



June 2024

# NUCLEAR WASTE CLEANUP

## Closer Alignment with Leading Practices Needed to Improve Department of Energy Program Management

Accessible Version

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# GAO Highlights

View [GAO-24-105975](#). For more information, contact Nathan Anderson at (202) 512-3841 or [AndersonN@gao.gov](mailto:AndersonN@gao.gov).

Highlights of [GAO-24-105975](#), a report to congressional requesters

June 2024

## NUCLEAR WASTE CLEANUP

### **Closer Alignment with Leading Practices Needed to Improve Department of Energy Program Management**

#### **Why GAO Did This Study**

EM has spent over \$215 billion since its creation in 1989 to clean up hazardous and radioactive waste at sites and facilities contaminated from nuclear weapons production and nuclear energy research. EM has acknowledged that it needs to strengthen program management to ensure that the completion of the remaining cleanup work is safe, efficient, and cost-effective.

GAO was asked to review EM's implementation of its 2020 Program Management Protocol. This report examines (1) how EM has implemented its Protocol and (2) the extent to which EM has incorporated program management leading practices as it implements the Protocol.

GAO reviewed documents and conducted semi-structured interviews with EM officials at cleanup sites and headquarters. GAO also evaluated EM processes against program management leading practices and additional supplemental criteria.

#### **What GAO Recommends**

GAO is making seven recommendations to the Department of Energy, including developing an EM program-wide schedule that is comprehensive, includes interdependencies, and is based on realistic assumptions; and ensuring that EM conducts root cause analyses of cost and schedule overruns, implements corrective actions, and reports annually on the outcome of their implementation.

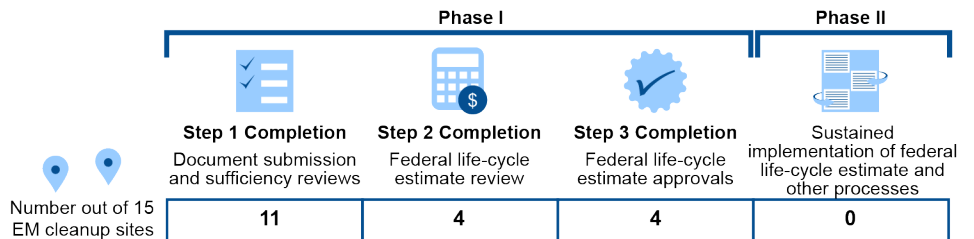
DOE concurred with the seven recommendations.

#### **What GAO Found**

The Department of Energy's Office of Environmental Management (EM) developed its 2020 Program Management Protocol to update its cleanup policy to reflect leading practices for program management. EM has begun a two-phase review of the implementation of the Protocol at its 15 cleanup sites. Phase I focuses on review and approval of sites' strategic planning, risk management, and life-cycle cost and schedule estimates. Phase II reviews are meant to ensure implementation of the sites' life-cycle scope, cost, and schedule estimates and supporting systems, processes, and procedures is sustainable, and to evaluate the continued reliability of these estimates (see

figure). EM's implementation of the Protocol is delayed—initially expected to be completed in fiscal year 2024, it is now likely to extend past August 2025.

**Office of Environmental Management's Progress in Completing Its Review of the Program Management Protocol Implementation at Its Cleanup Sites, as of April 2024**



Sources: GAO analysis of Department of Energy (DOE) Office of Environmental Management's (EM) information; and GAO (icons). | GAO-24-105975

**Accessible Text for Office of Environmental Management's Progress in Completing Its Review of the Program Management Protocol Implementation at Its Cleanup Sites, as of April 2024**

- Phase 1
  - Step 1 Completion - Document submission and sufficiency reviews - 11
  - Step 2 Completion - Federal life-cycle estimate review - 4
  - Step 3 Completion - Federal life-cycle estimate approvals - 4
- Phase 2
  - Sustained implementation of federal life-cycle estimate and other processes- 0

Sources: GAO analysis of Department of Energy (DOE) Office of Environmental Management's (EM) information; and GAO (icons). | GAO-24-105975

EM has incorporated some program management leading practices in its implementation of the Protocol and has opportunities to further incorporate others. For example:

- EM is updating its site-specific life-cycle cost and schedule estimates to use as baselines to track progress and monitor site work by government officials. However, EM does not yet have a comprehensive, program-wide life-cycle schedule estimate—called an integrated master schedule—which is the focal point of program management. EM is planning to update its schedule at the level needed to manage the program, track key decision points and see interdependencies across sites. Until that happens, EM will not be able to integrate and optimize its work to be more efficient and use this schedule as a baseline to monitor progress toward cleanup goals.
- EM requires cleanup sites to conduct root cause analyses if sites exceed defined thresholds for cost and schedule overruns and secure EM leadership

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approval for revised estimates. However, EM does not clearly require that corrective action plans accompany the root cause analyses, that the corrective actions are tracked through their completion, or that the implementation of corrective action is independently reviewed. EM is also not required to report on the root causes and the status of implementing corrective actions to ensure corrective actions are implemented in a timely and adequate manner. These steps would create an important accountability and oversight mechanism for a program approaching \$900 billion in estimated life-cycle costs.

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**Abbreviations**

DOD	Department of Defense
DOE	Department of Energy
EM	Office of Environmental Management
EVM	earned value management
FSLE	Federal Site Life-cycle Estimate
IPT	Integrated Project Team
NASA	National Aeronautics and Space Administration
OMB	Office of Management and Budget
PMI	Project Management Institute
TRU	Transuranic
WIPP	Waste Isolation Pilot Plant

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June 4, 2024

The Honorable Cathy McMorris Rodgers  
Chair  
The Honorable Frank Pallone, Jr.  
Ranking Member  
Committee on Energy and Commerce  
House of Representatives

The Honorable Diana DeGette  
Ranking Member  
Subcommittee on Energy, Climate, and Grid Security  
Committee on Energy and Commerce  
House of Representatives

The Honorable H. Morgan Griffith  
Chair  
Subcommittee on Oversight and Investigations  
Committee on Energy and Commerce  
House of Representatives

In 1989, the Department of Energy (DOE) established its nuclear waste cleanup program by creating the Office of Environmental Management (EM) to address hazardous and radioactive waste at sites and facilities contaminated from decades of nuclear weapons production and nuclear energy research.<sup>1</sup> Since 1990, we have designated DOE's acquisition and program management—which includes both contract administration and program and project management—as a high-risk area, in part because DOE needs to better manage its cleanup program, projects, and acquisition processes.<sup>2</sup> EM's 2022-2032 Strategic Vision states that EM must be best in its class when it comes to program and project management due to the scope and magnitude of the cleanup work it must

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<sup>1</sup>Fifty years of federal nuclear weapons production and energy research during the Cold War generated millions of gallons of liquid radioactive waste, millions of cubic meters of solid radioactive waste, thousands of tons of spent nuclear fuel and special nuclear material, and large quantities of contaminated soil and water. Spent nuclear fuel is fuel that has been withdrawn from a nuclear reactor following irradiation. Special nuclear material includes plutonium and uranium enriched in uranium-233 or uranium-235.

<sup>2</sup>GAO, *High-Risk Series: Efforts Made to Achieve Progress Need to Be Maintained and Expanded to Fully Address All Areas*, [GAO-23-106203](#) (Washington, D.C.: Apr. 20, 2023).



manage.<sup>3</sup> According to EM documents, EM headquarters and its sites are committed to strengthening program management to ensure it completes the remaining complex cleanup work in a safe, efficient, and cost-effective manner.

EM refers to itself as a program, and EM's organization and mission fit the Project Management Institute's (PMI) definition of a program.<sup>4</sup> According to PMI, programs include multiple program components, such as sub-programs, projects, and activities, that are interrelated and managed in a coordinated way to obtain benefits not available from managing them individually.<sup>5</sup> In EM's case, the program includes EM's headquarters and 15 cleanup sites (or sub-programs) where work is further divided into capital asset projects and operations activities.<sup>6</sup> EM spends about 20 percent of its annual budget on 27 capital asset projects and 80 percent on 62 operations activities. In fiscal year 2023, EM's enacted budget was about \$8.3 billion. Figure 1 shows the relationships among these elements for the EM program. In addition, EM has some

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<sup>3</sup>DOE, *EM Strategic Vision: 2022-2032* (Washington, D.C.: Mar. 8, 2022).

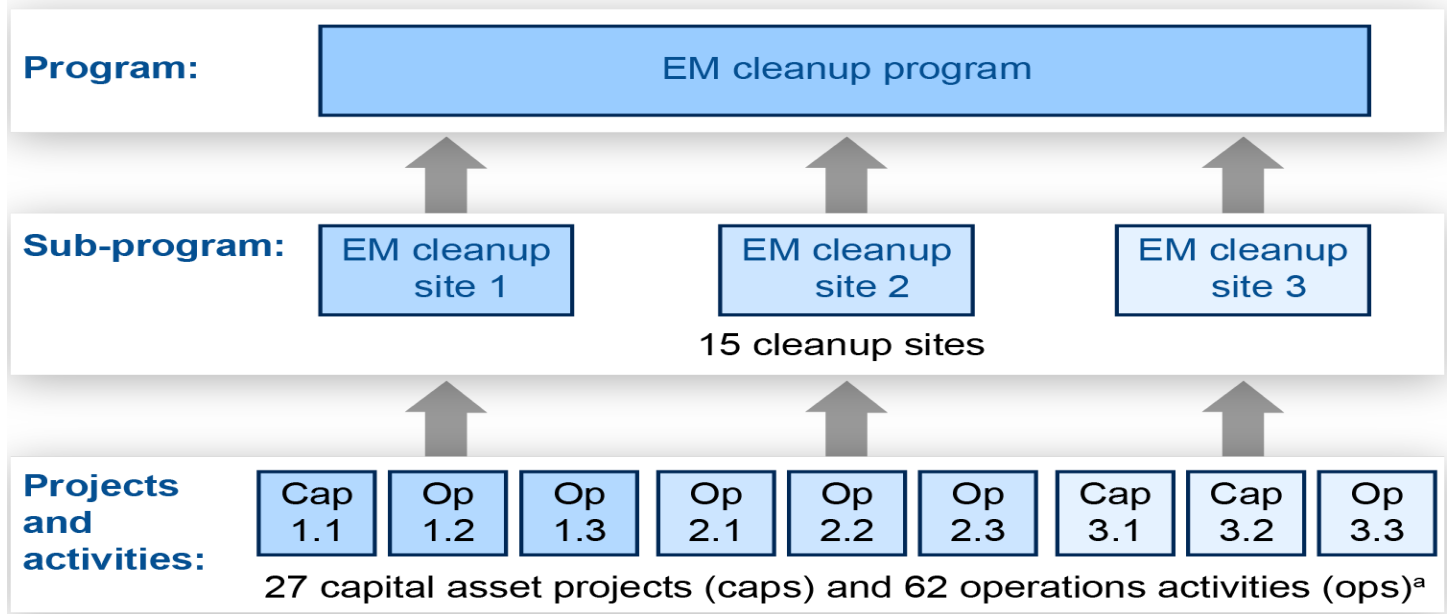
<sup>4</sup>PMI is a not-for-profit organization that has established standards for program and project management that are generally recognized as leading practices for most programs and projects. These standards are used worldwide and provide guidance on how to manage various aspects of projects, programs, and portfolios.

<sup>5</sup>Project Management Institute, Inc., *The Standard for Program Management*, Fourth Edition (2017).

<sup>6</sup>According to EM's 2020 Program Management Protocol, project activities include construction and demolition projects and must adhere to the requirements of DOE Order 413.3B and the EM Program Management Protocol, as applicable. Order 413.3B is DOE's order governing the management of capital asset projects. According to this order, a capital asset project is a project with defined start and end points required in the acquisition of capital assets. Department of Energy, *Program and Project Management for the Acquisition of Capital Assets*, Order 413.3B (Change 7) (Washington, D.C.: June 21, 2023). Operations activities include mission and mission support activities, which are routine or recurring activities to support and enable mission activities. Mission support activities are actions undertaken as part of the management and maintenance of site services and of the land. Requirements for the management of operations activities are included in EM's Program Management Protocol.

sub-programs—such as the National Transuranic Waste Program—that focus on a mission area and span multiple sites.<sup>7</sup>

**Figure 1: Relationship among the work at DOE’s Office of Environmental Management**



Source: GAO analysis of Department of Energy information. | GAO-24-105975

<sup>a</sup>A capital asset project is a project with defined start and end points required in the acquisition of capital assets. For DOE’s Office of Environmental Management, capital asset projects include construction and demolition projects. Operations activities include mission and mission support activities, which are routine or recurring activities to support and enable mission activities. Mission support activities are actions undertaken as part of the management and maintenance of site services and of the land.

<sup>7</sup>The National Transuranic Waste Program involves 22 locations across the United States that generate transuranic waste. This sub-program oversees the process of preparing transuranic waste from DOE sites to meet repository requirements at the Waste Isolation Pilot Plant and disposing of this waste in the repository. Transuranic waste is radioactive waste that contains human-made elements heavier than uranium on the periodic table. It is produced during nuclear fuel assembly, nuclear weapons research and production, and during the reprocessing of spent nuclear fuel. Transuranic waste largely consists of protective clothing, tools, and equipment used in these processes.

EM has spent more than \$215 billion from the beginning of its cleanup program in 1989 through fiscal year 2023. EM spends billions of dollars annually on environmental cleanup efforts, but the estimated environmental liability has generally risen over time.<sup>8</sup> For example, adjusted for inflation, the fiscal year 2023 environmental liability represents a \$95 billion increase (30 percent) from the fiscal year 2016.<sup>9</sup> DOE represents about 85 percent of the federal government's reported environmental liabilities, and we have had DOE on this area of our high-risk list since 2017.<sup>10</sup>

In February 2019, we developed a set of nine program management leading practices related to scope, cost, schedule, and independent review of performance that encompass basic principles of program management.<sup>11</sup> We used these leading practices to evaluate EM's 2017 cleanup policy and found that it did not follow any of the nine leading practices.<sup>12</sup> We recommended that EM update its policy to include them, and in November 2020, EM issued the Program Management Protocol that superseded the 2017 cleanup policy. EM's Protocol broadly establishes requirements and expectations for planning, budgeting, executing, and evaluating EM's work across all cleanup sites and management of the entire EM program. The Protocol includes many key

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<sup>8</sup>Federal accounting standards require agencies responsible for cleaning up contamination to estimate future cleanup and waste disposal costs and to report such costs in their annual financial statements as environmental liabilities when they are both probable and reasonably estimable.

<sup>9</sup>This estimate was \$257 billion in fiscal year 2016. DOE, *Agency Financial Report: Fiscal year 2023*, DOE/CF-0201 (Washington, D.C.: Nov. 15, 2023).

<sup>10</sup>[GAO-23-106203](#).

<sup>11</sup>We developed these leading practices in consultation with PMI, and they align with PMI's standards for program management. GAO, *Nuclear Waste Cleanup: DOE Could Improve Program and Project Management by Better Classifying Work and Following Leading Practices*, [GAO-19-223](#) (Washington, D.C.: Feb. 19, 2019); and Project Management Institute, Inc., *The Standard for Program Management*, Fourth Edition (2017).

<sup>12</sup>The Program Management Improvement Accountability Act of 2016 requires the Office of Management and Budget (OMB) to adopt and oversee implementation of government-wide standards, policies, and guidelines for program and project management in executive branch agencies. Pub. L. No. 114-264, § 2(a)(1), 130 Stat. 1371 (codified in relevant part as amended at 31 U.S.C. § 503(c)). In response, OMB issued a memorandum in June 2018, which stated, among other things, that agencies may use program management leading practices developed by us, other agencies, and external voluntary consensus standards bodies, such as PMI.

aspects of the leading practices that addressed our prior recommendation, which we have since closed as implemented.

You asked us to review EM's implementation of the Program Management Protocol. This report examines (1) how EM has implemented the Protocol and (2) the extent to which EM has incorporated program management leading practices as it implements the Protocol.

To examine how EM has implemented the Protocol, we reviewed documents from agency headquarters and cleanup sites, such as EM guidance on how to implement components of the Protocol and the EM Protocol Implementation Plan. We also interviewed EM officials at headquarters and five sites that we selected as a non-generalizable sample—Carlsbad, Hanford, Idaho, Lawrence Livermore, and Oak Ridge. We selected Hanford, Idaho, Lawrence Livermore, and Oak Ridge because EM considered them to be the most advanced in terms of their readiness to implement the Protocol. We selected Carlsbad as our fifth site because its Waste Isolation Pilot Plant serves as a national repository for transuranic waste for all cleanup sites and would provide an example of integration of cleanup efforts across the EM program.

To examine the extent to which EM has incorporated program management leading practices as it implements the Protocol, we reviewed EM's application of these leading practices at the five selected sites, and for the entire EM program at the headquarters level. We reviewed documents related to the application of the nine leading practices at the five sites and the program at the headquarters level. We conducted semi-structured interviews with officials from the sites and headquarters.<sup>13</sup>

We then evaluated their responses and supporting documents against the leading practices and additional relevant criteria that supplement these leading practices.<sup>14</sup> We scored the Oak Ridge site's implementation of the Protocol against the criteria, since that site was the most advanced in implementation. The documents from the other four sites needed to score

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<sup>13</sup>Some officials were also technical support contractors working for the federal government at the sites or EM headquarters. We refer to both these contractors and federal employees as EM officials throughout this report.

<sup>14</sup>We applied additional criteria to supplement some of the leading practices to better evaluate EM's actions. We identified the additional criteria based on previous GAO work, PMI best practices, and internal controls.

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those sites were either too early in draft form, or had not been developed. While it was too early for us to score these four sites, their information provided details of EM's implementation. Appendix I includes a description of the full scope and methodology of our review.

We conducted this performance audit from April 2022 to June 2024, 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.

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## Background

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### EM's Cleanup Sites and Mission Areas

EM manages its program from its headquarters in the Washington, D.C. area, and comprises 15 cleanup sites across the U.S. EM headquarters provides management oversight of activities, operations, and program integration across EM cleanup sites, including coordination, oversight, and leadership on scope, cost, and schedule components. At each of EM's cleanup sites, the site manager is responsible and accountable for management and integration of all site-level activities. The site manager relies on a federal team to manage and integrate the work that is conducted by contractors.<sup>15</sup> EM divides its cleanup work at sites into eight mission areas with associated goals, which are described in EM's 2022 Program Plan and listed in table 1.

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<sup>15</sup>DOE is one of the largest civilian contracting agencies in the federal government. DOE relies primarily on contractors to carry out its programs and projects, spending about 90 percent of its annual budget on contracts; in fiscal year 2023, EM's enacted budget was about \$8.3 billion.

**Table 1: Office of Environmental Management’s Mission Areas and Associated Goals**

<b>Mission area</b>	<b>Associated goals</b>
Nuclear materials <sup>a</sup>	Management of the remaining inventory of nuclear materials used for reactor fuel, nuclear weapons, isotope production, research and development, and other needs.
Spent nuclear fuel <sup>b</sup>	Management, storage, treatment/processing, and packaging of spent nuclear fuel.
Transuranic waste <sup>c</sup>	Management, packaging, shipping, and final disposal of transuranic waste.
Depleted uranium <sup>d</sup>	Management and disposition of depleted uranium.
Low-level waste/Mixed low-level waste /Other wastes <sup>e</sup>	Management (storage, treatment, and disposal) of waste inventories generated mainly from ongoing soil and groundwater remediation, facility demolition and decommissioning, and cleanup.
Tank waste <sup>f</sup>	Management, treatment, and disposition of the radioactive tank waste generated primarily from spent nuclear fuel reprocessing, and the associated tank closure activities.
Soils and groundwater	Characterization, development, and implementation of selected remedies to address soils and groundwater contamination and expedite cleanup completion and transitioning from active remediation to long-term surveillance and maintenance.
Excess facilities deactivation & decommissioning	Deactivation, decommissioning, demolition, and disposition of excess contaminated facilities and supporting infrastructure.

Source: Department of Energy’s Office of Environmental Management’s 2022 Program Plan. | GAO-24-105975

<sup>a</sup>Nuclear materials include uranium and plutonium.

<sup>b</sup>Spent nuclear fuel is nuclear fuel that has been withdrawn from a nuclear reactor following irradiation. Most spent nuclear fuel is generally highly radioactive and is expected to be disposed of in a geologic repository.

<sup>c</sup>Transuranic waste is radioactive waste that contains human-made elements heavier than uranium on the periodic table. It is produced during nuclear fuel assembly, nuclear weapons research and production, and during the reprocessing of spent nuclear fuel. Transuranic waste largely consists of protective clothing, tools, and equipment used in these processes.

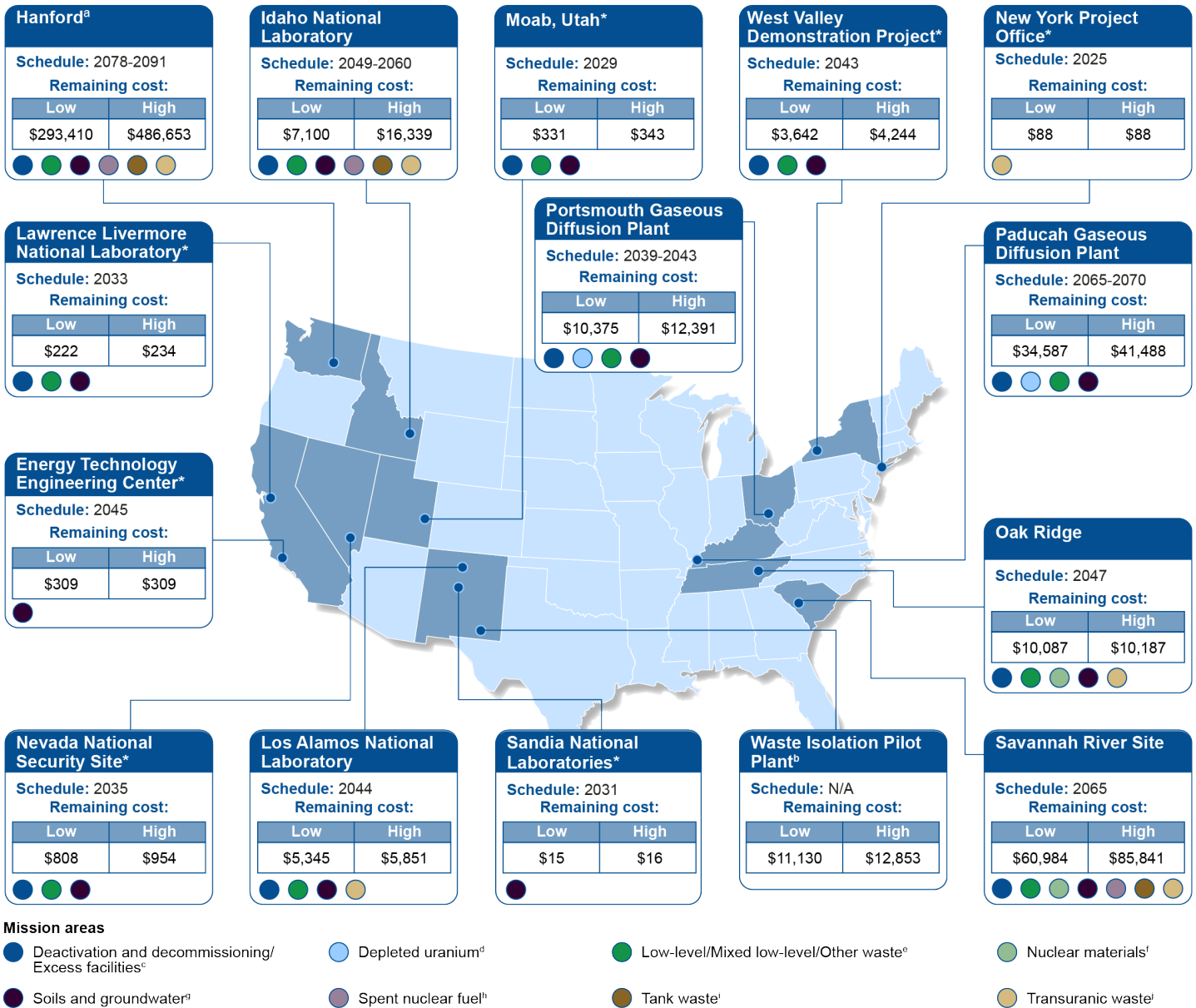
<sup>d</sup>Depleted uranium is the material left after most of the highly radioactive form of uranium (U-235) is removed from the natural uranium ore.

<sup>e</sup>Low-level waste is any radioactive waste that is not spent nuclear fuel, high-level waste, by-product material, or transuranic waste, and is classified as low-level radioactive waste, consistent with law, by the Nuclear Regulatory Commission. Low-level waste is considered mixed low-level waste if it also contains a hazardous waste component regulated under the Resource Conservation and Recovery Act of 1976, Pub. L. No. 94-580, 90 Stat. 2795.

<sup>f</sup>Tank waste forms include liquid tank waste, vitrified waste in canisters, calcined waste, and tank sludges.

Each of the 15 cleanup sites oversees different mission areas. According to EM officials, one key goal of the Protocol is to encourage sites to integrate all the cleanup efforts at the sites so EM can compare different scenarios or alternatives and strategize how to optimize the EM program to make it more efficient. Figure 2 shows EM sites’ estimated cleanup end date, remaining cost, and remaining mission work areas.

Figure 2: EM Sites' Estimated Cleanup End Date, Remaining Cost, and Mission Areas as of April 2024 (dollars in millions)



\* Managed by Department of Energy's Office of Environmental Management Consolidated Business Center\*

Sources: GAO analysis of Department of Energy (DOE) Office of Environmental Management's (EM) information; and Map Resources (map). | GAO-24-105975

**Accessible Data for Figure 2: EM Sites' Estimated Cleanup End Date, Remaining Cost, and Mission Areas as of April 2024 (dollars in millions)**

**Costs in millions of escalated dollars**

Site	Remaining cost (fiscal year 2023 and beyond, low)	Remaining cost (fiscal year 2023 and beyond, high)	Schedule	Mission area
Oak Ridge	\$10,087	\$10,187	2047	Nuclear materials; D&D excess facilities; TRU waste; LLW/MLLW/ other wastes; Soils and Groundwater Remediation
Nevada National Security Site	\$808	\$954	2035	D&D/excess facilities; LLW/MLLW/other wastes; Soils and Groundwater Remediation
Los Alamos National Laboratory	\$5,345	\$5,851	2044	D&D/excess facilities; Soils and Groundwater Remediation; TRU waste; LLW/MLLW/other wastes
Moab, Utah	\$331	\$343	2029	D&D/excess facilities; LLW/MLLW/other wastes; Soils and Groundwater Remediation
Hanford -RL & ORP	\$293,410	\$486,653	2078-2091	Tank waste; TRU waste; D&D/excess facilities; LLW/MLLW/other wastes; Spent nuclear fuel; Soils and Groundwater Remediation
Idaho National Laboratory	\$7,100	\$16,339	2049-2060	Tank waste; Spent nuclear fuel; TRU waste; D&D Excess facilities; LLW/MLLW/other wastes; Soils and Groundwater Remediation
Paducah Gaseous Diffusion Plant	\$34,587	\$41,488	2065 - 2070	Depleted uranium; D&D excess facilities; LLW/MLLW/other wastes; Soils and Groundwater Remediation
Portsmouth Gaseous Diffusion Plant	\$10,375	\$12,391	2039 – 2043	Depleted uranium; D&D/excess facilities; LLW/MLLW/other wastes; Soils and Groundwater Remediation
Lawrence Livermore National Laboratory	\$222	\$234	2033	D&D/excess facilities; LLW/MLLW/other wastes; Soils and Groundwater Remediation
Sandia National Laboratories	\$15	\$16	2031	Soils and Groundwater Remediation
New York Project Office	\$88	\$88	2025	TRU waste



Letter

Site	Remaining cost (fiscal year 2023 and beyond, low)	Remaining cost (fiscal year 2023 and beyond, high)	Schedule	Mission area
Waste Isolation Pilot Plant or Carlsbad Field Office <sup>16</sup>	\$11,130	\$12,853		
Energy Technology Engineering Center	\$309	\$309	2045	Soils and Groundwater Remediation
West Valley Demonstration Project	\$3,642	\$4,244	2043	D&D/excess facilities; LLW/MLLW/other wastes; Soils and Groundwater Remediation
Savannah River Site	\$60,984	\$85,841	2065	Tank waste; Nuclear materials; Spent nuclear fuel; D&D/excess facilities; TRU waste; LLW/MLLW/ other wastes; Soils and Groundwater Remediation

Sources: GAO analysis of Department of Energy (DOE) Office of Environmental Management's (EM) information; and Map Resources (map). | GAO-24-105975

<sup>a</sup>Hanford includes the Office of River Protection and the Richland Operations Office.

<sup>b</sup>The Waste Isolation Pilot Plant (WIPP) is a national repository for contact- and remote-handled defense transuranic (TRU) waste, enabling the disposition of TRU waste at EM's legacy cleanup sites. As such, it itself is not a cleanup site, and thus has no remaining cleanup work. According to EM officials, WIPP's end date will be determined by the completion of cleanup at other sites, and the achievement of its capacity, as defined in the Waste Isolation Pilot Plant Land Withdrawal Act. Pub. L. No. 102-579, 106 Stat. 4777 (1992).

<sup>c</sup>Deactivates and decommissions excess facilities and then either demolishes the facility (with resulting waste being disposed of) or transfers the facility to another DOE office or a community reuse organization.

<sup>d</sup>Depleted uranium is the material left after most of the highly radioactive form of uranium (U-235) is removed from the natural uranium ore.

<sup>e</sup>Low-level waste is any radioactive waste that is not spent nuclear fuel, high-level waste, by-product material, or transuranic waste, and is classified as low-level radioactive waste, consistent with law, by the Nuclear Regulatory Commission. Low-level waste is considered mixed low-level waste if it also contains a hazardous waste component regulated under the Resource Conservation and Recovery Act of 1976, Pub. L. No. 94-580, 90 Stat. 2795.

<sup>f</sup>Nuclear materials include uranium and plutonium.

<sup>g</sup>The soils and groundwater mission area is the remediation of contaminated soils and groundwater until a particular cleanup standard or measurable contaminant level is reached.

<sup>h</sup>Spent nuclear fuel is fuel that has been withdrawn from a nuclear reactor following irradiation. Most spent nuclear fuel is highly radioactive and must be disposed of in a geologic repository.

<sup>i</sup>Tank waste forms include liquid tank waste, vitrified waste in canisters, calcined waste, and tank sludges.

<sup>j</sup>Transuranic waste is radioactive waste that contains human-made elements heavier than uranium on the periodic table. It is produced during nuclear fuel assembly, nuclear weapons research and

<sup>16</sup> As a facility that supports the completion of EM work at other sites, the Waste Isolation Pilot Plant end date will be determined by the completion of cleanup at other sites, as well as the achievement of its capacity, as defined in the WIPP Land Withdrawal Act of 1992.

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production, and during the reprocessing of spent nuclear fuel. Transuranic waste largely consists of protective clothing, tools, and equipment used in these processes.

<sup>k</sup>Some EM sites are managed by the Consolidated Business Center. This office was created by DOE in 2004 to provide EM with required and improved business and technical support services.

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## Program Management Leading Practices

In 2019, GAO identified nine leading practices for program management, based on PMI's leading practices for program management.<sup>17</sup> The nine practices represent basic program management principles that, if followed, give agencies some assurance that the program is run efficiently and in an integrated way. We have grouped the nine leading practices into three broad areas: program planning, program performance, and program oversight.

### Program planning

1. Have a comprehensive program management plan, roadmap, and appropriate-level strategic plan that are updated regularly.
2. Have a comprehensive life-cycle cost estimate that is updated on a regular basis.<sup>18</sup>
3. Have an integrated master schedule that is updated on a regular basis.<sup>19</sup>

### Program performance

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<sup>17</sup>Project Management Institute, Inc., *The Standard for Program Management*, Fourth Edition (2017); and [GAO-19-223](#). In [GAO-19-223](#), we identified nine program management leading practices based on PMI standards related to a program's management of scope, cost, schedule performance, and independent review of performance. In the course of that audit, we shared these selected leading practices with PMI representatives and incorporated their feedback, as appropriate.

<sup>18</sup>A life-cycle cost estimate is a structured accounting of all labor, material, and other efforts required to develop, produce, operate and maintain, and dispose of a program. It encompasses all past, present, and future costs for every aspect of the program, regardless of funding source.

<sup>19</sup>The integrated master schedule integrates the planned work, the resources necessary to accomplish that work, and the associated budget, and should be the focal point of program management. The integrated master schedule constitutes a program schedule that includes the entire required scope of work, including from all government, contractor, and other key parties for a program's successful execution from start to finish. The integrated master schedule connects all the scheduled work of the government and the contractor in a network, or collection of logically linked sequences of activities. The sequences clearly show how related portions of work depend on one another, including the relationships between the government and contractors.

4. Conduct program risk management throughout the life of the program.
5. Measure performance against program-level cost and schedule baselines.
6. Complete performance reporting and analysis in a way that provides a clear picture of program performance.
7. Monitor and control the program, including conducting root cause analyses and developing corrective action plans.

**Program oversight**

8. Have a process to capture lessons learned.
9. Have an independent oversight body and conduct periodic independent reviews to measure progress of the program in delivering its expected benefits.

We applied additional criteria to supplement some of the leading practices to better evaluate EM's actions. We identified the additional criteria based on previous GAO work, PMI best practices and internal controls; the additional criteria and their sources are identified with the relevant leading practices.

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## Key Requirements in the Protocol Related to Program Management Leading Practices

In response to our recommendation that EM include program management leading practices in its policies, the updated November 2020 Protocol incorporates many elements of program management leading practices in its requirements for the EM program and sites.<sup>20</sup> For example, the Protocol requires:

- A strategic plan for the EM program that presents the overall goals for the EM program for the next 10 years, and an EM program plan that includes a description of the planned work at each of the sites and serves as a roadmap.<sup>21</sup>

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<sup>20</sup>GAO-19-223.

<sup>21</sup>The Protocol does not require site strategic plans, but EM headquarters requires sites to create a site strategic plan.

- Site program plans that document the plan for work accomplishments in the next 10 years to support the EM strategic plan.<sup>22</sup>
- The development of a Federal Site Life-cycle Estimate (FSLE) for each site that is developed and maintained by federal officials at each of the sites and includes the scope, cost, and schedule profiles for the work activities required to complete the EM mission at a site.<sup>23</sup> The FSLE comprises three components: prior year actuals, estimates for the next 5-to-10 year period, and out-year estimate beyond 10 years.
- The development and maintenance of an EM program life-cycle estimate that integrates cost and schedule estimates for the full scope of activities required to complete the EM mission.<sup>24</sup>
- The establishment of a formal change control framework that requires change control submissions to EM leadership if site FSLEs exceed certain thresholds for scope, cost, and schedule that are defined in the Protocol.
- The development of a comprehensive risk management policy in the near future to address, among other things, the various risks facing the entire EM program and sites.
- A root cause analysis that must be conducted if any site baseline or life-cycle cost or schedule change requires a level of EM leadership approval established in the Protocol.<sup>25</sup>

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<sup>22</sup>According to EM officials, a program plan is a publicly released strategic plan.

<sup>23</sup>According to EM officials, this FSLE established by the sites will serve as the original baseline for the site (original cost estimate and original end date). The Protocol also requires that the FSLE be updated annually or when there are potentially significant changes.

<sup>24</sup>The EM program life-cycle estimate integrates the individual FSLEs to be developed by each of the EM sites and includes major interfaces and dependencies between the sites. In its fiscal year 2025 budget request released in March 2024, EM estimated the life-cycle cost estimate for the EM program to be between \$640 billion to \$882 billion.

<sup>25</sup>According to the Protocol, a root cause analysis is a structured facilitated process used by EM to identify root causes of an event(s) that resulted in an undesired cost and schedule performance. The root cause analysis process provides EM with a way to identify and address the underlying causes of cost overruns, schedule delays, missed or postponed milestones, and performance shortcomings and it describes how to prevent future events from occurring. According to the Protocol, EM uses root cause analyses to find out what happened, why it happened, and determine what changes need to be made. EM leadership approval is required if the FSLE increase is 10 percent (cumulative) or greater than the original FSLE—or a cumulative increase of \$100 million or more for sites with FSLE of \$1 billion or more—or increases of 6 months or more (cumulative) from the original end date.

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## EM Is Using a Phased Approach to Review Cleanup Sites' Implementation of the Protocol but Has Been Delayed

EM is using a two-phased approach in its review of cleanup site's implementation of the protocol. Phase I focuses on reviewing sites' strategic planning and life-cycle cost and schedule estimates. Phase II assesses sites' broader implementation of the Protocol. EM's implementation of Phase I has been delayed, and EM officials expect further delays with Phase II.

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## EM Is Reviewing the Implementation of the Protocol Using a Two-Phased Approach

EM is following a phased approach to review the implementation of the Protocol, as determined by the Integrated Project Team (IPT) that EM established in 2022 to provide guidance to the cleanup sites, and to review FSLE documentation.<sup>26</sup> Phase I focuses on sites' strategic planning, risk management planning, and life-cycle cost and schedule estimates. This is an important part of implementing the Protocol because it establishes a realistic baseline against which to measure future performance. Phase II is to assess the sites' implementation of the Protocol to verify whether sites' new procedures and systems comply with the Protocol and other EM requirements. The IPT reviews the sites' work and supporting documents during each phase.

Phase I of the implementation review process is divided into three steps:

**Step 1 – Document Submission and Sufficiency Review:** The IPT conducts an initial sufficiency review of sites' FSLE documentation to determine whether the site's documentation is ready to begin step 2. According to EM documentation, this step involves determining whether

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<sup>26</sup>The objective of the IPT is to support independent review of documentation being submitted to headquarters by sites to receive FSLE approval. The IPT is made up of multidisciplinary personnel from across EM headquarters and is supported by staff from the EM Consolidated Business Center and contractors. Personnel participating in the IPT provide subject matter expertise specific to FSLE development, such as cost, scope, and schedule; metrics; and environmental liability and risk. The EM Consolidated Business Center also focuses on helping smaller sites within its cognizance, including Moab, the Energy Technology Engineering Center, West Valley Demonstration Project, or Nevada National Security Site.

the site strategic plan is complete and all scope of work through mission completion is included.

**Step 2 – Federal Life-cycle Estimate Review:** The IPT conducts a more in-depth review of FSLEs and underlying assumptions to determine whether they are technically sound, cost effective, reasonable, fully documented, and in compliance with the Protocol. These reviews are intended to establish confidence in the FSLE documentation. At the end of step 2, the IPT determines whether to recommend the FSLE to EM top leadership for final approval.<sup>27</sup>

**Step 3 – FSLE Approval:** EM top leadership approves the FSLEs as the sites' baselines.

According to EM officials, EM plans to develop a Protocol guidance document to be issued by the end of calendar year 2024. This document is intended to provide guidance on implementing the Protocol. EM officials said that this guidance document is intended to be the next level of detail below the Protocol. For example, the Protocol has the risk prioritization schema, and the guidance document will cover the application of the schema, and how sites should document their prioritization. According to EM officials, the guidance document could also address issues that are not necessarily required by the Protocol, but that need to be done to implement the intent of the Protocol.

According to EM officials, this guidance document will be a living document that will be updated as more guidance becomes available or as EM updates already developed guidance. EM officials explained that all site managers and the head of EM will review this guidance document following the same approval process as the Protocol and that it will be easier to update this document in the future than it would be to update the Protocol.

Under Phase II, the IPT is to assess the sites' implementation of the Protocol. According to EM officials, the Phase II reviews are meant to ensure implementation of the FSLE and supporting systems, processes, and procedures is sustainable, and to evaluate the continued reliability of scope, cost, and schedule estimates. According to EM officials, Phase II will include a comprehensive review of life-cycle cleanup elements based

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<sup>27</sup>According to the IPT charter, upon completion of this step, the IPT will make a recommendation to the EM leadership as to (1) unconditional approval, with or without comment; (2) approval with conditions; or (3) disapproval with actions to be completed prior to re-submission.

on the Protocol, rating criteria, and a systematic scoring system. The systematic scoring system will be used by the EM sites and headquarters to evaluate FSLEs based on criteria covering several areas, such as site program plans, risk management, budget processes, and performance measurement.

Furthermore, Phase II is to include site program peer reviews led by EM headquarters staff and include team members from other sites and independent consultants, as needed. According to EM officials, the peer reviews will focus on the quality and accuracy of sites' FSLEs and associated assumptions, with emphasis on specific cost and technical risks.

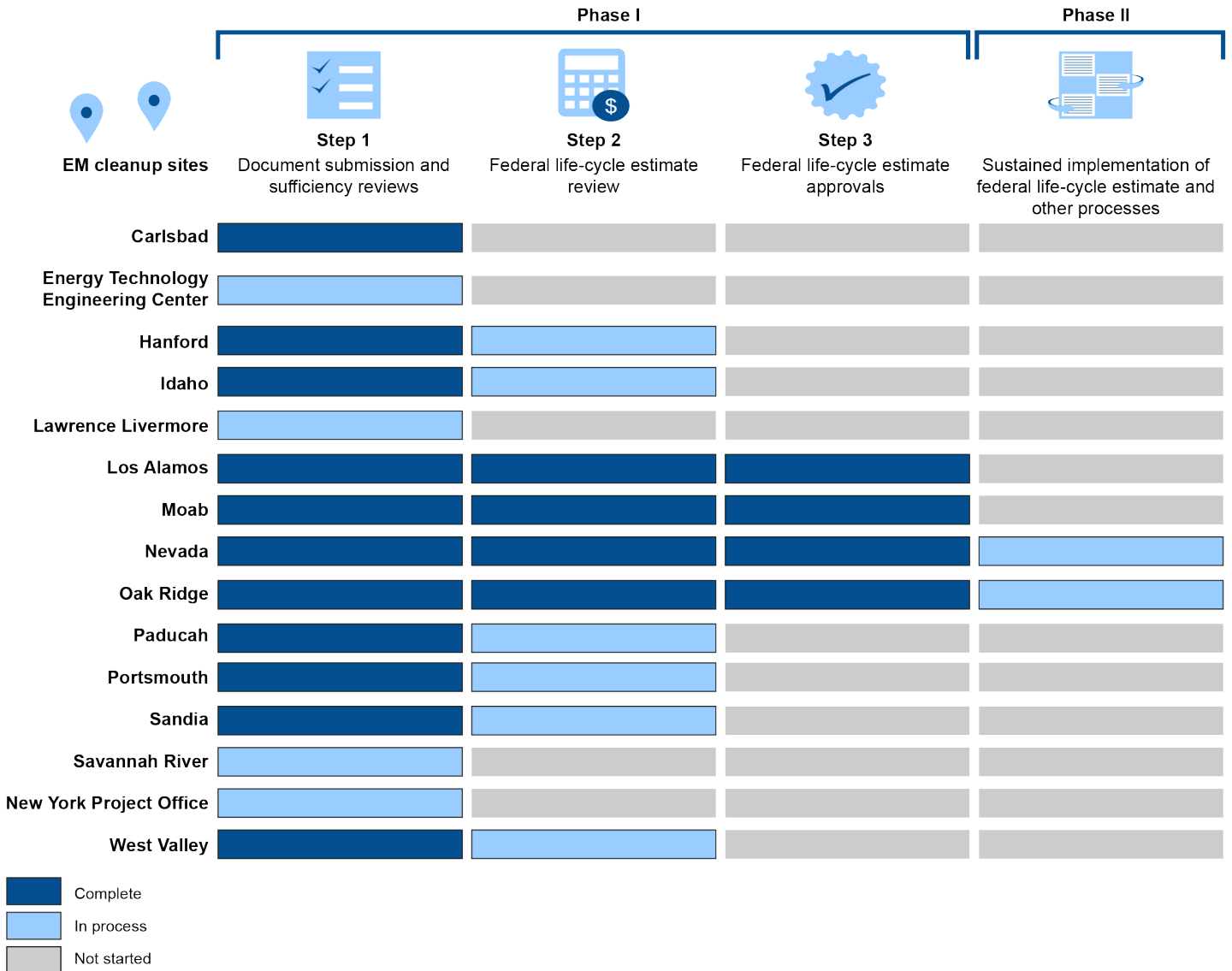
EM officials said that after the sites receive approval for their FSLEs, EM will integrate some of the sites' information at the EM program-wide level. For example, EM officials said they will develop an EM program life-cycle estimate for cost and schedule after approving all sites' FSLEs. Additionally, the Protocol requires EM to integrate all the site's program plans—which are part of the sites' strategic plans—into a single EM program plan.

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## EM's Implementation of the Protocol Has Been Delayed

The IPT established a preliminary schedule for implementing the Protocol and expected all the sites to complete Phase I by August 2023, according to EM officials. However, as of April 2024, four of the 15 cleanup sites had received EM leadership approval of their cost and schedule FSLE estimates to finish Phase I (Los Alamos, Moab, Nevada and Oak Ridge). Two of these sites (Nevada and Oak Ridge) are now under Phase II review. Seven more sites completed Phase I Step 1 and had their documentation considered to be sufficient by the IPT. The remaining four sites are still under Phase I Step 1 review (see fig. 3).

**Figure 3: Status of the Office of Environmental Management’s Implementation of the Protocol, by Site, as of April 2024**



Sources: GAO analysis of Department of Energy (DOE) Office of Environmental Management’s (EM) information; and GAO (icons). | GAO-24-105975

**Accessible Text for Figure 3: Status of the Office of Environmental Management’s Implementation of the Protocol, by Site, as of April 2024**

**EM cleanup sites**

- Phase 1
  - Step 1 - Document submission and sufficiency reviews
  - Step 2 - Federal life-cycle estimate review



- Step 3 - Federal life-cycle estimate approvals
- Phase 2
  - Sustained implementation of federal life-cycle estimate and other processes
  - Carlsbad – Complete (step 1)
  - Energy Technology Engineering Center - In process (step 1)
  - Hanford - complete (1) In process (step 2)
  - Idaho - complete (1) In process (step 2)
  - Lawrence Livermore - In process (step 1)
  - Los Alamos – complete (3)
  - Moab – complete (3)
  - Nevada – complete (3) in process (4)
  - Oak Ridge – complete (3) in process (4)
  - Paducah - complete (1) In process (step 2)
  - Portsmouth – complete (1) In process (step 2)
  - Sandia - complete (1) In process (step 2)
  - Savannah River - In process (step 1)
  - New York Project Office- In process (step 1)
  - West Valley – complete (1) In process (step 2)

Sources: GAO analysis of Department of Energy (DOE) Office of Environmental Management's (EM) information ; and GAO (icons). I GAO-24-105975

EM headquarters and site officials expressed different views of why they thought the implementation of the Protocol was behind schedule. According to EM headquarters officials, some sites have submitted their FSLE documentation to the IPT for review, but officials noted that portions of these sites' documents did not fully meet the requirements outlined in the Protocol. These officials were not sure why the sites' documentation did not align with the Protocol because, in their opinion, the Protocol requirements were clear. They added that they had anticipated the delays associated with their review of sites' documentation and that such delays were unavoidable because of the time needed to help sites understand all the requirements of the Protocol.

EM headquarters officials said that they believe issues with the site documentation would have arisen regardless of how EM executed the implementation of the Protocol because the process inherently involves a learning curve. They explained that many of the issues were site-specific. For example, some sites were not spreading their contingencies over time, as required by the Protocol, and were instead opting to add them at

the end of their schedules.<sup>28</sup> Furthermore, officials explained that other sites did not develop their FSLEs using realistic funding assumptions.

EM did not provide guidance documents until sites expressed confusion over Protocol implementation requirements. For example, in January 2023 officials at Lawrence Livermore said that they were not aware how the Protocol's requirements applied to that site because it is a smaller site—managed by the EM Consolidated Business Center—and is composed of several distinct facility deactivation and demolition projects that are not integrated in any way. However, EM headquarters officials told us during that time that there were some integrative components at Lawrence Livermore, such as an overall cost and schedule of facility demolition, and they thought this site could still be run as a sub-program. In March 2023, EM headquarters issued draft guidance to smaller sites to help them understand how the Protocol applies to them.<sup>29</sup> EM headquarters officials stated that delays still would have occurred had they issued guidance alongside the release of the Protocol.

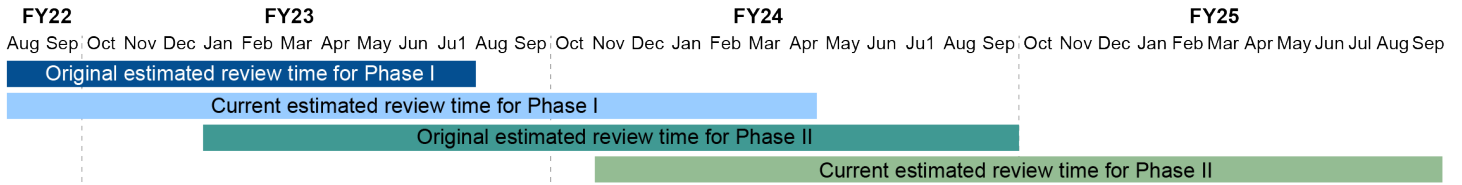
EM officials stated that delays resulting from site documentation not meeting requirements has caused EM to extend its completion of the Phase I review to April 2024, and completion of the Phase II review to at least August 2025, almost 5 years after the Protocol's issuance (see fig. 4). However, EM headquarters officials said that they will likely have to extend the completion dates of both phases again.

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<sup>28</sup>Under the terms of DOE Order 413.3B, contingency is the portion of the budget that is available for risk uncertainty. It is controlled by the federal personnel outside of a contract. According to EM's Program Management Protocol, EM fully funds contingency for capital asset projects under Order 413.3B. However, for operations activities, EM does not request funding for cost contingency due to competing budget priorities. Instead, it typically manages risk by making changes to the scope of work or schedule.

<sup>29</sup>Smaller sites managed by the EM Consolidated Business Center are Energy Technology Engineering Center, Lawrence Livermore National Laboratory, Moab, Nevada National Security Site, New York Project Office, Sandia National Laboratories and West Valley Demonstration Project.

**Figure 4: Initial Protocol Implementation Review Dates Provided by EM in December 2022 Compared to Current Dates as of February 2024**



Sources: GAO analysis of Department of Energy (DOE) Office of Environmental Management's (EM) information. | GAO-24-105975

**Accessible Text for Figure 4: Initial Protocol Implementation Review Dates Provided by EM in December 2022 Compared to Current Dates as of February 2024**

- Original estimated review time for Phase I – Aug 2022 – Jul 2023
- Current estimated review time for Phase I – Aug 2022 – April 2024
- Original estimated review time for Phase II – Jan 2023 – Sept 2024
- Current estimated review time for Phase II – Nov 2023 – Sep 2025

Sources: GAO analysis of Department of Energy (DOE) Office of Environmental Management's (EM) information . | GAO-24-105975

Note: In February 2024, EM officials stated that this schedule is subject to change as site reviews are in progress.

## EM Has Opportunities to Better Incorporate Program Management Leading Practices as It Implements the Protocol

EM is incorporating some leading practices for program management in its implementation of the Protocol but can improve in three key areas to fully incorporate all nine leading practices in a comprehensive manner: program planning, performance, and oversight.

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## EM Has Opportunities to Enhance Program Planning

As EM implements the Protocol, it has opportunities to improve its program and site planning by adopting supplementary practices related to planning, and better estimating cost and scheduling.

### Key Program Planning Documents

The EM program and some of the sites we reviewed have strategic plans, roadmaps, and program management plans. The first leading practice states that a program should have an appropriate-level strategic plan, a comprehensive program management plan, and a roadmap.<sup>30</sup>

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### Strategic Plans

EM and two of the five sites we reviewed had strategic plans, at the time of our review.<sup>31</sup> When comparing these three strategic plans to seven key components of a comprehensive strategic plan that we have previously outlined (see table 2), we found that they did not fully include three of the seven key components of a comprehensive strategic plan.<sup>32</sup>

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<sup>30</sup>According to PMI's *Standards for Program Management*, a strategic plan describes a set of goals and objectives for the program and may serve as a tool to evaluate a program's performance based on the vision it describes in the plan. A roadmap is a chronological representation of a program's intended direction that shows dependencies between major milestones, among other things. The purpose of a roadmap is to outline major program events for the purposes of planning and reflects the pace at which benefits are realized. A program management plan integrates the program's subsidiary plans and establishes an overall plan for integrating and managing the program's individual components. The purpose of the program management plan is to ensure the program is continually aligned with the strategic priorities of the organization and plans for integrating and managing the program's individual components.

<sup>31</sup>EM officials stated in April 2024 that additional sites have developed draft strategic plans that have been reviewed and commented on by the IPT, since the time of our review of these initial strategic plans.

<sup>32</sup>When evaluating the EM program's and sites' strategic plans, we looked at two types of documents, which together EM considers as being part of their strategic plans: documents called strategic visions, which EM officials explained that they represent EM's and sites' internal strategic plans, and program plans, which EM explained represent the publicly released strategic plans. We looked for the elements listed in table 2 in both these documents. When we refer to strategic plans in this report, we refer to our analysis of both these documents. A program plan is different than a program management plan discussed below.

**Table 2: Key Components of a Comprehensive Strategic Plan**

Key component	Definition
Mission statement	A comprehensive statement that summarizes the main purposes of the strategy.
Problem Definition, Scope, and Methodology	Identification of the issues to be addressed by the strategy, the scope of its coverage, the process by which it was developed, and key considerations and assumptions used in the development of the plan.
Goals and Objectives	Identification of goals and objectives to be achieved by the strategy, activities, or actions to achieve them, as well as milestones and performance measures.
Activities, Milestones, and Performance Measures	Identification of the steps to achieve the goals and objectives, as well as milestones and performance measures to gauge results.
Resources and Investments	Identification of costs to execute the plan and the sources and types of resources and investments, including skills and technology, human capital and other resources required to meet the goals and objectives.
Organizational Roles, Responsibilities, and Coordination	Development of roles and responsibilities in managing and overseeing the implementation of the strategy and the establishment of mechanisms for multiple stakeholders to coordinate their efforts throughout implementation and make necessary adjustments to the strategy based on performance.
Key External Factors	Identification of key factors external to the organization and beyond its control that could significantly affect the achievement of the long-term goals contained in the strategy. These external factors can include economic, demographic, social, technological, or environmental factors, as well as conditions that would affect the ability of the agency to achieve the results desired.

Source: GAO best practices from [GAO-13-201](#). | [GAO-24-105975](#)

The three strategic plans we reviewed did not clearly identify how the performance metrics gauge results for achieving the activities and milestones listed for each site. For example, in one site’s strategic plan, the performance measures listed under each goal and objective are activities and steps to achieve each goal and objective, not performance measures that gauge results. For instance, the performance measures for completing cleanup at this site are as follows: (1) complete soil remediation, (2) complete regulatory agreements for groundwater, and (3) implement groundwater remedies. However, these do not include specific measurable goals that could show the magnitude of the completed work.

Additionally, these three strategic plans did not identify any information on the resources and investments required to meet the goals and objectives of the program. EM officials stated that each task in the FSLE includes the resources it needed for completion. However, the information is not included directly in the strategic plans, which do not discuss the sources and types of resources and investments needed, including skills and technology, human, capital and other resources required.

These three strategic plans also did not identify the organizational roles and responsibilities for managing the implementation of the plan. For example, at one site, the strategic plan identifies the roles and

responsibilities of each contractor and acknowledges the need for coordination with the site landlord, the National Nuclear Security Administration. However, the strategic plan does not provide a description of roles and responsibilities for managing and overseeing the implementation of the strategy at the federal level outside the contractor's work. Nor does it address the establishment of mechanisms for multiple stakeholders to coordinate their efforts throughout implementation and to make necessary adjustments to the strategy based on performance. EM officials said that strategic plans may not address some of these elements because they are included in other documents.

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## Program Management Plans

One site we reviewed developed a program management plan that addresses almost all 14 key components of a comprehensive program management plan (see table 3). Specifically, we found that the program management plan did not address the key component of benefits management, but the site addressed all other key components in its program management plan or related documents. For example, the program management plan included information on site processes related to managing program stakeholders, communications, information, finances, procurement, risk, scope and schedule, and quality assurance. In addition, the plan included links to relevant DOE and site guidance for these components, where appropriate.

There were two additional components that the program management did not include—a roadmap or information on resource management. However, the site provided a roadmap as a separate document, which we evaluated separately. Although the program management plan did not describe resource management information, it explained that the site's Management Control System provides a formal resource plan and related information. The program management plan also includes the site's organizational structure, roles and responsibilities, and the site's work breakdown structure, which breaks down the site's scope into more manageable segments.

**Table 3: Key Components of a Comprehensive Program Management Plan**

Key component	Definition
Benefits management plan	Describes processes that clarify the program’s planned benefits and intended outcomes and includes processes for monitoring the program’s ability to deliver against these benefits and outcomes.
Stakeholder engagement plan	Describes stakeholder engagement guidelines, defines the metrics used to measure the performance of stakeholder engagement activities, and provides critical information used in the development of program documentation.
Governance plan	Describes the systems and methods to be used to monitor, manage, and support a given program, and the responsibilities of specific roles for ensuring the timely and effective use of those systems and methods.
Change management plan	Describes how to monitor, control, and administer changes during the course of the program.
Communications management plan	Describes activities necessary for the timely and appropriate generation, collection, distribution, storage, retrieval, and ultimate disposition of program information.
Financial management plan	Describes all of the program’s financial aspects: funding schedules and milestones, initial budget, contract payments and schedules, financial reporting activities and mechanisms, and the financial metrics.
Information management plan	Describes how the program’s information assets will be prepared, collected, organized, and secured. <sup>a</sup>
Procurement management plan	Describes how the program will acquire goods and services from outside of the performing organization.
Quality management plan	Describes how an organization’s quality policies will be implemented.
Resource management plan	Describes how program resource management ensures all required resources (people, equipment, material, etc.) are made available to the component managers to enable the delivery of benefits for the program.
Risk management plan	Describes how risk management activities will be structured and performed. A component of a risk management plan includes a program risk register.
Schedule management plan	Describes the order and timing of the components needed to produce the program benefits, estimate the amount of time required to accomplish each one, identify significant milestones during the performance of the program, and document the outcomes of each milestone.
Scope management plan	Describes how the scope will be defined, developed, monitored, controlled, and verified.
Roadmap	Describes a chronological representation of a program’s intended direction; a graphic depiction of the dependencies between major milestones and decision points; a reflection of the linkage between the business strategy and the program work; and the component details, their durations, and contributions to benefits. <sup>b</sup>

Source: Project Management Institute, The Standard for Program Management, Fourth Edition (2017). | GAO-24-105975

<sup>a</sup>The information management plan is often composed of (but not limited to) information management policies, distribution lists, appropriate tools, templates, and reporting formats. Such information will be gathered and retrieved through a variety of media including manual filing systems, electronic databases, project management software, and systems that allow access to technical documentation such as engineering drawings, design specifications, and test plans.

<sup>b</sup>A roadmap can be part of the program management plan or a standalone document.

For the other sites and the EM program, EM officials said they believe they have all the information that would be captured in a program management plan throughout multiple documents. EM officials told us they expect each site to conduct its own budgeting, change control, and oversight processes based on DOE’s operating procedures. EM officials

said they would still consider the sites to have program management plans even if their processes and procedures are not in a single document.

However, the same EM officials stated that it is beneficial for both site and headquarters officials to summarize information from multiple sources into one document. For example, EM officials told us they created guidance for the strategic plan and are developing a Protocol guidance document so both the sites and EM can find this information easily and consistently apply it across all sites. The same can be said of program management plans, which are summary documents of EM's and the sites' main processes and procedures.

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## Roadmaps

When comparing EM's roadmaps to key components of a comprehensive roadmap (see table 4), we found that the EM program and four of the five sites we reviewed have roadmaps, but they are not comprehensive. For example, the EM program's roadmap provides a 40-year chronological representation of the program and reflects the linkage between the business strategy and program work. However, EM and sites' roadmaps do not include dependencies between major milestones and decision points, nor do they include component details, their durations, or contributions to benefits.

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**Table 4: Key Components of a Comprehensive Roadmap**

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**Key components**

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A chronological representation of a program's intended direction.

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A graphic depiction of the dependencies between major milestones and decision points.

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A reflection of the linkage between the business strategy and the program work.

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The component details, their durations, and contributions to benefits.

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Source: Project Management Institute, *The Standard for Program Management*, Fourth Edition (2017). | GAO-24-105975

According to the Protocol, EM is required to develop a strategic plan that presents the overall goals for the EM program for the next 10 years. The Protocol also requires a program plan for the EM program and site program plans to document the plan for accomplishing work in the next 10 years to support the EM strategic plan. Though the IPT has provided guidance to sites for developing site strategic plans, we found that EM and the sites do not have comprehensive strategic plans that address all seven components of such a plan. Similarly, EM and the sites have not developed comprehensive program management plans or roadmaps for



the EM program or all the sites. By ensuring strategic plans, program management plans, and roadmaps incorporate key components for being comprehensive for the entire EM program and, as applicable, for each site, EM could better ensure that it has key planning documents for the entire program and its sites that will contribute to running the program efficiently.

### Life-Cycle Cost and Schedule Estimates

EM is updating its current program-wide comprehensive life-cycle cost estimate and integrated master schedule. The second and third leading practices state that programs should have comprehensive life-cycle cost estimates and integrated master schedules, and that they should be updated on a regular basis. Officials said that they will update the EM program life-cycle estimate after the sites' FSLEs are approved by EM leadership because the EM program estimate will be based on sites' cost estimates. As the sites are developing their FSLEs, officials from three of the five sites we reviewed said they will move their estimate from a milestone-based estimate to a realistic budget-based estimate, as required by the Protocol. Officials from one small site we reviewed said their work is a series of separate demolition and soil and ground water remediation projects prioritized based on the budget they receive. However, according to EM officials, the FSLE at Hanford—the largest site FSLE that represents about 60 percent of the entire EM life-cycle cost estimate—will be based on milestone dates that are being negotiated with the regulators. These milestones may or may not be based on realistic funding assumptions. Therefore, depending on the outcome of these negotiations, the Hanford FSLE may or may not be based on realistic funding assumptions.

The use of realistic budgets in EM planning is one of the four main challenges EM is facing today, the head of EM stated at the National Cleanup Workshop in September 2023.<sup>33</sup> Without Hanford's FSLE, the EM program life-cycle estimate will not accurately portray the cost of the entire program. EM headquarters officials explained that, to mitigate this issue, they may create a working scenario in which they would develop a life-cycle cost estimate based on realistic budgets for the Hanford site, if the negotiated estimate is not based on realistic funding assumptions. EM

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<sup>33</sup>The other three main challenges mentioned were: hiring, working with stakeholders towards identifying a shared vision for what cleanup and site closure looks like, and the changing conditions at EM sites due to climate change.

would then use this scenario to develop a realistic EM program life-cycle cost estimate.

EM plans to create an integrated master schedule to manage the EM program as part of the EM program life-cycle estimate once the sites' FSLEs are approved. Officials said the schedule will be at a high-level, though detailed enough to track key decision points and interdependencies across the sites. EM officials said they cannot have an integrated master schedule that includes all activities at all the sites because it would be too large, with hundreds of thousands of activities. However, while a high-level schedule provides a strategic view of the activities and milestones for the program, schedules defined at too high a level may disguise risk in lower-level activities, as explained in our schedule assessment guide.<sup>34</sup> Moreover, EM officials said that the schedule will not be dynamic and will not update automatically when changes occur at the sites. As explained in our schedule assessment guide, if the schedule is not dynamic, planned activities will not react logically to changes and management will lack confidence in the schedule dates.

EM officials stated that most of the cleanup work at the sites does not require integration across sites and they will have separate integrated master schedules at each site as part of the FSLE. However, EM officials also said that there are aspects of the work that require integration across sites, such as transuranic (TRU) waste disposal. Disposing of TRU waste from the 22 locations across the country that generate it consists of multiple, complex phases. These phases include the characterization and packaging of the waste at the generator sites, transportation of the waste to the disposal facility, building sufficient disposal space for this waste in the repository, and disposing of the waste in the repository.

Encountering a problem in any of these processes could impact the entire process at multiple sites. For example, DOE officials stated previously<sup>35</sup> that there could be potential impacts to DOE's TRU waste cleanup program at multiple sites across the country if DOE is not able to add additional physical space in time to prevent an interruption to waste

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<sup>34</sup>GAO, *Schedule Assessment Guide: Best Practices for Project Schedules*, [GAO-16-89G](#) (Washington, D.C.: Dec. 22, 2015).

<sup>35</sup>GAO, *Nuclear Waste Disposal: Better Planning Needed to Avoid Potential Disruptions at Waste Isolation Pilot Plant*, [GAO-21-48](#) (Washington, D.C.: Nov. 19, 2020).

disposal operations at the Waste Isolation Pilot Project (WIPP).<sup>36</sup> In addition, as we reported in 2017, the slowing or interruption of TRU waste disposal operations at WIPP could also impair DOE's ability to meet its cleanup and national security missions, as well as cleanup milestones agreed to with states that host DOE sites.<sup>37</sup> For example, a senior DOE official told us in March 2020 that an interruption to TRU waste disposal operations could negatively impact the efforts to resume plutonium pit production at Los Alamos National Laboratory.<sup>38</sup>

If the EM program's integrated master schedule does not accurately reflect the entire work of the EM program and integrate those aspects of cleanup that have dependencies within a site and across sites, EM cannot use the schedule as a basis for measuring technical progress. This may result in an incomplete and unreliable understanding of activity sequencing, required resources, and program completion dates. An unreliable schedule could also result in unreliable program life-cycle cost estimates due to their interconnectedness. By ensuring that the EM program's integrated master schedule (1) is comprehensive, (2) includes site-level and program-wide interdependencies, and (3) is based on realistic assumptions, EM can better ensure that it has an accurate cost and schedule estimate for the entire EM program for optimizing its work.

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## EM Has Opportunities to Improve Program Performance

As EM implements the Protocol, it has opportunities to improve its overall program performance by adopting supplementary practices for program-wide risk management and fully aligning its efforts to measure performance against cost and schedule baselines, report clear performance measures, and monitor and control processes with leading practices for program management.

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<sup>36</sup>The Waste Isolation Pilot Plant (WIPP) is a national repository for contact- and remote-handled defense transuranic (TRU) waste, enabling the disposition of TRU waste at EM's legacy cleanup sites. As such, it itself is not a cleanup site, and thus has no remaining cleanup work. According to EM officials, WIPP's end date will be determined by the completion of cleanup at other sites, and the achievement of its capacity, as defined in the Waste Isolation Pilot Plant Land Withdrawal Act, Pub. L. No. 102-579, 106 Stat. 4777 (1992).

<sup>37</sup>[GAO-21-48](#).

<sup>38</sup>[GAO-21-48](#).

Program-Wide Risk Management Process

EM is not implementing some key processes for managing risk through the life of the program. Conducting program risk management throughout the life of the program is the fourth program management leading practice. According to PMI’s risk management standards, the risk management life-cycle framework facilitates a structured approach for undertaking a comprehensive view of risk throughout a program (see table 5).<sup>39</sup>

**Table 5: Key Processes of a Risk Management Life-cycle Framework for a Program**

Process	Definition
Plan risk management	Develop a risk management plan that describes how risk management processes are to be carried out and how they fit in with other processes.
Identify risks	Identifies and records, to the extent practicable, all risks. <sup>a</sup> When a risk is identified, a risk owner and preliminary response to the risk may be established. <sup>b</sup>
Perform qualitative risk analysis	Evaluates the importance of each risk to categorize and prioritize individual risks for further attention. <sup>c</sup>
Perform quantitative risk analysis	Provides a numerical estimate of the overall effect of risk on the program objectives. Measures the combined effect of identified risks on the desired outcome. <sup>d</sup>
Plan risk responses	Determines the effective response actions that are appropriate for the priority of the individual risks and for the overall risk. <sup>e</sup>
Implement risk responses	Approves risk responses, includes them in risk management plans and delegate a risk response owner.  The risk owner monitors the actions taken to respond to risks to determine their effectiveness and to identify any secondary risks that may arise from the implementation of risk responses. The risk owner also decides whether the risk has been effectively dealt with or additional action is needed. <sup>e</sup>
Monitor risks	Enables the program management team to reevaluate the status of previously identified risks, identify additional risks, and determine the effectiveness of the risk management processes.

Source: Project Management Institute, *The Standard for Risk Management in Portfolios, Programs, and Projects®* (Newtown Square, PA: 2019). | GAO-24-105975

<sup>a</sup>A program risk is an uncertain event or condition that, if it occurs, has a positive or negative effect on the program. The program risk identification activity determines which risks might affect the program, documents their characteristics, and prepares for their successful management.

<sup>b</sup>The risk owner is the individual responsible for monitoring the risk and for selecting and implementing an appropriate risk response strategy.

<sup>c</sup>Assessing individual risks using qualitative risk analysis evaluates the probability that each risk, if it occurs, would have on the program objectives.

<sup>39</sup>This structured approach outlines a sequence of logical phases that can be iterated. A risk management framework is a structure that organizes the process and activities of managing risks in an iterative fashion. Project Management Institute, *The Standard for Risk Management in Portfolios, Programs, and Projects®* (Newtown Square, PA: 2019). *The Standard for Risk Management in Portfolios, Programs, and Projects®* is a registered mark of Project Management Institute, Inc.

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<sup>d</sup>Quantitative risk analysis is not always required or possible. Therefore, during the plan risk management process, the benefits of quantitative risk analysis should be weighed against the effort required to ensure that the additional insights and value justify the additional effort.

<sup>e</sup>There are five ways to respond to a risk: escalate, avoid, transfer, mitigate, or accept the risk.

As EM implements the Protocol, it has opportunities to improve its use of the seven key components of a risk management life-cycle framework. When comparing EM's risk management process to these processes, we found that EM has addressed some components of the risk management key processes but has not fully addressed all seven. Specifically:

- **Plan risk management.** EM has not yet developed a program-wide risk management plan. EM issued guidance to its sites in August 2023 that requires sites to develop program risk management plans covering all work in the FSLE and documenting that the risks at each site are adequately addressed.<sup>40</sup> EM officials stated that EM is planning to develop an EM program-wide risk management plan at the end of Phase I, after EM reviews and approves the site's risk management plans.
- **Identify risks.** EM officials said that they select program-wide risks annually from the sites' top risks for the purposes of reporting them to DOE's Chief Financial Officer, which is done as part of the Office of Management and Budget's (OMB) internal controls process (see table 6). However, EM officials explained that EM has identified these program-wide risks only for OMB purposes, and not for program management purposes. In addition, according to EM officials, EM does not yet have a program-wide risk register in which risks are recorded and managed as part of managing the EM program, despite the interconnectedness across sites of several program activities, such as TRU waste disposal described above. EM officials said that they plan to create an EM program-wide risk register that will only capture and focus on EM program-wide risks, because site risks are already captured at the site level and the Protocol requires sites to create a risk register as part of their FSLEs. Site officials told us that these EM program-wide risks are not captured or managed by the sites because they are supposed to be managed by EM headquarters. According to PMI risk management standards, a

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<sup>40</sup>According to this guidance, its purpose is (1) to document the comprehensive and iterative approach that EM takes to manage all risks associated with accomplishment of the FSLE at its sites, and (2) to ensure all estimable risks associated with accomplishment of the EM mission FSLE are identified and analyzed. Department of Energy, *Office of Environmental Management, Additional Guidance on Programmatic Risk Management for Federal Site Life-cycle Estimates* (Washington D.C.: Aug. 17, 2023). Because of the timing of the guidance, the sites within our review were not able to provide us with their risk management plans.

program should use a risk register to record risk management processes and ensure the effective management of any risk that can cause misalignment between the program roadmap and its supported objectives.<sup>41</sup>

**Table 6: Top EM Program Risks Identified by EM for Fiscal Year 2023**

Top risk	Likelihood risk will occur	Impact if risk occurs
Failure to meet milestones	High	High
Lack of waste disposal options	High	High
Failure to resolve technical challenges	High	High
Failure to address excess facilities and aging infrastructure	High	High
Failure to recruit and maintain skilled workforce	Moderate	High
Top non-financial fraud risk – Inadequate oversight of contractor deliverables	Low	Moderate
Top financial fraud risk – Improper contractor-related property transactions	Low	Low

Source: GAO summary of DOE information. | GAO-24-105975

- Perform qualitative risk analyses.** EM’s program-wide risks appear to be qualitatively analyzed. Specifically, according to EM documents, program-wide risks were categorized by different designations as high-, medium-, or low-risks, according to the estimated likelihood it will occur.
- Perform quantitative risk analysis.** EM’s program-wide risks did not have an estimate of the overall effect the combined risks might have on EM program’s life-cycle cost and schedule estimates. In addition, EM headquarters and site officials explained that the cost and schedule impact for EM program-wide risks are not included in sites’ FSLEs or managed by the sites because they are managed by EM headquarters.<sup>42</sup> Quantitative analyses of risks are used to evaluate the likelihood of success in achieving a program’s objectives and to estimate their cost and schedule impact, which are included in these estimates as contingencies.<sup>43</sup>

<sup>41</sup>PMI, *The Standard for Risk Management in Portfolios, Programs, and Projects*®.

<sup>42</sup>According to EM’s risk guidance, given to sites in August 2023, EM owns program-wide risks which are generally outside the sites’ control, such as variances between planned funding and funding received, and risks related to availability of a national repository for disposal of spent nuclear fuel and high-level waste. EM sites can include these risks in their risk management plan and risk registers, but they cannot include risks owned by EM in their site-level contingency estimate analyses.

<sup>43</sup>According to PMI’s *Standards for Program Management*®, contingency is time or money allocated in the schedule or cost baseline for known risks with active response strategies.

- **Plan risk responses.** EM risk documents described how EM is planning to respond to each top EM program-wide risk if it happened.
- **Implement risk responses and monitor risks.** EM did not provide documentation that demonstrates how it responded to the risks that were realized and how it monitors program-wide risks. Specifically, we asked EM officials to provide examples of how EM has implemented planned actions for their most recently realized program-wide risks, but they were unable to provide any documentation. According to PMI, these activities are also part of a risk register, which EM does not yet have for EM program-wide risks.

According to PMI, a program's risk management framework is described in a risk management policy.<sup>44</sup> The Protocol states that EM will develop a more comprehensive risk management policy to address the various risks facing the EM program and sites, and to address requirements and guidance for risks related to projects and mission activities. EM officials stated that the site guidance issued in August 2023 is the comprehensive risk management policy, and it does not plan to issue another policy. However, this guidance focuses on risk management at the sites and does not include information on how the EM program and the sites follow the key processes of a risk management life-cycle framework. Following the seven key processes for a risk management framework, including the establishment of an EM program-wide risk register and the management of program-wide risks, as EM implements its risk management policy, would allow EM to manage risk in a structured way to help align resources and processes with its strategy and goals.

### Program Life-Cycle Baselines

EM is not planning to set an EM program baseline for program cost and schedule against which to track program-wide performance. The fifth leading practice for program management states that a program should measure performance against program-level cost and schedule baselines. Instead, EM plans to rely on site FSLEs to measure site performance. EM officials explained that they could only measure performance for work that is ongoing and under contract. EM site officials further explained that under the new EM end-state contracting model, EM signs multiple task orders within each contract, each having its own cost and schedule that would serve as performance baselines. Therefore, even under one contract, EM may have multiple cost and schedule

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<sup>44</sup>PMI, *The Standard for Risk Management in Portfolios, Programs, and Projects*®.

baselines against which to measure performance—one for each task order.

EM officials explained that all the different baselines from various task orders and various contracts would eventually be integrated in a site's FSLE, and this estimate would be used as the overall site baseline for purposes of tracking overall performance at a site. For example, EM would use the FSLE as a baseline to measure the percent completion of work at the site and to monitor whether the cost and schedule increased over a certain threshold, which would trigger a root cause analysis and corrective actions at the site, as required in the Protocol.

EM plans to integrate the sites' FSLEs into the EM program life-cycle estimate for the entire EM program, as required in the Protocol. The Protocol states that this EM program-wide estimate will be used, among other things, to support the execution of the work and support evaluations of EM program progress. However, the Protocol provides no details on how EM plans to use the EM program-wide life-cycle estimate as the program-wide baseline and for program monitoring and change control processes at the program-wide level, and only discusses how the site FSLEs will be used for these purposes at the site level.

### Performance Measures

Our evaluation of EM's reporting on the three tools it uses to measure performance—program-wide performance metrics, milestones, and earned value management (EVM) systems—found that they did not provide a clear picture of EM's performance.<sup>45</sup> The sixth program management leading practice states that a program should complete performance reporting and analysis in a way that provides a clear picture of performance.

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### Performance Metrics

As EM implements the Protocol, it has opportunities to improve its performance metrics by using the key components of effective performance metrics (see table 7). Our analysis of EM's performance metrics found that they align with some but not all the nine key

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<sup>45</sup>EVM measures the value of work accomplished in a given period and compares it with the planned value of work scheduled for the period and with the actual cost of the work accomplished. EVM is an industry standard and is considered a best practice for conducting cost and schedule performance analysis for projects.



components for effective performance metrics. Specifically, we found EM's performance metrics were measurable, objective, reliable, covered core program activities, and had limited overlap. For example, EM's performance metrics are measurable because they include the number of cleanup site closures, the cubic meters of waste disposed of, and the number of closed radioactive liquid waste tanks. Moreover, we found each performance metric is objective, in that they are reasonably free from significant bias and manipulation, and reliable, because each metric produces the same result under similar conditions and provides new information beyond that provided by other measures. Additionally, EM's corporate performance metrics cover EM's core program activities, as they cover all mission areas, such as spent nuclear fuel, nuclear materials, or tank waste, and have limited overlap.

**Table 7: Key Components of Effective Performance Metrics**

Key component	Definitions
Linkage	Metrics are aligned with division and agency-wide goals and mission, linked to performance metrics, and clearly communicated throughout the organization.
Clarity	Metrics are clearly stated and the name and definition are consistent with the methodology used to calculate it.
Measurable target	Metrics have a numerical goal.
Objectivity	Metrics are reasonably free from significant bias or manipulation.
Reliability	Metrics produce the same result under similar conditions.
Core program activities	Metrics cover the activities that an entity is expected to perform to support the intent of the program.
Limited overlap	Metrics provide new information beyond that provided by other measures.
Balance	Metrics ensure that an organization's various priorities are covered.
Government-wide priorities	Metrics cover a priority such as quality, timeliness, and cost of service.

Source: GAO best practices from [GAO-03-143](#). | GAO-24-105975

EM's performance metrics, however, did not fully align with four of the key attributes of effective performance metrics—linkage, clarity, balance, and government-wide priorities. Specifically:

1. Goals and performance metrics for two sites that we were able to review did not have a direct link to EM's program goals, mission areas, and performance metrics. For example, one site's strategic plan described a site goal as the completion of cleanup in one area of the site and transitioning it to long-term stewardship. The objective under this goal is to complete reindustrialization, conservation, and historic preservation activities and transition the site to long-term stewardship. While the site goal and objective seem to relate to EM's broad mission, it is not clear how this site goal and objective align with

specific EM program's mission area, goal, and performance metric. EM officials said that conceptually all activities at the sites roll up into the EM mission and goals, and that every activity listed in the site strategic plans and program plans could be tied to a program performance metric. However, these officials acknowledged that the linkages to EM's mission were not clear.

2. EM's performance metrics lack clarity because EM lists two sets of performance metrics in its Program Plan that are not fully consistent. Specifically, the metrics listed under each mission area are slightly different than the EM program's overall performance metrics listed in this document that EM officials said EM has tracked from the beginning of the program and reports to the public and Congress. For example, the Program Plan identifies under each mission area specific performance metrics—such as the number of packages that are road-ready awaiting shipment or the number of tanks emptied of liquid waste—that we were not able to match to the EM program's overall metrics as identified in the Plan.
3. EM's performance metrics are not fully balanced because they do not address EM's highest priority in its risk-informed prioritization approach—to mitigate immediate risk to human health and environment. This is accomplished by prioritizing all cleanup activities based on achieving the greatest risk reduction benefit per radioactive content, according to EM's 2022 Program Plan.<sup>46</sup> We reported in May 2023 that there are three key interrelated units that measure radioactivity and estimate its health effects: curies, rads, and rems.<sup>47</sup> However, none of EM's program performance metrics measure the amount of radioactivity removed, or prioritize the removal of

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<sup>46</sup>According to EM's 2022 Program Plan, a core component of EM's strategy is the risk-based cleanup prioritization approach described in the EM Program Management Protocol. Employed since EM's inception, this approach assigns the highest priority to mitigating hazards posing an immediate risk to human health or the environment, and all cleanup activities are prioritized based on achieving the highest risk reduction benefit per radioactive content.

<sup>47</sup>Radioactivity is the energy released by a radioactive material. Different types of radiation also have the potential to damage human tissue. Curies are a measure of the intensity of the amount of radiation released when an element emits energy as a result of radioactive decay. Rads are a measure of the absorbed dose, which describes the amount of energy deposited per unit mass in an object or person. Rads are often used for measuring the dose from medical equipment. Rems are a measure of the effective dose, which takes the absorbed dose and adjusts it for radiation type and relative organ sensitivity. The result in rems is an indicator for the potential for long-term health effects from an exposure. GAO, *Hanford Cleanup: DOE Should Validate Its Analysis of High-Level Waste Treatment Alternatives*, [GAO-23-106093](#) (Washington, D.C.: May 24, 2023).

radioactivity based on the risk it poses to human health using any of these three units.<sup>48</sup>

4. EM's program performance metrics do not fully cover government-wide priorities, such as the cost of the service they provide. In February 2019, we recommended that EM include cost components in its performance metrics by integrating its EVM data with its performance metrics for operations activities.<sup>49</sup> This recommendation remains open. We continue to believe that by integrating reliable EVM data into EM's performance metrics for operations activities, EM could provide a clearer picture of performance and better indicate whether EM is achieving its objective of reducing risks and costs.

In addition, in September 2023 we provided an example of how such a performance metric might look by comparing the cost of immobilizing the same amount of radioactivity using two different methods at two sites—Hanford and Savannah River.<sup>50</sup> This analysis allowed us to compare the costs of reducing the same amount of radioactivity at these two sites (in cost per curie). We found that the cleanup method used at Savannah River was almost eight times cheaper at reducing the same amount of radioactivity. Tracking performance metrics against cost would allow EM to compare the costs of each activity, as appropriate, across the EM program.

Officials stated that current performance metrics are sufficient to provide a clear picture of EM's overall performance because EM has been reporting the same metrics since the inception of the program. However, EM has opportunities to better demonstrate the outcomes of its investments. By (1) linking EM's performance metrics to site activities, (2) identifying one clear set of performance metrics in all documents, (3)

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<sup>48</sup>There are usually many radioactive elements in a waste stream. For example, over 90 percent of the current radioactive material in tanks at Hanford will decay in the next 100 years. However, some of the remaining radioactive constituents, which currently account for about two percent of the Hanford tank waste's total radioactivity, are the most dangerous constituents to human health in the long term. [GAO-23-106093](#).

<sup>49</sup>According to EM's 2020 Program Management Protocol, operations activities include mission and mission support activities and are the primary focus of the requirements within the Protocol. Mission activities directly support the completion of the EM mission, such as legacy waste processing campaigns or environmental remediation of soil and groundwater. Mission support activities are routine or recurring activities to support and enable mission activities, such as management and maintenance of site services and of the land. Operations activities made up 77 percent of EM's fiscal year 2019 budget. [GAO-19-223](#).

<sup>50</sup>GAO, *Hanford Cleanup: Alternative Approaches Could Save Tens of Billions of Dollars*, [GAO-23-106880](#) (Washington, D.C.: Sept. 28, 2023).

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updating EM's performance metrics to capture its highest priorities, and (4) updating the performance metrics to include a cost component, EM could provide a clearer and more complete picture of program performance.

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## Milestones

We found that EM does not track original milestones, as suggested by the sixth leading practice for program management. Though EM officials said they track original milestone dates and newly created milestones, data from EM's tracking database with recent milestones from two of the sites we reviewed did not track the original milestone dates.

In February 2019, we reported that EM's recorded milestone dates are not reliable because EM does not accurately track cleanup-related milestones met, missed, or postponed.<sup>51</sup> We recommended that EM track original milestone dates and changes to its cleanup milestones. We closed this recommendation as implemented because, in August 2021, DOE issued a new standard operating procedure that standardized what sites are required to enter into its project planning and tracking systems, including the original milestone date.

We also recommended that EM comply with requirements in the fiscal year 2011 National Defense Authorization Act by reporting annually to Congress on the status of its cleanup milestones and the list of cleanup milestones for all sites required by the act.<sup>52</sup> The annual reports are also required to include, for each milestone, the original date along with the currently negotiated date. As of March 2024, this recommendation was still open. DOE officials told us that they have collected data from each of the cleanup sites and are now evaluating the information after which DOE will be able to provide a standard report on milestones at each site. We continue to believe that by tracking and reporting on the original milestones, EM's reporting on the status of cleanup milestones will be more accurate and useful to decision-makers in the future.

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<sup>51</sup>GAO, *Nuclear Waste: DOE Should Take Actions to Improve Oversight of Cleanup Milestones*, [GAO-19-207](#) (Washington, D.C.: Feb. 14, 2019).

<sup>52</sup>Ike Skelton National Defense Authorization Act for Fiscal Year 2011, Pub. L. No. 111-383, § 3116(a), 124 Stat. 4137, 4512–13 (codified as amended at 50 U.S.C. § 2582a).

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## Earned Value Management

Of the five sites we reviewed, one provided documentation showing that DOE had certified the contractor's EVM system in accordance with the industry standard; four sites did not provide certification documentation.<sup>53</sup> The purpose of a certification review is to validate that the EVM system complies with the industry standards. A certified EVM system gives assurance to management that the system provides reliable cost and schedule performance data for managing capital asset projects and operations activities and reporting their status to DOE and EM; and that it is actively used to manage the program. Additionally, EVM systems for contracts that include capital asset projects equal to or over \$100 million are to be certified by an independent DOE oversight body, the Office of Project Management, according to DOE's Order 413.3B.

This EVM system certification process can take 1 or 2 years, or longer to achieve, during which time EM does not know if the contractor's data were reliable. For example, we found in July 2023 that the contractor's EVM system at the Los Alamos site was self-certified about 3 years later than anticipated.<sup>54</sup> Notably, during this delay, costs increased at the site by more than \$3 billion and the schedule extended by 7 years.<sup>55</sup> The delays in finalizing a performance baseline and certifying a project control system hindered the Los Alamos site's ability to monitor what portion of the contracted cleanup work had been completed and how the actual costs and schedule for that work compared with what was planned at the beginning of the contract period. Unless the contractor's EVM system is validated, there will be a lack of assurance that it provides reliable data to the government and is actively to manage the program.

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<sup>53</sup>The Earned Value Management Systems EIA-748-D Intent Guide was created in August 2018 for organizations to be able to evaluate the quality of an EVM system to determine the extent to which the cost, schedule, and technical performance data can be relied on for program management purposes. These guidelines are best practices that provided a scalable approach to using EVM for any contract type, contract size, and duration. They consist of 32 guidelines in five categories: (1) organization; (2) planning, scheduling, and budgeting; (3) accounting considerations; (4) analysis and management reports; and (5) revisions and data maintenance. [GAO-19-223](#).

<sup>54</sup>GAO, *Nuclear Waste Cleanup: DOE Needs to Address Weaknesses in Program and Contractor Management at Los Alamos*, [GAO-23-105665](#) (Washington, D.C.: July 19, 2023). Self-certified means that the contractor's EVM system was certified by the contractor and not an independent party, like DOE's Office of Project Management.

<sup>55</sup>[GAO-23-105665](#).

One site that provided certification documentation had several unexplained anomalies that may call into question the accuracy of the data. We found that, as part of the certification process, DOE's Office of Project Management has visibility into EVM data that are manually entered into the EM's tracking system by the sites based on information received from the contractors. However, it does not have the ability to perform data checks to ensure the information is credible. EM officials stated they are working to develop systems to evaluate data quality. This limitation prevents EM from determining whether the data are reliable. Instead, EM must rely largely on written narratives accompanying the data, which is subjective information instead of objective data. Additionally, unvalidated contract performance data may not allow the detection of existing errors, resulting in erroneous metrics and less informed decision making.

### Monitoring and Controlling Processes

In its effort to implement the seventh program management leading practice—which states that monitoring and controlling should be at the program-level—EM relies on sites to carry out the relevant monitoring and controlling processes.<sup>56</sup> However, these processes are conducted mainly at the contract- or project-level, without integration of the information at a site- or EM program-level. EM officials explained that they rely on sites to perform monitoring and controlling, and that EM headquarters compiles data received from the sites. However, officials stated that these data are examined at the project level, and officials do not integrate the data in a way that can be used for monitoring and controlling at the entire EM program-wide level. Integration of site information within monitoring and controlling processes is important because it allows for data integration for all the work covered at the site, including better data on operations activities that represent about 80 percent of EM's annual budget and are subjected to less stringent requirements, as we have previously found.<sup>57</sup>

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<sup>56</sup>The monitoring process includes, for example, monitoring performance against the program or site baselines and independently validating information received from contractors. The controlling process consists of steps that sites and the program take in making changes to their baselines when significant changes to the cost, scope, and schedule occur, among other things.

<sup>57</sup>[GAO-19-223](#). When reviewing EM's budget in fiscal year 2023, one site's operations activities had a budget of \$413 million versus \$14 million for capital asset projects. At another site, EM's budget for operations activities was \$1.75 billion, while for capital asset projects was \$789 million.

The Protocol does not generally include requirements to integrate data obtained from monitoring and controlling processes at the site-level or provide an integrated view of site-level data that combine data for both capital asset projects and operations activities.<sup>58</sup> EM site officials we interviewed could not point to standardized guidance for monitoring and controlling at the site-level. For example, officials at three sites could not cite any guidance for monitoring at the site-wide level. Additionally, officials at four sites stated that the management of their control processes are at the project- or contract-levels, and not at the site level.

Furthermore, site monitoring reports that we reviewed demonstrated that sites conduct monitoring and report data to EM headquarters at the project level. Although the information sent to headquarters did not integrate information at the site level, site officials said that they will start reporting integrated information at the site-level once they have a site FSLE baseline established.

According to our program management leading practices, a program should have monitoring and controlling processes in place. Additionally, according to PMI, standardized reporting and controlling processes support a program's ability to monitor progress and strengthen its ability to assess program status.<sup>59</sup> However, EM's Protocol does not require the integration of monitoring data at the EM program- or site-level. Additionally, as stated above, site officials were unable to point to guidance describing any standardized practices with which to conduct monitoring and controlling at the site- or program-wide level. By ensuring that monitoring and change control processes to integrate and report data are standardized across all cleanup sites to facilitate integration and reporting EM-wide, EM could better monitor its program performance, fix program-wide problems, and possibly avoid significant cost increases and schedule delays.

### Root Cause Analyses and Corrective Action Plans

EM requires root cause analyses when the site-level FSLE baseline increases above a certain threshold. It does not require corrective action

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<sup>58</sup>The only reference to monitoring and controlling requirements in the Protocol is a series of specific thresholds for whether a change in the site FSLE requires site-level or EM-leadership approval. For example, if the FSLE overrun is greater than \$1 billion and the FSLE has a cumulative increase that is \$100 million or greater, it will require a root cause analysis and approval from EM leaderships.

<sup>59</sup>*The Standard for Program Management*, Fourth Edition (2017).

plans to accompany the root cause analyses, however, which is called for in the seventh program management leading practice. The Protocol requires sites to conduct root cause analyses to identify the underlying causes of events that result in undesirable cost and schedule performance—such as cost overruns, schedule delays, missed or postponed milestones, and performance shortcomings—when a site’s FSLE baseline increases by a certain threshold.<sup>60</sup> EM site officials said that they have not performed any root cause analyses because this is not possible before updating and receiving approval for their FSLEs, which EM is still in the process of doing for all sites.

Our previous work has highlighted the importance of identifying and addressing root causes for cost and schedule overruns at EM cleanup sites, which can contribute to significant increases over time if left uncorrected. For example, as mentioned above, we found in July 2023 that the EM Los Alamos cleanup site had experienced \$3 billion in estimated cost increases and a 7-year schedule delay in its FSLE since 2016.<sup>61</sup> However, the site did not have plans to conduct a root cause analysis or develop a corrective action plan to assess and address the source of these changes. Los Alamos and EM headquarters officials explained at that time that the requirement for conducting a root cause analysis applies only to revisions of the FSLE following approval of the initial FSLE developed in response to the Protocol, which has not been completed yet for Los Alamos.

At that time, we recommended that EM conduct a root cause analysis and develop a corrective action plan to prevent the unidentified and uncorrected issues from persisting. EM concurred with our recommendation and said that it will conduct a root cause analysis and develop a corrective action plan, if necessary, to determine the drivers behind these cost and schedule changes. EM headquarters officials said that these actions would occur as part of the IPT’s Phase II review.

The Protocol requires that any changes to the site’s FSLE requiring EM leadership approval will be accompanied by a root cause analysis. It also states that a root cause analysis should be supported by a corrective

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<sup>60</sup>A root cause is the core issue that sets in motion an entire cause-and-effect chain that leads to an identified problem. Root cause analyses are disciplined and rigorous processes resulting in the identification of the deepest-seated causes for a condition, issue, or event. Correcting these causes have a high likelihood of preventing recurrence of issues in the future.

<sup>61</sup>[GAO-23-105665](#).



action plan, but it does not clearly specify that a corrective action plan is also required in this instance.<sup>62</sup> None of the site officials at the sites we reviewed could provide site-level guidance for developing, implementing, and tracking corrective action plans. When asked about plans to develop additional guidance to support sites in the future, EM officials stated that they had no plans for releasing additional guidance.

Additionally, site officials at four sites said that the processes for conducting root cause analyses would focus on the project level rather than at the site level. DOE updated Order 413.3B in June 2023 to require (1) program offices develop formal corrective action plans to address root causes resulting from project performance baseline deviation and (2) conduct independent reviews assessing the effectiveness of the corrective action plans in resolving identified root causes.<sup>63</sup> However, these requirements are specific to capital asset acquisition projects, but a similar approach would be useful at the program level.

In addition, if a site FSLE increases over a certain threshold, there is no requirement for EM to report increases to Congress to ensure corrective actions are implemented in a timely and adequate manner. In contrast, other federal agencies have identified program-level reporting requirements and thresholds for root cause analyses and corrective actions. For example:

- We have previously reported on the Department of Defense's (DOD) reporting requirements under the Nunn-McCurdy statutory provision, which has been a tool for Congress to hold DOD accountable for cost

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<sup>62</sup>The Protocol specifies that a corrective action plan is an early step in a performance improvement plan to help identify what needs to be changed to improve EM cleanup performance.

<sup>63</sup>DOE took this action in response to our prior report issued in March 2022 in which we found while looking at the construction of the Safety Significant Confinement Ventilation System facility at the Waste Isolation Pilot Plant that DOE had neither a requirement that program offices develop corrective action plans to address root causes, nor a process to ensure that corrective actions would fully address root causes. We recommended that DOE update Order 413.3B to require program offices to develop corrective action plans that will address root causes and that DOE's Office of Project Management assess and validate the extent to which the program office has taken corrective actions to address root causes they have identified during the baseline change process. GAO, *Waste Isolation Pilot Plant: Construction Challenges Highlight the Need for DOE to Address Root Causes*, [GAO-22-105057](#) (Washington, D.C.: Mar. 15, 2022).

growth on major defense programs.<sup>64</sup> That statute supplies Congress with greater visibility into major defense programs' cost growth and encourages DOD to manage and control cost growth. It requires DOD to notify Congress if the program's cost increases more than 25 percent beyond the original estimate and calls for the termination of programs with total cost growth greater than 50 percent, unless the Secretary of Defense submits an explanation that meets certain requirements.<sup>65</sup>

- Similarly, the National Aeronautics and Space Administration (NASA) reports to its congressional authorization committees when certain program costs exceed their estimates by 15 percent or more, or a program's milestone is likely to be delayed from the baseline's date by 6 months or more.<sup>66</sup>

Our program management leading practices state that programs should conduct root cause analyses as part of their monitoring and controlling activities, and that programs should develop corrective action plans as part of these analyses. However, there are no clear requirements in the Protocol for the development of corrective action plans or that the corrective actions are tracked through their completion. In addition, there are no requirements that the implementation of resulting corrective actions be independently reviewed or that EM report on these root causes and the status of implementing the corrective actions. Without ensuring that when a site FSLE exceeds a change control threshold that requires EM leadership approval and a root cause analysis under the Protocol, (1) the site's root cause analysis be accompanied by a corrective action plan and that corrective actions are tracked through completion, (2) an independent review is performed that includes an assessment and validation of the extent to which the corrective actions resolve the root causes identified and (3) EM publicly report each year on the program impacts of the independent reviews and outcomes of corrective actions, such as through EM's program plan updates, the EM program and the

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<sup>64</sup>GAO, *DOD Cost Overruns: Trends in Nunn-McCurdy Breaches and Tools to Manage Weapon Systems Acquisition Costs*, [GAO-11-499T](#) (Washington, D.C.: Mar. 29, 2011).

<sup>65</sup>10 U.S.C. §§ 4371–77, commonly referred to as Nunn-McCurdy, requires the Department of Defense to notify Congress whenever a major defense acquisition program's unit cost experiences cost growth that exceeds certain thresholds. GAO, *Global Positioning System: Updated Schedule Assessment Could Help Decision Makers Address Likely Delays Related to New Ground Control System*, [GAO-19-250](#) (Washington, D.C.: May 21, 2019).

<sup>66</sup>GAO, *NASA: Assessments of Major Projects*, [GAO-22-105212](#) (Washington, D.C.: June 23, 2022).

sites could experience inefficiencies in implementing corrective actions. Correcting root causes would help ensure that the issues causing the increases would not recur, reduce the risk for program cost increases and schedule delays, and would help EM leadership make informed decisions. It may also help ensure EM looks at the integrative components or corrective actions that may be needed across multiple sites and EM headquarters, if any integrative root causes and corrective actions are identified.

## EM Has Opportunities to Improve Program Oversight

As EM implements the Protocol, it has opportunities to improve its program oversight by adopting supplementary practices for establishing a formal lessons learned process for the entire EM program and the sites, and by ensuring independent review, as described by leading practices for program management.

### Lessons Learned Process

Neither the EM program nor the five sites in our sample have a formal lessons learned process to improve program management—as called for by the eighth program management leading practice. Yet, as EM implements the Protocol, it has opportunities to improve its lessons learned process. We have previously outlined the six key components of a lessons learned process that programs should use to identify and apply lessons learned (see table 8).<sup>67</sup>

**Table 8: Key Components of the Lessons Learned Process**

Key practices	Description
Collecting information	Capture data through activities such as project critiques, written forms, interviews of participants, and direct observation.
Analyzing the information collected to identify lessons that lead to recommendations	Analyze information collected to determine root causes and identify appropriate actions, and result in lessons that lead to recommendations.
Validating the accuracy and applicability of lessons to other projects	Verify the accuracy of lessons and their applicability to other projects.

<sup>67</sup>GAO, *Telecommunications: GSA Needs to Share and Prioritize Lessons Learned to Avoid Future Transition Delays*, [GAO-14-63](#) (Washington, D.C.: Dec. 5, 2013).

Key practices	Description
Archiving the lessons	Store lessons in a manner—such as in an electronic database—that allows users to perform information searches using key words and functional categories. The database should also provide a logical system for organizing information that is easily retrievable and made available to any requester. In addition, archiving should be done on an ongoing basis to avoid becoming cumbersome and irrelevant.
Sharing and disseminating lessons	Disseminate lessons learned through a variety of communication media, such as briefings, bulletins, reports, e-mails, websites, database entries, the revision of work process or procedures, and training. For example, lessons can be disseminated through automated delivery or by having a user search the database.
Deciding to invest resources to apply lessons learned	Management determines whether to commit resources to a particular lesson. The decision focuses efforts on determining the most important issues on which to apply limited resources. Issues are prioritized by rank from most important to least important to determine where the greatest impact will be. Under a benefit-cost analysis, some recommendations coming out of the lessons-learned process may simply be too costly to implement.

Source: GAO key practices from [GAO-14-63](#) | GAO-24-105975

EM headquarters and the five sites in our sample collect lessons learned information on an ad hoc basis, and these lessons often focus on individual projects or cover topics outside of program management, such as health and safety. For example, officials at four sites said that they were either unaware of a formal lessons learned process at their sites or that they use an informal process for gathering lessons learned. Officials at one of these sites said they capture lessons learned at the project level through close-out reports for capital asset projects, in line with DOE Order 413.3B requirements. However, neither the officials at these four sites nor our reviews of sites' documentation explained how these lessons learned from the project level are used to improve processes and procedures for other projects or the overall site. Additionally, two sites said that they use an informal process that relies on the collective experience of everyone at the site for dealing with an issue or share lessons learned with officials from other sites at EM-wide workshops through presentations.

EM officials at one site stated that they have a dedicated office for lessons learned, which provides support to managers with a DOE-wide database called OPEXShare, where officials can choose to upload lessons learned they have identified for projects at the site. Our high-level review of the topics in this database shows that, even though it had a section on capital asset project management, the section contained only one entry.<sup>68</sup> In addition, the database did not have a dedicated section on program management. EM headquarters officials stated that they are now working to add more information into the database at the project level and

<sup>68</sup>The database had a subsection on construction/project management under general management topics that contained entries. A summary level of the database was accessed online on December 27, 2023.

that they are planning to transition monthly program and project lessons learned bulletins to the database. However, they stated that there is no overall EM guidance for having sites enter information in this database, nor did officials provide information on a dedicated EM office to ensure EM implements the key practices of a lessons learned process.

The Protocol states that EM will identify lessons learned at the sites and document them. It also states that these lessons will contribute to continual improvement of EM's planning, budgeting, and execution of activities. EM's sites are engaged in similar activities, including treating tank waste, remediating soil and groundwater, and deactivating and decommissioning contaminated facilities. While there are a number of different contractors carrying out these activities across the cleanup sites, EM has opportunities to ensure that successful practices at one site are shared with other sites. However, the Protocol does not describe the implementation of a formal lessons learned process for the sites or for the entire EM program.

By establishing a formal lessons learned process related to areas of program management that is applied EM-wide that incorporates key components, the EM program and the sites could ensure that they will not miss any opportunities to improve their processes and performance, and help ensure they do not repeat mistakes. Additionally, having a formal lessons learned process would decrease the risk of sites losing institutional knowledge once EM staff retire or leave because sites would no longer rely on informally sharing officials' collective experiences to address issues that arise.

### Independent Oversight

There is no formal, independent oversight body that performs comprehensive reviews of the EM program, as called for by the ninth program management leading practice, but EM is taking positive first steps toward independent oversight by planning to conduct regular reviews of sites. We identified two areas against which to evaluate EM: (1) having an independent oversight body that reviews the EM program or sites; and (2) conducting independent reviews for various program management leading practices, such as reviews of cost and schedule estimates, strategic plans, and a lessons learned process.

First, there is no oversight body that reviews EM at the EM-wide program level, though there are some reviews of EM projects. For example, DOE's Office of Project Management, the Project Management Risk Committee,

and the Energy Systems Acquisitions Advisory Board review capital asset projects, which cover about 20 percent of EM's annual budget, as previously noted.<sup>69</sup> The remaining 80 percent of EM's budget is covered by operations activities and is not subject to this type of independent oversight.

When asked about independent reviews of the EM program and sites by external entities, EM officials in headquarters and at one of the sites cited reviews conducted by GAO and other parties, including the DOE Office of Inspector General, the National Academy of Sciences, the Army Corps of Engineers, or the Defense Nuclear Facilities Safety Board. EM officials did not feel that additional independent reviews of the program are necessary and said the reviews by these outside bodies are sufficient because, in their opinion, the EM program is already heavily reviewed.

However, these reviews are only occasional and with limited scope, not regular independent reviews of the efficiency of the entire EM program or sites. EM officials also mentioned that an Environmental Management Advisory Board provides independent and external advice, information, and recommendations to the head of EM.<sup>70</sup> Nevertheless, according to this board's bylaws, these reviews are generally restricted to topics that EM would like recommendations and advice on. Board members may propose topics, but reviews of these topics are at the discretion of EM.

Under the Protocol, EM is planning to conduct independent site reviews, though these reviews have not yet begun. According to the Protocol, EM will conduct Site Program/Project Peer Reviews through federal and contractor experts to provide independent oversight of the sites'

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<sup>69</sup>DOE's Office of Project Management is an independent oversight body within DOE that reviews capital asset projects. The Project Management Risk Committee provides ongoing monitoring and assessments of projects and enterprise-wide project management risk assessment and expert advice to the Secretary of Energy and others in the department on cost, schedule, and technical issues regarding capital asset projects with a total project cost of \$100 million or greater. The Energy Systems Acquisitions Advisory Board provides advice, assistance, and recommendations at key decision points for major system acquisitions and designated major projects.

<sup>70</sup>This body works to identify applicable private and public sector best practices and provides counsel on how to integrate them into the EM program. According to the board's charter, it meets semiannually, and its reviews result in advice and recommendations on corporate issues related to site cleanup and risk reduction of the EM program, including project management and oversight, cost-benefit analyses, program performance, human capital development, and contracts and acquisition strategies.

contractors and the federal management of projects.<sup>71</sup> EM officials stated that these reviews will start after EM approves the site FSLEs, which will serve as the site baselines; as we described earlier, EM currently expects to complete these by August 2025. It is not clear how EM will ensure these reviews are independent. Additionally, officials from all the sites we reviewed said that they were not aware of any independent reviews of the sites based on the new requirements in the Protocol.

Second, EM is planning to perform regular reviews of cleanup sites that will address some, but not all program management leading practices. Specifically, the Protocol requires reviews of the sites' FSLEs at the initial development of the FSLEs, and any time major changes to the estimates are made requiring approval by senior EM leadership.<sup>72</sup> Such reviews are to be conducted every 4 years if no major changes trigger a review. The Protocol explains that subject matter experts from EM headquarters, other sites' personnel, the EM Consolidated Business Center officials, and other consultants conduct these reviews.

These reviews have not yet begun, so it is unclear if they will be independent and address all components of the leading practices, such as of the planning documents or the lessons learned process. EM officials also pointed out that the IPT reviewed the site's strategic plans, FSLEs, and risk documentation as part of Phase I and II of the Protocol implementation review. However, these IPT reviews are limited because they are either one-time reviews and are not regular, ongoing reviews; or are only focused on a few elements of the program, such as the FSLE; or are conducted by the program itself. Because EM is in the early stages of implementing the Protocol and conducting reviews, it is too early to tell if the extent of independence in these reviews fully aligns with this leading practice.

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## Conclusions

EM has acknowledged that it needs to strengthen its program management, and in November 2020 the agency issued its Program

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<sup>71</sup>The Protocol states that these review teams are established with staff from across the complex with program, project, contract, and technical expertise.

<sup>72</sup>The Protocol states that senior EM leadership approval is required at sites with FSLE's of less than \$1 billion when the increase in FSLE is 10 percent (cumulative) or greater. For sites with an FSLE that is greater than \$1 billion, EM senior leadership approval is required when there is an FSLE increase of \$100 million (cumulative) or greater.

Management Protocol. The Protocol codifies many leading program management practices as requirements for EM's sites and headquarters office. EM has followed many leading practices for program management as it works to implement the Protocol, and it is planning to develop a guide to achieve further implementation of the Protocol.

As EM implements the Protocol, it has opportunities to adopt additional program management leading practices. The agency has historically focused its management approach at the site-level and has not integrated its processes at the EM program level. In some cases, the sites do not understand how to implement the Protocol to address site- and EM-wide issues, showing the disconnect between headquarters' expectations and what sites understand. Comprehensive program management that includes, for example, key planning documents, an integrated master schedule, clear performance metrics linked to program goals and costs, standardized monitoring and change control practices, and a formal lessons learned process would enhance EM's planning, performance, and oversight across the complex. Having appropriate requirements or guidance and ensuring the implementation of the program management leading practices at both the site- and EM-program level would help ensure that DOE's cleanup work runs efficiently and in an optimized and integrated way.

A notable improvement that the Protocol helped bring about is that EM now requires its cleanup sites to conduct root cause analyses if sites exceed defined thresholds for overruns to cost and schedule estimates to secure EM leadership approval for revised estimates. However, EM does not clearly require that corrective action plans accompany the root cause analyses, that the corrective actions are tracked through their completion, or that the implementation of corrective action is independently reviewed. EM is also not required to report on the root causes and the status of implementing corrective actions to ensure corrective actions are implemented in a timely and adequate manner. These steps would create an important accountability and oversight mechanism for a program approaching \$900 billion in life-cycle costs at the high end. Public reporting would allow Congress and DOE to have greater assurance that corrective actions are implemented, root causes will not persist or recur, and that EM is addressing site- and program-wide issues that affect cost and schedule—all of which could better ensure efficient allocation of taxpayer resources.



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## Recommendations for Executive Action

We are making the following seven recommendations to DOE:

The Senior Advisor for the Office of Environmental Management should ensure EM strategic plans, roadmaps, and program management plans follow best practices for being comprehensive for the entire EM program and, as applicable, for each site. (Recommendation 1)

The Senior Advisor for the Office of Environmental Management should ensure the EM program's integrated master schedule (1) is comprehensive, (2) includes site-level and program-wide interdependencies, and (3) is based on realistic assumptions. (Recommendation 2)

The Senior Advisor for the Office of Environmental Management should ensure that, as EM implements its risk management policy, EM follows the seven key processes for a risk management framework. (Recommendation 3)

The Senior Advisor for the Office of Environmental Management should ensure EM develops program-wide performance metrics that follow the key components of effective performance metrics, as applicable, such as by developing performance metrics that measure the cost per unit of radioactivity treated. (Recommendation 4)

The Senior Advisor for the Office of Environmental Management should ensure that monitoring and change control processes are standardized to facilitate integration and reporting of data EM-wide. (Recommendation 5)

The Senior Advisor for the Office of Environmental Management should ensure that, when a site FSLE exceeds a change control threshold that requires the Senior Advisor's approval and a root cause analysis under the Protocol, (1) the site's root cause analysis be accompanied by a corrective action plan and that corrective actions are tracked through completion, (2) an independent review is performed that includes an assessment and validation of the extent to which the corrective actions resolve the root causes identified, and (3) EM report each year on the program impacts of the independent reviews and outcomes of corrective actions, such as through EM's program plan updates. (Recommendation 6)

The Senior Advisor for the Office of Environmental Management should ensure EM establishes a formal lessons learned process related to areas of program management that is applied EM-wide and that incorporates the six key components of a formal lessons learned process. (Recommendation 7)

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## Agency Comments

We provided a draft of this report to EM for review and comment. In its comments, reproduced in appendix III, DOE concurred with all seven of our recommendations. We look forward to DOE implementing our recommendations and believe that action beyond that described by DOE may be required to implement some of the recommendations. Specifically, in response to our fourth recommendation that EM develop program-wide performance metrics that follow the key components of effective performance metrics, as applicable, DOE stated that it has already completed this recommendation and no further action is required to address it. DOE explained that EM performance measures are well established and already follow GAO attributes of successful performance measures. We disagree. As stated in our report, EM's performance metrics did not fully align with four of the key attributes of effective performance metrics—linkage, clarity, balance, and government-wide priorities. EM has opportunities to better demonstrate the outcomes of its investments by (1) linking its performance metrics to site activities, (2) identifying one clear set of performance metrics in all documents, (3) updating its performance metrics to capture its highest priorities, and (4) updating the performance metrics to include a cost component. These steps would provide a clearer and more complete picture of program performance.

DOE also provided technical comments, which we incorporated in our report, as appropriate. DOE stated in its comments that during its review, it identified some inaccuracies regarding its program management activities and communicated them with us. DOE stated that GAO committed to address the inaccuracies. We found that some of EM's technical comments conflicted with evidence we collected during our review, and EM was unable to provide adequate evidence to support those technical comments. In those cases where additional evidence was not provided, we did not make changes.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the

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report date. At that time, we will send copies of this report to the appropriate congressional committees, the Secretary of Energy, and other interested parties. In addition, the report is available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-3841 or [andersonn@gao.gov](mailto:andersonn@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made significant contributions to this report are listed in appendix IV.

A handwritten signature in black ink that reads "Nathan Anderson". The signature is written in a cursive style with a large, sweeping initial "N".

Nathan Anderson  
Director, Natural Resources and Environment

# Appendix I: Objectives, Scope, and Methodology

This report (1) describes how the Department of Energy’s (DOE) Office of Environmental Management (EM) has implemented its 2020 Program Management Protocol and (2) examines the extent to which EM has incorporated program management leading practices as it implements the protocol.

To address these objectives, we reviewed agency documents—including plans, life-cycle cost estimates, integrated master schedules, and guidance—from EM headquarters and cleanup sites. We also interviewed officials from EM headquarters and five cleanup sites: Carlsbad, Hanford, Idaho, Lawrence Livermore, and Oak Ridge. We selected these cleanup sites as a non-generalizable sample because EM considered them to be the most advanced in implementing the Protocol. We assessed EM’s implementation efforts against leading practices for program management—developed in our prior work and based on Project Management Institute’s (PMI) *Standard for Program Management—Fourth Edition*—and against additional GAO and PMI best practices and federal standards for internal controls.<sup>1</sup>

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## Describing EM’s Efforts to Implement Its Protocol

To describe how EM has implemented its Protocol, we reviewed documents from EM headquarters and cleanup sites related to Protocol implementation since its issuance in November 2020. For example, we reviewed EM’s Program Management Protocol Implementation Plan Outline; this plan outlines the objectives of the Protocol, Protocol implementation responsibilities, a two-phased implementation approach,

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<sup>1</sup>Project Management Institute, Inc., *The Standard for Program Management, Fourth Edition (2017)*; and GAO, *Nuclear Waste Cleanup: DOE Could Improve Program and Project Management by Better Classifying Work and Following Leading Practices*, [GAO-19-223](#) (Washington, D.C.: Feb. 19, 2019). In [GAO-19-223](#), we identified nine program management leading practices based on PMI standards related to a program’s management of scope, cost, schedule performance, and independent review of performance. In the course of that audit, we shared these selected leading practices with PMI representatives and incorporated their feedback, as appropriate. Federal standards for internal controls are found in GAO, *Standards for Internal Controls in the Federal Government*, [GAO-14-704G](#) (Washington, D.C.: Sep. 2014).

and the program's execution plan. We also reviewed EM's federal life-cycle cost estimate (FSLE) Review Framework guidance, which includes information on the dates for when each site will be in each phase of review. In addition, we reviewed EM's guidance to its cleanup sites regarding implementation of the Protocol. These documents included strategic plan guidance and guidance for small sites, which describes a graded approach to review FSLEs. Other EM guidance to sites provided direction about how to manage risk and allocate risk contingency properly in site estimates. In addition, we reviewed information about EM's Integrated Project Team (IPT), established by headquarters in 2022 to provide guidance to sites on how to implement the Protocol and review sites' documentation that is required for implementation.<sup>2</sup>

We held semi-structured interviews with officials from EM headquarters and our selected sites.<sup>3</sup> We interviewed EM officials at headquarters that were part of the IPT, whose primary responsibilities were to review sites' documentation submitted to EM headquarters for FSLE approval and make recommendations to EM leadership for FSLE approval. We also interviewed officials from EM's Office of Project Management, which is responsible for developing and updating the Protocol, such as the work it does on project management review. We interviewed EM officials from our five selected sites: Carlsbad, Hanford, Idaho, Lawrence Livermore, and Oak Ridge.<sup>4</sup> During these discussions, we asked officials for further details about the Protocol implementation, the implementation guidance and direction provided to sites by headquarters, potential challenges that arose during implementation, and sites' understanding of the Protocol's requirements.

We used two criteria to select a non-generalizable sample of sites for our review—level of implementation or readiness and largest life-cycle estimate. We relied upon EM's February 2022 analysis examining sites'

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<sup>2</sup>The IPT is made up of multidisciplinary personnel from across EM headquarters and is supported by staff from the EM Consolidated Business Center and contractors. Personnel participating in the IPT provide subject matter expertise specific to FSLE development, such as cost, scope, and schedule; metrics; and environmental liability and risk.

<sup>3</sup>Some officials were also technical support contractors working for the federal government at the sites or EM headquarters. We refer to both these contractors and federal employees as EM officials throughout this report.

<sup>4</sup>We originally selected a sixth site, Sandia National Laboratories, but removed it from our sample because of Sandia National Laboratories' small volume of work left to be completed. According to EM officials, Sandia National Laboratories may follow an abbreviated implementation path for the Protocol because of the small volume of work.

readiness for implementation of the Protocol.<sup>5</sup> EM's analysis assigned three sites the highest levels of implementation readiness—Oak Ridge, Lawrence Livermore, and Idaho—relative to other cleanup sites.<sup>6</sup> There was a five-way tie in implementation readiness status for the fourth site in our sample, requiring that we use a secondary criterion—the largest life-cycle cost estimate. Based on this criterion, we identified the Hanford cleanup site as the fourth site in our sample. In addition to the four sites selected, we identified the Carlsbad site as our fifth site because its Waste Isolation Pilot Plant serves as a national repository for transuranic waste for all cleanup sites and would provide an example of integration of cleanup efforts across the EM program. We conducted an in-person visit with the Oak Ridge site and virtual visits with the remaining sites.

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## Examining EM's Incorporation of Leading Practices

To examine the extent to which EM has incorporated program management leading practices as it implements the Protocol, we conducted semi-structured interviews with officials from EM headquarters and the five selected sites listed above. During these interviews, we asked questions related to each leading practice and requested additional documentation to assess how EM's processes and policies aligned with each leading practice. The documents we requested and reviewed from each site and EM headquarters include (1) strategic plans, (2) program plans, (3) life-cycle cost estimates, (4) integrated master schedules, (5) a list of the top 10 programmatic risks, (6) risk documentation, (7) documentation of performance data reporting and evaluation, (8) analyses of information on lessons learned for the sites, and (9) independent reviews of the sites or the EM program.

We reviewed EM's incorporation of the nine program management leading practices that we developed in our prior work.<sup>7</sup> The nine leading practices represent basic program management principles that, if followed, give agencies some assurance that the program runs in an efficient and integrated way. We developed these leading practices based

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<sup>5</sup>The Department of Energy's *Environmental Management Program Management Plan Implementation Status Report* released in 2022.

<sup>6</sup>The table in this status report showed that Oak Ridge, Sandia, Lawrence Livermore, and Idaho were furthest along. Sandia was scoped out as mentioned earlier based on discussions with EM officials because of its small size and volume of work remaining to be completed.

<sup>7</sup>[GAO-19-223](#).

on Project Management Institute's (PMI) Standard for Program Management—Fourth Edition, generally recognized as the top leading practices for program management. We determined that these nine program management practices were relevant for assessing program management at EM, and we focused our assessment on these practices. For this report, we slightly modified leading practices one, four, five, six, eight and nine, as described below. We also identified and applied additional relevant and applicable criteria from prior GAO reports, PMI, and federal standards for internal controls, where applicable. The specific additional criteria used are described in detailed tables throughout the report above. Applying these additional criteria allowed us to further analyze and enrich our analyses by focusing on the quality of EM program's documents and processes.

In addition, for this report, we organized the leading practices under three broad areas: program planning, program performance, and program oversight:

**Program planning**

1. Have a comprehensive program management plan, roadmap, and appropriate-level strategic plan that are updated regularly.
2. Have a comprehensive life-cycle cost estimate that is updated on a regular basis.
3. Have an integrated master schedule that is updated on a regular basis.

**Program performance**

4. Conduct program risk management throughout the life of the program.
5. Measure performance against program-level cost and schedule baselines.
6. Complete performance reporting and analysis in a way that provides a clear picture of program performance.
7. Monitor and control the program, including conducting root cause analyses, and developing corrective action plans.

**Program oversight**

8. Have a process to capture lessons learned.
9. Have an independent oversight body and conduct periodic independent reviews to measure the progress of the program in delivering its expected benefits.

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### Leading Practice One

Leading practice one states that a program should have a comprehensive program management plan, roadmap, and appropriate-level strategic plan that are updated regularly. We slightly modified this leading practice to add “strategic plan” to the list of documents because that was the initial intent of this leading practice to also include strategic plan as a key planning document for a program, but that we initially published in another report.<sup>8</sup> We also added “appropriate-level” for a strategic plan to show that, depending on the size of the program, some programs may not have their own strategic plan and the information in the organization’s strategic plan related to that program may be sufficient.

For this leading practice we also identified additional criteria that make a strategic plan, program management plan, and roadmap comprehensive.<sup>9</sup> Table 2 describes key components for a comprehensive strategic plan previously identified by GAO.<sup>10</sup> See table 3 for the components of a comprehensive program management plan. See table 4 for the components for a comprehensive roadmap.

To evaluate this aspect of leading practice one, we reviewed two types of documents, which together EM considers as being part of their strategic plans: (1) strategic visions, which according to EM officials, represent EM’s and sites’ internal strategic plans, and (2) program plans, which represent the publicly released strategic plans.

### Leading Practice Two

Leading practice two states that a program should have a comprehensive life-cycle cost estimate that is updated on a regular basis. We slightly modified this leading practice from our earlier work to remove the word “integrated.” Under GAO’s cost estimating characteristics, “comprehensive” is inclusive of integration.<sup>11</sup> We also removed the word

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<sup>8</sup>[GAO-19-28](#).

<sup>9</sup>*The Standard for Program Management*, Fourth Edition (2017).

<sup>10</sup>GAO, *Defense Logistics: A Completed Comprehensive Strategy is Needed to Guide DOD’s In-Transit Visibility Efforts*, [GAO-13-201](#) (Washington, D.C.: Feb. 28, 2013).

<sup>11</sup>GAO, *Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Program Costs*, [GAO-20-195G](#) (Washington, D.C.: Mar. 12, 2020).



“reliable” because we did not evaluate the life-cycle cost estimate against GAO’s cost estimating best practices to assess their reliability.<sup>12</sup>

### Leading Practice Three

Leading practice three states that a program should have an integrated master schedule that is updated on a regular basis. We slightly modified this leading practice from our earlier work to remove the word “reliable.” This was done because we did not evaluate the integrated master schedule against GAO’s schedule estimating best practices to assess their reliability.<sup>13</sup>

### Leading Practice Four

Leading practice four states that a program should conduct program risk management throughout the life of the program. We focused our review on how the EM program has implemented risk management processes and what it requires of its sites. According to PMI’s risk management standards, there are seven key processes that provide a structured way for programs to manage risk through the life of the program (see table 5 above).

### Leading Practice Five

Leading practice five states that a program should measure its performance against program-level cost and schedule baselines. We slightly modified this leading practice for conciseness by replacing life-cycle cost estimate baseline with cost baseline and integrated master schedule baseline with schedule baseline. Additionally, this best practice was updated for clarity by identifying that the cost and schedule baselines should be established at the program level. For this leading practice, we examined if the EM program and the sites we reviewed established cost and schedule baselines consistent with their life-cycle cost estimate and integrated master schedule. Additionally, we examined if management compared current program status against the established baselines to measure cost and schedule performance.

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<sup>12</sup>GAO’s cost estimating best practices are found in [GAO-20-195G](#).

<sup>13</sup>GAO’s schedule estimating best practices are found in GAO, *Schedule Assessment Guide: Best Practices for Project Schedules*, [GAO-16-89G](#) (Washington, D.C.: Dec. 22, 2015).

### Leading Practice Six

Leading practice six states that a program should complete performance reporting and analysis in a way that provides a clear picture of program performance. For this leading practice, we evaluated EM based on three elements: 1) having successful performance metrics, 2) conducting earned value management at the highest possible level, and 3) tracking and meeting original milestones. To evaluate EM's performance metrics, we used key attributes of effective performance measures that GAO previously identified, listed in table 7 above.<sup>14</sup>

To evaluate cost and schedule performance reporting, we examined earned value management documentation against elements of the EVM best practices defined in the GAO Cost Estimating and Assessment Guide that are necessary for leadership to manage the program and make informed decisions.<sup>15</sup>

To evaluate EM's tracking and meeting of original milestones, we asked EM officials from the sites and EM headquarters to send us a list from their database that shows the tracking and meeting of original milestones, and we evaluated this information.

### Leading Practice Seven

Leading practice seven states that a program should conduct monitoring and controlling activities for a program, including conducting root cause analyses and developing corrective action plans. For this leading practice we identified additional criteria from PMI specifying that data reporting processes should be standardized.<sup>16</sup>

### Leading Practice Eight

Leading practice eight states that a program should have a process to capture lessons learned. We evaluated EM against the six key practices that programs should use to identify and apply lessons learned previously

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<sup>14</sup>GAO, *Tax Administration: IRS Needs to Further Refine Its Tax Filing Season Performance Measures*, [GAO-03-143](#) (Washington, D.C.: Nov. 22, 2002).

<sup>15</sup>[GAO-20-195G](#).

<sup>16</sup>*The Standard for Program Management*, Fourth Edition (2017).

identified by GAO, which are listed in table 8 above.<sup>17</sup> We slightly modified this practice from earlier work to focus on the lessons learned process; we revised the language of the practice itself by removing “database”, since a database is included in the six key components of a lessons learned process.

### Leading Practice Nine

Leading practice nine states that a program should have an independent oversight body and conduct periodic independent reviews to measure the progress of the program in delivering its expected benefits. For this leading practice, we identified two areas against which to evaluate EM: (1) having an independent oversight body that reviews the EM program or sites;<sup>18</sup> and (2) conducting independent reviews for various program management leading practices, such as reviews of cost and schedule estimates, strategic plans, and lessons learned process. The leading practice originally focused solely on whether a program has an independent oversight body. For this report, as described above, we expanded this leading practice to include regular independent reviews of the program or subprograms and independent reviews related to the nine program management leading practices for program development.

We also used federal standards for internal controls to evaluate the use of oversight bodies by the EM Program and its sites.<sup>19</sup> These state that an oversight body oversees the entity’s operations; provides constructive criticism to management; and where appropriate, makes oversight decisions so that the entity achieves its objectives. The federal standards also state that when selecting members for an oversight body, the entity or applicable body defines the entity knowledge, relevant expertise, number of members, and possible independence needed to fulfill the oversight responsibilities for the entity.<sup>20</sup> To better understand the benefits and drawbacks of any potential additional oversight at EM and to see if

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<sup>17</sup>GAO, *Telecommunications: GSA Needs to Share and Prioritize Lessons Learned to Avoid Future Transition Delays*, [GAO-14-63](#) (Washington, D.C.: Dec. 5, 2013).

<sup>18</sup>We define an independent oversight body as a body within the department that is outside the program’s chain of command and that conducts regular reviews of the program. It is not intended to include groups like us, the Inspector General, the National Academies of Sciences, or any other groups that might conduct occasional reviews of the program or specific areas of a program.

<sup>19</sup>[GAO-14-704G](#).

<sup>20</sup>[GAO-14-704G](#).

DOE already conducts any reviews of the EM or other programs, we also interviewed officials from two independent DOE-wide oversight bodies—the Office of Project Management and the Office of Enterprise Assessment.<sup>21</sup>

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## Evaluating EM Sites' Incorporation of Leading Practices

To determine the status of Protocol implementation at EM sites, and how EM has incorporated program management leading practices at the sites, we reviewed documents and interviewed EM officials from our five selected sites. We determined that Oak Ridge was the only site that had enough information to score. The documents from the other four selected sites were either too early in draft form or did not exist, preventing us from assigning a score for the extent to which those sites' program management aligned with our nine leading practices. The full details of our methodology for our analysis can be found in Appendix II below.

We conducted this performance audit from April 2022 to June 2024, 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.

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<sup>21</sup>DOE's Office of Project Management is an independent oversight body within DOE that reviews capital asset projects. DOE's Office of Enterprise Assessment is an independent oversight body within DOE that assesses whether national security material and information assets are appropriately protected.

## Appendix II: Scored Assessment of Oak Ridge's Incorporation of Program Management Leading Practices

We scored the Department of Energy's (DOE) Office of Environmental Management's (EM) incorporation of program management leading practices when implementing the 2020 Program Management Protocol at the Oak Ridge site. The nine leading practices relate to scope, cost, schedule, independent review of performance, and encompass basic principles of program management.

We reviewed and scored the Oak Ridge site's implementation of the Protocol for each of the nine leading practices individually. The five categories are:

- **Fully met:** we found complete evidence that satisfied the leading practice;
- **Substantially met:** we found evidence that satisfied a large portion of the leading practice;
- **Partially met:** we found evidence that satisfied about half of the leading practice;
- **Minimally met:** we found evidence that satisfied a small portion of the leading practice; and
- **Did not meet:** we found no evidence that satisfied the leading practice.

If the score for the leading practice was "fully met" or "substantially met," we concluded that the site followed the leading practice. In contrast, if the score was "partially met," "minimally met," or "not met," we concluded that the site did not follow the leading practice.

To score EM's incorporation of program management leading practices when implementing the Protocol at Oak Ridge, two analysts independently examined Oak Ridge's EM's implementation of the Protocol, and each provided a score for each leading practice using the

**Appendix II: Scored Assessment of Oak Ridge's Incorporation of Program Management Leading Practices**

scoring mechanism above. These determinations were then reviewed by two other independent analysts from outside the engagement team with expertise on program management leading practices to verify that the initial analysis came to an appropriate conclusion in their initial review.

We shared our initial draft assessment with Oak Ridge and EM headquarters officials. Oak Ridge officials provided additional written responses and documentation to clarify their original answers. Where warranted, we updated our analyses and provided a final score based on evaluating the additional information.

We found that the Oak Ridge site substantially met three program management leading practices, partially met five leading practices, and minimally met two leading practices (see table 9). See Appendix I for information about how we selected the Oak Ridge site for this evaluation and our methodology for assessing the site's progress.

**Table 9: Assessment of Oak Ridge Incorporation of Program Management Leading Practices**

Leading practice	Assessment
1. Have a comprehensive program management plan, roadmap, and appropriate-level strategic plan that are updated regularly	<p><b>Partially Met.</b> Oak Ridge provided a strategic plan and roadmap but not a program management plan. The strategic plan included most of the components of a comprehensive strategic plan, but some components were missing. For example, the strategic plan did not include performance measures for Oak Ridge that gauge results, but provided activities to accomplish. The strategic plan also does not include the process used to address the scope of the problem, types of resources and investments required to meet the goals and objectives, and a description of roles and responsibilities for managing and overseeing the implementation of the strategy outside of contract work.</p> <p>Oak Ridge's roadmap is a 10-year chronological pictorial representation of the intended direction of the site. However, the roadmap does not depict dependencies between major milestones and decision points of the site; reflect the linkage between the business strategy and program work; or include component details, their durations, or contributions and benefits.</p>
2. Have a comprehensive life-cycle cost estimate that is updated on a regular basis	<p><b>Substantially Met.</b> The Federal Site Life-Cycle Estimate (FSLE) contains the contracted scope along with future planned efforts. Additionally, the contingency was calculated at the 50 percent and 80 percent confidence levels required by the Protocol.<sup>a</sup> Assumptions were documented, and the FSLE had a work breakdown structure where work was broken down into six hierarchical levels (down to level 6).<sup>b</sup> FSLE assumptions were documented and inflation was accounted for, though the inflation source was unclear.</p>
3. Have an integrated master schedule that is updated on a regular basis	<p><b>Partially Met.</b> The site's schedule is the baseline schedule with an earliest date of October 1996 and has not been updated to show progress. Site officials explained that the schedule is detailed for the first 10 years and that less detail is required in subsequent years. There are 13,828 activities, none of which have any progress, and it is unclear that all activities are included. The schedule also has logic anomalies, such as instances of missing predecessor/successor activities, date constraints, and dangling starts/finishes. Also, almost 40 percent of activities have float greater than 44 days, and about 65 percent of the activities in the schedule also do not have resources assigned to them.</p>

**Appendix II: Scored Assessment of Oak Ridge's Incorporation of Program Management Leading Practices**

Leading practice	Assessment
4. Conduct program risk management throughout the life of the program	<b>Substantially Met.</b> Oak Ridge manages risk primarily through its individual projects. The site has a risk register, but risks are separated by each project. The site does not have a risk register where site-level risks are captured. However, the site does track risks by site component—Y-12, Oak Ridge National Laboratory, and East Tennessee Technological Park—and they identify the top 10 programmatic risks at the site. Oak Ridge officials said they could identify site-level risks if they analyzed the project-level risk information, but they could not do this without such analysis.
5. Measure performance against both a program's life-cycle cost and integrated master schedule baselines	<b>Substantially Met.</b> Oak Ridge measured cost and schedule milestones against their recently developed FSLE. Documentation of the schedule comparison showed schedule tasks compared against the established baseline. The document showed that the baseline uses updated estimates for most elements. It also showed that Long Term Stewardship costs were submitted, but the stewardship costs were not used because a more thorough evaluation of the impact of legacy management needed to be evaluated. <sup>c</sup>
6. Complete performance reporting and analysis in a way that provides a clear picture of program performance	<b>Partially Met.</b> Regarding the use of an earned value management (EVM) system, Oak Ridge measures cost and schedule performance using monthly EVM reporting from the contractor that is reviewed by support contractors. Oak Ridge officials provided documentation that the EVM system is certified. Also, we have previously found that Oak Ridge contracts that required EVM systems were compliant and had a certified system. <sup>d</sup> However, we identified several unexplained anomalies in the site's documentation, which calls into question the accuracy of the data. Additionally, we found that the estimate at completion was optimistic compared to our calculations, though it was not significantly outside the bounds we calculated.  In regards to performance metrics, we found issues for Oak Ridge's performance metrics related to many of the nine key attributes of successful performance measures, including linkage, clarity, having a measurable target, or objectivity. <sup>e</sup> For example, Oak Ridge's goals, objectives, and performance measures for the site are linked to each other, but there is no direct link between Oak Ridge's and EM's program goals, objectives, and performance measures. Additionally, Oak Ridge's performance metrics are met/not met end states and do not have numerical goals, making it difficult to track progress of performance.  Finally, regarding milestones, information about the original milestone and explanation of why milestones changed over time were not clearly entered in the documents Oak Ridge provided to us. However, this is an EM-wide issue, not necessarily a site issue.
7. Monitor and control the program, including conducting root cause analyses and developing corrective action plans	<b>Partially Met.</b> Oak Ridge conducts quarterly briefings where the portfolio directors discuss performance with the Oak Ridge site manager. The site also conducts weekly commitment reports and uses management assessments to provide updates on the status of issues raised in bi-weekly discussions. The site utilizes EVM analyses and reports and examines the data for over and underruns of performance measures. Monthly reports to EM leadership include EVM system summaries by mission area. However, information in these periodic meetings and reports is provided at the project level rather than being integrated at the site level.  Oak Ridge officials explained the site does not conduct its change control process at the site level, but focuses this process at the lower level where the work is done. Oak Ridge has guidance documents outlining the entirety of the change control process for projects, and the responsibilities of the contractors and federal officials who play a role in the process. However, there is no documentation formally outlining such a process at the site level.  Oak Ridge officials said that they have not conducted a site-wide root cause analysis because they that must first focus on developing an FSLE baseline. Once the FSLE baseline is established, they said they will conduct a root cause analysis, if needed, based on Protocol requirements. <sup>f</sup>

**Appendix II: Scored Assessment of Oak Ridge's Incorporation of Program Management Leading Practices**

Leading practice	Assessment
8. Have a process to capture lessons learned	<b>Minimally Met.</b> Oak Ridge officials said they were not aware of a formal lessons learned process at the site that would allow the site to identify and apply lessons learned to improve processes and procedures at the site. Oak Ridge officials provided documentation describing their lessons learned process at the project level for capital asset projects, as required under DOE Order 413.3B. However, this documentation did not provide an explanation of how the project-level lessons learned are used to improve processes and procedures for other projects or the site.
9. Have an independent oversight body and conduct periodic independent reviews to measure the progress of the program in delivering its expected benefits	<b>Minimally Met.</b> Oak Ridge officials said there is no overall independent oversight body that is external to the EM chain of command to review the site or components of the site—Y-12, Oak Ridge National Laboratory or East Tennessee Technology Park. Officials said that independent reviews of the FSLE will be conducted by EM headquarters, in line with the Protocol. However, these reviews will not focus on the site's incorporation of the nine program management leading practices within its processes.

Source: GAO analysis of information from the Department of Energy's Office of Environmental Management. | GAO-24-105975

<sup>a</sup>Under the terms of DOE Order 413.3B, contingency is the portion of the budget that is available for risk uncertainty. It is controlled by the federal personnel outside of a contract. According to EM's Program Management Protocol, EM fully funds contingency for capital asset projects under Order 413.3B. However, for operations activities, EM does not request funding for cost contingency due to competing budget priorities. Instead, it typically manages risk by making changes to the scope of work or schedule. Confidence levels are the likelihood—expressed as a percentage—that an occurrence will be realized. The higher the confidence level, the higher the probability of success. The Protocol requires that cost and schedule ranges are based on 50 percent and 80 percent confidence levels.

<sup>b</sup>A work breakdown structure defines in detail the work necessary to accomplish a program or project's objectives. A work breakdown structure deconstructs the program or project's end product in successive levels with smaller specific elements until the work is subdivided to a level suitable for management control. It facilitates establishing an EVM baseline.

<sup>c</sup>The FSLE must contain all costs from the beginning to the end of the work at the site. EM transfers sites to DOE's Office of Legacy Management for long-term stewardship once cleanup is complete. DOE's Office of Legacy Management is responsible for the post-cleanup stewardship of former EM sites.

<sup>d</sup>GAO, Nuclear Waste Cleanup: DOE Could Improve Program and Project Management by Better Classifying Work and Following Leading Practices, [GAO-19-223](#) (Washington, D.C.: Feb. 19, 2019).

<sup>e</sup>The nine key attributes of successful performance measures are: linkage, clarity, measurable target, objectivity, reliability, core program activities, limited overlap, balance and governmentwide priorities. More information can be found in Appendix I. GAO, Tax Administration: IRS Needs to Further Refine Its Tax Filing Season Performance Measures, [GAO-03-143](#) (Washington, D.C.: Nov. 22, 2002).

<sup>f</sup>According to the Protocol, a root cause analysis is a structured facilitated process used by EM to identify root causes of an event(s) that resulted in an undesired cost and schedule performance. The root cause analysis process provides EM with a way to identify and address the underlying causes of cost overruns, schedule delays, missed or postponed milestones, and performance shortcomings and it describes how to prevent future events from occurring. EM uses root cause analyses to find out what happened, why it happened, and determine what changes need to be made. EM leadership approval is required if the FSLE increase is 10 percent (cumulative) or greater of the original FSLE—or a cumulative increase of \$100 million or more for sites with FSLE of \$1 billion or more—or increases 6 months (cumulative) or more beyond the original end date.



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## Appendix III: Comments from the Department of Energy

**Appendix III: Comments from the Department  
of Energy**



**Department of Energy**

Washington, DC 20585

May 24, 2024

Mr. Nathan Anderson  
Director  
Natural Resources and Environment  
U.S. Government Accountability Office  
Washington, DC 20548

Dear Mr. Anderson,

This letter provides the Department of Energy (DOE) Office of Environmental Management's (EM) response to the Government Accountability Office's (GAO) Draft Report titled, *GAO-24-105975, NUCLEAR WASTE CLEANUP: Closer Alignment with Leading Practices Needed to Improve Department of Energy Program Management*.

EM's mission represents the government's strong commitment to cleaning up the environmental legacy of the national defense programs that helped end World War II and the Cold War. EM remains committed to improving program management across the EM complex. Significant progress has been achieved by the EM program, from managing one of the largest groundwater and soil remediation efforts in the world, to opening and operating the only deep geological repository for transuranic waste, as well as constructing first-of-a-kind systems to treat tank waste at three EM sites. These accomplishments reflect EM's strong focus on risk reduction and safely completing the mission.

To continue our enhanced focus on program management, EM published the EM Program Management Protocol and has been actively implementing the protocol across the EM sites. The protocol establishes requirements and further clarifies expectations for planning, budgeting, execution, and evaluation of all work across the EM complex. Implementation of the Program Management Protocol is ongoing. And as is common when new requirements are implemented, EM Headquarters is working with the field sites to ensure they are properly and consistently implementing the protocol throughout the program.

The Department appreciates the opportunity to review the draft report and GAO's recognition of EM's program management improvements. During our review we identified some inaccuracies regarding our program management activities and have communicated them with GAO. GAO committed to address the inaccuracies; however, an updated version of the narrative was not shared with the Department prior to publication. EM has implemented and continues to implement actions that are responsive to the recommendations in GAO's report. As such, DOE concurs with the seven recommendations in the report. EM's response to the recommendations is provided in the enclosure.

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**Appendix III: Comments from the Department  
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If you have any questions, please contact me or Mr. Dae Y. Chung, Associate Principal  
Deputy Assistant Secretary for Corporate Services, at (202) 586-9636.

Sincerely,



William I. White  
Senior Advisor for Environmental Management

Enclosure

Enclosure

**Management Response to Recommendations**  
**GAO-24-105975**

**GAO Draft Report, *NUCLEAR WASTE CLEANUP: Closer Alignment with Leading Practices Needed to Improve Department of Energy Program Management***

**Recommendation 1:** The Senior Advisor for the Office of Environmental Management should ensure EM strategic plans, roadmaps, and program management plans follow best practices for being comprehensive for the entire EM program and, as applicable, for each site.

**Management Response:** Concur.

The Office of Environmental Management (EM) will develop an implementation guidance document to clarify program management requirements at a level lower than the protocol. The guidance document will include the areas identified as requiring greater clarification during the Federal Site Life-Cycle Estimate (FSLE) reviews and those recommended by GAO.

**Estimated Completion Date:** June 30, 2025.

**Recommendation 2:** The Senior Advisor for the Office of Environmental Management should ensure the EM program's integrated master schedule (1) is comprehensive, (2) includes site-level and program-wide interdependencies, and (3) is based on realistic assumptions.

**Management Response:** Concur.

Each EM site develops an integrated master schedule in the site's FSLE based on overarching EM program priorities, site-specific considerations, and realistic assumptions. These site-specific schedules will inform the development of an EM program-level integrated master schedule at an appropriate level of detail to identify inter-site dependencies, such as disposal of waste at the Waste Isolation Pilot Plant. The EM program-wide schedule will not include interdependencies from the site-specific schedules that exist at and are maintained solely at the site level (unless there is good reason to maintain its visibility at the program-wide schedule level).

**Estimated Completion Date:** June 30, 2025.

**Recommendation 3:** The Senior Advisor for the Office of Environmental Management should ensure that, as EM implements its risk management policy, EM follows the seven key processes for a risk management framework.

**Management Response:** Concur.

EM will ensure the sites address the seven key processes for risk management, as appropriate, as EM implements its risk management policy. Risk management is part of the FSLE review and approval process as evidenced in the recently published, *Office of Environmental Management Program Sites Risk Management Guidance* (August 2023).

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**Appendix III: Comments from the Department  
of Energy**

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**Estimated Completion Date:** June 30, 2025.

**Recommendation 4:** The Senior Advisor for the Office of Environmental Management should ensure EM develops program-wide performance metrics that follow the key components of effective performance metrics, as applicable, such as by developing performance metrics that measure the cost per unit of radioactivity treated.

**Management Response:** Concur.

EM performance measures are well established and already follow GAO attributes of successful performance measures. Furthermore, EM site-level performance metrics already feed into the EM program-level performance metrics. As described in the EM Program Management Protocol, EM Corporate Performance Metrics, along with performance measures required by the contractor(s) to implement the contractor's management system, are incorporated into the baseline. The metrics used by EM measure the activities that EM finds applicable to managing the EM cleanup program. Therefore, no further action is required to address this recommendation.

**Estimated Completion Date:** Complete.

**Recommendation 5:** The Senior Advisor for the Office of Environmental Management should ensure that monitoring and change control processes are standardized to facilitate integration and reporting of data EM-wide.

**Management Response:** Concur.

EM's monitoring and change control processes are already standardized and described in a number of EM documents, including the EM Program Management Protocol, EM-HQ Life-Cycle Change Control Process (Standing Operating Policies and Procedure 74 (SOPP 74)), and other documents. SOPP 74 is currently being updated.

**Estimated Completion Date:** December 30, 2024.

**Recommendation 6:** The Senior Advisor for the Office of Environmental Management should ensure that, when a site FSLE exceeds a change control threshold that requires EM-1 approval and a root causes analysis under the Protocol, (1) the site's root cause analyses be accompanied by a corrective action plan and that corrective actions are tracked through completion, (2) an independent review occurs that includes an assessment and validation of the extent to which the corrective actions resolve the root causes, and (3) EM report on the program impacts of independent reviews and outcomes of corrective actions, such as through EM's program plan updates.

**Management Response:** Concur.

EM will ensure that, when a change to an FSLE exceeds that change control threshold requiring EM-1 approval, corrective action plans accompany root cause analyses and that corrective

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**Appendix III: Comments from the Department  
of Energy**

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3

actions are tracked through completion. Further, EM will ensure that an internal independent review occurs to ensure that corrective actions resolve the issues identified in the root cause analyses. Consistent with GAO's recommendation, EM will begin reporting significant changes to the EM program life cycle in the EM Program Plan.

**Estimated Completion Date:** September 30, 2025

**Recommendation 7:** The Senior Advisor for the Office of Environmental Management should ensure EM establishes a formal lessons learned process related to areas of program management that is applied EM-wide and that incorporates the six key components of a formal lessons learned process.

**Management Response:** Concur.

EM is already identifying and applying lessons learned from implementation of the EM Program Management Protocol. EM will work to establish a formal lesson learned process for program management that incorporates the six key components of a formal lessons learned process. This will be documented through additional or revised guidance.

**Estimated Completion Date:** June 30, 2025.

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## Appendix IV: GAO Contact and Staff Acknowledgments

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### GAO Contact

Nathan Anderson, (202) 512-3841 or [andersonn@gao.gov](mailto:andersonn@gao.gov)

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### Staff Acknowledgments

In addition to the contact named above, Wyatt R. Hundrup (Assistant Director), Cristian Ion (Analyst in Charge), Justin Cubilo, Christina Cuthbertson, Jennifer Echard, Gwen Kirby, Elizabeth Escobar Michalewicz, and Benjamin Wilder made key contributions to this report. Also contributing to this report were Wil Gerard, Cindy Gilbert, Suzanne Kaasa, Jennie Leotta, and Sara Sullivan.



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