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NUCLEAR WASTE CLEANUP

Enhanced Coordination, Prioritization, and Leadership Commitment Could Improve DOE Research and Development Efforts

Statement of Nathan Anderson, Director, Natural Resources and Environment

Accessible Version

GAO-22-106138

GAO Highlights

Highlights of GAO-22-106138, a testimony before the Subcommittee on Energy, Committee on Science, Space, and Technology, House of Representatives

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Why GAO Did This Study

R&D has played an essential role in EM's efforts to clean up contamination from decades of nuclear weapons production and energy research. Such R&D has led to safer, more efficient, and more effective cleanup approaches. Prior studies have found that investments in R&D could reduce the future costs of EM's cleanup efforts. These costs have increased by nearly $250 billion in the last 10 years and are included on GAO's High Risk List. However, funding designated for nuclear cleanup R&D has declined since 2000.

This testimony discusses the extent to which EM (1) coordinates R&D across the EM complex, (2) prioritizes cleanup-related R&D efforts, and (3) has had sustained and consistent leadership commitment. For the October 2021 and May 2022 reports on which this testimony is based, GAO reviewed DOE documents and compared EM's R&D coordination efforts with leading practices. GAO also interviewed EM and national laboratory officials and former EM leaders.

What GAO Recommends

In its October 2021 report, GAO made four recommendations, including that DOE develop (1) a system to collect R&D information across the complex and (2) a comprehensive approach to prioritizing R&D. DOE concurred with both recommendations and is considering how best to implement them. In its May 2022 report, GAO recommended two matters for congressional consideration, including establishing a term appointment for EM's top leader and creating a new DOE under secretary position.

View GAO-22-106138. For more information, contact Nathan Anderson at (202) 512-3841 or andersonn@gao.gov.

What GAO Found

The Department of Energy's (DOE) Office of Environmental Management (EM) coordinates research and development (R&D) related to nuclear waste cleanup across the EM complex—EM headquarters, its 15 sites, and the 11 DOE national laboratories that conduct R&D related to nuclear cleanup. EM's coordination of R&D efforts, which include ways to improve worker safety, such as by using robotics (see fig.), fully aligns with four of GAO's seven leading practices for collaboration. However, EM does not fully follow other leading practices, which affects its ability to evaluate the effectiveness of R&D efforts. For example, EM officials told GAO that EM does not have a formal system to collect information on R&D activities across the complex, which would enable it to monitor and evaluate the activities' outcomes. Collecting such information could help EM determine whether to encourage or discourage investments in certain areas.

Robotic Technologies Potentially Applicable to Department of Energy Nuclear Cleanup Efforts

Sources: U.S. Department of Energy (left), and photograph provided courtesy of Carnegie Mellon University (right). | GAO-22-106138

EM also does not take a comprehensive approach to prioritizing R&D. Individual EM sites and national laboratories have their own decision-making processes for prioritizing R&D, but these may not address long-term or complex-wide needs. GAO has found that risk-informed decision-making can help agencies weigh numerous factors and consider trade-offs and that doing so would help EM set cleanup priorities within and across its sites. By developing a comprehensive, risk-informed approach, EM would be better positioned to provide sites with guidance for R&D spending beyond their immediate operational needs and to direct its limited R&D resources to its highest priorities.

GAO identified opportunities to strengthen DOE's leadership commitment to the cleanup mission, which may also enhance the effectiveness of its R&D efforts. For example, EM has experienced frequent turnover in its top leadership position. Legislation establishing a term appointment for this position could help improve stability, address challenges, and better support EM's long-term mission. In addition, DOE's organizational structure has not provided sustained leadership commitment for addressing environmental cleanup. A new, dedicated DOE under secretary position for nuclear waste management and environmental cleanup could help ensure that EM receives the sustained attention and commitment it needs to make cleanup progress.

Chair Bowman, Ranking Member Weber, and Members of the Subcommittee:

I am pleased to be here today to discuss our work on the Department of Energy's (DOE) research and development (R&D) efforts related to nuclear cleanup and how DOE leadership could be strengthened to better ensure the effectiveness of R&D investments. R&D has played an essential role in federal efforts to clean up massive amounts of radioactive and hazardous contamination produced by more than 75 years of nuclear weapons production and energy research. Advances in R&D have enabled DOE's Office of Environmental Management (EM) to carry out this cleanup using safer, more efficient, and more effective approaches, but the proportion of EM's budget designated for R&D has generally declined since 2000.[1] At the same time, DOE's environmental liabilities—the estimated costs to clean up radioactive and hazardous waste—are now over $400 billion. DOE's costs of cleanup account for nearly 85 percent of the federal government's environmental liabilities, which are on our list of areas that are at high risk for fraud, waste, abuse, and mismanagement, or in need of transformation.[2]

This testimony provides information on the extent to which EM (1) coordinates R&D across the EM complex, (2) prioritizes cleanup-related R&D efforts, and (3) has had sustained and consistent leadership commitment.

My testimony today is based on two reports: (1) our October 2021 report on EM's R&D efforts and (2) our May 2022 report on EM's leadership capacity.[3] For these reports, we reviewed agency financial, program, and policy documents; compared EM's coordination of R&D with leading

[1]According to EM documents, EM's budget for headquarters-managed R&D decreased from about 5.5 percent of its total budget in the period between 1989 and 2002 to about 0.4 percent in fiscal year 2021.

[2]GAO, *High-Risk Series: Dedicated Leadership Needed to Address Limited Progress in Most High-Risk Areas,* GAO-21-119SP (Washington, D.C.: Mar. 2, 2021).

[3]GAO, *Nuclear Waste Cleanup: DOE Needs to Better Coordinate and Prioritize Its Research and Development Efforts,* GAO-22-104490 (Washington, D.C.: Oct. 28, 2021); and *Nuclear Waste: DOE Needs Greater Leadership Stability and Commitment to Accomplish Cleanup Mission,* GAO-22-104805 (Washington, D.C.: May 3, 2022).

practices for collaboration;[4] compared EM's efforts to prioritize R&D with GAO's risk-informed decision-making framework;[5] reviewed DOE data on changes in EM leadership; reviewed key literature on leadership tenure; and interviewed DOE and national laboratory officials and other stakeholders, including current and former EM leaders. Our reports each include a detailed description of our scope and methodology.

All work on which this testimony is based was performed in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

DOE and EM R&D Structure

A variety of DOE offices and laboratories, and EM sites, have a role in EM's R&D efforts.

EM's Technology Development Office. This office develops, manages, and operates EM's R&D program, which EM aims to manage as a single portfolio across EM sites and at the national laboratories. The Technology Development Office reports to EM's Office of Field Operations, which provides leadership and develops mission strategies, policy, and guidance for site operations.

The Technology Development Office has typically received between $25 million and $35 million in funding each fiscal year since fiscal year 2018. Of this amount, $15 million has typically been congressionally directed to

[4]GAO, *Managing for Results: Key Considerations for Implementing Interagency Collaborative Mechanisms,* GAO-12-1022 (Washington, D.C.: Sept. 27, 2012).

[5]GAO, *Environmental Liabilities: DOE Would Benefit from Incorporating Risk-Informed Decision-Making into Its Cleanup Policy,* GAO-19-339 (Washington, D.C.: Sept. 18, 2019).

specific initiatives.[6] The Technology Development Office may provide the remaining funds to EM sites to supplement their R&D efforts.[7]

National laboratories. DOE has 17 laboratories that conduct R&D and manage scientific facilities. Some DOE laboratories are co-located with EM cleanup sites; for example, Pacific Northwest National Laboratory—an Office of Science laboratory—is co-located with the Hanford Site in the state of Washington, and Savannah River National Laboratory—EM's lead laboratory—is co-located with the Savannah River Site in the state of South Carolina.[8]

The Network of National Laboratories for Environmental Management and Stewardship is a consortium of the 11 DOE laboratories that conduct R&D related to nuclear cleanup and long-term surveillance and maintenance of sites with contamination remaining after cleanup. This network supports EM and the Office of Legacy Management, advises DOE on cleanup-related policy decisions, and conducts strategic planning and peer review on behalf of EM.[9] According to EM officials, other EM

[6]Congressional direction is contained in legislative reports and explanatory statements and is not legally binding. However, DOE officials told us that they treat such report language as legally binding.

[7]DOE takes an additional 3.65 percent of the Technology Development appropriation for the Office of Science to use for DOE's Small Business Innovation Research and Small Business Technology Transfer programs. The Small Business Act requires DOE to spend a certain percentage of its R&D funds with small businesses through these programs.

[8]DOE's national laboratories generally have a primary DOE entity as a client. For example, EM is the primary client for Savannah River National Laboratory. Other DOE laboratories that conduct cleanup-related R&D have as clients DOE's Office of Science, Office of Nuclear Energy, or National Nuclear Security Administration. Multiprogram laboratories, such as the Pacific Northwest National Laboratory, may conduct large portions of their work for clients other than the primary DOE client.

[9]The network originally formed as a consortium of six core EM laboratories in 2017 and was called the EM National Laboratory Network. In 2021, it incorporated laboratories that conduct work for DOE's Office of Legacy Management and became the Network of National Laboratories for Environmental Management and Stewardship.

headquarters offices, such as the Laboratory Policy Office, direct funding to certain laboratories within the network for R&D efforts.[10]

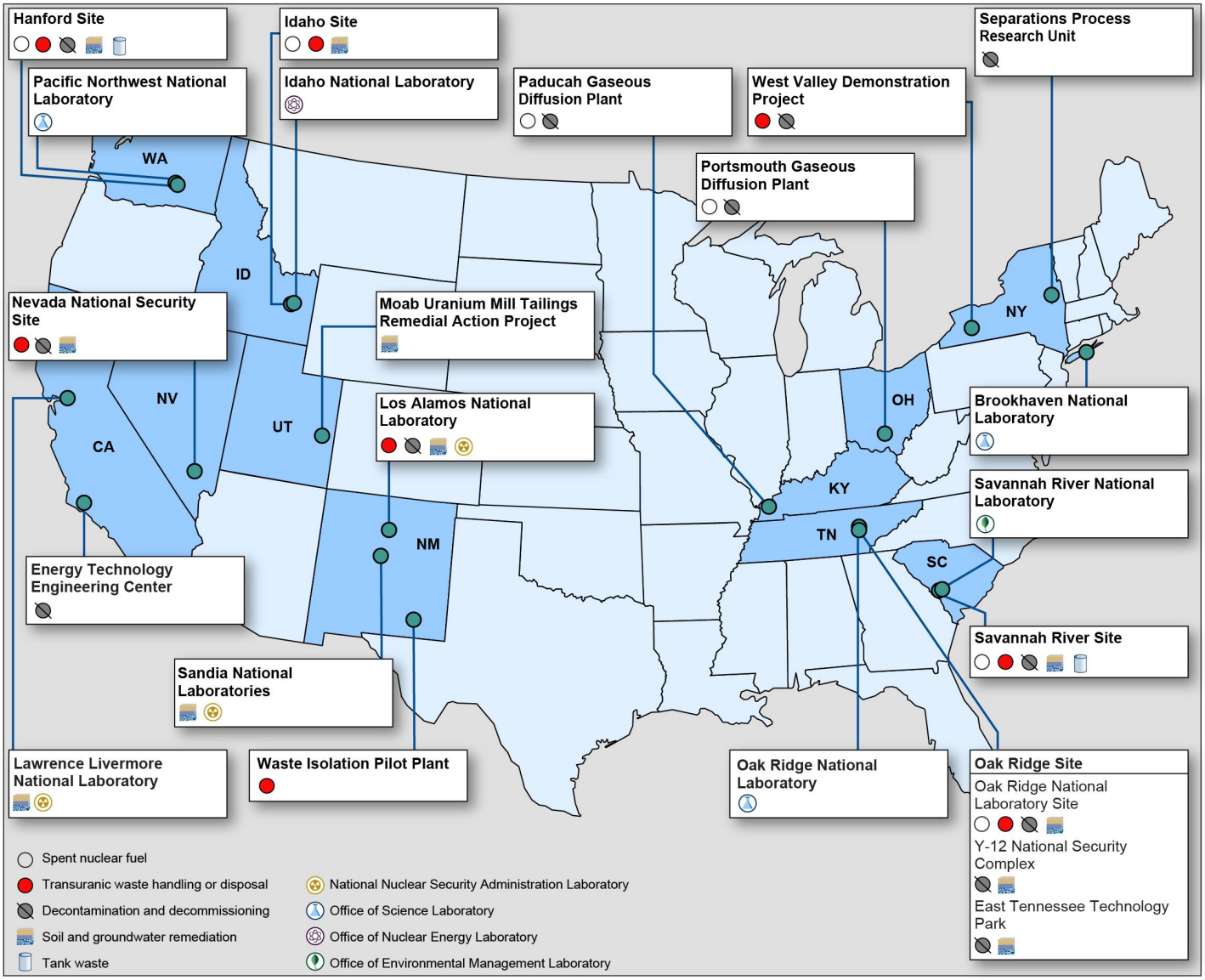
EM sites. EM has 15 active cleanup sites with varying R&D needs and efforts (see fig. 1).[11] At each site, EM oversees contractors that conduct the cleanup work.[12] EM sites collectively direct at least $80 million annually to national laboratories for site-specific operational R&D needs, according to EM officials. This includes R&D necessary to proceed with ongoing cleanup efforts, such as testing and demonstrating equipment to monitor contamination. EM officials we interviewed said that the sites directed an additional $180 million to these laboratories in fiscal year 2020, with an undetermined amount going to R&D expenditures.

[10]The Laboratory Policy Office contributed $2.8 million to Network of National Laboratories for Environmental Management and Stewardship participants in fiscal year 2020 and $1.7 million in fiscal year 2019, according to EM documents. EM officials told us that the Technology Development Office directed $10 million, and the Laboratory Policy Office directed $6 million, to certain laboratories within the network for R&D efforts in fiscal year 2020.

[11]EM has completed cleanup at 92 of its original 107 sites.

[12]DOE oversees its contractors' activities through headquarters offices and local federal field and site offices (local offices) co-located at each contractor's location.

Figure 1: Map of the Department of Energy (DOE) Environmental Management Complex



Sources: GAO analysis of DOE information and Map Resources (map). | GAO-22-106138

Accessible text for Figure 1: Map of the Department of Energy (DOE) Environmental Management Complex

Item	Symbol
Hanford Site	Spent Nuclear Fuel Transuranic Waste Handling or Disposal Decontamination and Decommissioning Soil and Groundwater Remediation Tank Waste
Nevada National Security Site	Transuranic Waste Handling or Disposal Soil and Groundwater Remediation Decontamination and Decommissioning
Lawrence Livermore National Laboratory	Soil and Groundwater Remediation National Nuclear Security Administration Laboratory
Waste Isolation Pilot Plant	Transuranic Waste Handling or Disposal
Oak Ridge National Laboratory Site	Decontamination and Decommissioning Soil and Groundwater Remediation Transuranic Waste Handling or Disposal Spent Nuclear Fuel
Y-12 National Security Complex	Decontamination and Decommissioning Soil and Groundwater Remediation
East Tennessee Technology Park	Decontamination and Decommissioning Soil and Groundwater Remediation
West Valley Demonstration Project	Decontamination and Decommissioning Transuranic Waste Handling or Disposal
Separations Process Research Unit	Decontamination and Decommissioning
Portsmouth	Spent Nuclear Fuel Decontamination and Decommissioning
Paducah	Spent Nuclear Fuel Decontamination and Decommissioning
Energy Technology Engineering Center	Decontamination and Decommissioning
Savannah River Site	Transuranic Waste Handling or Disposal Tank Waste Spent Nuclear Fuel Decontamination and Decommissioning Soil and Groundwater Remediation
Moab Uranium Mill Tailings Remedial Action Project	Soil and Groundwater Remediation
Pacific Northwest National Laboratory	Office of Science Laboratory
Sandia National Laboratories	Soil and Groundwater Remediation National Nuclear Security Administration Laboratory

Los Alamos National Laboratory	Transuranic Waste Handling or Disposal Soil and Groundwater Remediation Decontamination and Decommissioning National Nuclear Security Administration Laboratory
Idaho National Laboratory	Office of Nuclear Energy Laboratory
Oak Ridge National Laboratory	Office of Science Laboratory
Savannah River National Laboratory	Office of Environmental Management Laboratory
Brookhaven National Laboratory	Office of Science Laboratory
Idaho Site	Spent Nuclear Fuel Transuranic Waste Handling or Disposal Soil and Groundwater Remediation

Note: The Waste Isolation Pilot Plant is the only repository for the permanent disposal of transuranic waste. Other sites handle transuranic waste disposition by preparing such waste for disposal. Various sites also have on-site disposal areas, such as near-surface landfills, for other types of waste, such as low-level waste.

Source: GAO analysis of DOE information and Map Resources map. | GAO-22-106138.

EM officials and contractors at EM's sites identify project-specific needs, including needs that arise in the course of each site's cleanup operations. Sites often address such R&D needs by engaging the national laboratories or adapting commercially available technologies. For example, officials at the Hanford Site's Office of River Protection in Washington State identified the need to manage tank farm vapors and other odors, which posed worker-safety risks. Officials worked with the site contractor to develop and test a commercially available technology used in the cleanup of the Fukushima-Daiichi plant in Japan.[13]

EM Leadership and Oversight

Since EM's establishment in 1989, its top leader has been intended to be an Assistant Secretary.[14] DOE's principal officers, such as its three under

[13]On March 11, 2011, an earthquake and subsequent tsunami severely damaged the Fukushima-Daiichi nuclear power plant in Japan. Cleanup at the plant is ongoing.

[14]Officials holding the title of Senior Advisor have also been the top leader of EM. The Department of Energy Organization Act, as amended, establishes eight DOE Assistant Secretaries to be appointed by the President with the advice and consent of the Senate. The statute identifies the responsibilities that are to be assigned to the DOE Assistant Secretaries, including environmental and nuclear waste management responsibilities and functions carried out by the EM Assistant Secretary. Pub. L. No. 95-91, tit. II, § 203, 91 Stat. 565, 570 (1977) (codified as amended at 42 U.S.C. § 7133(a)).

secretaries, serve under the Secretary of Energy as the department's top leadership and oversee major departmental elements, including EM.[15]

EM Uses Several Mechanisms to Coordinate R&D, but Its Efforts Do Not Fully Align with Some Leading Collaboration Practices

In our 2021 report, we found that EM's efforts to coordinate nuclear cleanup R&D fully aligned with four of the seven leading collaboration practices we outlined in September 2012: identifying leadership, documenting agreement on collaboration, clarifying roles and responsibilities, and including relevant participants.[16] For example, EM, its sites, and the national laboratories understand their respective roles within the complex and in R&D activities, according to program documents and our interviews with agency officials. EM's Technology Development Framework defines the roles of several positions, such as the Technology Development Program Director, who is responsible for overall management and oversight of the Technology Development program.[17]

We found that EM's coordination efforts partially aligned with the remaining three leading practices for collaboration: bridging organizational cultures, identifying resources, and defining outcomes and monitoring progress for accountability. The following examples illustrate our findings.

Bridging organizational cultures. The leading practice of bridging organizational cultures calls for collaborating agencies to have ways to operate across agency boundaries, such as by agreeing on common terminology and definitions. EM has established ways to operate across

[15]The statutory provision establishing DOE's principal officers provides that the department will have three under secretaries to carry out various functions, to include (1) the Under Secretary whose duties are to be determined at the discretion of the Secretary of Energy; (2) the Under Secretary for Nuclear Security, who also serves as the Administrator for the National Nuclear Security Administration; and (3) the Under Secretary for Science. The provision also establishes that DOE will have two other principal officers: the Deputy Secretary and the General Counsel. 42 U.S.C. § 7132.

[16]GAO-12-1022.

[17]U.S. Department of Energy, Office of Environmental Management, *Technology Development Framework* (Washington, D.C.: January 2021).

agency boundaries such as by leveraging working groups as a means to share information among contractors, the national laboratories, and different DOE offices. However, EM's coordination efforts do not fully align with this leading practice because EM has not developed or disseminated a common definition of R&D for EM R&D stakeholders to use. We found in our interviews with officials throughout the EM complex that, in the absence of a common definition of R&D, EM R&D stakeholders—including EM headquarters and sites—interpreted R&D differently. For example, senior EM officials told us that first-of-a-kind construction and laboratory-directed research and development constituted R&D. However, Technology Development officials said that they did not track such activities as part of their oversight of EM's R&D program.

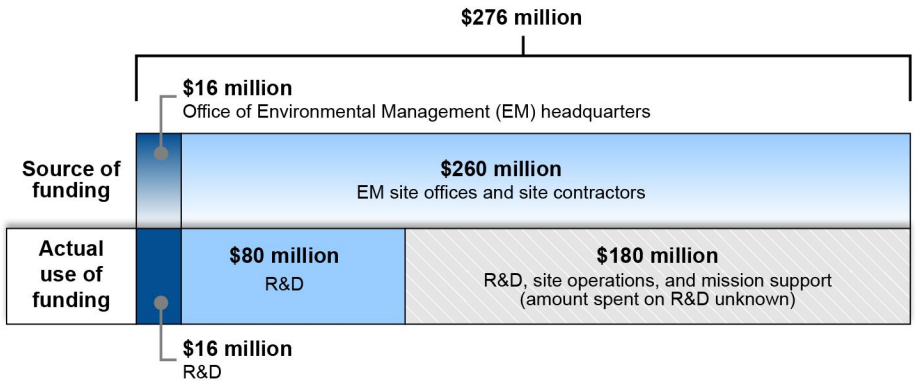
Without a common definition of R&D across the EM complex, sites may not document or report certain efforts as R&D to the Technology Development Office. As a result, EM may not have quality information from sites on their individual and collaborative R&D efforts in order to assess progress toward its R&D goals. We recommended that the Assistant Secretary for Environmental Management develop and disseminate a common definition of R&D throughout the EM complex. EM agreed with this recommendation and is considering how best to implement it.

Identifying resources. The leading practice of identifying resources calls for tracking interagency funding in a standardized manner for accountability, but EM does not have an internal system to systematically track R&D expenditures throughout the complex. Although the Technology Development Office has established processes to track its own expenditures on R&D, officials said they are not required to formally track site-funded R&D. It is also unclear whether EM's efforts to track R&D expenditures at its sites have captured all R&D activities across the entire EM complex. For example, officials said that EM's 2019 site assessments covered the entire complex, but only four of the 16 sites active at the time—the Hanford, Savannah River, Idaho National Laboratory, and Oak Ridge sites—issued reports on their assessments.[18]

[18]Cleanup activities at one of the sites—Brookhaven National Laboratory—were completed in March 2022.

EM officials told us that in fiscal year 2019 they began collecting information on cleanup-related R&D funding that sites provided to the Network of National Laboratories for Environmental Management and Stewardship, and officials plan to do so annually.[19] While Technology Development officials gave us a general breakdown of the approximately $276 million EM provided to six laboratories in the network in fiscal year 2020, they could not give us a detailed breakdown of these expenditures because they had not yet received all underlying data from the sites and laboratories. Technology Development officials specified that $16 million came from EM headquarters and an additional $80 million came from the sites. However, Technology Development officials could not specify how much of the remaining $180 million went toward R&D efforts (see fig. 2). By systematically tracking R&D expenditures, EM would have better assurance that it is collecting complete information about R&D expenditures across the complex—information that it can use to identify the resources it needs to sustain collaborative R&D for nuclear cleanup. We recommended that the Assistant Secretary for Environmental Management systematically and comprehensively track R&D funding throughout the EM complex. EM agreed with this recommendation and is considering how best to implement it.

Figure 2: Known and Possible Office of Environmental Management Research and Development (R&D) Funding to Certain Laboratories in Fiscal Year 2020



Source: GAO analysis of Department of Energy information. | GAO-22-106138

[19]As previously noted, prior to fiscal year 2020, the Network of National Laboratories for Environmental Management and Stewardship was called the EM National Laboratory Network.

Data table for Figure 2: Known and Possible Office of Environmental Management Research and Development (R&D) Funding to Certain Laboratories in Fiscal Year 2020

Total Funding = $276 million

Budgeted funding

- $16 million – Office of Environmental Management (EM) headquarters
- $260 million – EM site offices and site contractors

Use of funding

- $16 million – Research and Development (R&D)
- $80 million – R&D
- $180 million – R&D, site operations, and mission support (amount spent on R&D unknown)

Source: GAO analysis of DOE information | GAO-22-106138

Outcomes and accountability. EM has taken steps to define outcomes for R&D and monitor and evaluate progress toward these outcomes at some individual sites, but it may not be comprehensively capturing R&D activities across the entire EM complex. For example, EM's annual strategic vision documents provide a high-level overview of program goals and priorities, such as addressing groundwater contamination at the Savannah River Site through technology deployment.[20] However, we found that EM's monitoring and evaluation efforts do not fully align with this leading practice. Technology Development officials told us that they informally collect information on R&D projects in coordination with other EM offices and sites, project managers, and national laboratory personnel. EM officials acknowledged that the agency did not have an internal system to collect comprehensive information on R&D activities throughout the complex that would enable them to monitor and evaluate these activities' outcomes.

By systematically collecting data on R&D collaborative efforts, including those funded by both the Technology Development Office and individual site budgets, EM would be better able to monitor and evaluate the outcomes of R&D efforts throughout the complex and would have better assurance that it is getting a positive return on its R&D investments. We recommended that the Assistant Secretary for Environmental Management deploy a system to collect comprehensive data on R&D efforts to enable EM to monitor and evaluate outcomes throughout the

[20]U.S. Department of Energy Office of Environmental Management, *EM Strategic Vision: 2021-2031* (Washington, D.C.: April 2021).

EM complex. EM agreed with this recommendation and is considering how best to implement it.

EM Does Not Have a Comprehensive Framework for Prioritizing R&D Efforts

We also found that EM's Technology Development Office had not taken a comprehensive approach to prioritizing R&D for nuclear cleanup.[21] In the absence of a comprehensive approach, individual EM sites and DOE laboratories developed their own approaches for making R&D prioritization decisions, according to site and laboratory officials.

In our prior work on DOE nuclear cleanup efforts, we reported that setting national priorities and using a risk-informed decision-making framework could help EM save money and shorten cleanup time frames. In January 2019, we found that implementing a program-wide strategy to set national priorities, rather than prioritizing and funding cleanup activities by individual sites, would help EM better balance risks and costs across and within its sites, save tens of billions of dollars, and accelerate cleanup projects.[22] In September 2019, we found that by applying a risk-informed decision-making framework, EM would be better positioned to effectively set priorities within and across its sites and enhance its ability to direct its limited resources to address those priorities.[23]

The Technology Development Office had taken steps toward applying risk-informed decision-making as outlined in the design phase, such as defining the problem, according to our review of the office's documents

[21]GAO-22-104490.

[22]GAO, *Department of Energy: Program-Wide Strategy and Better Reporting Needed to Address Growing Environmental Cleanup Liability,* GAO-19-28 (Washington, D.C.: Jan. 29, 2019).

[23]We made two recommendations in GAO-19-339, including that DOE revise its cleanup policy to establish how EM should apply the essential elements of a risk-informed decision-making framework into its current decision-making requirements and guidance. DOE agreed with both recommendations. Although it has not implemented them as of September 2021, DOE noted in its response to our September 2019 report that the agency was working to develop a program-wide strategy to address risks in a more consistent manner to better align cleanup plans and activities with programmatic priorities and available budgets.

and our interviews with officials.[24] Specifically, the Technology Development Office used various mechanisms to identify R&D needs, such as through site managers and workshops. The office had also taken steps toward defining objectives and performance measures. For example, the Technology Development Framework describes the program's focus on solutions that support the EM cleanup mission through enhanced worker safety or that reduce risks, schedule, or costs of cleanup and that have a significant effect on site closures. Technology Development officials told us that they apply performance measures to R&D projects that receive funding from their office.

However, the Technology Development Office has not taken other steps integral to a risk-informed decision-making approach for its own decisions or to guide site decisions. For example, the office had not identified a formal, systematic method to integrate information into a basis for making a decision, along with an associated decision rule that specifies which option should be considered "best" under that method.[25] Such formal

[24]The essential elements of the risk-informed decision-making framework, which we outlined in our September 2019 report, consist of 16 steps across four phases. Organizations applying the framework should tailor the depth and extent of the phases and steps to the nature and significance of the decision being made. The first phase—the design phase—lays the groundwork for risk-informed decision-making throughout subsequent phases. The seven steps in the design phase are (1) identifying and engaging stakeholders, (2) defining the problem and decision to be made, (3) defining objectives and performance measures, (4) identifying constraints, (5) identifying options, (6) identifying a decision-making method and rule, and (7) developing an analysis plan. GAO-19-339.

[25]For example, one such method is "multiattribute utility theory," a type of multicriteria decision analysis for making decisions that have multiple, competing objectives. This method involves calculating a numerical score for each of the options under consideration as a way to evaluate their relative merit. To calculate a score, the performance of an option with respect to an individual objective is estimated, and then the individual estimates are summed or averaged into an overall score for that option. Objectives may be assigned weights as a way to express decision-maker or stakeholder preferences about the comparative importance of the objectives. For example, an option's performance with respect to reducing risks to human health may be weighted more heavily than its performance with respect to costs. The overall score for an option represents its expected utility, or value. For a risk-informed cleanup decision, decision rules that could be informed by such decision-making methods include selecting the option that minimizes either (1) human health risks subject to constraints on cost and any other factors or (2) cost subject to constraints on human health risks and any other factors. GAO-19-339.

decision-making methods provide a rigorous, transparent way to evaluate trade-offs among objectives.[26]

In addition, at the time of our review for our October 2021 report, the Technology Development Office's prioritization process—including its Standard Operating Policies and Procedures for evaluating and approving funding proposals—provided guidance only for the small portion of R&D funding that the office controls.[27] The Technology Development Office did not provide guidance on prioritizing R&D spending to the sites or laboratories, which spent the vast majority of R&D funds across the EM complex.

Throughout the course of our review, several officials told us that they face constraints that may inform prioritization of R&D efforts, including regulatory and resource constraints. Specifically, some EM site and laboratory officials told us that regulatory factors, such as delays in approval because of heavy regulator workload, have posed challenges to EM's ability to adopt certain technologies. In addition, many EM, site, and laboratory officials we interviewed said that limited budgets for R&D and restrictions on spending result in pressures to direct R&D resources to address immediate operational needs. According to many of these officials, such pressures can divert resources from forward-looking R&D efforts that could bring long-term efficiencies and gains for worker safety. Prior studies of EM's R&D efforts have identified concerns about EM's level of investment in basic and breakthrough research in favor of incremental research.[28] In addition, our prior work has found that effective management of R&D portfolios requires balancing investments between incremental R&D, which is tied to near-term products, and disruptive

[26]GAO-19-339.

[27]As noted earlier, EM could not provide a total for annual cleanup-related R&D expenditures throughout the complex. We identified a minimum of $110 million in such expenditures, between $30 million expended by the Technology Development Office and $80 million expended by the sites. Of the $30 million, the Technology Development Office decides how to spend about $15 million, and $15 million is congressionally directed. The Laboratory Policy Office also contributes $6 million to R&D expenditures, and the sites and laboratories may expend up to another $180 million.

[28]National Academies of Sciences, Engineering, and Medicine, *Independent Assessment of Science and Technology for the Department of Energy's Defense Environmental Cleanup Program* (Washington, D.C.: The National Academies Press, 2019); Secretary of Energy Advisory Board, Department of Energy, *Report of the Task Force on Technology Development for Environmental Management (*Washington, D.C.: 2014), accessed August 31, 2020.

R&D, which is intended to deliver innovative technologies that can provide longer-term growth.[29]

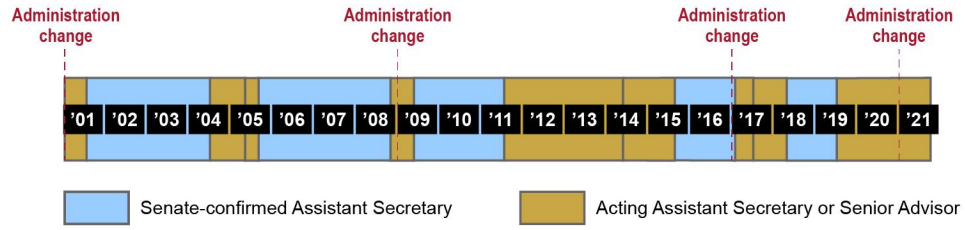
Risk-informed decision-making could provide a framework for managing constraints related to budgets and balancing such trade-offs, such as by developing a decision-making method or rule that factors in budgetary considerations. By establishing a comprehensive risk-informed decision-making framework for R&D investments across the EM complex, EM would be better positioned to provide sites with guidance for R&D spending beyond their immediate operational needs and to direct its limited R&D resources to its highest priorities. We recommended that the Assistant Secretary for Environmental Management develop a comprehensive approach to prioritizing R&D investments across the EM complex that follows a risk-informed decision-making framework. EM agreed with this recommendation and is considering how best to implement it.

DOE Needs Greater Leadership Stability and Commitment to Accomplish EM's Cleanup Mission

In our 2022 report, we identified opportunities to strengthen DOE's leadership commitment to the cleanup mission, which may also enhance the effectiveness of its R&D efforts. EM has experienced frequent turnover in its top leadership position since it was established in 1989, with the average top leader serving for less than 2 years. In the last 2 decades, there have been five Senate-confirmed assistant secretaries (political appointees) and nine acting assistant secretaries or senior advisors (see fig. 3).

[29]GAO, *Defense Science and Technology: Adopting Best Practices Can Improve Innovation Investments and Management,* GAO-17-499 (Washington, D.C.: June 29, 2017).

Figure 3: Turnover in the Office of Environmental Management's Top Leadership Position, 2001 to 2021



Source: GAO analysis of Department of Energy information. | GAO-22-106138

Frequent turnover has created challenges for achieving the department's complex and long-term cleanup mission, such as difficulty building relationships with stakeholders, inconsistent and incomplete initiatives, and a focus on short-term actions over long-term priorities, according to those we interviewed.[30] For example, several of those we interviewed said that, because EM leaders typically expect to be in the position for only a limited period, these leaders seek out short-term accomplishments that, in officials' views, are at odds with EM's decades-long clean-up mission.

Several options exist that can enhance leadership commitment. Specifically, DOE's Deputy Secretary told us that filling EM's top leadership position with a senior career official, rather than a political appointee, could help overcome some of the challenges, if the official serves for a long enough tenure. Alternatively, we have found that term appointments can help agencies facing long-term challenges that require sustained leadership attention over time. For example, we have previously supported establishing term appointments of at least 5 to 7 years for certain leadership positions.[31] Legislation establishing a term

[30]For GAO-22-104805, we interviewed 17 current and former EM leaders whose tenures, collectively, cover most of EM's history. We also interviewed other senior DOE and EM officials, as well as stakeholders from state regulatory agencies in some of the states with EM sites.

[31]Specifically, in 2007, we proposed that Congress consider strategies such as term appointments in implementing Chief Operating Officer/Chief Management Officer positions within federal agencies. We noted that providing such positions with term appointments of about 5 to 7 years would be one way to help ensure that long-term management and transformation initiatives provided meaningful and sustainable results. See GAO, *Organizational Transformation: Implementing Chief Operating Officer/Chief Management Officer Positions in Federal Agencies*, GAO-08-34 (Washington, D.C.: Nov. 1, 2007); and GAO, *Defense Business Transformation: Achieving Success Requires a Chief Management Officer to Provide Focus and Sustained Leadership*, GAO-07-1072 (Washington, D.C.: Sept. 5, 2007).

appointment for EM's top leader could help improve leadership stability, address challenges, and better support EM's long-term mission to clean up nuclear waste by helping create an organizational commitment that can endure across administrations.

In addition to frequent turnover in leadership, EM's different positions within DOE's organizational structure have not provided sustained leadership commitment for environmental cleanup. EM has reported to DOE's Deputy Secretary and three under secretaries at different points throughout EM's history, but EM leaders, senior DOE and EM officials, and stakeholders that we interviewed said that none of these organizational positions has supplied EM with the consistent leadership it needs. For example, many described EM as too big and too different from the other parts of DOE for a single leader to effectively oversee it in addition to other major DOE elements, such as the Office of Science or the National Nuclear Security Administration.

Our prior work shows that the nature and scope of the changes needed in federal agencies facing long-standing management challenges and high-risk operations require the sustained commitment of the top political leadership.[32] Congress has previously created new under secretary positions in DOE in the wake of concerns regarding departmental management of and leadership attention to particular mission areas. A new, dedicated under secretary position for nuclear waste management and environmental cleanup could help ensure that EM receives the sustained attention and commitment it needs to make cleanup progress.

We recommended two matters for congressional consideration, including establishing a term appointment for EM's top leader and creating a new DOE under secretary position.

In conclusion, our October 2021 report emphasized the importance of establishing a coordinated, complex-wide approach to EM's nuclear cleanup R&D efforts and a comprehensive approach for prioritizing those efforts. Our May 2022 report addressed how instability in EM, including increasingly frequent turnover in its leadership, has contributed to challenges in carrying out its mission, including slowed progress on cleanup. Implementing our recommendations on these issues would help

[32]GAO, *Highlights of a GAO Roundtable: The Chief Operating Officer Concept: A Potential Strategy to Address Federal Governance Challenges*, GAO-03-192SP (Washington, D.C.: Oct. 4, 2002).

ensure that EM can continue to make progress on its crucial cleanup efforts.

Chair Bowman, Ranking Member Weber, and Members of the Subcommittee, this completes my prepared statement. I would be pleased to respond to any questions that you may have at this time.

GAO Contact and Staff Acknowledgments

If you or your staff members have any questions about this testimony, please contact Nathan Anderson, Director, Natural Resources and Environment, at (202) 512-3841 or andersonn@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this statement. GAO staff who made key contributions to this testimony are Amanda K. Kolling (Assistant Director), Alisa Beyninson (Analyst-In-Charge), Antoinette Capaccio, Katherine Killebrew, and Cory Ryncarz. Also contributing to this report were Cindy Gilbert, Gwen Kirby, and Sara Sullivan.

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