundwater monitoring and intermittent maintenance activities on the repository.

Under current federal law there are different statutory authorities for DOE-LM to perform remediation at Title I sites and Title II sites under long-term federal management. For Title I sites, Congress authorized DOE-LM to implement groundwater remediation indefinitely, recognizing the ongoing remediation challenges at some Title I sites after decommissioning. UMTRCA does not provide DOE-LM remedial authority for Title II sites under long-term federal management. At Title II sites under long-term federal management, DOE-LM is authorized to perform monitoring, maintenance, and emergency measures. *Emergency measures* is not explicitly defined by statute, potentially raising issues of interpretation in the event of future remedial action needs. Selected issues with Title I and Title II long-term financial assurance are discussed in the following sections.

Title I Sites

Congress provides funding for the long-term federal management of Title I sites through DOE annual appropriations. For Title I sites under long-term federal management, program funding for DOE-LM is funded under Environmental and Other Defense Activities account in the Energy and Water Development and Related Agencies appropriations bill. DOE-EM continues to administer remediation at the Moab site in Utah. Funding for the Moab site is appropriated annually in the Energy and Water Development and Related Agencies appropriations bill under the Non-Defense Environmental Cleanup account.

DOE annual expenditures can vary from site to site depending on costs related to many factors, including the degree of groundwater remediation or monitoring and disposal site maintenance. For example, from 2008 and 2012, an interagency report from January 2013 noted that total DOE expenditures at the Tuba City disposal site were $13.96 million (approximately $2.8 million per

[105] See 42 U.S.C. §7925(a). "No amount may be expended under this subchapter with respect to any site licensed by the Commission under the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) or by a State as permitted under section 274 of such Act (42 U.S.C. 2021) at which production of any uranium product from ores (other than from residual radioactive materials) takes place."

[106] For example, see NRC's discussion of insolvencies and license transfer issues in NRC, "Staff Requirements—SECY-17-0081—Status and Resolution of Issues Associated with the Transfer of Six Decommissioning Uranium Mill Sites to the State of Wyoming," October 4, 2017.

year), while total expenditures at the Mexican Hat disposal site were $110,000 (approximately $22,000 per year).[107]

Neither DOE-LM annual budget justifications nor annual appropriations bills specify funding for annual long-term federal management costs by site or for the site inventory as a whole. Annual funding for DOE-LM is presented in annual budget requests and appropriations as a single line-item.[108] In all, DOE-LM oversees over 100 sites contaminated by radiological, chemical, and hazardous wastes associated with the legacy of nuclear weapons production during World War II and the Cold War. UMTRCA processing and disposal sites constitute 37 of those sites.[109] Congress appropriated $159 million to DOE-LM in the Energy and Water Development and Related Agencies Appropriations Act, 2019 (P.L. 115-244),[110] the same amount as requested.[111]

Title II Sites

For Title II sites, Congress intended that commercial uranium mill operators will pay for site decommissioning and the costs for a federal agency to perform long-term federal management. To cover these long-term federal management costs, NRC requires licensees to pay an LTSC upon the transfer of the site to DOE. Section 203 of UMTRCA provides NRC authority to collect this LTSC from the licensee to pay for DOE's costs to perform long-term maintenance, monitoring, and emergency measures.[112] This one-time LTSC fee is deposited as a miscellaneous receipt into the General Fund of the U.S. Treasury when each site license is transferred to DOE.

In the 1980 Final Generic Environmental Impact Statement for uranium milling, NRC described the justification for the minimum LTSC fee based on the assumption that average long-term monitoring at UMTRCA Title II sites would cost $2,500 per year.[113] NRC assumed an average annual real rate of return, and each licensee is required to pay the minimum one-time LTSC of $250,000 (in 1978 dollars, adjusted for inflation).[114] NRC has not revised the minimum LTSC since regulations were promulgated in 1985.[115] NRC allows for the minimum LTSC fee to be increased based on expected site-specific surveillance or controls requirements if needed.[116]

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[107] EPA (in coordination with the Bureau of Indian Affairs, NRC, DOE, and Indian Health Service), *Federal Actions to Address Impacts of Uranium Contamination in the Navajo Nation, Five-Year Plan Summary Report*, January 2013, p. 63, https://www.epa.gov/sites/production/files/2016-07/documents/navajouraniumreport2013.pdf.

[108] For example, the table in the conference report (H.Rept. 115-929) accompanying the Energy and Water Development and Related Agencies for the Fiscal Year Ending September 30, 2019 and for Other Purposes (H.R. 5895) lists DOE-LM annual appropriation on page 184.

[109] For a complete list of sites managed by DOE-LM, see DOE, "LM Sites," https://www.energy.gov/lm/sites/lm-sites.

[110] U.S. Congress, House Committee on Appropriations, *Energy and Water, Legislative Branch, and Military Construction and Veterans Affairs Appropriations Act, 2019*, 115th Cong., September 21, 2018, H.R. 5895.

[111] DOE, *FY2019 Congressional Budget Request*, vol. 2, March 2018, p. 60.

[112] Long-term monitoring and maintenance requirements are described in the long-term surveillance plan.

[113] NRC, "Final Generic Environmental Impact Statement on Uranium Milling," vol. 1, p. 14-14. "Since the conservatively estimated average annual long-term monitoring cost is about $2,500, assuming an average one percent real rate of return, a $250,000 deposit (1978 dollars) per site would be necessary to cover the costs for long-term monitoring activities."

[114] As an example of how the fee changes due to inflation, NRC reported the inflation-adjusted LTSC fee for one site as $931,454 in 2018, implying that LTSC fee would cover $9,315 per year for DOE to perform annual long-term maintenance and monitoring at that site. See NRC, "Technical Evaluation Report for Patherfinder Mines Corporation's Proposed 2017-2018 Surety Estimate for the Shirley Basin Mill Tailings Site," May 3, 2018.

[115] See 10 C.F.R. 40, Appendix A, Criterion 10 and NRC, "Uranium Mill Tailings Regulations; Conforming NRC Requirements to EPA Standards," 50 *Federal Register* 41865, October 16, 1985.

[116] NRC, Standard Review Plan for the Review of a Reclamation Plan for Mill Tailings Sites Under Title II of the

UMTRCA does not authorize a mechanism to recover additional fees from licensees once the license has been transferred to DOE-LM.

The adequacy of the LTSC to cover DOE's costs to perform long-term maintenance and monitoring has been an issue. In 1995, the GAO recommended that NRC improve "the accuracy of the one-time charge made to owner/operators to ensure that this charge fully covers future costs at their sites."[117] In 2014, the DOE Office of Inspector General (IG) found that DOE-LM had spent $4.25 million at six Title II sites under long-term management. During the same three-year period, the IG report found that the available funds from the LTSC fees were $0.148 million.[118]

To the extent that the LTSC fees are insufficient to cover annual monitoring and maintenance costs, DOE-LM would be responsible to carry out long-term management responsibilities, subject to availability of annual appropriations. DOE-LM has discretion to allocate appropriated funding among eligible sites under long-term federal management. If the current minimum LTSCs do not fully cover annual long-term federal management costs for the remaining Title II sites when they transfer to DOE-LM, the IG report states "the total cost to the American taxpayers could be significant."[119]

Yet, there is a limited availability of information by site and by year for DOE-LM's monitoring and maintenance costs at UMTRCA sites under long-term management. DOE-EM has provided life-cycle cost ranges and completion date estimates for Environmental Management sites, including the Moab site, in annual budget justifications.[120] CRS was unable to identify DOE cost estimates for any other UMTRCA site.

The federal government will be responsible for the long-term management costs for all UMTRCA sites once transferred to DOE-LM. Potential issues for Congress may include the decommissioning and transfer status of the remaining Title II sites, the adequacy of funding to complete decommissioning at certain sites if the licensee is unable to fulfill its obligations, and the adequacy of the long-term surveillance charges to meet future long-term management needs.

Uranium Mill Tailings Radiation Control Act, June 2000, pp. E-8, https://www.nrc.gov/docs/ML0037/ML003725860.pdf.

[117] GAO, *Uranium Mill Tailings, Cleanup Continues, but Future Costs Are Uncertain*, GAO/RCED-96-37, December 1995.

[118] DOE, Office of Inspector General, "Audit Report, Management of Long-Term Surveillance and Maintenance of Uranium Mill Tailings Radiation Control Act of 1978 Title II Sites," October 23, 2014.

[119] DOE, Office of Inspector General, "Audit Report, Management of Long-Term Surveillance and Maintenance of Uranium Mill Tailings Radiation Control Act of 1978 Title II Sites," p. 5. "Unless Legacy Management reduces its costs or convinces the Commission that its costs are reasonable and necessary to control radiological hazards, it will continue to incur costs that are not fully covered by the surveillance charges. While we recognize that excess costs cannot be recovered from the owners of the six closed sites, we estimate that the shortfall in revenues relative to costs at the six sites currently in Legacy Management custody will increase by nearly $10 million by FY 2020. In addition, Legacy Management anticipates spending another $3.1 million by FY 2020 for its pre-transfer work that will not be covered by revenues. Given that Legacy Management is responsible for ensuring protection at Title II sites for a minimum of 200 years, if costs for long-term surveillance and pre-transfer activities exceed revenue at the 21 additional sites in a similar manner, the total cost to the American taxpayers could be significant. However, Legacy Management asserted that its activities at Title II sites remain consistent with its primary mission of protecting human health and the environment."

[120] See DOE, *FY2019 Congressional Budget Request*, Environmental Management, pp. 77 and 110.

Appendix

Table A-1. UMTRCA Sites under Long-Term Federal Management

Site Name	State	Title	Lead Agency or State
Tuba City Disposal	AZ	I	DOE-LM
Monument Valley Processing	AZ	I	DOE-LM
Durango Disposal	CO	I	DOE-LM
Durango Processing	CO	I	DOE-LM
Gunnison Disposal	CO	I	DOE-LM
Gunnison Processing	CO	I	DOE-LM
Rifle Disposal	CO	I	DOE-LM
Rifle (New Site) Processing	CO	I	DOE-LM
Rifle (Old Site) Processing	CO	I	DOE-LM
Slick Rock Disposal	CO	I	DOE-LM
Slick Rock East Processing	CO	I	DOE-LM
Slick Rock West Processing	CO	I	DOE-LM
Grand Junction Disposal	CO	I	DOE-LM
Grand Junction Processing	CO	I	DOE-LM
Maybell Disposal	CO	I	DOE-LM
Naturita Processing	CO	I	DOE-LM
Naturita Disposal	CO	I	DOE-LM
Lowman Disposal	ID	I	DOE-LM
Shiprock Disposal	NM	I	DOE-LM
Ambrosia Lake Disposal	NM	I	DOE-LM
Lakeview Disposal	OR	I	DOE-LM
Lakeview Processing	OR	I	DOE-LM
Burrell Disposal	PA	I	DOE-LM
Cannonsburg Disposal	PA	I	DOE-LM
Falls City Disposal	TX	I	DOE-LM
Mexican Hat Disposal	UT	I	DOE-LM
Green River Disposal	UT	I	DOE-LM
Salt Lake City Processing	UT	I	DOE-LM
Salt Lake City Disposal	UT	I	DOE-LM
Riverton Processing	WY	I	DOE-LM
Spook Disposal	WY	I	DOE-LM
Maybell West Disposal	CO	II	DOE-LM
Bluewater Disposal	NM	II	DOE-LM
L-Bar Disposal	NM	II	DOE-LM

Site Name	State	Title	Lead Agency or State
Edgemont Disposal	SD	II	DOE-LM
Sherwood Disposal	WA	II	DOE-LM
Shirley Basin South Disposal	WY	II	DOE-LM

Source: U.S. Department of Energy, "Uranium Mill Tailings Radiation Control Act Sites," November 30, 2016. U.S. Nuclear Regulatory Commission, "Locations of Uranium Recovery Sites Undergoing Decommissioning," August 23, 2018, https://www.nrc.gov/info-finder/decommissioning/uranium/.

Table A-2. UMTRCA Sites Not under Long-Term Federal Management

Site Name	State	Title	Lead Agency or State
Moab Processing	UT	I	DOE-EM
Ambrosia Lake-West	NM	II	NRC
Church Rock	NM	II	NRC
Grants-Homestake	NM	II	NRC
Sequoyah Fuels	OK	II	NRC
Gas Hills-West	WY	II	NRC
Uravan	CO	II	Agreement State
Durita	CO	II	Agreement State
Canyon City	CO	II	Agreement State
Panna Maria	TX	II	Agreement State
Ray Point	TX	II	Agreement State
Conquista	TX	II	Agreement State
Intercontinental Energy Corporation[a]	TX	II	Agreement State
Shootaring Canyon[b]	UT	II	Agreement State
Lisbon Valley	UT	II	Agreement State
White Mesa[b]	UT	II	Agreement State
Ford	WA	II	Agreement State
Bear Creek	WY	II	Agreement State
Lucky MC	WY	II	Agreement State
Gas Hills-East	WY	II	Agreement State
Split Rock	WY	II	Agreement State
Highland	WY	II	Agreement State
Shirley Basin (North)	WY	II	Agreement State
Sweetwater[b]	WY	II	Agreement State

Source: U.S. Department of Energy, "Uranium Mill Tailings Radiation Control Act Sites," November 30, 2016; U.S. Nuclear Regulatory Commission, "Locations of Uranium Recovery Sites Undergoing Decommissioning," August 23, 2018, https://www.nrc.gov/info-finder/decommissioning/uranium/.

Notes:

a. Site is listed on NRC's decommissioning website, but the site is not listed as anticipated by DOE-LM.

b. Site is listed as anticipated by DOE-LM, but the site is not listed on NRC's decommissioning website.

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