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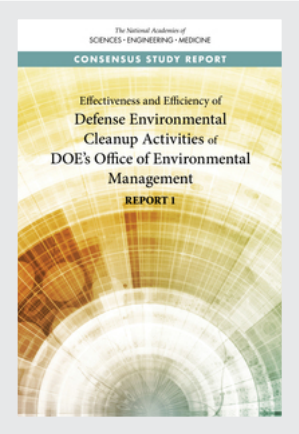

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Effectiveness and Efficiency of Defense Environmental Cleanup Activities of DOE's Office of Environmental Management

REPORT 1

Committee on Review of Effectiveness and Efficiency of
Defense Environmental Cleanup Activities of the
Department of Energy's Office of Environmental Management

Board on Infrastructure and the Constructed Environment
Division on Engineering and Physical Sciences

Nuclear and Radiation Studies Board
Division on Earth and Life Studies

A Consensus Study Report of
The National Academies of
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Preface

The U.S. Department of Energy's (DOE's) Office of Environmental Management (EM) is currently responsible for 17 sites in the continental United States. These sites evolved from years of defense nuclear activities and from civilian and defense nuclear fuel cycle activities. All of them entail some form of soil and groundwater cleanup or treatment; building demolition and disposal (often onsite); or waste processing and immobilization—collectively "cleanups." Some of these sites no longer support DOE missions while others lie situated on portions of larger reservations that continue mission activities to this day.

Starting in 1989, DOE elevated and consolidated the responsibility for the cleanups within the department and created an assistant secretary with line management responsibility. The new organization assumed responsibility for the onsite contractors who have cleaned up sites of varying size and complexity. By 2020 the number of sites the contractors were cleaning up had been reduced to 16 sites plus a 17th, a disposal site, representing a 90 percent reduction in land area.

The contracting model EM utilizes has evolved since 1989. Initially, management and operating (M&O) contracts were the norm, in which one contractor was responsible for activities at the site. Later DOE used cost-type contracts that had more specific work scope and performance-based awards and fees. By the mid-1990s, DOE began implementing so-called closure contracts, having designated certain facilities for accelerated closure.

The work of the Committee on Review of Effectiveness and Efficiency of Defense Environmental Cleanup Activities of the Department of Energy's Office of Environmental Management stems from a request in the National Defense Authorization Act for 2019 (NDAA) to issue a report focused on the "effectiveness and efficiency" of the defense environmental cleanups in EM. The

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committee engaged with the various elements of the department that oversee and execute large projects. Through public meetings and written queries, the committee gathered information to answer its congressional charge from the NDAA. Many of the committee's queries led to informative responses, while others continue to be the subject of inquiry. The committee has been the beneficiary of prior and ongoing reviews of this subject, including those initiated by the department and by Congress (and carried out by the U.S. Government Accountability Office [GAO], the National Academies of Sciences, Engineering, and Medicine, and others).

This first phase of the study provides DOE with recommendations on the execution of projects and the application and adequacy of its controls, oversight and directives. It also addresses how EM realizes projects through contracts. The report discusses how DOE can apply metrics to track project value and performance and on how contract performance can be measured. The second phase will address how EM manages and measures progress on cleanups both at the site level and the program level such as those that cut across more than one site (e.g., for Portsmouth and Paducah). The committee will also look at how these pieces are rolled-up into an EM-wide portfolio. The second phase will also consider how the policies and directives described by EM headquarters during the work on this first report are realized in projects at the sites. It will also consider further issues that obtain when considering the larger suite of EM activities, such as the cleanup and disposal liabilities ascribed to EM's (currently 17) sites.

The committee wishes to thank the numerous individuals who briefed the committee and were responsive to information requests. The committee is particularly indebted to the staff of EM, including Rodney Lehman, Catherine Bohan, Norb Doyle, Paul Bosco, Dae Chung, and Beth Moore. The GAO was a great help, including Amanda Kolling and David Trimble who presented their own work on the subject and offered numerous insights accumulated from their extensive experience. The Congressional Budget Office assisted with budget information. Lastly, we were privileged to take part in a lengthy discussion of the report's origin with Jonathan Epstein of the staff of the Senate Armed Services Committee.

It was with great sadness that the committee learned of the death of one of its members, Kirk Smith, on June 15, 2020. During his career, Kirk studied and clarified the risk to human health of various uses of energy to provide services from electricity generation to simpler uses such as indoor cooking. The latter led him to widespread advocacy as he established for the first time the contribution of indoor cooking using firewood in developing countries to the global burden of disease. He also used his abilities to volunteer on community groups concerned with the disposition of formerly-used nuclear sites. The latter piqued his interest in the broader issue of nuclear waste cleanup, and he joined our committee with enthusiasm. A winner of the Tyler Prize for Environmental Achievement, Kirk's

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manner nonetheless concealed the towering figure he was, and his unassuming contributions to the committee's work improved the rigor of the study and expanded it to consider the ultimate goal of the cleanups in reducing risk to human health. We are saddened that Kirk will not be with us for the second phase of study.

Katharine G. Frase and Joseph S. Hezir, *Co-Chairs*
Committee on Review of Effectiveness and
Efficiency of Defense Environmental
Cleanup Activities of the Department of Energy's
Office of Environmental Management

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Acknowledgment of Reviewers

This Consensus Study Report was reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise. The purpose of this independent review is to provide candid and critical comments that will assist the National Academies of Sciences, Engineering, and Medicine in making each published report as sound as possible and to ensure that it meets the institutional standards for quality, objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process.

We thank the following individuals for their review of this report:

Gena E. Cadieux, Harris, Wiltshire & Grannis, LLP,
Sanjiv Gokhale, Vanderbilt University,
Carl F. Kohrt, Battelle Memorial Institute (retired),
Keith Molenaar, University of Colorado, Boulder,
Deborah Nightingale, NAE,[1] University of Central Florida,
Howard A. Stone, NAS[2]/NAE, Princeton University, and
Cynthia A. Vallina, The Vallina Group, LLC.

Although the reviewers listed above provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations of this report nor did they see the final draft before its release. The review of this report was overseen by RADM David Nash, NAE, Dave Nash & Associates

[1] Member, National Academy of Engineering.
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International, LLC, and by Lt. Gen. Henry Hatch, NAE, U.S. Army (retired). They were responsible for making certain that an independent examination of this report was carried out in accordance with the standards of the National Academies and that all review comments were carefully considered. Responsibility for the final content rests entirely with the authoring committee and the National Academies.

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APPENDIXES

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Summary

The Department of Energy (DOE) and its predecessor agencies have conducted activities to develop atomic energy for civilian and defense purposes since the initiation of the World War II Manhattan Project in 1942. These activities took place both at large federal land reservations of hundreds of square miles involving industrial-scale operations and at many smaller federal and nonfederal sites, such as uranium mines and materials processing and manufacturing facilities. At its peak, this nuclear complex encompassed 134 distinct sites in 31 states and one territory, with a total area of more than 2 million acres. The nuclear weapons and energy production activities at these facilities produced large quantities of radioactive and hazardous wastes and resulted in widespread groundwater and soil contamination at these sites.

DOE initiated a concerted effort to clean up these sites beginning in the 1980s. Many of these sites have been remediated and are in long-term caretaker status, closed, or repurposed for other uses. There are currently 17 sites undergoing major cleanup and disposal activities. These activities are managed by the DOE Office of Environmental Management (EM), which, in fiscal year 2020, had budget authority of over $7 billion for cleanups and site services that are performed by contractors.

The present study is responsive to a request in the National Defense Authorization Act for Fiscal Year 2019 (P.L. 115-232) to conduct a review of the effectiveness and efficiency of the management of the various EM projects. Congress asked the National Academies of Sciences, Engineering, and Medicine to consider the following: (1) project management practices, (2) project outcomes, and (3) the appropriateness of the level of engagement and oversight by the DOE-EM organization. The committee entered into an agreement with EM that

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divided the study into two phases, with the first phase focusing on the execution of projects, the appropriateness and effectiveness of the controls and oversight applied to these projects, and the effectiveness with which these projects are realized through contracts.[1]

This summary provides background information on the sites currently assigned to EM undergoing cleanup; discusses current practices for management and oversight of the cleanups; offers findings and recommendations on such practices and how progress is measured against them; and considers the contracts under which the cleanups proceed and how these have been and can be structured to include incentives for improved cost and schedule performance.

The 17 sites currently in the EM portfolio include 16 contaminated from civilian nuclear fuel cycle, naval propulsion, or nuclear weapons development activities: see Figure S.1. The 17th site, in Carlsbad, New Mexico, carries out disposal operations. Eleven of these sites are colocated with currently operating DOE facilities; the other six are inactive other than for cleanup activities.

The EM contracting model has evolved over time to meet changing requirements. Initially, management and operating (M&O) contracts prevailed, embodying a unique relationship between the government and contractor where the contractor was expected to apply its management expertise to implement the full suite of activities at a particular site within a general work scope established by the government. These were cost-type contracts with fees paid either on a fixed fee schedule or incentive basis. Later, EM used cost-type contracts that had more specific work scope and performance-based awards and fees.[2] In 2000 DOE implemented two "closure contracts" at the Rocky Flats Plant in Colorado and the Fernald site in Ohio directed toward a defined end state with large monetary incentives for the contractor to achieve that end state in the most efficient and expeditious manner.

During the study, DOE explained that in the future large contracts will be implemented under a new end-state contracting model (ESCM). The end state is defined as the specified situation, including accomplishment of completion criteria, for an environmental cleanup activity at the end of the task order period of performance. This end-state concept will be implemented using single-award contracts of a certain type—indefinite delivery/indefinite quantity (IDIQ)—with a 10-year draw period during which task orders with very specific work scope and 5 years' duration may be issued as either firm fixed price or cost reimbursable. Three IDIQs have been awarded to date, two at the Hanford site and one at

[1] The second phase will address how EM manages and measures progress on cleanups both at the site level and those of programs that cut across more than one site (e.g., for Portsmouth and Paducah), and how these pieces are rolled-up into an EM-wide portfolio. The second phase will also consider how the policies and directives described by EM headquarters during the work on this first report are realized in projects at the sites. It will further consider relevant issues when considering the larger suite of EM activities, such as the cleanup and disposal liabilities ascribed to EM's (currently 17) sites.

[2] Norbert Doyle, Deputy Assistant Secretary, Office of Acquisition & Project Management (EM-5.2), "Contract Overview," presentation to the committee, February 24, 2020, Washington, D.C.

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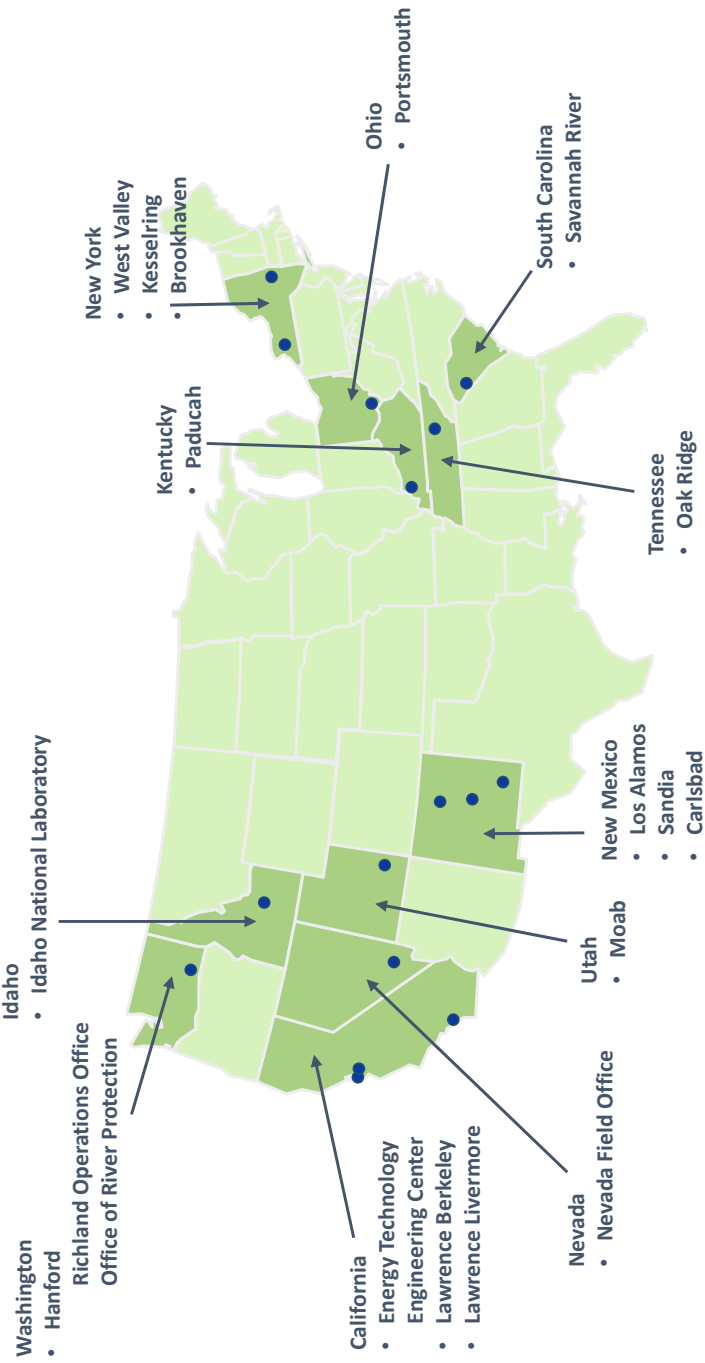

FIGURE S.1 Sites in Office of Environmental Management inventory as of 2020.
SOURCE: Adapted from Todd Shrader, Principal Deputy Assistant Secretary (EM-2), Office of Environmental Management, Department of Energy, "EM Program History and Overview," presentation to the committee, February 24, 2020, Washington, D.C.

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the Nevada National Security Site; a fourth ESCM IDIQ procurement process is under way at the Savannah River site.

The EM project management and control systems also have evolved. Concerns regarding the effectiveness and efficiency of project management, not only within EM but also department-wide, prompted a series of studies and actions beginning in the 1990s. These include several prior studies by the National Academies; a series of investigations and reports by the Government Accountability Office (GAO); as well as internal DOE-initiated and -led reviews. These activities have led to the establishment and updating of department-wide program and project management guidelines, currently codified in DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets: Change 5*. The order sets out procedures for project development and management, with the attendant controls and oversight, including review by the Energy Systems Acquisition Advisory Board (ESAAB); a hierarchy of project approval authority based on size of project; and on-going tracking of project performance via management information systems owned by a separate Office of Project Management (PM) within DOE. EM applies Order 413.3B to certain line-item construction projects, which, as of February 2020, numbered 14 projects and with an estimated $21.6 billion total project cost (TPC) in obligations (taking into account funding across multiple years) and comprised roughly one-quarter of EM's annual (1-year) budget authority.

The EM program has made substantial progress over the past several decades, primarily evidenced by the fact that it has reduced the footprint of contaminated sites from 134 to 17. EM also has been responsive to the various external and DOE internal management reviews by adopting a number of management improvements over time. EM, however, is currently at an inflection point, an appropriate time for further review and recalibration. Completion of cleanup activities at the remaining 17 sites will take many decades (and 11 of the EM sites are colocated with operating DOE facilities that will not be closing in the foreseeable future), and so project completions and site closures will no longer suffice as the principal program performance metric. Moreover, estimates of financial liability for cleanup of the remaining sites has outpaced the rate of expenditure for cleanup, with total cleanup liabilities currently estimated at over $400 billion, about 60 times the current annual EM budget. While EM has adopted many management reforms in recent years, challenges remain, with further opportunities to improve the effectiveness and efficiency of program performance. It is in this spirit that the committee has taken on this task.

The committee met several times to hear testimony from the principals involved in the above-described efforts, supplemented this information with written queries to EM, and deliberated on its own. During public meetings, the committee heard presentations chiefly from EM but also from other elements of the department that oversee or execute large projects. The committee made roughly 60 written queries of DOE to gather further information. The committee read and considered prior and ongoing reviews of project management at DOE including those conducted by the

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department, the GAO—who also briefed the committee during the public meetings—and the National Academies.

The committee's findings and recommendations are included below along with the context for each as given in the chapters. All the recommendations appear in this summary. The committee observes that these recommendations will have more impact if implemented in a coordinated fashion rather than piecemeal, and we urge EM to strive for that coordination.

PROJECT MANAGEMENT

The committee assessment of EM project management proceeded on two tracks: assessing the extent to which Order 413.3B represents best practice for project management and assessing how EM applied Order 413.3B to its portfolio of projects. The committee compared the requirements and procedures of Order 413.3B with other leading international protocols for project management, including the Project Management Institute best practices, the Construction Industry Institute best practices, and the UK Government Functional Standard GovS 002. The committee found that DOE Order 413.3B generally compared favorably with these other benchmarks but did identify several areas where the order could be further enhanced.

For example, DOE interprets Order 413.3B such that it "applies ONLY to construction projects, major items of equipment (MIEs) and (currently) environmental cleanup projects."[3] This interpretation appears relatively narrow compared to the Order's stated purpose to implement "new requirements and leading practices for project and acquisition management" such as those derived from U.S. Office of Management and Budget (OMB) Circulars. In particular, OMB Circular A-11 in Appendix 1 of the supplement, Capital Programming Guide states, "Capital assets include the environmental remediation of land to make it useful." EM however, based on the narrow interpretation of Order 413.3B, does not apply the order to groundwater remediation projects that clearly have the intent of remediating land to make it useful.

In addition, Order 413.3B is only applicable to projects with estimated TPC of $50 million or higher, which excludes a number of EM activities. EM-funded projects below $50 million TPC are not currently subject to the controls and oversights noted for the larger projects. EM has addressed this issue through a memorandum[4] requiring that projects below the $50 million threshold follow the principles of project management outlined in Appendix C of Order 413.3B.

[3] Paul Bosco, Office of Project Management, DOE, "Project Management (PM) Governance, Systems and Training," presentation to the committee, May 6, 2020, Washington, D.C.

[4] DOE reiterates that "all projects equal to or less than $50 million shall follow the Project Management Principles as established in Appendix C of DOE Order 413.3B." In U.S. Department of Energy. 2018. Office of Environmental Management Policy for Management of Capital Asset Projects with Total Project Cost Equal to or Less than $50 Million. EM Policy. April.

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The committee, however, has not found evidence of the tracking accorded such projects. In the future, even more EM cleanup projects could be excluded under the proposed end-state contracting model where more of the work will be broken down into smaller task orders. Extending the applicability threshold down to $20 million would have the beneficial effect of: (1) applying a consistent set of principles across all such small projects; (2) invoking the controls and oversights of 413.3B such as ESAAB, (3) tracking by the Office of Project Management's management information systems, and so forth. The small projects (between $20 million and $50 million TPC) could have a more streamlined application of Order 413.3B commensurate with their size and risk.

Order 413.3B Section 3b requires the contractor requirements document (CRD). The CRD is inserted into the Contract, and the list of requirements for the CRD are found in Attachment 1 of the Order.

Application of Order 413.3B to specific projects or project types is best carried out through effective use of the project execution plans (PEPs), as successfully demonstrated in the National Nuclear Security Administration (NNSA), another division of DOE that makes substantially more outlays on contracting than the EM program. More generally, the committee found applying the requirements of Order 413.3B to be beneficial and that the order compared well against recognized benchmarks. The majority of activities however do not fall under the order, and such activities thus do not benefit from the full range of processes and requirements. The Demolition Protocol, for example, applies to projects in a certain category but does not include all such processes and requirements. The Demolition Protocol appears to exclude roles for the Project Management Risk Committee (PMRC) and the ESAAB, which would apply in Order 413.3B in certain instances. It also appears that certain independent reviews called for per Order 413.3B (e.g., independent project reviews [IPRs] and external independent reviews [EIRs]) have been replaced with independent field office and headquarters assessments.

In addition to the issue of the $50 million threshold, the committee also reviewed several other major instances where Order 413.3B was not applied within the EM project portfolio. As noted earlier, EM applies Order 413.3B only to large line-item construction projects, which, as of February 2020, numbered 14 projects and totaled $21.6 billion TPC in obligations (taking into account funding across multiple years) and comprised roughly one-quarter of EM's annual (one-year) budget authority. The remaining three quarters of them include activities to which EM is not applying Order 413.3B: EM activities that are implemented outside the order include site services, demolition of buildings, and waste disposal operations, as well as environmental remediation under $50 million, noted above. The committee found that the narrow interpretation of the applicability of Order 413.3B, relative to the OMB Capital Programming Guide for capital asset projects, is a major factor contributing to this situation. EM does not appear to meet the criteria that would otherwise exempt it from Order 413.3B.

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Finally, the committee reviewed the recent effort by EM to establish a new project management process for demolition projects. DOE has large numbers of buildings and facilities that are no longer in use and require demolition. Within DOE, both the NNSA and EM have "ownership" of buildings to be demolished. NNSA currently implements demolition projects under the same guidelines and procedures as apply to new construction. EM, on the other hand, believes that its demolition activities, driven as they often are by regulatory requirements, are not optimal for oversight under Order 413.3B guidelines and procedures. In July 2020, the Under Secretary (S3) approved and issued a demolition protocol "for operations-funded projects demolishing excess decontaminated facilities";[5] such activities are not subject to 413.3B. The committee review did not find a strong rationale for EM demolition projects to be managed under different procedures than NNSA demolition projects, which do follow 413.3B.

EM's protocol for demolition projects states, "Disaggregation of site program work into smaller, discrete work activities is encouraged as it provides better project definition and clarity, is more manageable, reduces time horizons and risks, and is consistent with the project management best practices found in DOE Order 413.3B." A multiplicity of projects transfers a greater burden for program and project management to EM; increases responsibilities with respect to interface management; creates a growing level of risk in the "white space" between individual projects (i.e., omissions); partitions risks which were demonstrated to be best aggregated on both the Rocky Flats Plant and the Fernald site; and limits the scope for innovations in project delivery and the opportunity for accruing meaningful incentives by the contractor.

The committee recommends that the Department of Energy (DOE) confirm, clarify, and expand DOE Order 413.3B to establish its applicability to all capital asset projects (not just construction and major instruments and equipment and certain cleanup projects) and all Office of Environmental Management projects, whether major systems projects or work carried out by a management and operating (M&O) contractor. The committee makes the following specific recommendations regarding the Order as well:

1. **Pending the outcome of the National Nuclear Security Administration pilot project, reduce the threshold value for applicability of Order 413.3B from $50 million to $20 million;**
2. **Continue applying the requirements of Order 413.3B to M&O contract work on capital asset projects—the latter including construction projects, major items of equipment and cleanup projects; (Recommendation 4-1, first half)**

[5] Mark W. Menezes, Under Secretary of Energy, July 13, 2020, "Memorandum for Heads of Department Elements, SUBJECT: Demolition Projects."

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The Department of Energy should clarify Order 413.3B to incorporate best practices with respect to dispute prevention and resolution, which will be of growing significance as the Office of Environmental Management implements the end-state contracting approach. Sources for such best practices include the Construction Industry Institute. (Recommendation 4-2)

The Office of Environmental Management should apply the requirements for project execution plans equivalent to those in Order 413.3B to those projects that are not formally managed under Order 413.3B. (Recommendation 4-3)

PROJECT MANAGEMENT METRICS

EM, with the help of DOE's Office of Project Management, has developed detailed processes and methods for tracking project-level outcomes and success measures. The committee reviewed five primary performance measurement approaches used by EM, including an earned value management system (EVMS), project dashboards, project evaluation and measurement plans (PEMPs), contract performance metrics, and progress reports to Congress. After reviewing EM's success measures and how they are used to guide decisions and report progress, the committee identified several issues for further action.

In general, an EVMS represents a principal system for an organization to monitor project management through an integrated set of work scopes, schedules, and budgets. An EVMS should provide a transparent and reliable process and approaches that explicitly, consistently, and clearly highlight the projects' temporal status. Previous studies have advised EM to use such a system.[6,7] A key element of an EVMS is a Schedule Performance Index (SPI), defined by the Project Management Body of Knowledge as a metric that is used to measure schedule efficiency. EM currently includes a measure of SPI in its EVMS system that is based on dollars expended, not time.

Because it is the key measure of schedule performance, it is important to calculate SPI based on time, not dollars, using the ratio of scheduled time of work performed (STWP) over actual time of work performed (ATWP). The difference between calculating SPI using dollars versus time can be dramatic. For example, SPI based on dollars will not flag a project as behind schedule at the completion as long as the project completes within budgeted cost of work scheduled. Hence, a calculation based on cost does not always reliably convey

[6] Daniel B. Poneman, Deputy Secretary of Energy, September 9, 2011, "Secretarial Review of Environmental Management Programs and Projects."

[7] National Research Council, 2004, *Progress in Improving Program Management in the Department of Energy: 2003 Assessment*, Washington, D.C.: The National Academies Press.

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possible schedule delays at the project completion and can lead to wrong conclusions about how successful it was. In contrast, SPI based on time, SPI(t), will always reflect how delayed a project is regardless of the actual cost of the project.

The Department of Energy Office of Environmental Management (EM) should implement a modification to its earned value management system that captures the project's temporal status more clearly and explicitly. Specifically, EM should immediately require that a revised Schedule Performance Index, SPI(t), which is the ratio of scheduled time of work performed (STWP) and actual time of work performed (ATWP), be reported to accurately track schedule performance. (Recommendation 5-2)

EM's portfolio of projects (work that is subject to following Order 413.3B) is approximately 25 percent of its annual budget. The percentage of actively tracked projects using certified EVM systems is even smaller (required for capital investment projects greater than $100 million). EM could similarly track a larger majority of activities, but does not now do so.

It should be recognized that EM project management issues are not unique; environmental cleanup for the Department of Defense (DoD) base realignment and closure (BRAC) and formerly used defense sites (FUDS) provide similar examples of the challenges faced by EM.[8] Both programs use a variety of contract forms, and the procurement processes vary to fit the project need. DoD manages them as decentralized projects and are closer in size and term (5-10 years) to EM's new ESCM). For BRAC, program management and program management oversight are typically performed internally, such as the Naval Facilities Engineering Systems Command (NAVFAC) for the Department of the Navy BRAC.

The committee recommends that as the Office of Environmental Management (EM) increases its project management (PM) and Office of Project Management responsibilities using indefinite delivery/indefinite quantity (IDIQ) contracts, it should share and compare best PM practices with others across the U.S. government. To implement this, EM should form a "Joint Task Force" or less formal cooperative structure with Naval Facilities Engineering Systems Command (NAVFAC) and other base realignment and closure (BRAC) and formerly used defense sites (FUDS) program management organizations. (Recommendation 5-1)

[8] Environmental Protection Agency, 2017, *BRAC and EPA's Federal Facility Cleanup Program: Three Decades of Excellence, Innovation and Reuse*, 505-R-17-001, November, https://www.epa.gov/sites/production/files/2017-12/documents/brac_v9_11_2_2017_508.pdf.

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The other key measure of project performance is cost management. The committee found two areas in which information on cost management was not being reported with sufficient transparency. The first issue involves the calculation of cost performance for the EM project portfolio. Performance is based on number of projects rather than aggregate cost performance of the portfolio of projects considered. In the IDIQ approach, comprised of task orders, EM would disproportionately weigh many small projects toward their overall performance. Estimates at completion based on the cost-performance index are a floor to actual final cost given that program cost performance rarely improves as the program proceeds to its completion.

The committee recommends that DOE

3. **Clarify the definition related to project performance found at Section 3c(4), point 3 to calculate performance on aggregate value and not number of projects; and**
4. **Shift eligibility for project overruns, currently 10 percent per project, to be applied instead based on the aggregate value.**

(Recommendation 4-1, second half)

A second area for improvement is the reporting of cost information in the project dashboards and project success reports. Currently, EM integrates all cost overruns into binary success metrics of Yes/No, which does not provide information on the magnitude of a cost overrun or underrun. Including the percentage of cost over- or underrun, compared to the baseline (i.e., Original Critical Decision (CD)-2 TPC) in the project success metrics would provide more clarity. Some projects have significant cost overruns (and some of which EM has still not completed have more than doubled their original estimated cost) and others have lower cost overruns (reference Project Success Spreadsheet, 2020). There are also some projects that finished exactly at the estimated cost.

The Department of Energy Office of Environmental Management should explicitly include the percentage of cost overrun or underrun in the project success metrics dashboard, rather than the current "green/yellow/red" metric, to bring more transparency to cost performance. (Recommendation 5-3)

CONTRACTING

The committee reviewed the rationale for the new ESCM, reviewed the advantages and disadvantages of different contract types, and then compared the previous clean-up contract models for Fernald and Rocky Flats with the ESCM in use today by EM.

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EM has focused increased attention on the need to be on a trajectory toward end-states. Creating and motivating a culture of completion is important to EM's mission success. In its own management analysis, EM has identified important ongoing efforts including "defining requirements in measurable outcomes" and "using objective performance measures focusing on outcomes to balance considerations of cost control, schedule achievement, and technical performance." The committee concurs with the imperative of outcomes-based completion contracting and agrees with the need to build on past, successful initiatives such as Rocky Flats and Fernald completion contracts.

EM has advanced the ESCM as a new and improved vehicle for achieving outcomes-based completion contracting. The committee has carefully reviewed the ESCM model and compared it to the attributes of the completion contracts successfully deployed at the Fernald and Rocky Flats sites. The committee found that many of the features of the completion contracts that made Fernald and Rocky Flats successful are not present in the current ESCM.

In short, the committee found that the ESCM is neither outcomes based nor completion focused. Rather, the ESCM is focused on delivery of a set of discrete outputs that are not clearly mapped by contract to achievement of either a clearly defined intermediate or final end state. This significant deficiency deprives EM and the IDIQ contractor of the benefits of having a completion-oriented contract fully integrated throughout the supply chain and the fostering of innovation at the scale the program requires. Finally, the ESCM approach, as defined, focuses on narrowly defined performance criteria and increases risks associated with incomplete statements of work. These concerns and deficiencies were largely successfully addressed in Rocky Flats and Fernald.

Under the ESCM, EM awards a single IDIQ[9] contract for a draw period of up to 10 years. Within the IDIQ contract umbrella, EM will establish a series of smaller, shorter-term task orders within the IDIQ umbrella, using a combination of firm fixed price and cost reimbursement task orders.[10] DOE sees the benefits of this end-state concept to include: quicker evaluations of proposals; less risk of protest loss; freeing up of contractor key personnel; and less proposal cost to industry.

The committee notes that the IDIQ task order structure will create a significant number of task orders, triggering a pro rata increase in the project management burden to EM. The anticipated size of the task orders in the IDIQ cleanup contracts, averaging about $100 million, will result in EM having to manage potentially 100 task orders over the life of one cleanup contract. This process carries greater risk for EM, requiring the possible management of an unwieldy number of task orders and a significant amount of DOE oversight.

[9] Norbert Doyle, Deputy Assistant Secretary, Office of Acquisition & Project Management (EM-5.2), "Contract Overview," presentation to the committee, February 24, 2020, Washington, D.C.
[10] Ibid.

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Discrete task orders also could limit benefits that might come from contractor innovation that contributed to the success at Fernald and Rocky Flats. Breaking up the scope of work into a large number of discrete tasks will diminish the focus on project outcomes and overall project optimization within an outcomes-based framework. The committee believes that the current contract procurement process can be adapted by awarding larger task orders that define one or more intermediate end states, thereby reducing residual risk to EM. Larger task orders could increase the opportunity for contractor innovation and provide for focused oversight at a higher level within EM.

DOE's reliance on "discrete tangible progress" through individual task orders under an IDIQ contract, without identifying an overall strategy or program management plan is not, in the committee's view, outcomes-based contracting. The ESCM concept does not define what "end states" (or reasonable subsets thereof) truly are. The committee supports true end-state or outcomes-type contracts but has not seen the requisite strong links between the management of portfolio, program, and projects that are a core element of moving toward end-state completion.

Finally, the committee notes that the ESCM single-award IDIQ contracts may not achieve the desired streamlining in the procurement process. The protest of the Hanford central plateau end-state contract, which ultimately was decided in DOE's favor, necessitated significant and lengthy corrective actions. Contractor key personnel had to be maintained from date of award (December 2019) until notice to proceed in mid-September 2020.

The Office of Environmental Management (EM) should establish well-defined, outcomes-based intermediate end states in its 10-year cleanup contracts. Any intermediate outcomes should have clear, measurable metrics to assess site-based (versus task-based) achievement of the defined end states. EM should report progress on these metrics across the portfolio of end-state programs on a quarterly basis and such reports should represent a key EM performance measure. (Recommendation 6-1)

The Office of Environmental Management (EM) should structure task orders on a scale that is appropriate for defining intermediate outcomes, award fewer individual tasks. EM should apply to such task orders the same management oversight as currently required for major systems projects exceeding $750 million in total cost. (Recommendation 6-2)

CONTRACT EXECUTION: FEES AND INCENTIVES

EM seeks to obtain the maximum return from its contractors by offering a balanced mix of integrated, fair, and challenging incentives. This requires

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that contractor fees be directly tied to contractor performance. In establishing appropriate incentives for contractors, fees should be reasonable, reflecting effort (noting the complexity of the work and the resources required for contract completion), cost risk (the cost responsibility and associated risk the contractor assumes under the contract type and the reliability of the cost estimates in relation to the complexity of the task), and other factors (e.g., support of federal socioeconomic programs, investment in capital, and independent development).

EM contracts typically provide a two-part fee structure consisting of a base fee and a performance fee. The performance fee generally includes both objective and subjective fee components and must relate to clearly defined performance objectives and measures. Where feasible, these objectives and measures should be expressed as desired results or outcomes.

As noted by GAO,[11] there appear to be few guidelines to distinguish between "objective" and "subjective" award fee criteria. Using subjective fee components is less desirable than using objective fee components because the link between performance and reward is less clear for the former. Only when it is not feasible to use objective measures of performance should subjective fee components be used. For example, although it might be feasible, it is difficult to specify performance metrics for "environmental stewardship and compliance." If there are well-specified subjective criteria, they should be tied to identifiable interim outcomes, discrete events, or milestones.

The committee examined subjective and objective performance assessment summaries and resulting fees as presented in "scorecards" posted on applicable DOE field office websites, particularly for contracts awarded at the Hanford site. After reviewing the evaluation of performance with Hanford cleanup contracts, DOE-EM's rating of contractor performance does not appear to be consistent through years for a specific contract or across contracts in a specific year. Performance ratings sometimes do not appear to correspond to comments by the contract evaluator.

To increase transparency in contractor performance evaluation, the committee recommends that the Department of Energy's Office of Environmental Management should ensure that the contracts it issues for cleanup work (1) create a consolidated set of unambiguous "subjective" criteria for similar types of cleanup activities, and (2) use these criteria in the evaluation of all contract performance across its portfolio. (Recommendation 7-1)

[11] DOE "has a different process for determining incentive and award fees, depending on whether the fee is tied to objective or subjective performance criteria." In Government Accountability Office, 2019, *Department of Energy Performance Evaluations Could Better Assess Management and Operating Costs*, GAO-19-5, Washington, D.C.

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Introduction

ORIGIN OF STUDY

Congress in the National Defense Authorization Act of 2019 (P.L. 115-232) directed the Secretary of Energy to enter into an arrangement with the National Academies of Sciences, Engineering, and Medicine to conduct a study of the effectiveness and efficiency of defense environmental cleanup activities. These activities are managed by the Department of Energy's (DOE's) Office of Environmental Management (EM) and involve materials controlled per the Atomic Energy Act and are subject in large part to two environmental laws governing cleanups, the Resource Conservation and Recovery Act and the Comprehensive Environmental Response, Compensation, and Liability Act. The cleanups themselves are effected by contractors at 16 sites in the continental United States, with waste meeting certain criteria being disposed in a 17th site.

Congress specifically asked the National Academies to focus on the management and oversight of these cleanups by considering the projects into which these cleanup activities are organized. The primary tasks for the study as described by Congress were to provide the following:

> (a) In General.—The Secretary of Energy shall enter into an arrangement with the National Academies of Sciences, Engineering, and Medicine to conduct a review of the defense environmental cleanup activities of the Office of Environmental Management of the Department of Energy.
> (b) Elements.—The review conducted under subsection (a) shall include—
> (1) an assessment of—
> (A) project management practices with respect to the activities described in subsection (a);

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(B) the outcomes of such activities; and
(C) the appropriateness of the level of engagement and oversight of the Office of Environmental Management with respect to such activities; and

(2) recommendations with respect to actions to enhance the effectiveness and efficiency of such activities.

The DOE-EM and the National Academies agreed to a modification of an existing cooperative agreement on August 13, 2019, in order to accomplish the study. The National Academies established the Committee on Review of Effectiveness and Efficiency of Defense Environmental Cleanup Activities of the Department of Energy's Office of Environmental Management. The committee was composed of diverse experts in the fields of project management, civil and nuclear engineering, acquisition and contracting, construction management, and other fields. Committee member biographical information is provided in Appendix A.

STATEMENT OF TASK

Per the contract, the committee was given the following statement of task:

> The National Academies of Sciences, Engineering, and Medicine will appoint a committee to review and identify ways to enhance the effectiveness and efficiency of defense environmental cleanup activities of the Department of Energy's Office of Environmental Management (DOE-EM). The committee's review will:
>
> A. Assess DOE-EM's program and project management practices benchmarked against DOE 413.3B and other practices used elsewhere for project planning and acquisition, technology insertion, controls, review, reporting, contract management, and other management activities;
> B. Evaluate whether DOE-EM has well-defined and measurable outcomes for its cleanup activities and review DOE-EM's prioritization strategy and decision support for operational actions for achieving the stated outcomes; and
> C. Evaluate the level and appropriateness of DOE-EM's oversight of technical contractors and site operations, as well as engagement with external stakeholders, to meet the stated outcomes.
>
> The committee will make recommendations on actions to enhance the effectiveness and efficiency of DOE-EM's cleanup activities. The committee will issue two consensus studies, one at approximately 10 months after the contract is signed and a second at 18 months. The first report will make recommendations on changes to DOE-EM's project management practices that can be implemented immediately. The second report will make recommendations on how such practices should be transformed over 5 to 10 years.

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COMMITTEE'S APPROACH TO THE STATEMENT OF TASK

This is the first of two reports envisaged in the statement of task. While conducting this first study, the committee members relied on their own expertise, information from publications they judged to be of high quality, and many interactions with officials at DOE, including those with EM, the Office of Project Management, and the National Nuclear Security Administration. During public meetings, the committee heard presentations chiefly from EM but also from other elements of the department that oversee or execute large projects. A list of activities appears as Appendix B. The committee made roughly 60 written queries of DOE to gather further information. The committee read and considered prior and ongoing reviews of project management at DOE, including those conducted by the department itself, the U.S. Government Accountability Office (GAO)—whose staff also briefed the committee during the public meetings—and the National Academies. All of the above discussions and information provided the basis for the committee's deliberations and for the writing of the report. The following section describes how the report was written to address the committee's statement of task.

STRUCTURE OF THE REPORT

Chapters 2 and 3 provide the history of the organization and management of the cleanup activities at DOE and of the laws, directives, and processes under which the cleanups proceed. The remaining chapters address specific aspects of the management and oversight of the projects within EM. Chapters 4 and 5 consider the project management of cleanup activities within EM and how progress on such is tracked and measured. Chapters 6 and 7 consider the contract structures available to EM, which ones have been used and how these fared, and then discusses the incentives in the contracts aimed at encouraging improved schedule and cost performance. Chapters 4 through 7 address the key aspects of the committee's charge, with the outcome of the committee's analysis and deliberations explained in a stylized way: "findings" are facts the committee noted to be of particular importance; "conclusions" describe the significance of these facts for project effectiveness and efficiency; and "recommendations" translate these into action, assigning a measurable action to a specific actor. Chapter 8 presents all the recommendations in one place.

The statement of task is addressed by the chapters as outlined in Table 1.1.

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TABLE 1.1 How the Statement of Task Is Addressed in the Report

Element of Statement of Task	Chapter(s) Addressing the Element
A. Assess DOE-EM's program and project management practices benchmarked against DOE 413.3B and other practices used elsewhere for project planning and acquisition, technology insertion, controls, review, reporting, contract management, and other management activities;	4, 6
B. Evaluate whether DOE-EM has well-defined and measurable outcomes for its cleanup activities and review DOE-EM's prioritization strategy and decision support for operational actions for achieving the stated outcomes; and	5
C. Evaluate the level and appropriateness of DOE-EM's oversight of technical contractors and site operations, as well as engagement with external stakeholders, to meet the stated outcomes.	7; the second phase of study will consider EM's oversight of site operations in more detail and EM's engagement with external stakeholders

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Overview of Environmental Management Program Evolution

HOW THE PROGRAM CAME ABOUT

The mission of the earliest precursor agencies of the present-day U.S. Department of Energy (DOE) involved the use of atomic energy for defense purposes and then, with the passage of the McMahon Act in 1946, the use of atomic energy for civilian purposes as well. During the 1940s, wartime activities occurred at industrial scale on land reservations of hundreds of square miles in size. Smaller sites conducted upstream activities to fabricate materials needed at the larger sites for production of weapons grade materials (or for nuclear power fuel assemblies) and for the assembly of the weapons themselves. Interspersed within these sites and elsewhere in the larger complex were sites hosting research, development, and test operations also using atomic energy. In the following years, as peacetime activities involving atomic energy and other forms of energy and topics of research increased, and defense activities escalated, so too did the number of sites in the complex. The department's inventory of sites for all its activities is now well over 150 (NASEM, 2017).

Several years after wartime activities ended, the Atomic Energy Commission (AEC) began considering the final disposition not only of the materials, the core of which were so-called "Atomic Energy Act materials,"[1] but of the lands

[1] These are defined in section 11 of the Atomic Energy Act (AEA) of 1954, as amended, as being of three types: source material, special nuclear material, and byproduct material. Source material is actinides, or ores containing actinides, that are fissionable with neutrons. Such ores can be milled and, when specified, selectively enriched in isotopes more suitable for nuclear chain reactions (becoming special nuclear material), and fabricated into fuel assemblies. The latter are used in the production of heavier elements or for release of fission energy to provide heat or generate mechanical or electric power (e.g., by raising steam to turn a Rankine cycle). Byproduct materials are chiefly those that

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themselves at the dozen or so contract-operated laboratories and test ranges with significant land-holdings. The most radioactive of these wastes received the most attention, and by the late 1950s a consensus emerged that deep underground disposal in the lithosphere was the preferred method to isolate such wastes from the biosphere (NAS-NRC, 1957). Preparing and immobilizing wastes for ultimate disposition became the focus of further large-scale operations. In parallel, the issue of containing the wastes generated during the wartime activities became more urgent as natural processes conveyed radionuclide fractions outside site boundaries into environmental media and, within the sites, into soil and groundwater. The cleanup of environmental media[2] thus became a significant mission area for the department.

By 1980, the responsibility for managing defense wastes had been assigned to DOE's Office of Defense Programs pursuant to the National Defense Authorization Act for Fiscal Year 1981. The annual budget for management of such wastes was approximately $300 million (Ghosling and Fehner, 1994, p. 29).

In 1989 DOE elevated and consolidated the responsibility for the cleanups within the organization. This created for the first time an assistant secretary with line management responsibility for the disposition of defense wastes.[3] The organizational unit was called the Office of Environmental Restoration and Waste Management—albeit now headed by a presidentially-appointed, Senate-confirmed official—but within a few years became known as the Office of Environmental Management (EM).[4]

The Office of Environmental Management currently has three verticals: Field Operations (EM-3), Regulatory and Policy Affairs (EM-4), and Corporate Services (EM-5). This tri-partite structure followed from a reorganization in June 2016 that consolidated seven offices down to current three. Perhaps most prominently, this consolidation included "changes in the reporting relationships of the EM field organizations."[5] Whereas previously the headquarters units through

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evolve during fission of source material and special nuclear material. Byproduct materials can also include mill tailings from the processing of source material; purified quantities of a particular isotope of the element radium; or material that has become radioactive in physics experiments involving highly-energetic particles. Interested readers should consult the AEA for definitions of the above having proper legal meaning and effect.

[2] Collectively, "cleanup" may refer to soil and groundwater treatment, building demolition, disposal (often on-site), or waste processing and immobilization.

[3] On November 8, 1981, Secretary of Energy James Watkins issued SEN-13-89 affirming the Department's intention to ask for congressional authority for a new assistant secretary.

[4] References to EM include both the Office of Environmental Management and the assistant secretary-level predecessor, the Office of Environmental Restoration and Waste Management.

[5] Michele Inge-Farmer, Workforce Analytics & Planning Division, HC-52 Office of the Chief Human Capital Officer. June 30, 2016, "Memorandum for Mark Whitney, Principal Deputy Assistant Secretary, Subject: Organization Change Implementation Material – Environmental Management." H-14-16 (06/27/16).

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which the sites reported were gathered under the assistant secretary (EM-1),[6] they now reported to an associate principal deputy assistant secretary (EM-3).

REGULATORY REGIMES FOR WASTE MANAGEMENT

In the 1960s and 1970s, the department began to reckon with its major waste streams. A pilot project in New Mexico was proposed in a salt formation in the Permian Basin, and various wastes became candidates for final disposition there. A Defense Waste Processing Facility was proposed at the Savannah River Site (SRS) to immobilize the 25 million gallons of liquid waste in a form suitable for deep underground or "geologic" disposal. At the same time, the environmental laws that had been created in the years since the Atomic Energy Act led to debate over the applicability of these same laws to defense wastes.

Congress passed the Resource Conservation and Recovery Act (RCRA) in 1976, but, to a literal reading, the Act exempted sites with so-called mixed waste that has both AEA material and RCRA-hazardous constituents. The Department continued to assert for several years that the exemption of RCRA Section 1006 applied. Litigation followed, including a 1984 decision in which a federal court ordered DOE to comply with RCRA. See Legal Environmental Assistance Foundation v. Model, 586 F Supp. 1163 (E.D. Tenn.1984).

Definitive resolution would have to wait until 1992 and the passage of the Federal Facilities Compliance Act (P.L. 102-386), which amended section 6001 of RCRA to specify that federal facilities are subject to "all civil and administrative penalties and fines, regardless of whether such penalties or fines are punitive or coercive in nature."

The cleanup of inactive sites in the department's inventory became subject to a further environmental law, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund), created in 1980. The Superfund Amendments and Reauthorization Act of 1986 required DOE to enter into cleanup agreements for all sites on the National Priorities List. CERCLA and RCRA are the two main laws under which EM cleanups proceed. (DOE, 2017).

While these legalities were being resolved, DOE in 1989 elevated and consolidated the responsibility for the cleanups within the department. This created for the first time an assistant secretary with line management responsibility for the disposition of defense wastes.[7] EM was charged with the responsibility of cleaning up 107 contaminated sites in 35 states, covering approximately 3,100 square miles.[8] Over time the on-site contractors funded by EM cleaned up sites

[6] In addition, there is EM-2, the principal deputy assistant secretary.

[7] Secretary of Energy James Watkins issued SEN-13-89 on November 8, 1981, affirming the Department's intention to ask for congressional authority for a new assistant secretary.

[8] Todd Shrader, Principal Deputy Assistant Secretary (EM-2), Office of Environmental Management (EM), "EM Program History and Overview," presentation to the committee, February 24, 2020, Washington, D.C.

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of varying size and complexity. (See the section "Accomplishments to Date," below.) In 1989 four parcels at the Hanford Plant were added to the National Priorities List.[9] By 1990, nine of the weapons complex sites were proposed or listed on the National Priorities List (OTA, 1991).

The authority to regulate radioactive material also shifted over time. In 1970, the newly created U.S. Environmental Protection Agency (EPA)[10] was given authority set standards for radiation exposure and for the concentrations of Atomic Energy Act materials in the general environment. This authority was clarified in 1974 to allow EPA to specify such standards to apply outside the boundaries of sites without specificity on the particular activity occurring within.[11] The AEC and its successors, the Energy Research and Development Administration (ERDA) and DOE, retained authority to regulate its own sites contaminated with AEA materials. There were exceptions to the latter; for example, the Waste Isolation Pilot Plant Land Withdrawal Act of 1993 (P.L. 102-579) gave EPA authority to set standards for that site, which EM developed and operates.

SIZE, SCOPE, AND SCALE OF EM PROGRAM

At its 1989 inception, EM was charged with the environmental cleanups of 107 sites in 35 states.[12] The office set the priorities for cleanups in a 5-year plan issued in 1989 (Gosling and Fehner, p. 73). By one estimate, the 5-year plan contained over 1,500 projects (Gosling and Fehner, p. 77). The early years of EM were dominated by constructing and operating waste management facilities (over half of budget authority). Further significant outlays addressed corrective actions necessary to bring sites into compliance with the environmental laws and regulatory regimes noted above.

Today's EM includes 17 sites (Figure 2.1), or a six-fold reduction versus 1989. Sixteen of these are contaminated from the use of atomic energy for defense purposes (see Table 2.1), the civilian nuclear fuel cycle, development of naval propulsion systems, or other Atomic Energy Commission objectives. A 17th site in Carlsbad, New Mexico, carries out disposal operations and accepts a specific type of waste ("transuranic") contaminated with AEA material containing chiefly plutonium but also other actinides heavier than uranium.

Sites that are deemed sufficiently cleaned up are transferred to the Office of Legacy Management (LM). LM has responsibility for "long-term surveillance and maintenance, workforce restructuring and benefits, property management,

[9] K. Schneider, 1989, "Agreement for a Cleanup at Nuclear Site," *The New York Times*, February 28.

[10] Reorganization Plan No. 3 of 1970. *Federal Register* 35: 15623; and 84 Stat. 2086.

[11] R.D. Lyons, 1973, "E.P.A. Loses Power to Limit Radiation," *The New York Times*, December 12.

[12] Todd Shrader, Principal Deputy Assistant Secretary (EM-2), Office of Environmental Management (EM), "EM Program History and Overview," presentation to the committee, February 24, 2020, Washington, D.C.

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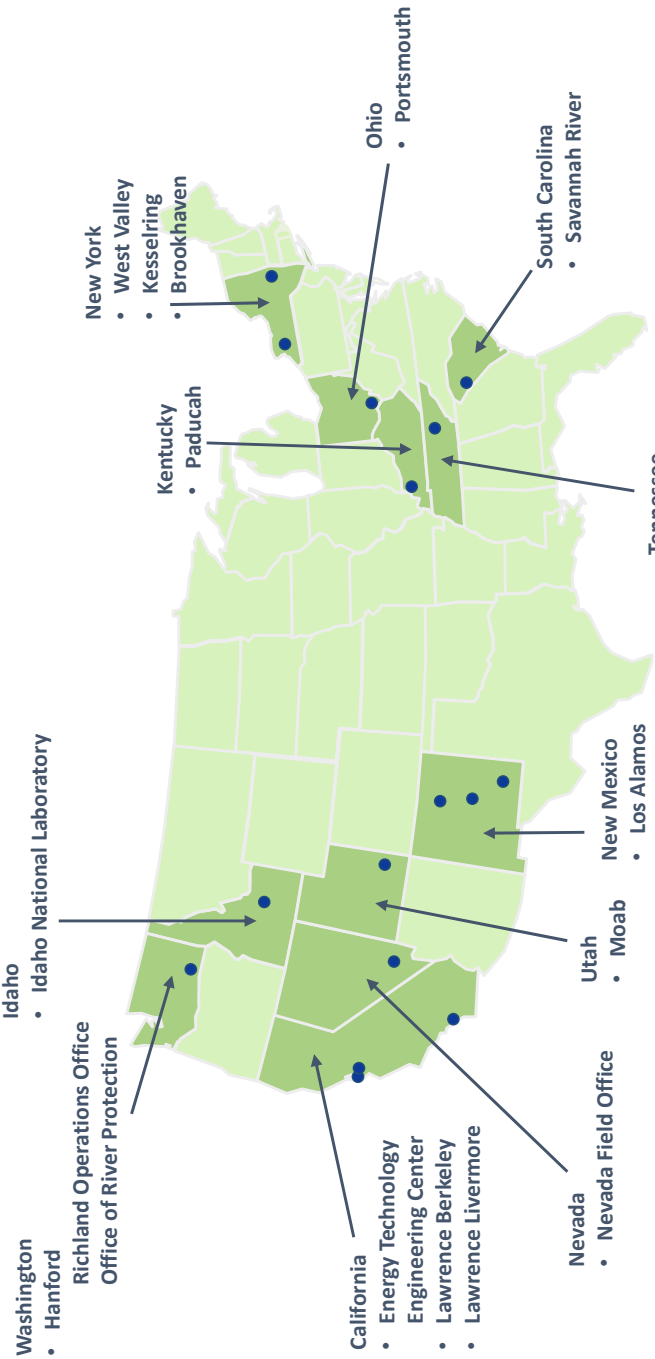

FIGURE 2.1 Locations of sites in the Office of Environmental Management inventory as of 2020. SOURCE: Adapted from Todd Shrader, Principal Deputy Assistant Secretary (EM-2), Office of Environmental Management, Department of Energy, "EM Program History and Overview," presentation to the committee, February 24, 2020, Washington, D.C.

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TABLE 2.1 List of Defense Sites

Hanford Site[a]
Idaho National Laboratory
Lawrence Livermore National Laboratory
Los Alamos National Laboratory
Nevada Nuclear Security Site
Oak Ridge
Sandia National Laboratory
Savannah River Site
Separations Process Research Unit
Waste Isolation Pilot Plant

[a] Administered as two separate sites: the Office of River Protection and the Richland Operations Office.
SOURCE: DOE (2017).

land use planning, and community assistance."[13] LM continues the groundwater treatment activities from the EM ownership phase. For example, at the former Rocky Flats Plant in Colorado within the 1,300-acre Central Operable Unit, LM continues groundwater treatment and site monitoring. (The former security buffer zone, the Peripheral Operable Unit, was transferred in July 2007 to the U.S. Fish and Wildlife Service as the Rocky Flats National Wildlife Refuge.[14]) Since its establishment in December 2003, LM has accepted the transfer of 101 sites.

The budget authority for EM comes from more than one source, the dominant one being Atomic Energy Defense Activities, which is part of the National Defense Budget Function (050). Smaller portions of budget authority are sourced from the Non-Defense Environmental Cleanup account and the Uranium Enrichment Decontamination and Decommissioning account. These three accounts are allocated predominantly to the sites through headquarters and the monies obligated in contracts. The topline budget authority for the EM since its inception is shown in Figure 2.3. Figure 2.4 shows allocation to the eight largest sites in terms of budget authority. The budget priorities for FY 2021 are sorted by program breakdown structure (PBS) in Figure 2.5.

Recent accomplishments include, for example, the decontamination and decommissioning of the K-25 building at East Tennessee Technology Park (Oak Ridge National Laboratory), a gaseous diffusion plant; removal of sludge, debris and water from the K-West basin at the inactive K-West nuclear reactor in

[13] U.S. Department of Energy "Office of Legacy Management," https://www.energy.gov/lm/office-legacy-management.

[14] Office of Legacy Management, 2020, "Fact Sheet: Rocky Flats Site, Colorado," June, https://www.energy.gov/sites/prod/files/2020/06/f75/RockyFlatsFactSheet.pdf.

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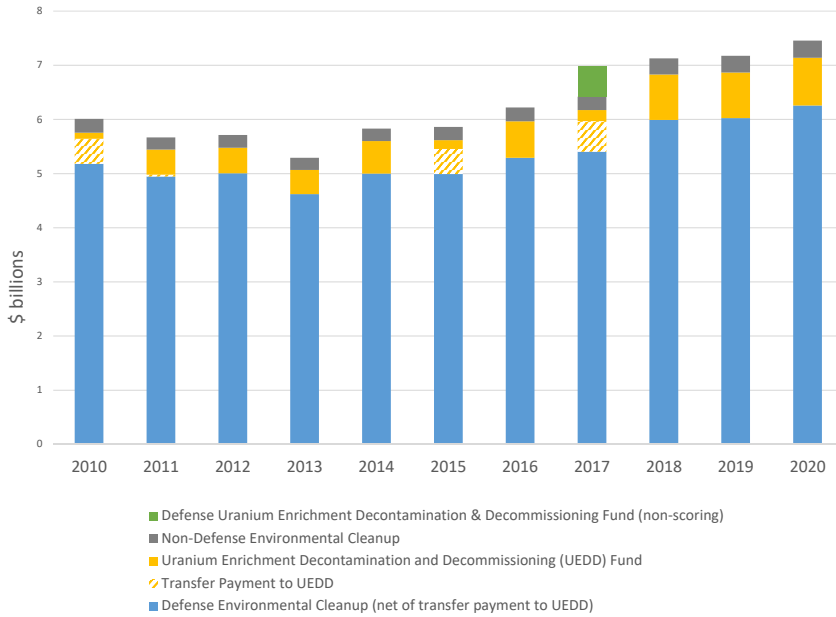

FIGURE 2.2 Detail of budget authority for the Office of Environmental Management, 2010 to 2020. NOTE: DOD = Department of Defense; UEDD = Uranium Enrichment Decontamination and Decommissioning Fund.

Richland Operations Office (Hanford Site) in Washington state; and closure of almost 90 acres of coal ash and contaminated soil at the D-Area Ash Basin, adjacent to a steam and electricity plant that provided energy services at the Savannah River Site (Aiken, South Carolina).

One measure of the size, scope, and scale of EM's activities is the dollar amount of its cleanup liabilities. Environmental laws such as CERCLA and RCRA, noted above, require the cleanup of contaminated sites. These requirements and any specific remedies are negotiated with EPA and state authorities, and such remedies can be estimated and reported as liabilities. Since 2010 liabilities have increased $271 billion (see Figure 2.6). During the same time period, EM spent $70 billion on the sites. In recent years DOE has taken on additional contaminated sites from other DOE organizations (GAO, 2019, p. 7). The liabilities themselves have occasioned numerous studies by the Government Accountability Office (GAO).[15]

[15] Amanda Kolling, Government Accountability Office, "DOE's Environmental Cleanup Mission: Scope and Growth in DOE's Environmental Liabilities and Challenges to Progress," presentation to the committee, February 24, 2020, Washington, D.C.

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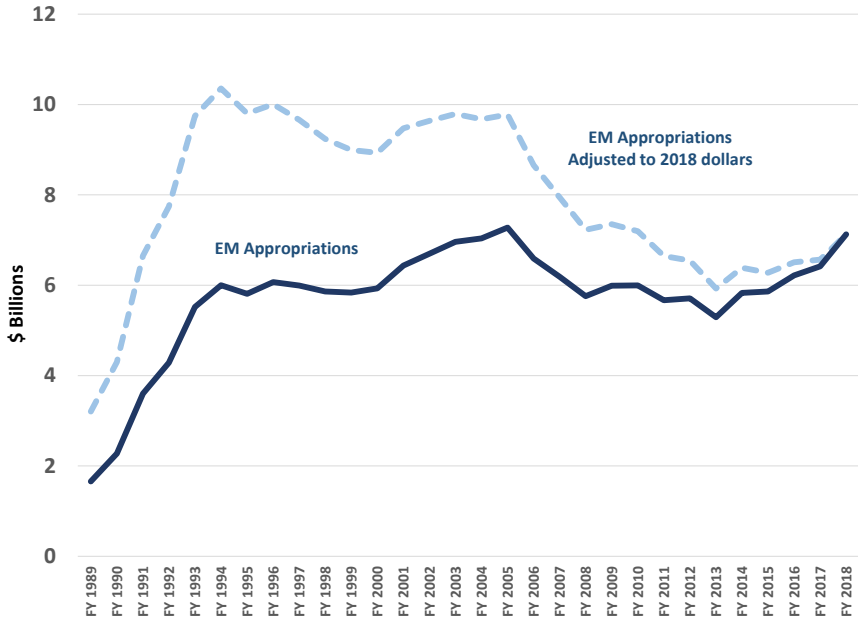

FIGURE 2.3 Topline budget authority (BA) since 1989 for Office of Environmental Management and predessor offices. NOTE: The BA is given both in as-spent dollars and in amounts inflated forward to 2018. SOURE: Rodney Lehman, Department of Energy, "EM Historical Appropriations as of 1989," email to committee staff, July 14, 2020.

ACCOMPLISHMENTS TO DATE

The cleanup of the industrial complex maintained by DOE and its predecessor agencies has proved to be a massive enterprise. The U.S. Army Corps of Engineers, Manhattan Engineering District, started constructing the complex during the Second World War. The complex was expanded during the ensuing Cold War by the AEC, the Energy Research and Development Administration, and starting in 1977, DOE. At its peak, this nuclear complex encompassed 134 distinct sites in 31 states and 1 territory, with a total area of more than 2 million acres (DOE, 1998, Figure 2.7. Nuclear weapons and energy production activities required the construction of many buildings and facilities, produced large quantities of radioactive and hazardous wastes, and resulted in widespread groundwater and soil contamination at these sites, often referred to as "nuclear legacy sites."

More than 100 of the DOE nuclear legacy sites required cleanup actions. Eleven were cleaned up prior to 1989; the majority of sites, 55, were cleaned up in the 10 years between 1989 and 1998; 20 sites were cleaned up between

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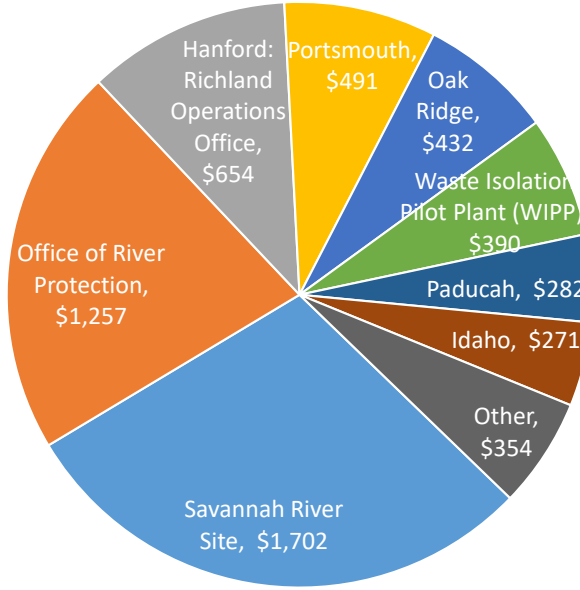

FIGURE 2.4 Office of Environmental Management Budget Request ($000,000), listed by site; fiscal year 2021. "Other" includes monies for, in decreasing order: Los Alamos National Laboratory; West Valley Demonstration Project; Nevada National Security Site; Moab; Separations Process Research Unit; Energy Technology Engineering Center (ETEC); Sandia National Laboratories (managed by the National Nuclear Security Administration); Lawrence Livermore National Laboratory; and Brookhaven National Laboratory.

1999 and 2008; and 5 sites between 2009 and 2019 (see Table 2.2).[16] In total, EM and its predecessor offices have completed cleanup actions at 90 out of 107 sites.[17] The remaining cleanup sites, listed in Table 2.3, are often cited as the most complex, and therefore the most costly to remediate with the longest timelines to completion.

To meet this objective, EM has undertaken a major cleanup effort, which, according to DOE, is the largest environmental cleanup in the world. Estimates of the remaining cost to cleanup have long been uncertain because the magnitude of contamination, the level of cleanup effort required at some sites, and the

[16] Cleaned up refers to the state of the site in which cleanup actions were completed and the site determined "closed" by EM.

[17] Todd Shrader, Principle Deputy Assistant Secretary (EM-2); Office of Environmental Management (EM), "EM Program History and Overview," presentation to the committee, February 24, 2020, Washington, D.C.

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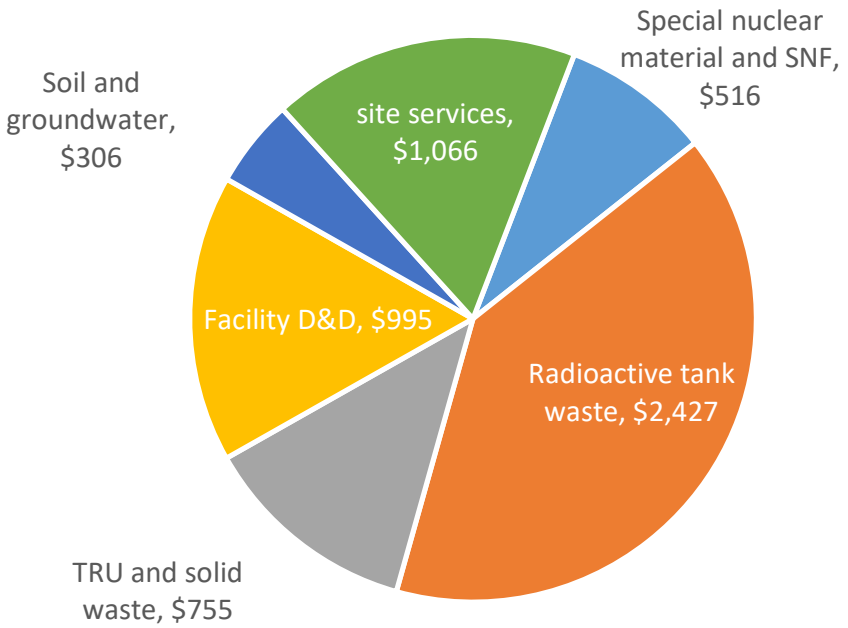

FIGURE 2.5 Office of Environmental Management fiscal year 2021 budget request ($000,000), by program breakdown structure (PBS). NOTES: D&D = decontamination and decommissioning; SNF = spent nuclear fuel; and TRU = transuranic radioactive waste. SOURCE: Adapted from Todd Shrader, Principal Deputy Assistant Secretary (EM-2), Office of Environmental Management, "EM Program History and Overview," presentation to the committee, February 24, 2020, Washington, D.C.

environmental liability (one of the largest in the U.S. government) are still poorly understood (NRC, 2000, p. 14).

EM reports of continuing progress, as reported to the committee, include the following:[18]

- At Hanford's Richland site, radioactive sludge has been transferred away from the Columbia River to T Plant.
- At Hanford's other site, River Protection, significant steps were made in the ongoing construction of the Waste Treatment and Immobilization Plant required for processing the direct feed low activity waste.

[18] The list of EM reports of continuing progress is adapted from Todd Shrader, Principal Deputy Assistant Secretary (EM-2), Office of Environmental Management, "EM Program History and Overview," presentation to the committee, February 24, 2020, Washington, D.C.

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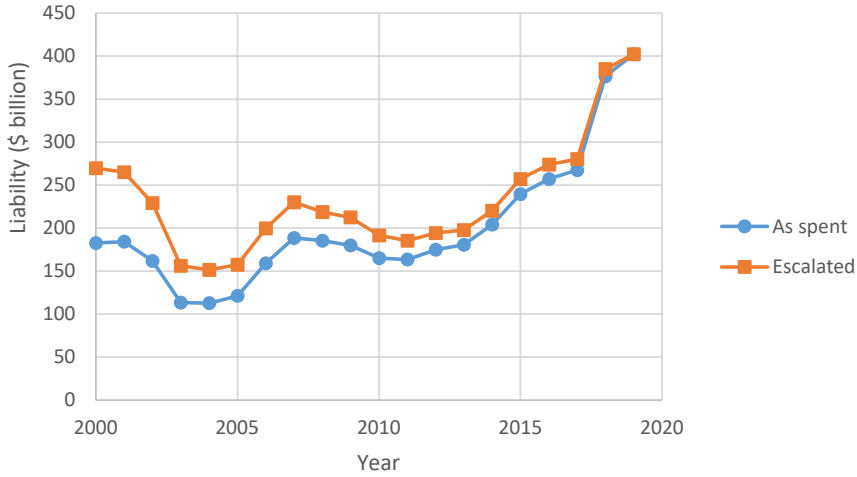

FIGURE 2.6 Cleanup liabilities ($ billions) for sites in the inventory of the Office of Environmental Management. SOURCE: Data from U.S. Department of Energy, email to committee staff from Catherine Bohan, Office of Environmental Management, "NAS 3133 Response to Request for Additional Information #1 dated 03062020 (Item 2)," April 8, 2019.

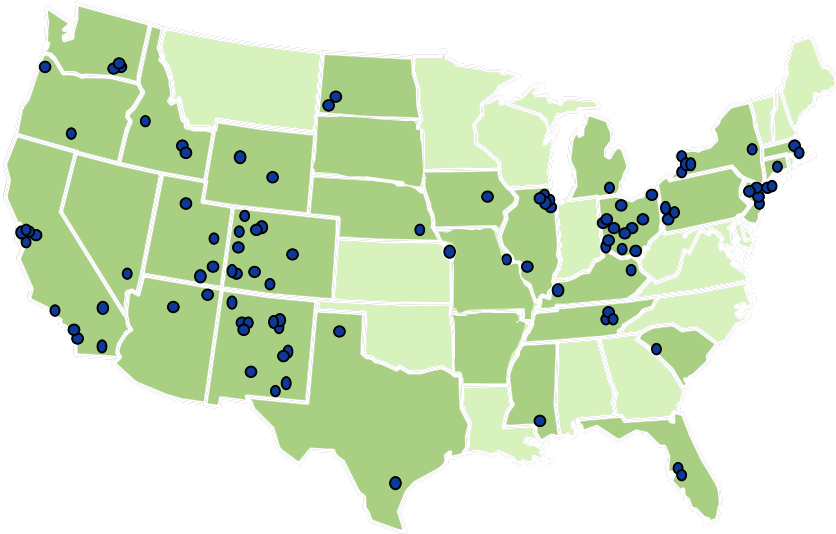

FIGURE 2.7 Sites requiring environmental remediation in 1989 when the Office of Environmental Restoration and Waste Management (later the Office of Environmental Management) was created. Blue circles indicate locations of sites. Additional sites (not shown) were located in Alaska, Hawaii, and Puerto Rico.

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TABLE 2.2 Department of Energy Office of Environmental Management's Cleanup Completion of Sites

Site	Closure Date
Hallam Nuclear Power Facility, NE	1969
Piqua Nuclear Power Facility, OH	1969
Bayo Canyon, NM	1982
Kellex/Pierpont, NJ	1982
University of California, CA	1982
Acid/Pueblo Canyons, NM	1984
Chupadera Mesa, NM	1984
Canonsburg, PA	1986
Shiprock, NM	1987
Middlesex Municipal Landfill, NJ	1987
Niagara Falls Storage Site Vicinity Properties, NY	1987
Salt Lake City, UT	1989
Spook, WY	1989
National Guard Armory, IL	1989
University of Chicago, IL	1989
Green River, UT	1990
Lakeview, OR	1990
Riverton, WY	1990
Tuba City, AZ	1990
Durango, CO	1991
Lowman, ID	1992
Pagano Salvage Yard, NM	1992
Elza Gate, TN	1992
Albany Research Center, OR	1993
Baker and Williams Warehouses, NY	1993
Falls City, TX	1994
Grand Junction Mill Tailings Site, CO	1994
Monument Valley, AZ	1994
Salton Sea Test Base, CA	1994
Project Chariot, AK	1994
Aliquippa Forge, PA	1994
Granite City Steel, IL	1994
Seymour Specialty Wire, CT	1994
Ambrosia Lake, NM	1995

continued

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Effectiveness and Efficiency of Defense Environmental Cleanup Activities of DOE's Office of Environmental ...

TABLE 2.2 Continued

Site	Closure Date
Holloman Air Force Base, NM	1995
Kauai Test Facility, HI	1995
Mexican Hat, UT	1995
Peak Oil PRP Participation, FL	1995
Alba Craft, OH	1995
Associate Aircraft, OH	1995
C. H. Schnoor, PA	1995
Chapman Valve, MA	1995
General Motors, MI	1995
Herring-Hall Marvin Safe Co., MA	1995
Gunnison, CO	1995
Oxnard Facility, CA	1996
South Valley Superfund Site, NM	1996
B&T Metals, OH	1996
Baker Brothers, OH	1996
Oak Ridge Associated Universities, TN	1996
Fermi National Accelerator Laboratory, IL	1996
Site A/Plot M, IL	1997
Geothermal Test Facility, CA	1997
New Rifle, CO	1997
Old Rifle, CO	1997
Pinellas Plant, FL	1997
Slick Rock Old North Continent, CO	1997
Slick Rock Union Carbide, CO	1997
New Brunswick Site, NJ	1997
Ventron, MA	1997
Bellfield, ND	1997
Bowman, ND	1998
Maybell, CO	1998
Naturita, CO	1998
Center for Energy and Environmental Research, PR	1998
Ames Laboratory, IA	1998
Princeton Plasma Physics Laboratory, NJ	1999
Sandia National Laboratories – CA	1999
Monticello Remedial Action Project, UT	1999

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TABLE 2.2 Continued

Site	Closure Date
Columbus Environmental Management Project - King Avenue, OH	2000
Argonne National Laboratory - West, ID	2000
General Atomics, CA	2001
Grand Junction Office, CO	2001
Weldon Spring Site, MO	2001
Maxey Flats Disposal Site, KY	2002
Salmon Site, MS	2005
Laboratory for Energy-Related Health Research, CA	2005
Rocky Flats Environmental Technology Site, CO	2006
Kansas City Plant, MO	2006
Lawrence Livermore National Laboratory - Main Site, CA	2006
Amchitka Island, AK	2007
Columbus Environmental Management Project - West Jefferson, OH	2007
Ashtabula Environmental Management Project, OH	2007
Lawrence Berkeley National Laboratory, CA	2007
Fernald Environmental Management Project, OH	2007
Miamisburg Environmental Management Project, OH	2008
Pantex Plant, TX	2009
Argonne National Laboratory - East, IL	2009
General Electric Vallecitos Nuclear Center, CA	2010
Inhalation Toxicology Laboratory, NM	2011
Stanford Linear Accelerator Center, CA	2014

SOURCE: Modified from Department of Energy, Office of Environmental Management, "Completed Cleanup Sites," https://www.energy.gov/em/completed-cleanup-sites, accessed October 14, 2020.

- Cleanup of the East Tennessee Technology Park (ETTP) at Oak Ridge gained headway with completion of demolition of the K-1037 Building.
- The Savannah River Site completed an 11-year demonstration of two interim salt waste processing facilities, which support preparations for the startup of the Salt Waste Processing Facility, to be used to process tank waste on-site.
- The Waste Isolation Pilot Plant (WIPP) received its 12,500th shipment of transuranic waste for disposal.
- At the Idaho site, safely completed processing at the Advanced Mixed Waste Treatment Facility of stored transuranic waste, preparing it for offsite disposal;

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TABLE 2.3 Department of Energy Sites and Locations with Current Remediation and Cleanup Activities; Fiscal Year (FY) 2021 Budget Request Values Included

Site Name	Location	FY 2021 Budget Request	End Date[a]
Hanford: Office of River Protection	Richland, WA	$1.258 billion	
Hanford: Richland Operations Office	Richland, WA	$655 million	
Lawrence Livermore National Laboratory	Tracy, CA	$1.764 million[b]	
Savannah River Site	Aiken, SC	$1.703 billion	
Portsmouth	Piketon, OH	$491 million	2038
Oak Ridge	Oak Ridge, TN	$432 million	
Paducah	Paducah, KY	$282 million	2065
Idaho	Idaho Falls, ID	$271 million	
Los Alamos National Laboratory	Los Alamos, NM	$120 million	
West Valley Demonstration Project	West Valley, NY	$92 million	
Nevada National Security Site	near Las Vegas, NV	$61 million	
Moab	Moab, UT	$48 million	
Separations Process Research Unit (SPRU)	Niskayuna, NY	$15 million	2030
Energy Technology Engineering Center (ETEC)	Canoga Park, CA	$11 million	
Sandia National Laboratories	Albuquerque, NM	$5 million	2031
Brookhaven National Laboratory	Upton, NY	$0 million	2020

[a]As reported by EM's 2020 strategic plan.

[b]Some EM-funded work is also managed by the National Nuclear Security Administration.

SOURCE: Modified from Department of Energy, Office of Environmental Management, "Cleanup Sites," https://www.energy.gov/em/mission/cleanup-sites, accessed October 14, 2020.

- At Portsmouth, reached the highest operating uptime at the site's depleted uranium hexafluoride conversion plant since it began operations; and
- At the West Valley site, completed disposition of waste from the demolition of the West Valley Demonstration Project vitrification plant, shipping nearly 460 containers of waste by train and truck to off-site disposal facilities.

These successes reported by EM do show progress at the remaining sites. However, as discussed above, the rate of increase of EM's environmental liabilities eclipses the rate of closure of these sites and have increased $271 billion since 2010.

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3

Contracting and Project Management in the Office of Environmental Management

CONTRACTING PRACTICES IN THE OFFICE OF ENVIRONMENTAL MANAGEMENT

The contracting model used by the Office of Environmental Management (EM) of the U.S. Department of Energy (DOE) has evolved since its inception in 1989. Initially, management and operating (M&O) contracts prevailed, embodying a unique relationship between the government and contractor and a general work scope so as to comprehend the full suite of activities at a particular site, in some instances. These were cost-type contracts with fees paid either on a fixed fee schedule or incentive basis. Later EM employed contracts that had more specific work scope with cost reimbursement plus performance-based awards and fees.[1] In the mid-1990s, DOE implemented several so-called closure contracts at the Rocky Flats Plant and the Fernald site, both chosen for accelerated closure by the Assistant Secretary for Environmental Management in 1996 (DOE, 2006, p. 3-23). These contracts were aimed at progressing the cleanup activities at the site toward a defined end state supported by fees and monetary incentives. The fees and awards were made following a set of award criteria in cost-plus-incentive fee (CPIF) contracts (DOE, 2020, p. 7), a type of cost reimbursement contract.

During the present study, EM explained that in the future large procurements will be subsumed under a new end-state contracting model (ESCM).[2] The end state itself is described as follows:

[1] Norbert Doyle, Deputy Assistant Secretary, Office of Acquisition & Project Management (EM-5.2), "Contract Overview," presentation to the committee, February 24, 2020, Washington, D.C.

[2] Written statement of Anne Marie White, Assistant Secretary for Environmental Management, before the Subcommittee on Strategic Forces Committee on Armed Services U.S.House of Repre-

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> Within the Performance Work Statement of the applicable contracts, the term "End State" is defined as the specified situation, including accomplishment of completion criteria, for an environmental cleanup activity at the end of the Task Order period of performance (POP).[3]

EM further explained the relationship between these end states and site completion: "End-state contracting is not a contract type but an approach to creating meaningful and visible progress through defined end-states, even at sites with completion dates far into the future. This is intended to create and motivate a culture of completion." DOE envisages "a two-step process using a competitive qualifications-based Request for Proposal for selection of the offeror representing the best value and subsequent single source, Task Order(s) negotiations through effective partnering." (DOE, 2020, p. 8) The first step results in a single-award indefinite delivery/indefinite quantity (IDIQ) contract to capture a substantial scope of work.[4] The draw period of the IDIQ will be 10 years and uses a combination of firm fixed price (FFP) and cost reimbursement task orders. DOE sees the benefits of this end-state concept to include: quicker evaluations of proposals; less risk of protest loss; freeing up of contractor key personnel; and less proposal cost to industry.[5]

DOE has awarded two IDIQs under the ESCM at Hanford—the Central Plateau Cleanup Contract and the Tank Closure Contract—and one IDIQ for Nevada Environmental Program Services. Proposals for a fourth, the Integrated Management Cleanup Contract at the Savannah River Site, were accepted through December 1, 2020.[6]

PREVIOUS STUDIES OF PROJECT MANAGEMENT

The management of these projects has been the subject of study by different groups, and these studies led to specific changes at DOE. A rough chronology begins in 1998, when a series of reports by the National Research Council (NRC)

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sentatives April 9, 2019, https://docs.house.gov/meetings/as/as29/20190409/109269/hhrg-116-as29-wstate-whitea-20190409.pdf.

[3] Rodney Lehman, EM-5.22, Department of Energy, "Responses to NAS Questions" sent to committee staff, June 30, 2020.

[4] DOE described its "Principles of End State Contracting" to include the goal of having a very specific work-scope which potentially allows for a firm fixed price. DOE describes the benefits of this approach to include but not limited to: quicker evaluations of proposals; less risk of protest loss; frees up contractor key personnel; and less proposal cost to industry. (See Norbert Doyle, Deputy Assistant Secretary, Office of Acquisition & Project Management (EM-5.2), "Contracting Overview," presentation to the committee, February 24, 2020, Washington, D.C.)

[5] Norbert Doyle, Deputy Assistant Secretary, Office of Acquisition & Project Management (EM-5.2), "Contracting Overview," presentation to the committee, February 24, 2020, Washington, D.C.

[6] American Nuclear Society, 2020, "Proposals Being Accepted for $21 Billion Savannah River Contract," October 7, https://www.ans.org/news/article-2261/proposals-being-accepted-for-21-billion-savannah-river-contract.

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were initiated by Congress. DOE subsequently worked to improve project management in three areas recommended by the NRC: "strengthening project management policies and guidance, developing consistent and objective performance information on ongoing projects, and improving the quality of federal oversight" (GAO, 2007a, p. 4). The Office of Engineering and Construction Management (OECM)[7] (DOE, 1999) was formed within the Office of the Chief Financial Officer "to drive changes in DOE's project management system and establish a strong project management capability" (NRC, 2007, p. 8); subsequently, DOE published Order 413.3, *Program and Project Management for the Acquisition of Capital Assets* on October 13, 2000.

The NRC reports continued annually and in 2004 found "inadequate planning, inadequate risk management, and inadequate monitoring and follow-up." (NRC, 2004, p. 70). DOE issued the revised project management order, Order 413.3A on July 28, 2006 to incorporate lessons learned ((GAO, 2007b, p. 8) and in November 2010 issued the successor Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets* (hereafter "Order 413.3B" or "the Order"). The DOE Office of Project Management, created in 2015, manages Order 413.3B and is the secretariat for the Energy Systems Acquisition Advisory Board (ESAAB) and the Project Management Risk Committee (PMRC).[8]

An internally led, externally advised study by DOE addressed project management as well. Initiated by a tasker memo from Secretary Steven Chu (March 31, 2011), this latter effort noted: "Appropriately constituted program offices with empowered program managers; strong line management with well understood roles and responsibilities; effective peer reviews; stability in organizational structure and personnel; and a culture of open information sharing could address many of EM's program and project performance issues."[9]

The U.S. Government Accountability Office (GAO) found problems with DOE's contract and project management and added the latter to its High-Risk Report first in 1990 where it has remained (GAO, 2019a). GAO further noted in 2019 that EM's cleanup policy did not follow the majority of the leading practices for project management selected by GAO for evaluation (GAO, 2019b). The congressional request for the present study was made about this time.

The Department's activities addressing project effectiveness and efficiency have evolved from the above activities and recommendations. EM applies Order 413.3B to those activities over $50 million in the following categories: major items of equipment (MIEs); environmental cleanup projects; and line-item construction projects. As of February 2020, there were 14 line-item construction

[7] Congress had eliminated funding for the DOE office that was responsible for project and facilities management in 1999.

[8] Office of Project Management, "About Us," https://www.energy.gov/projectmanagement/about-us.

[9] Daniel B. Poneman, Deputy Secretary of Energy, 2011, "Secretarial Review of Environmental Management Programs and Projects," Washington, D.C., September 9.

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projects and with a total project cost (TPC) of $21.6 billion, comprising roughly one-quarter of EM's annual budget authority.[10] The remaining three-quarters includes activities to which EM is not applying Order 413.3B. Some of these activities include site services while others include projects for decommissioning of buildings—a new protocol for these latter activities was published by EM in 2020—waste disposal operations, or environmental remediation.

The various studies discussed above are described in greater detail in Appendix C.

PROJECT MANAGEMENT AT DOE

The project management directive that applies to the work of EM is Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*. The earliest version was issued in 2000 following a period of concerted activity by DOE to address project management. The Deputy Secretary (S2)[11] had, earlier that year, issued an interim instruction to serve as policy guidance on critical decisions by acquisition executives (AEs) and ESAAB and on the conduct of corporate level performance reviews. In June of 2000, DOE had issued Policy P413.1, which addressed project management accountability, the establishment of project management organizations, project management tools, and training of personnel. Order 413.3 followed from that policy.

In meetings with the committee, DOE described Order 413.3B as being "intended to provide the DOE Elements, including NNSA, with program and project management direction for the acquisition of capital assets with the goal of delivering projects within the original performance baseline (PB), cost and schedule, and fully capable of meeting mission performance unless impacted by a directed change."[12] It implements three directives from the U.S. Office of Management and Budget: A-11, Preparation, Submission, and Execution of the Budget and the included Capital Programming guide; A-123, Management's Responsibility for Internal Control; and A-131, Value Engineering. The applicability of Order 413.3B is to certain types of activities over $50 million TPC: construction projects, MIEs and environmental cleanup projects. It does not apply to information technology projects, weapons life extension projects, or financial assistance projects (cooperative agreements and grants).[13]

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[10] Norbert Doyle, Deputy Assistant Secretary, Office of Acquisition & Project Management (EM-5.2), "Contracting Overview," presentation to the committee, February 24, 2020, Washington, D.C.

[11] The Secretary has the designation "S1," the Deputy Secretary "S2", and the undersecretaries "S3", "S4," and "S5."

[12] Rodney Lehman, Director, EM Office of Project Management (EM-5.22), "Overview of DOE O[rder] 413.3B and EM Project Management Protocol for Demolition Projects," presentation to the committee, February 24, 2020, Washington, D.C.

[13] Paul Bosco, Director, Office of Project Management (PM), "Project Management (PM) Governance, Systems and Training," presentation to the committee, May 6, 2020, Washington, D.C.

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Order 413.3B contemplates several critical decision (CD) points as depicted in Figure 3.1. The official who can authorize each CD varies according to the total project cost (see Table 3.1).

There are a number of oversight committees internal to DOE including those concerned with project management:[14]

- *Project Management Risk Committee (PMRC).* PMRC is chaired by a noncareer senior advisor to the Deputy Secretary. (The Deputy Secretary is also Chief Executive (CE) for Project Management.) The director's office of the Office of Project Management (PM-1) serves as executive secretariat. PMRC provides advice on cost, schedule, and technical issues regarding capital asset projects with a TPC of greater than $750M and on other high risk/high visibility projects, as needed.
- *Energy Systems Acquisition Advisory Board (ESAAB).* Chaired by the Deputy Secretary, ESAAB advises project management policy and issues, and assists the CE on each CD milestone (i.e., those of more than $750 million TPC).

In addition, the department operates a number of management information systems owned by the Office of Project Management (PM), which is a line office reporting to a different under secretary than EM. Two are most important for project management and oversight:[15]

- *Project Assessment and Reporting System (PARS).* Reporting on a monthly basis, PARS is DOE's System of Record for project management information. PARS tracks projects with TPC greater than $50M, and PARS is the system that captures the progress reporting and documentation required per Order 413.3B to include: (1) At CD-0, Approve Mission Need: Start Narrative assessments/document upload; and (2) At CD-2, Approve Performance Baseline, to CD-4 (Completion): Start Cost and Schedule Data Reporting. Starting in June 2019, PARS was updated to include EMPOWER, a commercial off-the-shelf analysis and reporting tool to enable informed decision making.
- *Earned Value Management System (EVMS) Project Control System.* This control system implements the requirement of the Federal Acquisition Regulation to certify the use of an EVMS, which captures schedule, cost,

[14] Adapted from Paul Bosco, Director, Office of Project Management (PM), "Project Management (PM) Governance, Systems and Training," presentation to the committee, May 6, 2020, Washington, D.C.

[15] Adapted from Paul Bosco, Director, Office of Project Management (PM), "Project Management (PM) Governance, Systems and Training," presentation to the committee, May 6, 2020, Washington, D.C.

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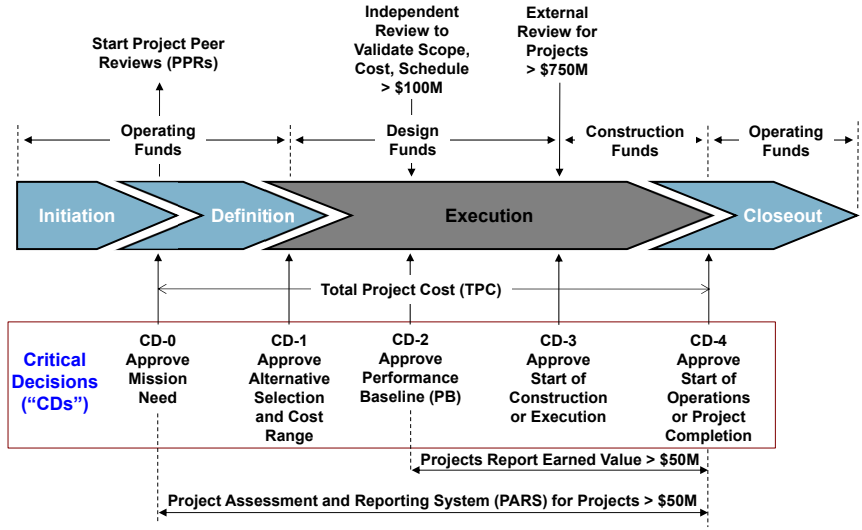

FIGURE 3.1 Department of Energy Project Management Process. SOURCE: Paul Bosco, Director, Office of Project Management (PM), "Project Management (PM) Governance, Systems and Training," presentation to the committee, May 6, 2020, Washington, D.C.

TABLE 3.1 Decision Authority for Various Levels of Total Project Cost (TPC)

Critical Decision Authority	Total Project Cost Thresholds
Deputy Secretary	≥ $750 million
Under Secretary	≥ $100 million and < $750 million
Program Secretarial Officer	> $50 million and < $100 million

SOURCE: Paul Bosco, Director, Office of Project Management (PM), "Project Management (PM) Governance, Systems and Training," presentation to the committee, May 6, 2020, Washington, D.C.

and technical performance data to be used for informed decision making. The corporate ownership of this control system is with PM.

This chapter has described DOE's process and controls for project management. Crucially, the above are applied according to threshold criteria and to certain types of projects as described in the applicability of Order 413.3B. The committee has received briefings and exchanged written queries and replies with DOE to understand these processes and controls as used in EM for the defense nuclear waste cleanups. The following chapters analyze these in more detail and offer findings and recommendations.

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4

Project Management Policies, Processes, and Procedures

DESCRIPTION OF CURRENT EM PROGRAM AND PROJECT STRUCTURES AND TYPES

This chapter describes and assesses Order 413.3B of the U.S. Department of Energy (DOE), *Program and Project Management for the Acquisition of Capital Assets* (DOE, 2018a). The chapter assesses Order 413.3B by comparing it against recognized industry standards and looking at its current application within the Office of Environmental Management's (EM's) cleanup program. The committee deferred the review of program management to the second phase of work and has emphasized project management for this first phase. The two levels of management—program and project—are linked, with one enabling the success of the other. The chapter provides specific findings regarding Order 413.3B compared to "best practice" status for significant elements of Order 413.3B together with actionable recommendations.

In meetings with the committee, EM staff outlined an approach to end-state contracting, discussed in greater detail in Chapter 3. This approach will utilize indefinite delivery, indefinite quantity (IDIQ) contracts, with 5-year task orders issued over a 10-year draw period. Under this concept, EM plans to utilize such contracts but with a single award.[1]

In one sense, DOE-EM does not thoroughly define successful outcomes or end states. The use of IDIQ, typically employed when an agency has not defined the work except in broad terms, underscores this. Rather, an end-state contracting model (ESCM) is focused on delivery of a set of discrete outputs

[1] Rodney Lehman, EM-5.22, DOE, "Responses to NAS Questions," sent to committee staff, June 30, 2020.

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that are not clearly mapped by contract to achievement of either a clearly defined intermediate or final end state. This significant deficiency deprives EM and the IDIQ contractor of the benefits of having a completion-oriented contract fully integrated throughout the supply chain and the fostering of innovation at the scale the program requires. Finally, the ESCM approach, as defined, focuses on narrowly defined performance criteria and increases risks associated with incomplete statements of work. These concerns and deficiencies were largely successfully addressed in Rocky Flats and Fernald.

EM appears to be at an inflection point where outcomes-based contracting for an entire site is not feasible given the scale of the challenges at the individual site. However, the committee believes that subgroupings of cleanup activities exist which lend themselves to end-state approaches similar to what was achieved on a site-wide basis at Rocky Flats and Fernald. This chapter considers the lessons learned from these two sites and their impact on DOE's path forward and choice of the IDIQ task order approach and the degree to which this approach can be linked with meaningful end states.

OMB Circular A-11 and PMIAA Applicability

This section discusses three areas where additional clarity and expansion would be beneficial, particularly in applying Order 413.3B to the EM cleanup program. (The section following this, Assessment of Order 413.3B compared to other project management standards, discusses Order 413.3B vis-à-vis best practices for project management.) These include the following:

- Applicability of Order 413.3B. There is an inconsistency between the statements by DOE and what is stated in Order 413.3B itself. The Office of Project Management states that Order 413.3B "Applies ONLY to construction projects, major items of equipment (MIE's) and (currently) environmental cleanup projects—Over $50 (M) Million Dollars."[2] In EM currently, the active (i.e., Critical Decision 3 [CD-3]) construction projects include 14 projects with a combined $21.6B total project cost (TPC). The "recorded" cleanup projects include four projects with combined TPC of $717 million.[3] DOE Order 413.3B itself, however, describes its purpose as being:

[2] Paul Bosco, Office of Project Management, DOE, "Project Management (PM) Governance, Systems and Training," presentation to the committee, May 6, 2020, Washington, D.C.

[3] Rodney Lehman, Director, EM Office of Project Management (EM-5.22), "Overview of DOE O[rder] 413.3B and EM Project Management Protocol for Demolition Projects," presentation to the committee, February 24, 2020, Washington, D.C.

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> To provide the Department of Energy (DOE) Elements, including the National Nuclear Security Administration (NNSA), with program and project management direction for the acquisition of capital assets with the goal of delivering projects within the original performance baseline (PB), cost and schedule, and fully capable of meeting mission performance, safeguards and security, and environmental, safety, and health requirements unless impacted by a directed change.
>
> To implement Office of Management and Budget (OMB) Circulars to include: A-11, and its supplement, Capital Programming Guide, which prescribes new requirements and leading practices for project and acquisition management . . . (DOE, 2018a, p. 1)

To a literal reading of the above, Order 413.3B would apply to all projects meeting the definition in Appendix 1 of *Capital Programming Guide V 3.0: Supplement to Office of Management and Budget Circular A-11, Preparation, Submission and Execution of the Budget concerning capital assets* (OMB, 2016).

- *Overly narrow interpretation of OMB Circular A-11, Appendix 1 - Capital Programming Guide.* The Capital Programming Guide of A-11, Appendix 1 notes that "capital assets include the environmental remediation of land to make it useful…" It continues, "Examples of capital assets include the following, but are not limited to them…. Environmental restoration (decontamination and decommissioning efforts)." Further it states, "The cost of a capital asset is its full life-cycle costs, including all direct and indirect costs for planning, procurement (purchase price and all other costs incurred to bring it to a form and location suitable for its intended use), operations and maintenance (including service contracts), and *disposal* [italic added]."

  Additional clarity in A-11 Appendix 1 Capital Programming Guide and DOE Order 413.3B, to clearly establish that all environmental restoration that derives from the prior construction and operation of a capital asset is to be included in the definition of a capital asset as provided for in OMB Circular A-11, would be beneficial.

A third area may be added to the above observations on applicability, one which the committee will further examine in the Phase 2 report when discussing the links from portfolio-to-program-to-project, as follows:

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- *Portfolio and program management.* The Program Management Improvement Accountability Act (PMIAA) requires portfolio reviews[4] as part of the agency's annual strategic review process. PMIAA established a new position, the Program Management Improvement Officer (PMIO), responsible for implementing program management policies established under respective agencies (DOE). Currently, Order 413.3B represents itself as encompassing program management.

FINDING: The applicability of Order 413.3B is to "capital asset projects" which DOE describes as being construction projects, major items of equipment, and certain environmental cleanup projects. Projects less than $50 million total project cost are exempted. Order 413.3B applies to a small subset of EM's budget, chiefly to construction projects and to "recorded" cleanup projects.

Demolition Protocol

The Department released a new Demolition Protocol on July 13, 2020. This is expressly for the "demolition of excess decontaminated buildings."[5] Formally called *Office of Environmental Management Cleanup Project Management Protocol and Implementation Standard for Demolition Projects*, the Protocol has the stated purpose "to establish tailored project management requirements that are applicable to EM demolition projects and consistent with DOE Order (O) 413.3B." (DOE, 2020, p. 1). EM further elaborated that the Demolition Protocol is suited for activities that take place in a regulatory framework that governs the cleanup. It employs the same terminology as Order 413.3B.[6]

EM described the new Protocol in comparison to Order 413.3B in terms of the Critical Decision points in a high-level process map comparison.[7] The largest differences are found at CD-0/CD-1, in which the Protocol requires a memorandum

[4] OMB defines program as the functions or activities which agencies are authorized and funded by statute to administer and enforce. Programs typically involve broad objectives. OMB views projects as temporary efforts with defined scopes to create products or services to improve the efficient and effective implementation of programs. Because programs are comprised of projects, programs inherently address the projects subsumed within them. Finally, OMB defines portfolios as organized groupings of programs whose coordination in implementation enables agencies to achieve their objectives (Office of Management and Budget, 2018, "Improving the Management of Federal Programs and Projects through Implementing the Program Management Improvement Accountability Act (PMIAA)," OMB Memorandum M-18-19, Washington, D.C., June 25).

[5] Mark W. Menezes, Under Secretary of Energy, July 13, 2020, "Memorandum for Heads of Department Elements; Subject: Demolition Projects," Washington, D.C.

[6] Rodney Lehman, Director, EM Office of Project Management (EM-5.22), "Overview of DOE O[rder] 413.3B and EM Project Management Protocol for Demolition Projects," presentation to the committee, February 24, 2020, Washington, D.C.

[7] Ibid.

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describing mission need and the framework under which the project will proceed. At those same CD points, Order 413.3B has a number of reviews and documentation steps. As of March 2020, EM intended to include five cleanup projects under the Demolition Protocol that were previously under Order 413.3B. The TPC of these was $1.084 billion.

The following sections discuss the Demolition Protocol in terms of its applicability and its relation to other DOE requirements.

FINDING: EM has created a new Demolition Protocol that applies to selected cleanup projects that were previously proceeding under Order 413.3B. DOE's objective in creating this Protocol is to provide a set of requirements more suited for activities subject to regulatory frameworks. The Protocol is streamlined compared to Order 413.3B, particularly at the CD-0 and CD-1 stages.

ASSESSMENT OF ORDER 413.3B COMPARED TO OTHER PROJECT MANAGEMENT STANDARDS

The committee assessed DOE Order 413.3B against three reference systems for program and project management:

- Project Management Institute (PMI) best practices (nine elements)[8]
- Construction Industry Institute (CII) best practices[9]
- UK Government Functional Standard GovS 002: Project delivery—portfolio, programme, and project management[10]

The first of these three systems, the PMI's best practices, encompasses nine elements of success. Founded in 1969, PMI is a professional extension of the project management trend that emerged from the 1960's explosion of project management in the defense industries. Today, PMI has over 600,000 global members. PMI best practices were also considered in the Government Accountability Office's (GAO's) report entitled *Nuclear Waste Cleanup: DOE Could Improve Program and Project Management by Better Classifying Work and Following Leading Practices* (GAO, 2019). The second system was the CII best practices. CII is a consortium of more than 140 leading owner, engineering-contractor,

[8] See, for example, J.N. Salapatas, 2000, "Best Practices—The Nine Elements to Success," paper presented at Project Management Institute Annual Seminars and Symposium, Newtown Square, PA: Project Management Institute.

[9] Further information available at Construction Industry Institute, "Best Practices," https://www.construction-institute.org/resources/knowledgebase/best-practices.

[10] Available at Government of the United Kingdom, "Government Functional Standard GovS 002: Project Delivery," last update July 18, 2019, https://www.gov.uk/government/publications/project-delivery-functional-standard.

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and supplier firms from both the public and private arenas and includes the U.S. Department of Energy among its members. The final system considered in benchmarking is the UK Government Functional Standard GovS 002: "Project delivery—portfolio, programme and project management" (July 2017). This standard looks across portfolios, programs and projects and was specifically developed for government project use. Its program management standards will serve as a benchmarking basis for this committee's second report focused more on programs.

In this section and as shown in Table 4.1, the committee assesses the extent to which Order 413.3B represents best practice for project management and will note areas for improvement for portfolio and program management, with "portfolio" not indicated as a coverage area for Order 413.3B (program and project). Table 4.1 is organized by major topical areas that cut across the various benchmarking standards. Within the topical areas the project life-cycle as described in DOE Order 413.3B is used as an organizing principle for comparison.

FINDING: DOE Order 413.3B generally compares favorably with benchmarks for project management practices, including those of PMI, CII, and the UK government.

FINDING: DOE Order 413.3B does not incorporate CII's best practices for advanced work packaging, materials management, planning for modularization, or disputes prevention and resolution.

Program Management

- Portfolio and program management are not adequately addressed in Order 413.3B:
  - Order 413.3B does not address the challenges, opportunities, and processes that affect project to project interfaces and efficient "end-state" oriented program delivery.
  - Order 413.3B does not address the risks associated with the totality of a program and, more broadly, the EM program.
- Order 413.3B does not specifically address commercial and financial considerations, which are more typically found at the portfolio and program levels from a management perspective. Other governance documents will become important in evaluating the proposed use of end-state contracts using IDIQs.

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TABLE 4.1 Evaluation of Order 413.3B[a] versus Three Benchmarking Standards: Project Management Institute (referred to as "PMI" in the Table); Construction Industry Institute ("CII"); and UK Government Functional Standard GovS 002: Project Delivery – Portfolio, Programme and Project Management ("GovS 002")

Topic	Assessment	Growth Areas
Governance Frameworks	• Overall governance framework for projects outlined in Order 413.3B is largely consistent with GovS 002	• Areas requiring further attention include portfolio and program management, which DOE does not address in Order 413.3B; CII best practices on alignment and partnering are not addressed in Order 413.3B; assurance frameworks of Order 413.3B do not address the role/value of internal/project audit; Order 413.3B does not highlight a data/information-centric approach essential for managing a program of the scale of EM's cleanup; coverage of configuration management requires improvement (the parallel approach to CD-1,2,3 in EM was judged to be reasonable given the nature of the program and the required environmental and regulatory processes it is subject to).
Critical Decisions (CD)	• The critical decision process laid out in Order 413.3B provides for the phases, deliverables, key milestones and sufficiency criteria envisioned in best practice (1) of PMI	• The parallel execution of CD 1, 2, and 3 in EM is not consistent with PMI best practices (1) and (5)iii but the committee has judged it to be reasonable. This is now codified in the Demolition Protocol[b] which the committee regards as a project execution plan (PEP) within the context of Order 413.3B and consistent with the PEP approach used by NNSA. The appropriate use of PEPs for EM projects could address this concern across all EM project types. See DOE G 413.3-15,[c] Project Execution Plans.[d] • DOE construction management plans and processes are not well developed in Order 413.3B or associated guides.
	• Approvals–Order 413.3B demonstrates PMI best practice (9) work authorization and change control	

continued

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TABLE 4.1 Continued

Topic	Assessment	Growth Areas
	• Cost estimates–This will be looked at in conjunction with the committee's second report	Under Secretary Mark Menezes's July 13, 2020, memorandum on Demolition Projects states in section IV that: Disaggregation of site program work into smaller discrete work activities is encouraged as it provides better project definition and clarity, is more manageable, reduces time horizons and risks, and is consistent with the project management best practices found in DOE O[rder] 413.3B.[e] • While improved project definition and clarity is a desired outcome, what is gained in definition and clarity for small individual tasks may come at the expense of delivering on EM's overall cleanup objectives for a particular site and EM's broader mission. The disaggregation of work introduces risks between each of the projects comprising the program and has the effect of limiting opportunities (negative risks) while increasing complexity from a program perspective. • Management of multiple task order projects requires multiple scope development activities and negotiations. Scope development must be clearly linked to overall site outcomes in a manner that assures that missing scope is not just picked up in a subsequent task. Scope completeness responsibilities weigh much heavier on DOE than the contractor. • Segregation of resources, funds and accounting by task requires DOE to assure that funds paid for one task are not being applied to another task by a sole source contractor. This is important when incentives are task based versus overall outcome based and when both cost-reimbursable and fixed price work are being carried out simultaneously.

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TABLE 4.1 Continued

Topic	Assessment	Growth Areas
		• The committee is concerned that completion schedules may be extended as more tasks introduce more schedule precedences into the overall program. As expressed in this report the absence of strong schedule performance indexes underscores this concern and time is clearly a significant cost adder. • Final program cost is closer to the estimates at completion based on the schedule-cost index (product of the cost-performance index and the schedule-performance index), which suggests a ceiling to the final cost. Estimates at completion based on the cost-performance index are a floor to actual final cost given that program cost performance rarely improves as the program proceeds to its completion. • The committee in its next report will look at DOE's ability to deliver the cleanup mission utilizing its current approach to project and program delivery and likely levels of funding. At current levels of funding overall EM cleanup is extended by 15 years if escalation in cleanup costs exceeds general inflation, a surrogate for growth in the federal budget, by 1%. With a 2% differential similar to that anticipated in nuclear plant decommissioning, current funding levels do not support the cleanup mission being completed. The committee will examine whether the task order approach further exacerbates this situation. • Finally, with respect to risk reduction the committee is concerned that the focus on tasks can lead to disaggregation at the expense of overall portfolio risk and optimization. The committee views high end risks as outweighing low-end uncertainties resulting in the sum of the likely values of the individual tasks being significantly less than likely program and portfolio costs. We believe that a high degree of statistical correlation exists between the various tasks in a program and to a degree the overall EM portfolio.

continued

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TABLE 4.1 Continued

Topic	Assessment	Growth Areas
		Total program cost grows with both the level of correlation between projects and the number of projects. Correlation in a program or portfolio is driven by common resources, project execution methods, management practices, common regulatory drivers and outcomes and schedule (precedence) interdependencies. These are all present.
	CD-0 • Establishment of requirements is consistent with PMI best practice (2) • Program requirements document defining ultimate goals project must satisfy, currently used by NNSA, would improve EM linkage between program and project aiding the approach to "end-state" contracting.	• Areas requiring further attention include: Expanded basis of design established at CD-0, addressing technical, construction and O&M considerations • DOE should require project risk review by PMRC for all projects >$100 million at this stage, considering their involvement at CD-1.
	CD-1 • System engineering methods and other requirements are consistent with PMI best practices (4), (5)iv, (5)vi.	• The combined CD-1, -2, and -3 approach by EM raises concerns on the timing of completion of risk identification and analysis • Areas that require further attention include ensuring that the safety design strategy requirements ensures that nonhazardous and nuclear safety through design principles and practices extend to all projects

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TABLE 4.1 Continued

Topic	Assessment	Growth Areas
	CD-2 • Order 413.3B meets PMI best practices (2) and (9). In EM, the stated PMI requirements are not met until CD-3 given the combined approach to CD-1,2,3. • The covered scope includes both scope of facilities and scope of services.	• EM needs to provide better evidence of assessing and controlling schedule baselines to demonstrate meeting PMI best practice (6). • EM should fully establish key performance indicators (KPIs) for assessing project performance at this stage. • Requirements related to preliminary/final design need to clarify the facility lifetime EM is considering in sustainability • Configuration control for facilities not covered by the defined hazard categories (HC-1,2,3) is required • EM needs to clarify how they accumulate life-cycle costs from the value management process into the broader EM program and portfolio.
	CD-3	• EM does not clearly identify detailed submissions and construction planning documents for external independent reviews to confirm construction and execution readiness (corresponds to CII best practices).
	CD-4 • Order 413.3B meets PMI best practice (5)vii.	• EM should emphasize the importance of validation and verification in complex programs and recognize that this emphasis cascades into projects comprising the program. • EM must begin startup (shutdown) and commissioning (decommissioning) planning at a much earlier stage than outlined in DOE Order 413.3B

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TABLE 4.1 Continued

Topic	Assessment	Growth Areas
Control Documents	• DOE Order 413.3B meets PMI best practice (5)v; (5)vi; (9) • It appears EM partially addresses PMI best practice (8) escalation and issue management through the quarterly project reviews, but effectiveness and timeliness require further assessment. If EM defines the Energy Systems Acquisition Advisory Board (ESAAB) meetings as meeting these PMI best practices, they appear not to have the level of granularity that effective project reviews require.	• Benchmarking at CD-0, 1, and 2 across EM projects is not apparent and not addressed in Order 413.3B. • Properly implementing Order 413.3B requires incorporating more leading indicator type metrics and predictive performance tools. • EM would benefit from more frequent deep-dive project reviews with greater project coverage. • EM should thoroughly reconcile Final Project Data Sheet and funding documents with performance baseline and systemic lessons learned identified. • EM should consider final peer reviews for the lessons learned stage. DOE Order 413.3B could be improved to require implementing DOE Order 210.2A related to reviewing, vetting, and sharing lessons learned. EM should distribute lessons learned to all DOE federal project directors (FPDs).
Project Life-Cycle Control	• Concerning organization roles and responsibilities, Order 413.3B meets PMI best practice (3) and NNSA has implemented its guidance. The committee has not yet reviewed EM's systems. Given the nature of the EM mission it might be expected the responsibilities of the Office of Project Management (EM 5.22) within EM's Office of Corporate Services would fall at a higher organizational level.	• Changes to the baseline schedule would be better controlled if they required approval by the chief executive for project management. Currently, only technical and cost require approval. • EM should define change control boards consistently across the PEPs. This is especially significant given the new Demolition Protocol.[b] • Order 413.3B does not address roles and responsibilities with respect to portfolio and program, and these should be considered in light of the comment in the previous column on EM 5.22.

[a] Order 413.3B refers to U.S. Department of Energy (DOE), 2018, *Program and Project Management for the Acquisition of Capital Assets: Change 5. DOE O[rder] 413.3B: Change 5*, Washington, D.C., April 12.

[b] DOE Office of Environmental Management, 2020, *Office of Environmental Management Cleanup Project Management Protocol and Implementation Standard for Demolition Projects*, EM Protocol, Final June 8, 2020, Washington, D.C.

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TABLE 4.1 Continued

[c] DOE G 413.3-15 refers to DOE Office of Project Management, 2018, *Project Execution Plans: DOE G 413.3-15A, 9-14-2018,* Washington, D.C.

[d] The Project Execution Plan, described in DOE G 413.3 and referenced throughout Order 413.3B, is interwoven with other requirements beginning at the CD-1 stage, including the Tailoring Strategy (Order 413.3B, p. A-6), the Integrated Project Team (p. A-6), the Risk Management Plan (p. A-7), the Funding Profile (p. A-9) and so forth.

[e] Mark W. Menezes, Under Secretary of Energy, "Memorandum for Heads of Department Elements; SUBJECT: Demolition Projects," July 13, 2020.

CONCLUSION: Overall, DOE Order 413.3B represents best practice for project management, but there are opportunities for improvement for portfolio and program management, for example, by expanding its applicability to include portfolio in addition to program and project management.

CURRENT COVERAGE OF ORDER 413.3B

The scope and applicability of Order 413.3B to portfolios and programs is discussed above, as are two overly constrained interpretations of Order 413.3B. The first, noted above in the section "OMB Circular A-11 and PMIAA Applicability," is DOE's interpretation that Order 413.3B "applies ONLY to construction projects, major items of equipment (MIE's) and (currently) environmental cleanup projects."[11] This appears to be inconsistent with the purpose as stated in the introduction to Order 413.3B. This interpretation of the scope of 413.3B in large part appears to have driven EM's development of a Demolition Protocol (DOE, 2020) (discussed in detail below). The committee considered the possibility of increasing the applicability of Order 413.3B. Table 4.2 includes the committee's analysis of what would be the effect of applying Order 413.3B to a greater number of projects in EM and also what would be the effect of adding provisions addressing certain issues. The latter include, for example, dispute prevention provisions, which are discussed further in Chapter 6.

The second instance of EM's narrow interpretation and application of the DOE Order 413.3B is the exclusion, for example, of groundwater remediation. Here EM's position could be seen as inconsistent with OMB Circular A-11, *Preparation, Submission and Execution of the Budget*—specifically the supplement, "Capital Programming Guide"—which states, "Capital assets include the environmental remediation of land to make it useful" (OMB, 2016, p. 55). This latter concern is somewhat mitigated by the issuance of the Demolition Protocol (DOE, 2020).

DOE further described its application of Order 413.3B to site-based contracts and projects. Where applicable (e.g., if the threshold requirements are met),

[11] Paul Bosco, Office of Project Management, DOE, "Project Management (PM) Governance, Systems and Training," presentation to the committee, May 6, 2020, Washington, D.C.

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Order 413.3B Section 3b requires a contractor requirements document (CRD), and Attachment 1 of the order elaborates a list of requirements applicable to the contract into which the CRD is inserted. As noted, much of the work under contracts awarded by EM is not subject to 413.3B. Management and operating (M&O) contractors have a stewardship role at two of EM's sites (Savannah River Site and Waste Isolation Pilot Plant [WIPP]). In certain instances, M&Os are tasked with performing cleanups, such as at Savannah River,[12] and capital asset projects (CAPs), such as at WIPP.[13] To the extent M&Os are, or will be, conducting or overseeing cleanup contracts and CAPs, the committee believes EM should ensure the requirements of Order 413.3B are applied at the project level.

The incorporation of the Demolition Protocol into Order 413.3B was either planned or in progress during the committee's study, and the specifics of how the incorporation was to be accomplished were not known to the committee. If this is to be accomplished by invoking one of the exemptions in Order 413.3B, the committee notes that section 3c(4) requires approval by the Deputy Secretary (S2) for any exemption to meeting the requirements of Order 413.3B and the meeting of all three requirements of this section. EM does not appear to meet the first requirement of an established Project Management Support Office (PMSO) with "adequate project management requirements, processes and procedures defined to enable project success," given their high percentage of capital asset projects that they do not perform per DOE Order 413.3B.

The definition found in Section 3c(4) of Order 413.3B, third bullet point, defines eligibility for exemption as:

> Completed 90% of projects across a three-year rolling average, not to exceed by more than 10% of the original cost baseline for the original approved scope at CD-2 for all capital asset projects with TPC [Total Project Cost] greater than $50 million. (DOE, 2018a, p. 4)

This definition implies a number of possible issues:

- There is acceptance of a 10 percent overrun.
- Performance is based on number of projects as opposed to aggregate cost performance of the portfolio of projects considered. In the proposed IDIQ approach EM disproportionately weighs many small projects toward their overall performance. A simple example to illustrate the point would be a group of 10 projects, 9 with TPC at $50 million and one with TPC of $1 billion. The 9 projects are each completed for $55 million

[12] For example, the Savannah River Nuclear Solutions LLC contract was expanded to include cleanups. See Fluor, 2020, "U.S. DOE Savannah River Site Management & Operations," https://www.fluor.com/projects/savannah-river-nuclear-management-operations.

[13] Catherine Bohan, Office of Environmental Management, DOE, "NAS 3133 Response to Request for Additional Information #1 dated 03062020 (Item 5)," April 6, 2020.

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(10 percent overrun and deemed acceptable); the 10th project experiences a 20 percent overrun and deemed unacceptable). That is, 90 percent of the projects have been completed within 10 percent, but the aggregate of the 10 projects is an overrun of nearly 17 percent.

- The Demolition Protocol (DOE, 2020) objectives could also be accomplished as a PEP for a class of projects within the context of Order 413.3B and is consistent with the PEP approach taken by NNSA. The formal incorporation of the Demolition Protocol into Order 413.3B was still either planned or in progress during the study and therefore not known to the committee.

FINDING: Adoption of Order 413.3B to specific projects or project types is best carried out through effective use of the PEPs as successfully demonstrated in NNSA.

The committee considered the possibility of increasing the applicability of Order 413.3B. Table 4.2 includes the committee's analysis of what would be the effect of applying Order 413.3B to a greater number of projects in EM and also what would be the effect of adding provisions addressing certain issues. The latter include for example dispute prevention provisions that are discussed further in Chapter 6.

COMPARISON OF ORDER 413.3B AND NEW PROPOSED CLEANUP PROTOCOL

DOE presented its rationale for why the Demolition Protocol was needed and why the protocol is envisaged to be separate from Order 413.3B:

> EM often demolishes and disposes of facilities where the design elements common to construction may not be applicable. Further, demolition projects are often conducted against the requirements of a regulatory framework, court orders, consent decrees, or site-specific cleanup agreements that are legally binding and may govern their processes, schedules, alternative selections, technical approaches, scope, end states, decision points and required approvals. The work is frequently covered by a Record of Decision (ROD) or Action Memorandum. The draft Protocol establishes a standard tailored approach to comply with project management requirements specifically related to demolition projects within the framework of DOE O[rder] 413.3B, by allowing substitution of equivalent processes, and consolidating Critical Decision (CD) phases.[14]

[14] Rodney Lehman, EM-5.22, DOE, "Responses to NAS Questions" sent to committee staff June 30, 2020.

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TABLE 4.2 Assessment of Benefits and Challenges of Broader Application of Order 413.3B to EM Projects

Coverage of Order 413.3B	Benefits	Challenges
Increase Order 413.3B coverage	Generally represents best practice for project management and should be broadly applied within EM to improve the overall quality of project execution and the results obtained Acts to strengthen the culture of project management required to deliver EM's mission	Increases the need for FPDs and associated PM staff Requires a broad consistent PM culture to be built across the sites Requires a resource sharing culture to be built across sites to meet evolving EM priorities Requires strengthening of EM project support capabilities and potential elevation of these within the organization when program management needs are considered in the second part of our report
Address relationship to PMIAA and expand coverage to address relationship of programs and projects to portfolios	Strengthens links between portfolio, program, and project Creates defined linkage between portfolio outcomes, program end states (and defined portions thereof), and projects including those awarded under a task order approach, if appropriate	
Clarify that scope of coverage includes capital assets as defined in A-11, not just construction projects, including the full life-cycle, through environmental restoration, of projects related to a capital asset	Ensures Order 413.3B coverage of EM projects of all types within established size thresholds	
Explicitly recognize the circumstances that allow for a combined CD-1,2,3 approach	Maintains EM as consistent with Order 413.3B and can be accomplished through the PEP process as contrasted with the inclusion of the protocol as an Appendix to Order 413.3B	

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TABLE 4.2 Continued

Coverage of Order 413.3B	Benefits	Challenges
Life-cycle cost accumulation and links to portfolio and program goals need to be expanded	Strengthens links between portfolio, program, and project and provides increased transparency of overall EM progress toward ultimate cleanup outcomes	
Links to DOE Order 210.2A related to lessons learned should be strengthened	The committee found the lessons learned process to be an opportunity for improvement	
Changes to the baseline schedule should require Chief Executive for project management approval	Increased focus on program and project schedule performance	
Dispute prevention and resolution should be added to Order 413.3B	Growing reliance on single-award IDIQs for end-state contracting require strengthening of dispute prevention	
Retain Order 413.3B coverage for EM projects without the proposed addition of the issued protocol as an appendix to Order 413.3B	NNSA has demonstrated how to comply with Order 413.3B through appropriate use of PEPs. This approach is viewed as appropriate for EM and retains Order 413.3B best practices	
Modify the definition of eligibility for exemption found at Section 3c(4), point 3, as described previously	Reinforces a higher standard of performance, which is increasingly important given increased use of IDIQ	
Reduce threshold for Order 413.3B applicability to $20 million consistent with current pilot project in NNSA	PEPs for small projects can adapt Order 413.3B to improve project management systems and practices and build the broader project management culture that task order contracting requires. This would foster greater cross-site consistency of implementation of Appendix D	

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The rationale given above for the need for a separate Demolition Protocol, however, still appears to take a narrower view of the applicability of Order 413.3B, as follows:

- The OMB Circular A-11 supplement, "Capital Programming Guide," includes in its scope environmental restoration (i.e., "decontamination and decommissioning efforts") in its Appendix on Definition of Capital Assets (OMB, 2016, p. 55); and
- There is limited overall coverage of EM outlays (i.e., spending) by Order 413.3B. In particular, it is the committee's understanding that projects below $50 million are not covered[15,16] although equivalency is encouraged through a DOE (2018b) policy (issued by memorandum in August 31, 2018).[17] Deactivation projects were described as not covered by Order 413.3B.

The committee's concerns are underscored by the committee's finding that Order 413.3B is generally a best practice with respect to project management.

The Demolition Protocol appears to exclude roles for the Project Management Risk Committee (PMRC) and the Energy Systems Acquisition Advisory Board (ESAAB), which were in Order 413.3B. Given the scale of the demolition challenge, it is possible that specific projects may exceed the $750 million threshold laid out for major systems projects that would otherwise require Deputy Secretary approval, whereas, in the Demolition Protocol, approval has been delegated to a lower organizational level (S4). In addition, although the Protocol's development was heavily influenced by the regulatory processes that are often present, the demolition projects that would be covered include those for which such regulatory frameworks are not present. Such projects would have been amply covered by Order 413.3B and its PEP process. It also appears that certain independent reviews called for per Order 413.3B (e.g., independent project reviews (IPRs) and external independent reviews (EIRs), have been replaced with Independent Field Office and Headquarters Assessments. Many of the features that contribute to Order 413.3B representing a "best practice" for project management have been diluted by or not included in the Protocol.

The new Demolition Protocol discusses end states as they relate to specific projects. The protocol further advises, "Federal teams should consider how best to package their site program and/or projects within a task order or series of task

[15] Paul Bosco, Office of Project Management, DOE, "Project Management (PM) Governance, Systems and Training," presentation to the committee, May 6, 2020, Washington, D.C.

[16] The National Nuclear Security Administration (NNSA) has a pilot project setting this threshold at $20 million for four projects. See Bob Raines, NNSA, "NNSA and DOE O[rder] 413.3B," presentation to the committee, May 6, 2020, Washington, D.C.

[17] DOE (2018b) reiterates that "all projects equal to or less than $50 million shall follow the Project Management Principles as established in Appendix C of DOE O[rder] 413.3B."

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orders, if possible." As noted previously, EM has expressed an intent to utilize an IDIQ form of contract.[18] Some observations about this approach include the following:

- End-state or outcomes-type contracts are desirable but EM's interpretation of end state is not aligned with past examples. Historically, Fernald and Rocky Flats (from year 2000 onward, when the closure contract took over from the cleanup contract [see Table 6.1, in Chapter 6]) represented DOE best practices toward "end-state" contracts, and EM can further improve on these examples in current projects by incorporating the lessons learned from each project and defining end states that represent significant integral portions of remaining portions of EM's mission.
- The shortcomings EM finds in Order 413.3B are fully addressed within the context of Order 413.3B through effective use of PEPs. The committee noted both deficiencies in maintaining PEPs, as well as the successful approach adopted by NNSA.
- EM's application of the IDIQ contract form does not follow traditional procurement practices. IDIQ contracts place less burden on agencies to be precise about the scope of work, which is instead defined when task orders are issued. The contractor can heavily influence the subsequent task order statements of work, and the negotiations for scope of work and cost. The schedule goals in a single-award IDIQ are determined on a sole-source basis, further adding to the risk. Multiple-award contracts, such as is the case with EM's multiple contractor award for a national deactivation contract at the Paducah Gaseous Diffusion Plant, maintain effective competition throughout the acquisition.
- EM's Demolition Protocol for demolition projects states, "Disaggregation of site program work into smaller, discrete work activities is encouraged as it provides better project definition and clarity, is more manageable, reduces time horizons and risks, and is consistent with the project management best practices found in DOE O[rder] 413.3B." (DOE, 2020, p. 3) The committee does not agree with this assessment. Specifically, a multiplicity of projects transfers a greater burden for project management to the DOE from a selected contractor; increases responsibilities with respect to interface management; creates a growing level of risk in the "white space" between individual projects; partitions risks which were demonstrated to be best aggregated on both Rocky Flats and Fernald; and limits the scope for innovations in project delivery and the opportunity for accruing meaningful incentives by the contractor. Industry best practices on large complex programs have sought to maximize risk aggregation consistent

[18] Norbert Doyle, Deputy Assistant Secretary, Office of Acquisition & Project Management (EM-5.2), "Contracting Overview," presentation to the committee, February 24, 2020, Washington, D.C.

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with industry appetite and capabilities and provide sufficient scope for innovation. The committee was unable to identify a clear reference to this as a best practice in Order 413.3B.[19]

FINDING: M&O contractors have a stewardship role at two of EM's sites (Savannah River Site and the Waste Isolation Pilot Plant). In certain instances, such as the Savanah River Nuclear Solutions contract, M&Os are tasked with performing cleanups.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSION: The rationale for creating a new set of requirements outside of Order 413.3B that applies to projects proceeding under the Demolition Protocol is not apparent. There is a risk that these projects will have insufficient oversight.

CONCLUSION: The current focus of Order 413.3B is on project management. The Order lacks attention to program management issues that are included in its stated purpose.

RECOMMENDATION 4-1: The committee recommends that the Department of Energy (DOE) confirm, clarify, and expand DOE Order 413.3B to establish its applicability to all capital asset projects (not just construction and major instruments and equipment and certain cleanup projects) and all Office of Environmental Management projects, whether major systems projects or work carried out by a management and operating (M&O) contractor. The committee makes the following specific recommendations regarding the Order as well:

1. Pending the outcome of the National Nuclear Security Administration pilot project, reduce the threshold value for applicability of Order 413.3B from $50 million to $20 million;
2. Continue applying the requirements of Order 413.3B to M&O contract work on capital asset projects—the latter including construction projects, major items of equipment and cleanup projects;
3. Clarify the definition related to project performance found at Section 3c(4), point 3 to calculate performance on aggregate value and not number of projects; and
4. Shift eligibility for project overruns, currently 10 percent per project, to be applied instead based on the aggregate value.

[19] This will be further considered when the committee turns its attention to program management, as risk and end state must be considered from a programmatic perspective recognizing that the sum of project risks is less than the programmatic risk in large complex programs.

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RECOMMENDATION 4-2: The Department of Energy should clarify Order 413.3B to incorporate best practices with respect to dispute prevention and resolution, which will be of growing significance as the Office of Environmental Management implements the end-state contracting approach. Sources for such best practices include the Construction Industry Institute.

RECOMMENDATION 4-3: The Office of Environmental Management should apply the requirements for project execution plans equivalent to those in Order 413.3B to those projects that are not formally managed under Order 413.3B.

REFERENCES

DOE (U.S. Department of Energy). 2018a. *Program and Project Management for the Acquisition of Capital Assets: Change 5.* DOE O 413.3B. Washington, D.C. April 12.

_____. 2018b. "Office of Environmental Management Policy for Management of Capital Asset Projects with Total Project Cost Equal to or Less than $50 Million." EM Policy. April.

_____.2020. *Office of Environmental Management Cleanup Project Management Protocol and Implementation Standard for Demolition Projects.* EM Protocol. Final June 8. Washington, D.C.

GAO (U.S. Government Accountability Office). 2019. *Nuclear Waste Cleanup: DOE Could Improve Program and Project Management by Better Classifying Work and Following Leading Practices*. GAO-19-223. Washington, D.C.

OMB (U.S. Office of Management and Budget). 2016. *Capital Programming Guide V 3.0: Supplement to Office of Management and Budget Circular A-11, Preparation, Submission and Execution of the Budget.* Washington, D.C.: Executive Office of the President. July.

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5

Project Management Metrics

PROJECT METRICS

This chapter reviews the use of project management metrics by the Office of Environmental Management (EM) of the U.S. Department of Energy (DOE).[1] EM, in coordination with DOE's Office of Project Management (PM), has developed detailed processes and methods for tracking project-level outcomes and success measures for activities it has defined as projects (DOE, 2015a). For example, EM's headquarters staff use earned value management (EVM) techniques to track and monitor project cost and schedule performance. Key measures, discussed in detail below, include the Cost Performance Index (CPI) and the Schedule Performance Index (SPI), along with other typical EVM measures, such as management reserve (MR), estimate at completion (EAC), total project cost (TPC), and funding profile. Additional project management metrics that are typically specific to a given situation, such as objectives linked to safety performance, removal of specific amount of waste, or compliance with consent decrees, are not tracked by EVM techniques.

EM contractors are responsible for reporting project-level outcomes and their key measures through DOE's Project Assessment and Reporting System (PARS) II system. In addition to cost and schedule, the PARS II system helps with tracking project specific metrics.[2] This system provides up-to-date and reasonably

[1] Project management metrics necessarily roll up into *program* performance metrics. However, this interim report focuses on *project* metrics; a future report by this committee will examine and discuss in detail EM's program performance metrics.

[2] See P. Bosco, "Project Management (PM) Governance, Systems and Training," presentation to the committee May 6, 2020, Washington, D.C.

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timely information to EM on a monthly basis so it can monitor, assess, and, if need be, take action to correct project problems as time elapses.

As with any project management measurement system, the PARS II and EM's EVM systems are only as good as the information that the contractor puts into them. This has been an ongoing criticism of EM by the U.S. Government Accountability Office (GAO) as referenced in a number of reports (GAO, 2019b, c). For example, a lack of adequate scope definition during the front-end planning process creates an unstable baseline in which the scope changes or "creeps" as the project or program proceeds. This can lead to a situation in which the baseline is updated and the original baseline is lost, hence the metrics are not really indicative of the critical decisions (CDs).

EM's portfolio of projects subject to DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets,* includes approximately 25 percent of its overall yearly budget.[3] A large majority of activities are not defined as "projects" or fall outside applicability of Order 413.3B in other respects and are therefore not similarly tracked and managed. For instance, projects characterized as operations—the majority of EM's work, including activities such as groundwater remediation—are not tracked by EVM systems certified by the project manager per requirements of Order 413.3B. This latter requirement is invoked for projects of more than $50 million and classified currently as a capital investment (DOE, 2015a; 2018a). As of October 31, 2020, 33 of 34 capital asset projects (CAPs) that were post CD-2 were tracked by EVM System (EVMS). (The one project that is not was approved for alternative project controls.[4]) EM advises but does not require contractors[5] who perform projects costing between $20 million and $50 million to use EVMS, per Appendix C of Order 413.3B (DOE, 2018a), but does, for these smaller projects, nonetheless track earned value data. EM defines projects smaller than $20 million as minor capital projects and they are aggregated into programs (i.e., not tracked separately), further limiting EVM requirements of its activities.

GAO states that:

> EM manages most of its cleanup work as operations activities, under less stringent oversight requirements than capital asset projects. EM manages its cleanup work under different requirements, depending on whether it classifies the work as a capital asset project or an operations activity. EM currently manages most of its work as operations activities. In its fiscal year 2019 budget, operations activi-

[3] Rodney Lehman, Director of Project Management, Office of Corporate Services, Office of Environmental Management (EM), Department of Energy (DOE), comments during the committee's July 21, 2020, public data-gathering session.

[4] Paul Bosco, DOE Office of Project Management, email to Martin Offutt, committee staff, November 11, 2020.

[5] Rodney Lehman, Director of Project Management, Office of Corporate Services, DOE EM, comments during the committee's July 21, 2020, public data-gathering session.

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ties accounted for 77 percent of EM's budget (about $5.5 billion), and capital asset projects accounted for 18 percent about $1.3 billion)" (GAO, 2019a, p. 12).

The following sections explore project management metrics in more detail.

EM'S REQUIREMENTS FOR THE USE OF PROJECT METRICS

In its discussions with EM and review of the documents provided and existing websites, the committee has identified five primary performance management approaches used by EM on its projects:

- EVMS and PARS (described in Chapter 3)
- Project dashboards
- Project evaluation and measurement plans (PEMPs)
- Contract and project performance metrics and targets
- Progress reports to Congress

In general, EVMS is an organization's system for monitoring project/program management that integrates a defined set of associated work scopes, schedules, and budgets. An organization's leadership uses performance management information, produced from the EVMS, to plan, direct, and control the execution and accomplishment of contract/project cost, schedule, and technical performance objectives (scope of work). EVMS is a robust approach to project management and is well defined for use government wide. As described earlier, the EVMS approach is used for EM's cost-based[6] projects with contract values that exceed $50 million. By integrating scope, cost, budget, schedule, and risk, it can assess current performance and project future trends. Data are reported to and warehoused in DOE's PARS II.[7]

Project dashboards[8] are prepared monthly and provide a green, yellow, or red assessment of each active capital project and measures EM's expectation that the project will meet its expected baseline cost (e.g., Monthly Cleanup Portfolio Report, DOE EM-5.22, Office of Project Management, January 2020). The color coding is assessed against cost, schedule, and scope. Evaluation criteria for these ratings were not identified, but as noted in Chapter 4, when discussing Order 413.3B Section 3c(4), point 3, that allowing for a 10 percent overrun is undesirable.

PEMPs measure the contractors' performance and are the primary tool to establish incentive and award fees earned by each contractor. They are

[6] Fixed-price, lump-sum, and guaranteed maximum price (GMax) contract types are excluded.

[7] The committee will evaluate the effectiveness of PARS as it relates to the EM program in its second report.

[8] DOE, Office of Project Management, 2020, "Project Dashboard - June 2020," June, https://www.energy.gov/sites/prod/files/2020/06/f76/June%202020%20Project%20Dashboard.pdf.

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established at each cleanup site with EM HQ's review based on the size of the contract. Chapter 7 provides detail on criteria and rating methodology used for PEMPs. EM uses the phrase "key performance parameters" (KPPs) and describes KPP principles and their use in two documents, DOE Guide: *U.S Department of Energy Performance Baseline Guide* (DOE, 2015b) and *Special Notice—Modification to End State Contracting Model* (DOE, 2018b, App. C9). The documents focus on establishing baseline project definition and design basis and suggest that KPPs be established for any area where changes will have a major impact. The documents do not offer sample KPPs.[9] A best practices reference providing examples of KPPs used on successful projects perhaps would be helpful to practitioners.

EM has identified a list of performance metrics used to assess project performance. This list was originally titled the Overall Contract/Project Management Performance (OCPMP) and is reported quarterly[10,11] (see Table 5.1). The goal of the metrics is to measure progress toward completing the scope of work for the contract and the entire life of an operations activity. Notable is that the number of metrics has decreased from 17 in 2008 to 7 in 2020, and the title of the report has been changed to "Overall Root Cause Analysis (RCA)/Corrective Action Plan (CAP) Performance Metrics."[12]

REPORTING OF PROJECT METRICS

The committee has reviewed sample copies of EM's project management reports,[13] among other provided documents. These reports show EM extensively using EVM project control practices along with capital asset project dashboards, and corporate performance measures. Regarding EVM, EM routinely calculates the following indices: SPI, CPI, EAC, budget at completion (BAC), budgeted cost of work scheduled (BCWS), budgeted cost of work performed (BCWP), and actual cost of work performed (ACWP).

Effective implementation of an EVMS requires a transparent and reliable process and approaches that explicitly and clearly highlight the project's temporal

[9] The committee did not see examples of DOE's KPPs.

[10] DOE, "FY 2020 Second Quarter Report: Overall Root Cause Analysis (RCA)/Corrective Action Plan (CAP) Performance Metrics," https://www.energy.gov/sites/prod/files/2020/05/f74/FY%202020%20Q2%20Project%20Management%20Performance%20Metrics%20Report.pdf, accessed August 11, 2020.

[11] DOE, "FY 2008 4th Quarter Metrics: Overall Contract and Project Management Performance Metrics and Targets," https://www.energy.gov/sites/prod/files/FY2008%204th%20Quarter%20RCA_GAO_OMB%20Attachmentv02%202008-11-17.pdf, accessed August 11, 2020.

[12] The committee will explore what led to the reduced number of reporting metrics and changed title in its second report.

[13] Catherine Bohan, DOE-EM, "NAS 3133 Response to Request for Additional Information #1 dated 03062020 (Item 14)" email April 8, 2020.

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TABLE 5.1 Comparison of the DOE's Office of Environmental Management's (DOE-EM's) Project Management Performance Metrics and Targets from 2008 to 2020

No. Contract/Project Management Performance Metrics FY 2020, 2nd Qtr Actual FY18-FY20	Contract/Project Management Performance Metrics FY 2008 Target FY 2008 Actual Comment
1. Capital Asset Project Success: Complete 90% of capital asset projects at original scope and within 110% of CD-2 TPC.	1. Capital Asset Line Item Projects: 90% of projects completed within 110% of CD-2 TPC by FY11.
	2. EM Cleanup (Soil and Groundwater Remediation, D&D, and Waste Treatment and Disposal)
2. Certified EVM Systems: Post CD-3, greater than $100 million.	3. Certified EVM Systems: Post CD-3, 95% of line item projects and EM cleanup projects by FY11 and FY12, respectively.
	4. PDRI Use: By the end of FY11, 80% of projects (>$100M) will use PDRI methodologies no later than CD-2.
	5. TRA Use: By end of FY11, 80% of projects >$750M will implement TRA no later than CD-2.
	6. Federal Staffing: By the end of FY11, federal contract and project management positions (based on new model) are staffed at 80% of the desired level.
3. Certified FPDs at CD-1: Projects have certified FPDs no later than CD-1.	7. Certified FPDs at CD-1: By the end of FY11, 95% of projects have certified FPDs no later than CD-1.
4. Certified FPDs at CD-3: Projects have FPDs certified at the appropriate level assigned to projects no later than CD-3.	8. Certified FPDs at CD-3: By the end of FY11, 90% of projects have FPDs certified at the appropriate level assigned to projects no later than CD-3.
5. Certified Contracting Staff: By the end of FY 2011, 85% of the 1102 contracting series will be certified.	9. Certified Contracting Staff: By the end of FY11, 85% of the 1102 contracting series will be certified.
	10. Projects Completed Below TPC: By the end of FY11, for all capital asset line item projects that are completed at CD-4, 50% are completed below their currently approved TPC.
	11. Full Funding: By the end of FY13, 80% of capital asset line item projects (less than $50 million) are fully funded in 1 fiscal year (one appropriation).

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No. Contract/Project Management Performance Metrics FY 2020, 2nd Qtr Actual FY18-FY20	Contract/Project Management Performance Metrics FY 2008 Target FY 2008 Actual Comment
	12. Cost Estimating Staffing: By the end of FY10, establish and staff (at 80% of authorized FTEs) a cost estimating and analysis organization in the Chief Financial Officer, Office of Cost Analysis (CF-70) organization.
	13. Award Contracts within 25% of IGE: By the end of FY11, 80% of contract awards are within plus or minus 25% of independent government cost.
	14. Contract Specialist Staffing: By the end of FY11, achieve a contract specialist to contract value ratio of 1 per $X* million or less.
	15. FPD Staffing: By the end of FY12, achieve a FPD (including Deputy FPD(s), as applicable) to annual work in place ratio of 1 per $X* million or less, and/or in accordance with the staffing study.
6. Schedule Compliance, Projects Greater Than 5 Years Duration: Projects will meet the project schedule metric that follows: from CD-3 to CD-4, projects greater than 5 years duration will be completed within 20% of the original CD-3/4 duration.	16. Schedule Compliance, Projects less than 5 years Duration: By the end of FY11, on a program portfolio basis, 90% of all projects will meet the project schedule metric that follows: from CD-3 to CD-4, projects less than 5 years duration will be completed within 12 months of the original CD-3/4 duration.
7. Schedule Compliance, Projects Greater Than 5 Years Duration: Projects will meet the project schedule metric that follows: from CD-3 to CD-4, projects greater than 5 years duration will be completed within 20% of the original CD-3/4 duration.	17. Schedule Compliance, Projects greater than 5 years Duration: By the end of FY11, on a program portfolio basis, 90% of all projects will meet the project schedule metric that follows: from CD-3 to CD-4, projects greater than 5 years in duration will be completed within 20% of the original CD-3/4.

NOTE: FY = fiscal year.
SOURCE: Data from DOE EM: *FY 2020 Second Quarter Report* (see footnote 9) and *FY 2008 4th Quarter Metrics* (see footnote 10) and "FY 2020 Second Quarter Report: Overall Root Cause Analysis (RCA)/Corrective Action Plan (CAP) Performance Metrics," https://www.energy.gov/sites/prod/files/2020/05/f74/FY%202020%20Q2%20Project%20Management%20Performance%20Metrics%20Report.pdf; "FY 2008 4th Quarter Metrics: Overall Contract and Project Management Performance Metrics and Targets," https://www.energy.gov/sites/prod/files/FY2008%204th%20Quarter%20RCA_GAO_OMB%20Attachmentv02%202008-11-17.pdf, accessed August 11, 2020.

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status. Such approaches bring transparency to cost *and* schedule overruns. Some observations on these documents include:

1. The calculation of the SPI is based on dollars, not time. By extracting two new variables from the progress reports, namely: actual time of work performed (ATWP) and scheduled time of work performed (STWP), a revised SPI(t) (equivalent to STWP/ATWP) could be created and would better track schedule performance. Figure 5.1 depicts these two new variables.

   The difference between these two methods can be dramatic. For example, if a project scheduled for 4.5 years with a BCWS of $300 million actually finishes in 6 years, the traditional SPI at completion is 1.0, whereas the revised SPI(t) at completion is 0.75; the traditional schedule variance at completion is 0, whereas the revised schedule variance(t) is negative 1.5 years. SPI(t) captures the impact of increased time on performance whereas SPI does not, and thus SPI(t) may be used to forecast schedule delays.
2. Including the percentage of cost over (under) run, compared to the baseline (i.e., original critical decision (CD)-2 TPC) in the project success metrics would provide more clarity. Some projects have significant cost overruns (e.g., some EM projects have more than doubled their baseline

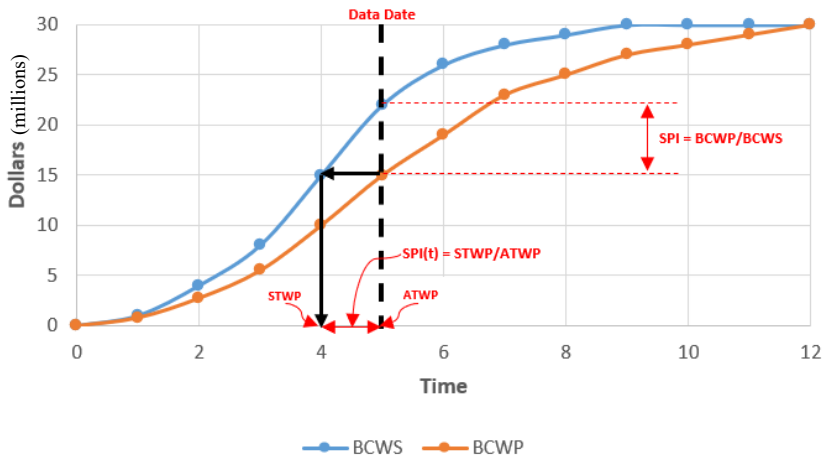

FIGURE 5.1 Example of Schedule Performance Index (SPI) which tracks only cost and SPI(t) which tracks time. NOTE: BCWP = budgeted cost of work performed; BCWS = budgeted cost of work scheduled; STWP = scheduled time of work performed; ATWP = actual time of work performed, SPI(t) is the ratio of STWP to ATWP.

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cost and are not yet complete) and others have lower cost overruns. There are also some projects that finished exactly at the estimated cost. Currently, EM integrates all cost overruns into binary success metrics of Yes/No, which does not provide information on the magnitude of a cost overrun or underrun (i.e., the variance).[14] The variance can be calculated as the difference between BAC and EAC, with the latter determined as BAC divided by CPI.

A robust, reliable, effective, and efficient governance process for the EVMS provides EM headquarters with more clarity on projects' status. However, several reviews of EM's EVMS indicate issues with its implementation and governance process. Examples provided by EM include: the certified EVMS is not fully used; a governance process is not in place; and some datasets provided by contractors are not accurate, complete, repeatable, and auditable (see Table 5.3 for more examples and references). Further investigation of the linkage between the governance and data collection processes, on the one hand, and effective implementation of EVMS, on the other, could be of assistance to EM.

Throughout the review of documents that EM shared with the committee, DOE made several statements that led to specific concerns associated with EVMS and its implementation. Table 5.3 contains a list of statements that were made in the existing documents by EM and its contractors related to EVMS.

All of these issues indicate the need for a robust, reliable, effective, and efficient governance process for EVMS. Therefore, for the second phase of this study, the committee plans to review EVMS governance in more detail, including:

- Current EVMS governance process, the involved parties, and their roles and responsibilities;
- Current EVMS certification process and enforcement of such certification;
- Current data collection processes for EVMS to ensure they are current, accurate, complete, repeatable, and auditable; and
- Current project control systems that EM actively uses.

Over the past 10 years, major projects around the world have adopted some form of digital design and workflow processes. Computer-aided design (CAD) and building information modeling (BIM) are the primary digital systems that improve collaboration, cost estimating, project visualization, scheduling, and project handover, among other metrics. DOE participates in the U.S. Army Corps

[14] Rodney Lehman, Director of Project Management, Office of Corporate Services, DOE EM, "Overview of DOE O[rder] 413.3B and EM Project Management Protocol for Demolition Projects," presentation during the committee's February 24, 2020, Washington, D.C., public data-gathering session, Slide 11. Also see Cathy Bohan, DOE, "Project Success List.xls" in "NAS 3133 Response to Request for Additional Information #1 dated 03062020 (Item 6)" email to committee staff, March 25, 2020.

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TABLE 5.3 List of Earned Value Management System (EVMS)-Related Issues that Were Explicitly Stated in the Documents Provided to the Committee

Issue	SOURCE
1. The certified EVMS was not fully used to develop the performance measurement baseline (PMB) and performance baseline (PB) for tank-side cesium removal (TSCR).	(a)
2. Several EVMS areas need further attention to ensure EIA-748 EVMS.	(a)
3. A governance process is not in place for reviewing the health of the EVMS.	(a)
4. The review team determined that the Bechtel National, Inc. (BNI) EVMS data is not current, accurate, complete, repeatable, or auditable, and neither the current project status nor forecast completion cost and schedule are credible.	(a)
5. Given the magnitude, breadth, and nature of the findings, BNI's ability to retain its March 4, 2008, DOE EVMS certification of compliance is in jeopardy.	(b)
6. DOE PM completed a surveillance review of the contractor's (BNI) project controls system (EVMS) and issued the final report on December 2, 2019. The report concluded that BNI has not maintained its EVMS compliant system. As a result of the noted deficiencies, the government cannot have confidence in BNI's report on its project control system.	(c)
7. BNI submitted its corrective action plan on January 17, 2020, focusing on developing a credible PMB and a disciplined change control process.	(c)

SOURCE: (a) "14_January 2020 Master Segment Quad Charts 03.02.20.pdf," slide 25; (b) "14 January 2020 Monthly CAP quad charts 03.03.20.pdf," slide 12; (c) "14 January 2020 Monthly CAP quad charts 03.03.20.pdf," slide 16.

of Engineers CAD/BIM Technology Center and the A/E/C CAD Standard.[15] The committee's review of the Central Plateau Cleanup Contract–Final Request for Proposal (RFP)[16] and Section H of that RFP did not find DOE requirements[17] for a BIM execution plan or other forms of digital delivery.

Projects in the United States have begun to follow ISO 19650, following its successful use in the United Kingdom.[18] These standards are best practices for BIM collaboration and production. The standard integrates the project's work and organizational breakdown structures (WBS and OBS) and enhances project estimating, scheduling, and status. EM may want to investigate ISO 19650 and, moving forward, determine a consistent requirement for inclusion in its contracts.

[15] See Whole Building Design Guide, "CAD/BIM Technology Center: A/E/C CAD Standard," https://www.wbdg.org/ffc/army-coe/cad-bim-technology-center.

[16] See DOE, Environmental Management Consolidated Business Center, "CPCC Section H IDIQ," https://www.emcbc.doe.gov/SEB/CPCC/Documents/RFP/CPCC_Section_H_IDIQ.pdf.

[17] Every design and construction contractor has in-house digital standards and these are likely established through the contractors' quality programs.

[18] Organization and digitization of information about buildings and civil engineering works, including building information modeling (BIM)—Information Management Using Building Information Modelling—Part 1: Concepts and Principles.

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Recent GAO Findings and Recommendations

In a 2019 report, GAO stated that EM follows only 25 percent (3 of 12) of PMI's project management guidelines (GAO, 2019b). Among those project management guidelines that were identified as not met, or minimally met, were (1) developing and maintaining an integrated master schedule using GAO best practices; and (2) establishing project-reporting systems/databases to provide a clear picture of project performance to management and to keep the contractor accountable. In its response to the GAO, EM stated it would issue an update to the policy. EM issued the new policy by memorandum[19] in November 2020. Chapter 4 of the present report also considers PMI guidelines.

GAO further stated:

> EM relies on contractors' EVM systems to measure the performance of its contractors' operations activities, but EM has not followed (i.e., has not met, has minimally met, or has partially met) best practices to ensure that these systems are (1) comprehensive, (2) provide reliable data, and (3) are used by EM leadership for decision-making—which are the three characteristics of a reliable EVM system. Moreover, EM has allowed the contractors to categorize a large portion of their work in a way that limits the usefulness of the EVM data" (GAO, 2019b, p 36).

A further example of project progress tracking and its impact on closure and perception is the Hanford Waste Treatment and Immobilization Plant (WTP) during the early 2010s. The facility was employing a strategy of feeding liquid tank waste into a pretreatment facility at the WTP that would separate the feed into two streams—low activity waste (LAW) and high activity waste—for subsequent treatment and immobilization in respective facilities for each type of waste.[20] However, EM stopped the construction of the facility in 2012 due to technical challenges. Following a period of rework, the contractor proceeded under a new strategy that would allow LAW sourced directly from the tanks to be pretreated to remove cesium and solids in a new purpose-built facility, the LAW Pretreatment System (LAWPS).[21] From there it would be fed to the Low Activity Waste Facility, which would immobilize the waste. Over half of the $752 million EM spent on the pretreatment facility of the WTP in fiscal year 2013 to 2018 was for overhead, oversight, procurements, and facility maintenance. According to the contractor's EVM reports, 43 percent was spent resolving technical challenges

[19] William I. White, DOE EM, 2020, "Issuance of the Environmental Management Program Management Protocol," Memorandum for Distribution, Washington, D.C., November 6.

[20] DOE, Office of River Protection, 2016, "Low Activity Waste Pretreatment System: RCRA Notice of Intent Meeting," November 14, https://www.hanford.gov/files.cfm/Attachment_1_LAWPS_NOI_presentation_Nov_20161.pdf.

[21] DOE, "Direct Feed Low-Activity Waste," https://www.hanford.gov/page.cfm/DFLAW, accessed November 10, 2020.

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(GAO, 2020a). Despite the halt in construction and rework, an EM press release on August 4, 2020, stated that the project remained on schedule.[22]

METHODS FOR TRACKING PERFORMANCE VALUE

As examples of project metrics in a performance-based approach, the committee provides the following, which may be of use in developing an organization-wide consistent method of assessing the value gained by this relatively new approach. The committee observed through information it was provided and documents that it reviewed that these metrics were different from site to site and also even within sites.

Project Performance Measures and Outcomes

In late 2018, EM changed its primary contracting method to a performance-based approach, ostensibly to reinvigorate and accelerate cleanup and reduce risk and financial liability (DOE, 2018b). Performance-based contracts focus on outcomes and results, in contrast to a focus on the processes used to achieve the results. EM introduced the use of an indefinite delivery/indefinite quantity (IDIQ)[23] delivery model to allow flexibility in the scope, duration, and type of contractual commitment.

This section will focus on performance metrics and benchmarks and the ability to define project outcomes and performance measures. As noted previously, EM is familiar with KPP principles as they are referenced in two of their documents (DOE, 2015, 2018a). DOE's recent change in contracting method is a good time to reevaluate its metrics and KPPs at the project and program level. Some areas to consider:

- Does the flexibility of fixed price and cost-based contract types within an IDIQ conflict with exceptions for EVMS and PARS? For example, are too many or too few projects included?
- What is the median size on an IDIQ project, and does it exceed the $50 million contract exception?

[22] The title of the article does explain how the progress made on the facility could be related to project metrics and performance goals. This example also shows the difficulty in determining technology requirements for a first of its kind facility, but also the very large costs of delay especially once construction is under way. See DOE EM, 2020, "Hanford Tank Waste Pretreatment System on Schedule," August 4, https://www.energy.gov/em/articles/hanford-tank-waste-pretreatment-system-schedule.

[23] See J.S. Gansler, W. Lucyshyn, and A. Carl, 2012, An Evaluation of IDIQ Contracts for Service, Center for Public Policy and Private Enterprise, University of Maryland, January, https://jocexcellence.org/wp-content/uploads/2017/02/UMD_09014_An-Evaluation-of-IDIQ-Contracts-for-Service_January-2012.pdf, for an industry survey of IDIQ strengths and weaknesses.

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- For the large number of projects that are below the threshold for EVMS and PARS is there a guidance document for the field offices to assure that minimum requirements are met? For example, is there consistency in safety metrics, design, construction, and demolition performance measurement. How are those data aggregated and reported?
- How will changes in the IDIQ delivery model affect historical benchmarks established for large and small contracts?
- Does guidance on adjectival ratings exist and remain consistent?

Based on the committee members' many years of experience working on major capital programs, the committee offers four performance measurement principles for developing a robust set of performance metrics:

Principle 1 Establish performance metrics consistent with delivery and contract forms and that can stand the test of time.

Successful outcomes are largely the result of a sound program management strategy. The strategy is necessary to translate the vision and intent across the enterprise or program to deliver desired outcomes. The executing program strategy is implemented by an organization through program-wide performance metrics and key performance indicators (KPIs) that measure project components. While benchmark performance expectations may change over time, the primary KPIs and metrics remain consistent and narrowly defined. This is particularly important for programs that are long-lived with multiple contractors and project managers.

To be clear, certain metrics' importance may change throughout the project, but the individual metric should not. Such consistency allows for comparison across programs, projects, and tasks.

Principle 2 Limit KPIs to a handful at each level of execution.

At the project level,[24] focus metrics on tasks, schedule, and costs. General categories for metrics and KPIs include:

[24] Project KPIs are well established by all contractors. Autodesk performed a survey of 200 US-based contractors that measured frequently used KPIs in seven areas. They were:

- Consistency in capturing constructability issues in the bid documents;
- Logging requests for information;
- Documenting change order root cause and schedule impacts;
- Frequent schedule updates;
- Technology to manage safety and inspections;
- Labor productivity due to poor coordination, documents, and schedule; and
- Software to manage closeout activities.

See Autodesk, Inc., "KPIs of Construction: Benchmarking the Industry," https://www.autodesk.com/bim-360/kpi-construction-data-report-infographic.

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- Financial
- Schedule
- Safety and Operational
- Quality
- Risk

Sound performance management is a data intensive effort requiring data capture, data storage, normalization, and analysis. Since most data today are captured electronically at the source of production on large projects, it is easy to compile large sets of spreadsheets and performance measures for every operational issue. A common error is measuring too many details with far too many metrics. No metric is perfect, and all have some unintended consequences. Good metrics are actionable, easy to visualize, and support the program strategy. For metrics, "less is more" and having fewer increases focus on desired outcomes.

Principle 3 Use benchmarks and metrics to foster competition.

Team competition among and across projects and programs will encourage productivity and innovation. Benchmark thresholds are often established to reflect minimum and up to exceptional expectations. Such thresholds levels are difficult to determine; stakeholder agreement and buy-in is often tedious and unproductive. In contrast, competition among similar teams offers an elegant way to challenge productivity and foster continuous improvement.

Principle 4 Capture, share, and train successes.

Allow top performance techniques to be shared program-wide. Except for a few patented processes, planning, design, construction, and operational innovations are short-lived. New approaches are shared via joint ventures, talent migration, and technical trade associations and papers. As early as the RFP stage in a project, processes to share technical ideas should be established by the customer.[25] Contractual incentives can reward innovation but also demand that innovation be shared for future EM use.

The major takeaway concerning project metrics is that the relationship and importance of key metrics to driving program strategy is central to overall strategy attainment. The IDIQ delivery approach places greater emphasis on EM's program management staff to establish metrics that improve performance and complement strategy. The importance of using metrics as a driver of continuous improvement and behavioral change cannot be overemphasized.

[25] See discussion of Infrastructure Ontario, below.

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In 2018, when Assistant Secretary White described the end-state contracting model (ESCM),[26] her goals were to reduce risk and financial liability, accelerate cleanup, and share risk between government and industry. Guidelines for the ESCM focus on process, time to complete the procurement, and a post-award incentive fee. The ESCM guidelines do not offer guidance on how EM should address the lack of cost- and schedule-competition, post-award, a strategy to share innovation, or the use of metrics or methods to assess best value. Other large infrastructure programs that rely on EM's list of primary contractors may offer EM an opportunity to review their best practices to prepare thoughtful metrics prior to issuing a request for quote (RFQ). One such organization is Infrastructure Ontario (IO), described in Box 5.1); another is environmental cleanup activities at the Department of Defense (DoD) base realignment and closure (BRAC) and formerly used defense sites (FUDS), described in Box 5.2.

FINDINGS AND RECOMMENDATIONS

FINDING: DOE's Office of Environmental Management, with the help of DOE's Office of Project Management, has developed detailed processes and methods for tracking project-level outcomes and success measures. The management of EM's projects by headquarters' staff uses earned value management, including key measures such as CPI, SPI, management reserve, EAC, TPC, funding profile, and others. DOE-EM contractors report project-level outcomes and their key measures through DOE's Project Assessment and Reporting System (PARS) II. This system provides EM monthly data on the projects they track and provides up-to-date and reasonably timely information they can monitor, assess, and act on. However, the committee found evidence that EM and its contractors are not following best practices in EVM reporting. Further, the committee found that the current metric (i.e., SPI) does not effectively track schedule performance.

FINDING: EM's portfolio of projects (work that is subject to following 413.3B) is approximately 25 percent of its annual budget. The percentage of actively tracked projects using certified EVM systems is even smaller (required for capital investment projects greater than $100 million). EM could similarly track a larger majority of activities, but does not.

FINDING: Joint task forces are common to military operations and are now used throughout the government.

[26] Anne Marie White Assistant Secretary for Environmental Management, Written Statement Before the Subcommittee on Strategic Forces Committee on Armed Services United States House of Representatives April 9, 2019, https://docs.house.gov/meetings/as/as29/20190409/109269/hhrg-116-as29-wstate-whitea-20190409.pdf.

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BOX 5.1
Infrastructure Ontario

Infrastructure Ontario (IO) acts as procurement and commercial lead for all major public infrastructure projects in Ontario, Canada. Its four lines of business are major projects, real estate services, infrastructure lending, and commercial projects. As such, it is the program manager for most large projects in Ontario.[a] IO's procurement process (request for qualifications [RFQ], request for proposals [RFP], and Contract Award) has a strong "value-for-money"[b] focus and aims to achieve quality[c] at a low cost. For some of its smaller infrastructure projects, where the design-builder did not have equity, financing, or a long-term maintenance role, it relied on benchmarking techniques to drive its value-for-money strategy. For example:

1. RFQs required the contractor to submit:
   a. Resumes for IO-defined key project positions available for the project
   b. Nonproprietary technology and innovation the contractor planned to use
   c. IO project experience
2. From the above, IO would typically shortlist three to five prime contractors on a "pass-fail" basis (i.e., no future advantage for superior technical scores). IO's RFP would:
   a. Encourage nonproprietary alternative technical concepts (ATCs)
   b. Request unit costs for major quantities
   c. Request salary rates and markup for the key staff proposed in the RFQ
   d. Offer schedule incentives
   e. Request a fixed price bid for the base program and any approved ATC modifications

IO selected contractors based on best value using an undisclosed formula. This approach drove IO's best-value outcome in several ways:

- IO discouraged expensive personnel that exceeded requirements.
- IO predetermined cost basis for scope growth.
- IO shared ATCs and their costs and enabled the selected contractor to use them if desired.
- The bid detail offered IO a range of schedule and cost estimates were available to assess owner contingencies.

IO's approach for certain infrastructure projects is unlikely suitable for EM. The example intends to show that a strategic outcome of "best value" starts with the agency's RFQ, driven by competitive benchmarks and metrics.

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[a] The 2018 annual audit of IO performance can be found at Infrastructure Ontario, 2019, *2018 Track Record Report*, July, https://www.infrastructureontario.ca/Third-Party-Reports/.

[b] Value for money is based on the minimum purchase price and on the maximum efficiency and effectiveness of the purchase over its life cycle.

[c] As defined by Crosby as "meeting requirements."

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BOX 5.2
Department of Defense Base Realignment and Closure and Formerly Used Defense Sites: A Joint Task Force Idea

Generally considered a success, environmental cleanup at the Department of Defense (DoD) Base Realignment and Closure (BRAC) and Formerly Used Defense Sites (FUDS) provides similar examples of the challenges faced by the Office of Environmental Management (EM).[a] Both programs use a variety of contract forms and procurement processes to fit the project need. DoD manages the sites as decentralized projects and are closer in size and term (5 to 10 years) to EM's new approach of "chunkable" indefinite delivery/indefinite quantity (IDIQ) contracts. Due to these similarities, EM may want to form a "joint task force" or less formal cooperative structure with Naval Facilities Engineering Systems Command (NAVFAC) and other BRAC and FUDS program management organizations to share experiences and best practices with their indefinite delivery/indefinite quantity (IDIQ) approach. Joint task forces are common to military operations[b] but are now used throughout the government.

For BRAC, program management and program management oversight (PMO) are typically performed internally, for example, NAVFAC for the Department of Navy (DON) BRAC.[c]

Under FUDS, the U.S. Army Corps of Engineers (USACE) is the overall program manager on behalf of the U.S. Army and DoD.[d] USACE manages closures at thousands of Army sites, and prioritizes the work based on exposure to human population. It manages stakeholder relationships with the Environmental Protection Agency, state environmental and regulatory agencies, and the local community. In 2005, it began to use performance-based contracting methods.

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[a] U.S. Environmental Protection Agency, 2017, *BRAC and EPA'S Federal Facility Cleanup Program: Three Decades of Excellence, Innovation and Reuse*, 505-R-17-001, November, https://www.epa.gov/sites/production/files/2017-12/documents/brac_v9_11_2_2017_508.pdf.

[b] Further information is available at Wikipedia, "Joint Task Force," https://en.wikipedia.org/wiki/Joint_task_force.

[c] See Naval Facilities Engineering Command, Base Realignment and Closure Program Management Office, https://www.bracpmo.navy.mil/, accessed October 27, 2020.

[d] See U.S. Army Corps of Engineers, "Formerly Used Defense Sites Program," https://www.usace.army.mil/Missions/Environmental/Formerly-Used-Defense-Sites/, accessed October 27, 2020.

RECOMMENDATION 5-1: The committee recommends that as the Office of Environmental Management (EM) increases its project management (PM) and Office of Project Management responsibilities using indefinite delivery/indefinite delivery (IDIQ) contracts, it should share and compare best PM practices with others across the U.S. government. To implement this, EM should form a "Joint Task Force" or less formal cooperative structure with Naval Facilities Engineering Systems Command (NAVFAC) and other base

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realignment and closure (BRAC) and formerly used defense sites (FUDS) program management organizations.

RECOMMENDATION 5-2: The Department of Energy Office of Environmental Management (EM) should implement a modification to its earned value management system that captures the project's temporal status more clearly and explicitly. Specifically, EM should immediately require that a revised Schedule Performance Index, SPI(t), which is the ratio of scheduled time of work performed (STWP) and actual time of work performed (ATWP), be reported to accurately track schedule performance.

RECOMMENDATION 5-3: The Department of Energy Office of Environmental Management should explicitly include the percentage of cost overrun or underrun in the project success metrics dashboard, rather than the current "green/yellow/red" metric, to bring more transparency to cost performance.

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6

Contract Structures

RATIONALE FOR COMPLETION-ORIENTED CONTRACTING

A review of the U.S. Department of Energy's (DOE's) *Agency Financial Report Fiscal Year 2019* (DOE, 2019) highlights the continued growth in environmental cleanup and disposal liabilities, rising from $377 billion in 2018 to $402 billion (not including future inflation). In 2015, the Office of Environmental Management's (EM's) liability was only $240 billion. Changes in technical approach, scope, regulations, laws, and inflation adjustments drove this growth.

In its management analysis, DOE has identified important ongoing efforts, including "defining requirements in measurable outcomes" and "using objective performance measures focusing on outcomes to balance considerations of cost control, schedule achievement, and technical performance." Specifically, continued performance initiatives include:

- Incorporating the concept of end-state contracting in major contracts and procurements to reinvigorate the sense of urgency and the completion mindset:
  - Building on successes of past initiatives, such as the accelerated closure of the Rocky Flats Plant[1] in Colorado, to include a well-defined work scope with specific end states aimed at limiting increases to liabilities at EM sites;

[1] Once it became no longer operational, the plant was known by other names such as "Rocky Flats Environmental Technology Site."

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- Demanding strong performance from contractors to make meaningful, discrete, and tangible progress in accomplishing EM's important cleanup mission;
- Driving down operating and maintenance costs at EM's facilities, which are a significant portion of EM's annual budget, to provide more available funding to complete cleanup work; and
- Changing the culture to refocus on the completion of cleanup activities; linking contract objectives to DOE's overall strategic goals.

The committee concurs with the imperative of outcomes-based completion contracting and agrees with the need to build on past successful initiatives such as the accelerated closure of the Rocky Flats Plant and the Feed Materials Production Center[2] (known as the Fernald site) in Ohio. (Both the Rocky Flats Plant and the Fernald site had been chosen for accelerated closure by the Assistant Secretary for Environmental Management in 1996 [DOE, 2006, p. 3-23]. The closure contract issued in 2000 for Rocky Flats Plant was somewhat exceptional, being granted a sole-source justification by Secretary Richardson and a 30-day congressional review period [DOE, 2006, p. 4-9].) Outcomes-based, completion-oriented contracting allows the intent of a DOE program strategy to be fully integrated into the cleanup enterprise. An outcomes-based contracting approach:

- Focuses on reducing the cleanup footprint (i.e., the number of acres requiring remediation), an approach which reduces associated overhead costs and life-cycle costs;
- Reduces the risk of contractors focusing on narrowly defined performance criteria associated with performance-based incentive contracts; establishes results-oriented outcomes measures with incentives tied to completion;
- Reduces risks associated with incomplete statements of work for highly complex work activities to support fixed-price contracts;
- Ensures that white space risks (i.e., the risks of gaps between the scopes of work of contracts or task orders) are transferred in a broader outcome-based completion contract; and
- Fosters incentive driven innovations in outcomes focused on project execution, as seen in the reduction of expected cleanup time at Rocky Flats Plant and the Fernald site.

[2] Once it became no longer operational, it was known as the "Fernald Environmental Management Project."

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DESCRIPTION OF CURRENT PLANS FOR USING IDIQ MODEL AS BASIS FOR COMPLETION CONTRACTS

EM has started implementing a redefined end-state contracting model (ESCM) approach.[3] An end state in this new construct is described as follows:

> Within the Performance Work Statement of the applicable contracts, the term "end state" is defined as the specified situation, including accomplishment of completion criteria, for an environmental cleanup activity at the end of the Task Order period of performance (POP).[4]

Emphasizing the manner in which the end-states achieved contribute to site completion, EM has described ESCM as follows: "End-state contracting is not a contract type but an approach to creating meaningful and visible progress through defined end states, even at sites with completion dates far into the future. This is intended to create and motivate a culture of completion." DOE envisages "a two-step process using a competitive qualifications-based Request for Proposal for selection of the offeror representing the best value and subsequent single source, Task Order(s) negotiations through effective partnering" (DOE, 2020, p. 8). The first step results in a single-award indefinite delivery/indefinite quantity (IDIQ) contract to capture a substantial scope of work.[5] The draw period of the IDIQ will be 10 years and uses a combination of firm fixed price (FFP) and cost reimbursement task orders.

DOE awarded two IDIQs under the ESCM at Hanford—the Central Plateau Cleanup Contract and the Tank Closure Contract—and one IDIQ for Nevada Environmental Program Services. Proposals for a fourth, the Integrated Management Cleanup Contract at the Savannah River Site, were accepted through December 1, 2020.[6]

The Federal Acquisition Regulation (FAR) expresses a preference for multiple contract awards unless exceptions are met (see Chapter 7). Multiple award

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[3] Anne Marie White Assistant Secretary for Environmental Management, Written Statement Before the Subcommittee on Strategic Forces Committee on Armed Services United States House of Representatives April 9, 2019. Available at https://docs.house.gov/meetings/as/as29/20190409/109269/hhrg-116-as29-wstate-whitea-20190409.pdf.

[4] Rodney Lehman, Department of Energy (DOE), EM-5.22, "Responses to NAS Questions" sent to committee staff June 30, 2020.

[5] DOE described its "Principles of End State Contracting" to include the goal of having a very specific work-scope which potentially allows for a firm fixed price. DOE describes the benefits of this approach to include but not limited to: quicker evaluations of proposals; less risk of protest loss; frees up contractor key personnel; and less proposal cost to industry. Information from Norbert Doyle, Deputy Assistant Secretary, Office of Acquisition & Project Management (EM-5.2), "Contracting Overview," presentation to the committee, February 24, 2020, Washington, D.C.

[6] American Nuclear Society, 2020, "Proposals Being Accepted for $21 Billion Savannah River Contract," October 7, https://www.ans.org/news/article-2261/proposals-being-accepted-for-21-billion-savannah-river-contract/.

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contracts are traditional IDIQ acquisition strategies, and the committee did not learn of how EM's choice of a single-award IDIQ is complying with FAR 16.504(c)(1) or how it documents the use of the exceptions.

EM views ESCM as enabling "success similar to that experienced at the Rocky Flats, Mound[7] and Fernald Sites."[8] A comparison of various contracting approach attributes follows for the Fernald site, the Rocky Flats Plant, and the ESCM in Table 6.1. The rows in the table describe elements of the contract. Reading across these rows, the reader can see the differences in approach including for example the streamlined regulatory process, the use of innovation, and the strong partnering, some or all of which were noteworthy at Fernald and Rocky Flats.

ANALYSIS OF PAST CASE STUDIES OF COMPLETION CONTRACT MODELS

Two of EM's cleanup efforts that are often cited as successes in achieving program objectives at low cost and accelerated schedule were the aforementioned Rocky Flats Plant in Colorado and the Feed Materials Production Center (Fernald site) in Ohio. The Project Management Institute recognized both as a Project of the Year (Rocky Flats in 2006; Fernald in 2007). The Fernald Preserve, Ohio, Site, as it is called today, is managed by the DOE's Office of Legacy Management (LM), which carries out ongoing groundwater cleanup and other site monitoring and remediation activities and monitors the on-site disposal facility.[9] Today's Rocky Flats Site is also managed by LM and carries out continued groundwater treatment and site monitoring on a 1,300-acre Central Operable Unit. The former security buffer zone of Rocky Flats, the Peripheral Operable Unit, was transferred in July 2007 to the U.S. Fish and Wildlife Service as the Rocky Flats National Wildlife Refuge.[10] Both the Rocky Flats Plant and the Fernald site had, as noted, been chosen for accelerated closure in 1996 (DOE, 2006, p. 3-23).

This section describes the program and contract approaches that contributed to the programs' success. An important takeaway is the contracts for the Fernald site and Rocky Flats Plant employed approaches that allowed DOE to overcome the initial poorly defined costs, schedule estimates, and technical approaches. The lessons learned from this experience have informed the recommendations at the end of the chapter.

[7] The site in Mound, Ohio, fulfilled diverse mission requirements related to nuclear weapons, space missions and energy research and development. After operations ceased in 2003, it was cleaned up to an end state that could support industrial and commercial uses and was assigned to the Office of Legacy Management.

[8] DOE, Office of Environmental Management (EM), "Acquisition," https://www.energy.gov/em/services/program-management/acquisition.

[9] DOE, Office of Legacy Management, 2020, "Fact Sheet: Fernald Preserve, Ohio, Site," May, https://www.energy.gov/sites/prod/files/2020/05/f75/FernaldPreserveFactSheet.pdf.

[10] DOE, Office of Legacy Management, 2020, "Fact Sheet: Rocky Flats Site, Colorado," June, https://www.energy.gov/sites/prod/files/2020/06/f75/RockyFlatsFactSheet.pdf.

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TABLE 6.1 Comparison of Contracting Approaches Used by the Department of Energy (DOE)

Contract Attribute	Fernald	Rocky Flats	End-State Contracting Model
Total closure cost ($B)	$4.40	$10.00	
Original closure estimate (years)	27	65	
Actual closure (years)	15 (1992-2006)	11 (1995-2005)	
Closure time savings (years)	12	44	
Original Closure Estimate ($B)	$12.20	$37.0	
Closure cost savings ($B)	$7.80	$27.00	
Closure contract value ($B)	$2.40	$4.86	
Closure contract start date	12/2000	1/2000	
Closure contract end date	12/2006	12/2006	
Actual completion	10/2006	10/2005	
Authorization/funding	Levelized funding; unique funding flexibility approach	All closure work authorized at contract signing	Task-order driven
Contract completion and transition document	Yes	No	No
Nature of relationship	Strong partnering focus	Strong partnering focus	Transactional approach limits partnering benefits
When end state defined to contractor (definition/scope of end state and date)	Pre-award	Pre-award	Post-award
Approach to achieving end state	Contractor	Contractor	DOE via task orders
Ownership of white space risk between defined projects to accomplish closure	Contractor	Contractor	DOE
Incentives	Outcomes (closure) based	Outcomes (closure) based	Output based task by task
Contractor performance focus	Overall closure	Overall closure	Task-based performance focus
Nature of contractor improvement focus	Contract (closure)	Contract (closure)	Task order (with emphasis on FFP tasks)
Focus on innovation and continuous process improvement	High	High	Limited opportunity to capture benefits

continued

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TABLE 6.1 Continued

Contract Attribute	Fernald	Rocky Flats	End-State Contracting Model
DOE project oversight responsibilities	Focused on managing the contract not the contractor	Focused on managing the contract not the contractor	Tasks each require DOE oversight
Contract management	Strategic (outcomes focus)	Strategic (outcomes focus)	Tactical (task focus)
Cost control	Opportunity for DOE savings	Opportunity for DOE savings	Little incentive for contractor to control costs.
Land use end state—Wildlife refuge (acres)	950	4,883	
Land use end state—Other (acres; approximate)	100	1,617	
Regulatory approach	Traditional	Streamlined	Unknown

Fernald

The original cost to complete the cleanup of Fernald had been estimated to be $12 billion and to take until 2025.[11] By 1996, this completion date had been revised to 2010 (GAO, 1997). Final cleanup costs totaled $4.4 billion when completed in 2006, a reduction of nearly $8 billion versus the original estimate. EM initially expected a cost-plus incentive fee closure contract to complete in December 2009, but were able to execute the project with a revised completion date of December 2006, completed over a month early and under the contract's target cost. EM and its contractor (Fluor) were able to close and restore portions of the site to its native habitat in 2006.

The shared focus of Fluor and EM on closure and program structure flexibility while addressing the inevitable contingencies that arise on large, complex projects led to innovative project execution in all dimensions, including:

- Developing and implementing an end-state closure plan;
- Challenging all costs through the implementation of an "austerity program";
- Reducing indirect costs from 45 to 15 percent, saving $600 million in this category alone

[11] C. Maag, 2006, "Nuclear Site Nears End of Its Conversion to a Park," *New York Times*, September 20.

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- Developing and maintaining a set of execution-ready projects to work around any delays experienced in planned project execution activities and position to take advantage of any additional funding that might become available; and
- Utilizing a unique funding flexibility approach that allowed deferral of provisional fees to maintain or accelerate overall closure schedule.

The projects to achieve closure and the programs to support and provide oversight of the projects were within the incentivized contractor's control. In large part, success resulted from the significant culture change driven by the contractor's project integration management strategy and powerful focus on safety.

Negotiated about 6 months after that of the Rocky Flats Plant, the contract for Fernald required development of a contract completion and transition document, which improved on the Rocky Flats contract (DOE, 2006, p. 4-14).

Rocky Flats

A report by EM initially predicted that site closure would take approximately 65 years and more than $37 billion in cleanup costs for the Rocky Flats Plant (DOE, 1995). DOE, the contractor (Kaiser-Hill Co.), and the state of Colorado worked together to develop a cooperative cleanup agreement and a streamlined regulatory process.[12] Using a performance- and incentive-based contract, the site team set an aggressive target closure date of 2006. The work was completed a year early (and 50 years earlier than initially predicted) and $7.4 billion under budget (and over $20 billion less than original estimates).

Four key factors contributed to the early completion of the physical cleanup of Rocky Flats:

- The cost-plus-incentive-fee contract provided the contractor with strong profit incentives to complete the work quickly and safely (DOE, 2020, p. 7). These profit incentives drove site workers to look for innovative and creative cleanup solutions because they could receive bonuses for cost-saving suggestions. The incentives also led to a continuing focus on safety, as one significant safety infraction could shut down work in a building or throughout the site. DOE offered the contractor $560 million in total incentive fees to finish the cleanup ahead of schedule and under cost.

[12] The State of Colorado, U.S Environmental Protection Agency Region VIII, and U.S. Department of Energy, 1996, "Rocky Flats Cleanup Agreement: Federal Facility Agreement and Consent Order," CERCLA VIII-96-21, RCRA (3008(h)) VIII-96-01, and State of Colorado Docket # 96-07-19-01, July 19.

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- DOE and the contractor overcame several major challenges through innovation, as workers constantly sought ways to complete their tasks quickly and under budget. Resolution of the question of expected future use led to resolution of the uncertainty about what cleanup levels were appropriate.[13] In the mid-1990s, DOE, EM, the contractors, and Colorado collaborated with the community and regulatory agencies to resolve this uncertainty and determine a suitable end state (Rocky Flats FSUWG, 1995). A further challenge that has proved to be an obstacle to completion of other sites—namely, finding a path to disposal for the numerous waste types—was overcome at Rocky Flats (DOE, 2006, p. 5-7).
- DOE and the site's regulatory agencies agreed to use an accelerated process to clean up the site. EPA's Superfund accelerated cleanup process allowed cleanup actions to proceed much more quickly and collaboratively than they would have under the traditional Superfund process. As the cleanup progressed, DOE, the contractor, EPA, and state staff often worked side by side in the field.
- Several site-specific characteristics combined to limit the scope and complexity of the cleanup effort. Site-specific characteristics (e.g., climate, geography, the robust construction of the buildings, and the chemical nature of the key contaminants) physically limited the extent of the contamination. For example, the dry Colorado climate and the alluvial fan on which the site is situated helped minimize erosion, thereby inhibiting off-site migration of contaminants. Also, the thick shale and claystone that underlie the site prevented contaminants from seeping into the deep drinking-water aquifer.

Authorization of all project completion work when EM executed the contract moved the project from an annual planning cycle to one with a project completion focus. The closure contract included simplified terms and conditions supporting accelerated, efficient, and cost-effective project execution. DOE approval thresholds were high for any work sequence or process changes. DOE-directed changes automatically resulted in requests for equitable adjustment acting to check such requests.

The project's final evolution to simplified, objective performance measures focused on overall site closure led to a consensus on the "critical few" performance measures and, eventually, end-state criteria. A cost-plus-incentive fee (CPIF) contract such as the one used at the Rocky Flats Plant may need to be adjusted if incentives no longer function as intended in the contract.

[13] See, for example, DOE EM, 2003, "DOE P 455.1, Use of Risk-Based End States," https://www.directives.doe.gov/directives-documents/400-series/0455.1-APolicy July 15.

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IDENTIFICATION AND DISCUSSION OF OPTIONS FOR MOVING TOWARD COMPLETION CONTRACTS

EM has recognized that creating a culture of completion is important to its mission success[14] and that creating a culture of completion led to the successes at Fernald and Rocky Flats.

The work at the Fernald site and Rocky Flats Plant relied on a strong definition of end states—defined in then-contemporary DOE policy documents as "representations of site conditions and associated information that reflect the planned future use of the property"[15]—and overall used a different approach than currently planned and practiced in the EM cleanup program. An end state is not solely a contracting method but must be subsumed under programmatic goals for individual sites.

Applying lessons learned from the Rocky Flats Plant and Fernald site will necessitate defining interim end states moving to ultimate closure. Strong definition supported by program strategies and plans will open the door for more appropriate contracting strategies, such as those used at Fernald and Rocky Flats. It will focus EM on managing the contract and not the contractor, undertaking a more strategic, governance role focused on partnership for success.

How Different Contract Types Are Intended to Work

There are many ways to look at the potential range of contract types. First, however, it is useful to look at the behaviors that contracts seek to drive. The broad universe of contract types includes various types of input and output contracts procured through various contract forms. A subset of these are performance-based contracts, which focus on delivering specific project-based outputs. Finally, a further subset of these contracts are outcomes-based contracts, focused on enterprise-level outcomes such as completion or closure: see Figure 6.1. The Fernald and Rocky Flats contracts were very much in this category.

The new ESCM and IDIQ contracting approach is limited to achieving project-based outputs. It relieves EM of defining end states at the time of procurement.

The four common types of government contracts available to EM include:

- Fixed-price contracts—used when contract risks are defined within acceptable limits. Such contracts require "delivery of a product or services

[14] Anne Marie White Assistant Secretary for Environmental Management, Written Statement before the Subcommittee on Strategic Forces Committee on Armed Services United States House of Representatives April 9, 2019. Available at https://docs.house.gov/meetings/as/as29/20190409/109269/hhrg-116-as29-wstate-whitea-20190409.pdf.

[15] See, for example, DOE EM, 2004, "DOE P 455.1, Use of Risk-Based End States," https://www.directives.doe.gov/directives-documents/400-series/0455.1-APolicy, July 15.

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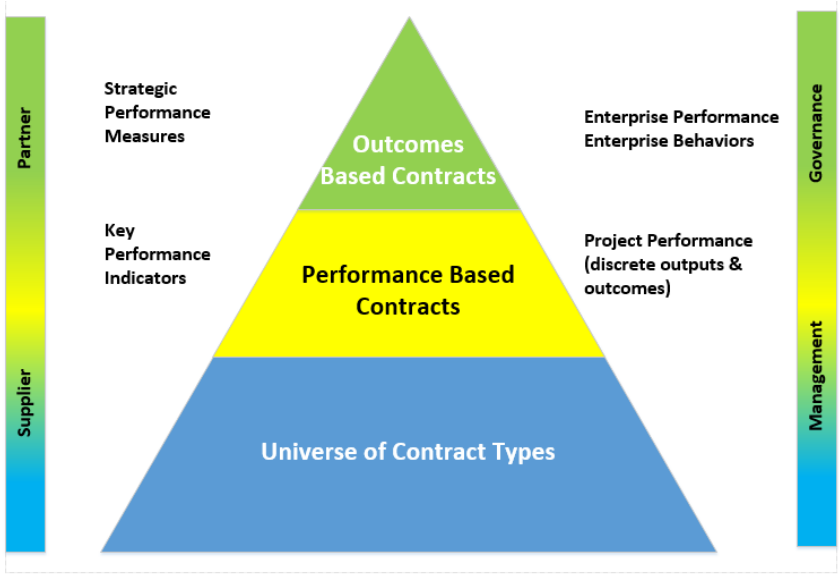

FIGURE 6.1 Universe of contract types with specific attributes associated with each type.

at a specified price, fixed at the time of contract award and not subject to any adjustment" (DOE, 2008).
  - — FFP contract
  - — FFP level-of-effort term contract
  - — FFP materials reimbursement type contract
  - — Fixed-price contract with award fees
  - — Fixed-price contract with economic price adjustment
  - — Fixed-price incentive (FPI) contract
  - — Fixed-price with prospective price redetermination
  - — Fixed-ceiling-price with retroactive price redetermination contracts
- Cost-reimbursement and cost-plus contracts—used when uncertainties involved in contract performance do not permit fixed-price contracts to be used; used when long-term quality is of higher concern than cost; cost-plus incentive contracts provide reimbursement for costs to budgeted authorization and other incentives to the contractor, reducing government risks.
  - — Cost contracts
  - — Cost-plus-fixed-fee (CPFF) contracts
  - — Cost-plus incentive contracts
    - Cost-plus-incentive fee (CPIF) contracts—this form of contract was used by Fernald and Rocky Flats
    - Cost-plus-award-fee (CPAF) contracts

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  - — Cost-sharing contracts
- Time-and-material (T&M) contracts—highest risk to government, lowest risk to contractor
- Indefinite delivery/indefinite quantity (IDIQ) contracts—can be used on both a fixed-price and cost-reimbursement basis; streamlines contracting process; often are multi-award contracts
  - — Task-order contracts (TOCs) and job-order contracts (JOC)
  - — Advisory and assistance (A&A) services

Figure 6.2 illustrates the relative risk to EM and a contractor under different forms of contracts.

As contractor risk increases, so too does its required risk contingency and profit margin. Lowering EM risk by shifting its responsibility to the contractor is not always a desired outcome. The private sector's limited tolerance for risk often demands excessive contingencies and margins. Where EM has difficulty defining the requirements for an end-state, shorter cost-based contracts are its best choice. Where end states and the risks are well known and manageable, a fixed-price contract with incentives to drive productivity and innovation can often benefit all parties.

FINDINGS AND RECOMMENDATIONS

A program manager, public or private, has the responsibility to package the subcomponents of a program into projects in a coordinated manner to obtain benefits and control not available from managing them individually. Contract structure is one tool a program manager has for improving program synergy and success.

There is extensive literature about the most suitable contract forms to use in program delivery. Over the past 30 years, EM has experienced strengths and weaknesses of various contract forms and currently is implementing the IDIQ delivery method to select the best contract form for the task or project.

FINDING: The single-award IDIQ contract vehicle DOE is currently implementing is one approach, though by no means the only one, to implement end-state contracting.

FINDING: The use of IDIQs for end-state contracting entails the use of task orders during the 10-year IDIQ draw period which themselves can have a further 5-year period of performance. The outputs and outcomes of the task orders could collectively progress not only toward an end state of the IDIQ, but also toward an intermediate outcome on the path to site closure. Measuring performance toward this outcome can be done using metrics established at the beginning of the draw period.

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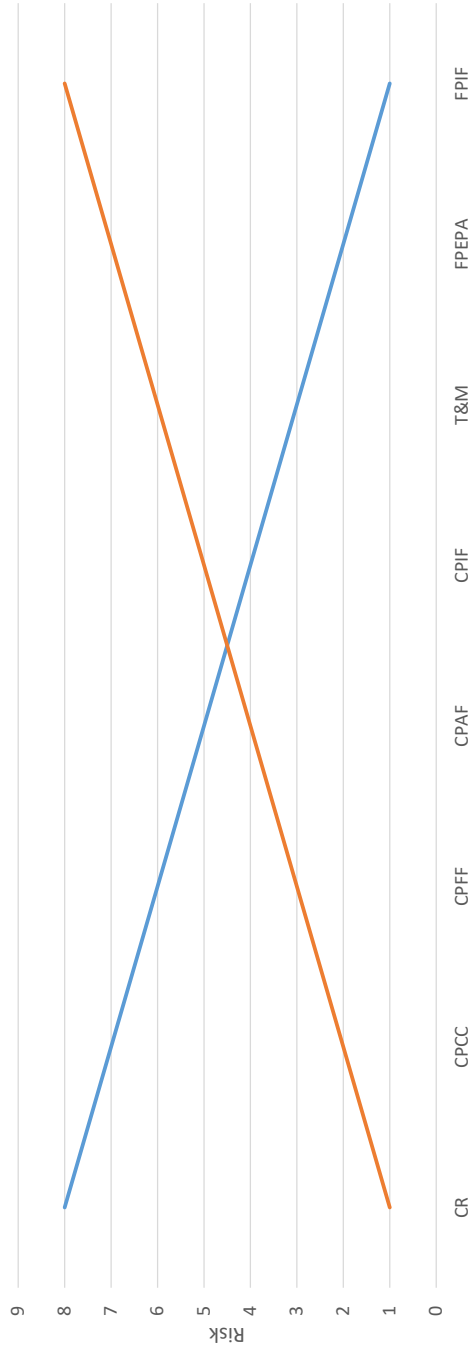

FIGURE 6.2 Relative risk to Office of Environmental Management (EM) and to its contractor.
NOTE: CR = cost reimbursable; CPPC = cost plus percentage of cost; CPFF = cost plus fixed fee; CPAF = cost plus award fee; CPIF = cost-plus-incentive fee; T&M = time and materials; FPEPA = fixed price with economic price adjustment contract; and FPIF = fixed price incentive fee.

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CONCLUSION: Measuring progress toward an end state in an IDIQ contract with multiple task orders necessitates setting metrics at the outset of the draw period aiming toward a defined end state (or intermediate end state in a broader program) that will have been reached at the completion of the IDIQ task orders.

RECOMMENDATION 6-1: The Office of Environmental Management (EM) should establish well-defined, outcomes-based intermediate end states in its 10-year cleanup contracts. Any intermediate outcomes should have clear, measurable metrics to assess site-based (versus task-based) achievement of the defined end states. EM should report progress on these metrics across the portfolio of end-state programs on a quarterly basis and such reports should represent a key EM performance measure.

FINDING: The recently awarded $10 billion IDIQ for the Hanford Central Plateau was described accurately as a cleanup contract and requires the provision of a variety of services with no end state clearly defined. Similarly, EM has declared the $21 billion IDIQ for the Savannah River Site Integrated Mission Completion Contract to be a completion contract. (DOE took bids on the RFP until December 1, 2020.)

CONCLUSION: The definition of end state in the RFP for the Savannah River Site Integrated Mission Completion Contract is essentially correct but needing clear outcomes related to completing the site's cleanup. IDIQs are typically issued because an agency has not defined the work except in broad terms.

FINDING: In the committee's interviews with EM project management, they stated that the average size for task orders is approximately $100 million. For a nominal $10 billion IDIQ contract awarded for cleanup, this would require EM to manage 100 task orders over the life of just one cleanup contract. Further, this number of task orders creates a huge residual risk for EM and does not assure an intermediate end state that is outcome focused.

FINDING: There will be substantial work needed to provide sufficiently robust cost estimates for the number of task orders implicit in the ESCM approach in a single-award negotiating environment. Not using the PEP process envisaged in Order 413.3B will compound this.

RECOMMENDATION 6-2: The Office of Environmental Management (EM) should structure task orders on a scale that is appropriate for defining intermediate outcomes and award fewer individual tasks. EM should apply to such task orders the same management oversight as currently required for major systems projects exceeding $750 million in total cost.

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7

Contract Management Metrics

PERFORMANCE INCENTIVE IN DOE-EM CONTRACTS

Overview of Contracts Having Performance Fees and Incentives

The U.S. Department of Energy (DOE) accomplishes its defense environmental cleanup activities through the work of contractors. The Office of Environmental Management (EM) has been attempting to finish the cleanup activities using many different contract vehicles. Some of the sites at which cleanup activities are now completed employed novel incentive schemes in their contracts. Further, the variety of cleanup activities—groundwater treatment, demolition, waste treatment and immobilization, etc.—and the varied path to disposal for the different atomic energy act materials, mixed waste and other descriptors suggests that incentives will vary. This chapter examines the metrics used for contract performance and the award incentives and fees.

As explained in DOE (2008b), DOE's guiding principle is to obtain the maximum return from its contractors by offering a balanced mix of integrated, fair, and challenging incentives. The principles require the department to tie fees to contractor performance. In establishing appropriate incentives for contractors, the fee should be reasonable, reflecting effort (the complexity of the work and the resources required for contract performance), cost risk (the cost responsibility and associated risk the contractor assumes under the contract type and the reliability of the cost estimates in relation to the complexity of the task), and several other factors (e.g., support of federal socioeconomic programs, investment in capital, and independent development).

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Linking the Performance Fee to Acquisition Outcomes

DOE has available to it a variety of contract types. The choice of contract type can depend in part on the purpose of the work to be accomplished in the contract. A cost-plus-award-fee (CPAF) contract is generally the appropriate contract type for a management and operating contract. The total available fee in this case is the sum of the base fee and the performance fee. The performance fee can comprise both objective and subjective fee components and must relate to clearly defined performance objectives and performance measures.[1]

A cost-plus-incentive fee (CPIF) contract is, as stated in the Federal Acquisition Regulation, a "cost-reimbursement contract that provides for the initially negotiated fee to be adjusted later by a formula based on the relationship of total allowable costs to total target costs."[2] The CPIF vehicle is appropriate when the parties can negotiate a target cost and a fee adjustment formula that are likely to improve the management of the contract (DAU, 2018).

The cost-plus-fixed-fee (CPFF) contract "provides for payment to the contractor of a negotiated fee that is fixed at the inception of the contract."[3] The fee, although in principle fixed, may be adjusted as requirements change during execution. These contracts are often used in research or exploratory development (DAU, 2018).

In all the contracts described above, the performance objectives and measures should where feasible be expressed as desired results or outcomes. The specific measures used to determine the contractor's achievement must be stated as concretely as possible. Following these principles will increase the probability that the contractor will only receive a performance fee for government negotiated acquisition outcomes.

These DOE sites have a designated officer for evaluating the contractor's performance against its objectives and measures for subjective fee components. Using subjective fee components is less desirable than using objective fee components because there is not as clear a link between performance and reward. Only when it is not feasible to use objective measures of performance should

[1] There has been an active economics literature on incentives and performance for decades; see, for example, Baker, Gibbons, and Murphy (1994), cited in 1,808 papers as of December 2020. Although their assumptions are too restrictive to apply to the situation of the Department of Energy (DOE) managing environmental remediation contracts, the basic conclusions are relevant, "We also show, however, that in some circumstances objective and subjective measures are complements: neither an explicit nor an implicit contract alone yields positive [value], but an appropriate combination of the two does," where explicit (objective) contract terms are those that have been written and implicit (subjective) contracts terms are those that are difficult to define, but are understood by both parties to a contract. Therefore, Baker, Gibbons, and Murphy show that it is important to have both objective and subjective criteria in the evaluation of a contractor's performance. This is discussed specifically in "Performance Metrics in PEMPs," below.

[2] 48 CFR 16.405-1.

[3] 48 CFR 16.306.

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subjective fee components be used. For example, although it might be feasible, it is difficult to specify performance metrics for "environmental stewardship and compliance" and "worker safety, health, and safety culture." If they are, they should be tied to identifiable interim outcomes, discrete events, or milestones to the maximum extent practicable. When using subjective fee components, it is especially important to ensure that the contract or award fee plan clearly defines how the government will measure the contractor's performance. Fee payment must depend on only one thing—the contractor's providing the acquisition outcomes for which DOE negotiated.

Rollover of Performance Fee

Some performance evaluation and measurement plans contemplate the rollover of unearned performance fee—typically the subjective fee component—from one period to another. Rollover is a fee not earned in an evaluation period available for payment in a subsequent period.

Award Term

An award term incentive provides a new dimension in contractor incentives. An award term incentive has similarities to award fees, with the major difference being that the contractor earns additional periods of performance instead of an award fee. Performance objectives for earning an award term should be distinct from those for earning award fees.

Major Cost Reimbursable Contracts Types Used by DOE

The document, General Guide to Contract Types for Requirements Officials (DOE, 2008a), describes various contract types as follows:

- *Cost reimbursable* (CR), bearing no fee, generally these contracts are parts of other contracts that are not associated with incentive fees, such as site benefit plans.
- *Firm fixed price* (FFP) contracts require "delivery of a product or services at a specified price, fixed at the time of contract award and not subject to any adjustment."
- *Cost-plus-fixed-fee* (CPFF) contracts contain a fee that is fixed at the inception of the contract. The fixed fee will not vary with the actual costs that the contractor incurs but might be adjusted as a result of negotiated changes in the work to be performed under the contract.
- *Cost-plus-award-fee* (CPAF) is an incentive contract where the fee might include (1) a base amount that is fixed at the contract's inception, and (2) an award amount the contractor might earn depending on performance

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measured with contract criteria, determined by the DOE-EM's contract officer evaluation of the contractor's performance.

- *Cost-plus-incentive-fee* (CPIF) contracts may contain both performance and delivery incentives. CPIF contracts specify a (1) target cost, (2) a target fee, (3) minimum and maximum fee thresholds, and (4) a fee adjustment formula. The formula provides for an increase in the fee paid to the contractor above (below) the target fee when total allowable costs are less (greater) than the target cost.

In each of EM's incentive contracts—CPAF, CPIF, and CPFF—there is a performance evaluation and measurement plan (PEMP) defining how the department will evaluate the contractor's performance and determine how much of the maximum fee they will award. EM has released information relating to contractor fee determinations under its major cost-reimbursable contracts. Performance assessment summaries and fees earned under CPAF, CPIF, and CPFF contracts can be found in the "Scorecards" posted on the applicable DOE field office website, see, for example, DOE-ORP (2018), as discussed below, "Performance Metrics in PEMPs."

Incentive Ratings and Definitions in Performance Evaluation and Measurement Plans

The committee spent time examining the contracts and PEMPs; see DOE (2012) for current and recent work at the Hanford Site. Cleanup activities for Hanford have been ongoing for some time and currently are managed by DOE as two geographical sites: the Office of River Protection (ORP) and the Richland Operations Office.

DOE-ORP (2018) describes the Performance Evaluation Measurement Plan for the Hanford Tank Waste Treatment and Immobilization Plant project. It contains the following seven award fee objectives (these are similar to those in all PEMPs):

- Project performance (cost, schedule, and efficiencies);
- System startup, commissioning, and plant management, and engineering performance;
- Construction, field, and resident engineering, occurrence reporting, and conduct of operations;
- Environmental, safety, health, and safety conscious work environment;
- Quality assurance program and quality of performance;
- Nuclear safety; and
- Pretreatment and high-level waste facilities.

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EM rates each of these objectives (as well as those in other contract PEMPs) using the adjectives and percentage of award fee granted as described in Table 7.1. Each objective has a maximum award for the contractor and is given a specific percentage of the maximum award. These percentages are summed, and the total percentage is equal to the sum of the awards divided by the sum of the maximum awards.

Regarding the determination of the award fee percentages (DOE-ORP, 2018, p. 3),

> ORP will compare the contractor's actual incurred costs and schedule performance to the total estimated costs of that work and the planned schedule. The analysis of cost control performance considers changed programmatic requirements, changed statutory requirements, and sometimes changes beyond the contractor's control. ORP relies on other *objective* or *subjective (or both)* cost and schedule performance elements, such as critical path and float analysis, to evaluate the contractor's performance . . . [emphasis added]

> Cost and Schedule Control – The contractor maintains cost and schedule control (i.e., actual costs incurred for work performed are equal to or less than the estimated costs for that work) and actively pursues cost containment and reduction through innovative approaches and management of resources. EM monitors cost control against the Performance Measurement Baseline for the Low-Activity Waste Facility, Balance of Facilities, and Analytical Laboratory, Direct-Feed Low-Activity Waste (DFLAW), and Project Services.

Performance Metrics in PEMPs

As noted, certain of the contracts evaluated by the committee—specifically, CPFF, CPAF and CPIF—include fees that the department can pay the contractor

TABLE 7.1 Award Criteria Used by the Hanford Tank Waste Treatment and Immobilization Plant Project

Adjectival Rating	Percentage of Award Fee Earned	Definition: "Contractor has…"
Excellent	91 to 100	"exceeded **almost all** of the significant award-fee criteria"…
Very Good	76 to 90	"exceeded **many** of the significant award-fee criteria"…
Good	51 to 75	"exceeded **some** of the significant award-fee criteria"…
Satisfactory	≤ 50	"**met overall** cost, schedule, and technical performance requirements"…
Unsatisfactory	0	"**failed** to meet overall cost, schedule, and technical performance requirements"…

SOURCE: Table 1 of DOE-ORP (2018, p. 1).

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above and beyond any fixed price or reimbursable costs. Awarding of these fees contemplates measuring the contractor's performance against performance metrics included in the PEMPs. The Department makes its determination on the awarding of fees using criteria.

There appear to be no guidelines to distinguish between objective and subjective award fee criteria. According to GAO (2019, p. 25) [emphasis added]:

> Our review of DOE documents showed that the Site-Specific approach has a different process for determining incentive and award fees, depending on whether the fee is tied to objective or subjective performance criteria. According to agency officials and documents, the Site-Specific approach generally provides more money toward incentive fees tied to *objective* criteria than to award fees tied to *subjective* criteria—about 60 to 75 percent of available fee money goes to incentive fees. Incentive fees tied to objective performance criteria are awarded based on completion of the specific tasks or quantitative targets defined by the performance criteria.

For example, in DOE-ORP (2018, Appendix A) "Award Fee Rating Guide" under "Does not meet requirements"/"Failing or will fail":

(1) *Objective* items
- Clear (or high) risk of objectives not being achieved on time
- High probability of not achieving the outcome
- Expect to not meet or significantly miss cost, scope, or schedule
- *Inadequate degree of transparency*

(2) *Subjective* items
- Overall, most key areas meeting or close to meeting requirements
- Inadequate percentage of key deliverables are satisfactory or better
- Inadequate percentage of sub or supporting areas are performing satisfactorily
- Too high a frequency of mid-level safety, security, or quality issues of note
- Major safety, security, or quality issue
- Less than approximately 75 percent of issues are self-identified and reported in a timely manner
- *Inadequate degree of transparency*
- Significant safety, fine, injury, security deviation(s) (see DOE, 1995),
- Significant deviations of Integrated Safety Management System practices, reporting, critiques, Emergency Operations Center reviews, multiple safety basis/Conduct of Operations/engineering deviations, or a significant deviation with nuclear safety or operational implications

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Regarding the aggregation of performance metrics, DOE-EM (2018, p. J-4-1) states, "Objective performance outcomes are allocated at least 60 percent of the available fee, and subjective performance outcomes are allocated up to 40 percent of the available fee." This corresponds roughly to the findings made by GAO (2019, p. 25) on the topic.

CURRENT INCENTIVE STRUCTURES IN EM CONTRACTS

Incentive Structures in Cleanup Contracts

The committee considered the fees earned by DOE contractors under the three types of contracts noted previously—CPFF, CPAF and CPIF. According to DOE-EM's (2020) description of how it makes fee determinations, performance assessment summaries and fees earned under CPAF, CPIF, and CPFF contracts can be found in the "Scorecards" posted on applicable DOE field office websites.

Waste Treatment and Immobilization Plant

Table 7.2 is an example of a summary of information on fees awarded to Bechtel National, Inc. (BNI) for "Design, construction, and commissioning of the Hanford Tank Waste Treatment and Immobilization Plant," Contract Number: DE-AC27-01RV14136, from 2014 through 2019.

To examine the 2017 performance evaluation more closely, consider Table 7.3, taken from DOE ORP (2017), which states, "Incentive B.1 – Award Fee-Project Management – Satisfactory. The fee for Project Management is divided into five [six] award fee objectives (AFOs) as follows" and lists these to include AFO2 through AFO7 in Table 7.3 below.

TABLE 7.2 Bechtel National Inc. Hanford Tank Waste Treatment and Immobilization Plant

Calendar Year	Maximum Available Fee	Adjectival Rating	Averaged Score	Fee Awarded
2014-A	$6,300,000	Good	63.0%	$3,970,000
2014-B	$6,300,000	Good	65.0%	$4,095,000
2015	$12,600,000	Good	66.0%	$8,310,000
2016	$10,200,000	Good	71.0%	$7,242,000
2017	$7,872,103	Satisfactory	48.3%	$3,805,961
2018	$7,872,603	Satisfactory	47.9%	$3,767,815
2019	$7,872,603	Good	63.6%	$5,003,178

SOURCE: DOE-ORP (2020).

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TABLE 7.3 Bechtel National Inc. Hanford Tank Waste Treatment and Immobilization Plant, 2017

Award Fee Objective	Award Fee Code	Maximum Available Fee	Adjectival Rating	Averaged Score	Fee Awarded
Project Performance	AFO1	$1,400,000	Satisfactory	40.0%	$560,000
System Startup, Comm., Eng.	AFO2	$1,400,000	Satisfactory	40.0%	$560,000
Environmental, Health, Safety	AFO3	$1,100,000	Good	53.0%	$583,000
Quality Assurance	AFO4	$1,200,000	Satisfactory	40.0%	$480,000
Nuclear Safety	AFO5	$1,300,000	Good	52.0%	$676,000
Pretreatment Facility	AFO6	$900,000	Good	55.0%	$495,000
High-Level Waste Facility	AFO7	$572,103	Very Good	79.0%	$451,961
Total Award Fee		$7,872,103	Satisfactory	48.3%	$3,805,961

SOURCE: DOE-ORP (2017).

Also, in the PEMP, DOE-ORP (2017) states, "Incentive B.2 – Award Fee-Cost – Satisfactory. The fee for Cost consists of one AFO as follows…" and gives information on AFO1 as in Table 3.3. The "Adjectival Rating" of BNI's performance declined in 2017 involved Award Fee Objective #1: Project Performance (Cost, Schedule, and Efficiencies). According to DOE-ORP (2017, p. 1):

- DOE-ORP had concern with the performance trends as reported in calendar year 2017 that indicated completion of the commissioning milestones were at risk.
- The considerable number of trends, baseline change proposals, and realized risks is a significant concern, because BNI is using a significant amount of its management reserve (MR). The MR is being managed by questionable processes leading ORP to doubt BNI's ability to commission the Direct-Feed Low-Activity Nuclear Waste (DFLAW) facility on time.

As further discussed in Hamel (2017): "Incentive structure emphasizes integrated cost and schedule performance; fee for completion milestones declines monthly to a minimum fee after defined period; and performance (award) fee criteria updated annually to emphasize current project phase and priorities." Thus, the award would decline as a function of the project completion date from $179 million in March 2021 to $119 million between October 2021 and April 2022 to $0 after December 2022. At present, the plant is scheduled to start treating low-activity waste for disposal by the end of 2023 and EM is now looking for a contractor to operate the facility. Bechtel is expected to remain on the project through 2036 when the vitrification plant is expected to be fully operational.

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Although there was little change in the percentage of the maximum award fee in 2018, the contract evaluator found BNI "aligned the baseline schedule with the forecast schedule. This was considered a necessary effort, given the large disparity between the two schedules at the beginning of the year" (DOE-ORP, 2019a, p. 1). By 2019 the rating improved to "good" with the comment, "BNI continued to establish and maintain tools for identifying, tracking, and communicating mitigation of DFLAW project threats, risks, opportunities, and barriers necessary to meet the contractual dates for startup and commissioning of the LAW Facility." However, "to increase the project pace, BNI drove up overtime costs. Going forward, process and performance improvements will be needed to reduce costs to complete the project on budget." Regarding the Hanford Waste Treatment and Immobilization Plant (WTP), GAO (2020, p. 29) concluded:

> After nearly 20 years and with over $11 billion spent since EM awarded the contract to design and build the WTP, the WTP is not complete and has faced numerous technical challenges, cost overruns, and schedule delays. According to a recent study by the U.S. Army Corps of Engineers and EM's *Hanford Lifecycle Report*, the largest and most complex portion of the WTP—the pretreatment facility—is unlikely to be completed as designed and scheduled.

Tank Operations Contract

The committee compared these awards for BNI with those made by the same office for Washington River Protection Solutions (WRPS), a limited liability corporation owned by Amentum and Atkins, with Orano as its integrated subcontractor. Table 7.4 summarizes information on fees awarded to WRPS for the "Tank Operations Contract," Contract Number DE-AC27-08RV14800, from 2013 through 2019. In the fiscal year 2019 performance review (DOE-ORP, 2019b), EM divided criteria into two sections: *Objective* Fee (Performance Based Incentives) on which the contractor received 99 percent of its award, and *Subjective* Fee (Award Fee) Criteria, on which the contractor received 85 percent of its award. The WRPS contract was recently extended up to September 30, 2021.[4]

Hanford 222-S Laboratory Analysis and Testing Services

Finally, the committee compared these contracts with a much smaller and less complex contract for Wastren Advantage, Inc. (WAI), a company held by French-owned Veolia. Table 7.5 is a summary of information on fees awarded to WAI for "Hanford 222-S Laboratory Analysis and Testing Services," Contract Number DE-EM0003722, from 2016 through 2019. In the 2019 performance

[4] DOE Hanford Site, "WRPS Contract Modifications," https://www.hanford.gov/page.cfm/DOE-ORPPrimeContracts/WRPSContractMods.

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TABLE 7.4 Washington River Protection Solutions: Tank Operations Contract

Fiscal Year	Maximum Available Fee	Adjectival Rating	Averaged Score	Fee Awarded
2013-SEA*	$7,994,699	Very good	81%	$6,483,701
2014-SEA*	$12,597,052	Very good	83%	$10,459,418
2015-SEA*	$15,600,000	Very good	88%	$13,782,000
2016-SEA*	$12,471,000	Very good	77%	$9,638,450
2017-SEA*	$13,355,000	Very good	89%	$11,890,000
2018-SEA	$15,417,500	Very good	83%	$12,797,845
2018-PBI	$35,905,500	Excellent	98%	$35,105,500
2018	$51,323,000	Excellent	93%	$47,903,345
2019-SEA	$13,005,000	Very good	85%	$11,059,450
2019-PBI	$27,995,000	Excellent	99%	$27,615,000
2019	$41,000,000	Excellent	94%	$38,674,450

NOTES: * = No PBI breakdown was given. PBI = performance-based incentives. SEA = special emphasis areas.
SOURCE: DOE-ORP (2020).

TABLE 7.5 Wastren Advantage Inc. Hanford 222-S Laboratory Analysis Contract

Calendar Year	Maximum Available Fee	Adjectival Rating	Averaged Score	Fee Awarded
2016	$142,771	Very good	88%	$125,782
2017	$191,743	Excellent	96%	$184,265
2018	$217,055	Excellent	98%	$211,846
2019-PBI	$142,317	Very good	83%	$118,597
2019-SEA	$94,878	Excellent	98%	$92,743
2019-TOTAL	$237,195	Very good	89%	$211,341

NOTE: PBI = performance-based incentives; SEA = special emphasis areas.
SOURCE: DOE-ORP (2020).

review (DOE-ORP, 2019c), criteria were divided into two sections: Performance Based Incentives (PBIs), on which it received 83 percent—50 out of a possible 60 points—of its award: (1) delivery, (2) evaluations/proficiency tests, and (3) maintain holding times and special emphasis areas (SEAs), on which it received 98 percent—39.1 out of a possible 40 points—of its award: (4) business interfaces and efficiency, (5) analytical reporting and data quality, (6) environmental stewardship and compliance, and (7) worker safety, health, and safety culture. However, in the review, one of the key positives was, "WAI maintained

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a 98.1 percent combined factor for the delivery, proficiency tests, and holding times performance based incentives," whereas as just noted the average score for PBI was, in fact, 83 percent and the average score for SEA was 98 percent. The public version of this evaluation does not include much detail.

Recently Awarded Contracts and Requests for Proposals

During this past year, EM has awarded two major contracts at the Hanford site. Not considering the occupational medical services contract, awarded in 2018 for 7 years, there are five major contracts at Hanford:

(1) The Mission Support Contract, which expired in 2019, replaced by the Hanford Mission Essential Services Contract (HMESC), awarded December 15, 2019 (see Table 7.6), to HMIS LLC, including Leidos Integrated Technology, LLC (Gaithersburg, MD); Centerra Group, LLC (Palm Beach Gardens, FL); and Parsons Government Services, Inc. (Pasadena, CA), "replacing" the Leidos and Centerra Group.[5]
(2) The Plateau Remediation Contract, expired in 2019, replaced by the Central Plateau Cleanup Contract (CPCC), awarded December 12, 2019, to Central Plateau Cleanup Company LLC, members are Amentum (Germantown, MD), Fluor Federal Services, Inc. (Greenville, SC), and Atkins Nuclear Secured, LLC (Oak Ridge, TN), replacing the CH2M HILL Plateau Remediation Company, a subsidiary of Jacobs.[6] A protest over the contract award filed by a Bechtel Corp.-led team was rejected by the GAO on May 13, 2020.
(3) Tank Operations Contract awarded to WRPS, which, though originally set to have expired, was recently extended up to September 30, 2021.[7] An end state Tank Closure Contract (TCC), had been awarded to Hanford Works Restoration[8] on May 14, 2020,[9] but DOE suspended the award in August 2020.[10]

[5] DOE Office of Environmental Management (EM), 2019, "DOE Awards Contract for Hanford Site Mission Essential Services to Support Cleanup," December 5, https://www.energy.gov/em/articles/doe-awards-contract-hanford-site-mission-essential-services-support-cleanup.

[6] DOE EM, 2019, "DOE Awards Hanford Central Plateau Cleanup Contract," December 12, https://www.energy.gov/em/articles/doe-awards-hanford-central-plateau-cleanup-contract.

[7] DOE Hanford Site, "WRPS Contract Modifications," https://www.hanford.gov/page.cfm/DOE-ORPPrimeContracts/WRPSContractMods.

[8] A group including BWXT Technical Services Group, Inc. (Lynchburg, VA), Fluor Federal Services, Inc. (Greenville, SC), INTERA, Inc. (Austin, TX), and DBD, Inc. (Richland, WA).

[9] DOE EM, 2020, "DOE Awards Hanford Tank Closure Contract," May 14, https://www.energy.gov/em/articles/doe-awards-hanford-tank-closure-contract.

[10] M.B. Powers, 2020, "US Energy Dept. Suspends $13B Hanford Nuke Waste Cleanup Award," *Engineering News Record*, August 13.

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TABLE 7.6 Recent Requests for Proposals (RFPs) at the Hanford Site

Code	Mission	Type	Years	Final RFP Date	Awarded	Max Value
HMESC	Services, Infrastructure, Contract Adm.	CPAF w/ IDIQ	5	9/20/2018	12/15/2019	$4B
CPCC	Completion and Closure (End State)	IDIQ w/ FFP+CPIF	10	2/14/2019	12/12/2019	$10B
TCC	Dispose of Tank Waste (End State)	IDIQ w/ CPAF+CPIF	10	2/14/2019	5/14/2020[a]	$13B
222-S LAB	Operate Laboratory Complex	CPAF + CR	5	2/7/2019	not yet	TBD
DFLAW	Vitrify Low Activity Waste	Unknown	NA	RFI: 4/12/2020	not yet	TBD

[a] The Department of Energy suspended the award in August 2020. See M.B. Powers, 2020, "US Energy Dept. Suspends $13B Hanford Nuke Waste Cleanup Award," *Engineering News Record,* August 13.

SOURCE: U.S. Department of Energy, Environmental Management Consolidated Business Center, "Current Acquisition Websites," https://www.emcbc.doe.gov/About/CurrentAcquisitionWebsites.

(4) 222-S Analytical Laboratory Services, to expire in 2020, to be replaced by the 222-S Laboratory (222-S Lab) contract, which has not yet been awarded.
(5) A new contract, the direct feed low activity waste (DFLAW) contract to operate the DFLAW facility, for which a Request for Information was issued on April 12, 2020.

Incentive Structures in Bundled Cleanup and Site Operations Contracts

Since 1988, EM has had the responsibility of cleaning up 107 sites across the United States. Many of these sites were small so EM grouped services across and within sites to achieve their mission efficiently. In 2020, only 16 sites remain, and most of these remaining sites are large in land area, scope, cost, remaining duration, and complexity.

Opportunities to group tasks together to create efficiencies exist horizontally and vertically for DOE and its contractors. For example, a task with similar technical requirements can be performed by one contractor across multiple sites. Likewise, tasks at a site that are unrelated may have a common subcomponent. For example, information technology network security or records retention for all activities at a site may be better grouped together as one contract. All the

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existing sites' contracts have a legacy structure that may predefine expectations on bundling and some support operations may be provided through "government furnished services which limit bundling benefits."

None of the committee's discussions with EM have focused on overlapping line items in contracts for cleanup and site operations. Still, there are always efficiencies to be found in every large, complex project. The EM field manager is the position charged with the responsibility to "integrate Site level activities for mission accomplishment" and to "Conduct periodic reviews for contracts with segment costs less than $200M."

Despite the efficiencies that might be gained by combining smaller contracts into larger ones, there are regulations that apply in specific situations involving smaller business concerns. The Federal Acquisition Regulation, Section 2.101 defines bundling in federal procurement as "consolidation that combines two or more requirements for supplies or services, previously provided or performed under separate smaller . . . into a solicitation for a single contract, a multiple-award contract, or a task or delivery order that is likely to be unsuitable for award to a small business concern. Because small business concerns typically do not have the resources or size to bid on large integration projects, the bundling of contracts tends to limit their prime contracting opportunities. Congress has debated bundling[11] and introduced legislation,[12] and the Small Business Administration[13] and OMB have taken efforts to restrict bundling to promote small and medium-sized businesses to increase competition. Finally, GAO has made observations in bid protest decisions that have implied the practice has a deleterious effect on competition.[14] In FY16, for all the federal government, 12 contracts were approved for bundling, a relatively small number.

FAR 16.504(c)(1) establishes the general preference for multiple awards (multiple award contracts [MACs]) on IDIQ[15] contracts but identifies six situations in which agencies "should not" make multiple awards. It is stated in subsection (ii)(B) that:

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[11] See page 161 of U.S. House of Representatives, Subcommittee on Energy and Water Development, 2005, "Hearings Before a Subcommittee of the Committee on Appropriations, House of Representatives, 109th Congress, First Session: Subcommittee on Energy and Water Development." Washington, D.C.: U.S. Government Printing Office. March 9.

[12] See U.S. Congress, Contracting Data and Bundling Accountability Act of 2014, H. Rept. 113-410, 113th Congress (2013-2014), https://www.congress.gov/congressional-report/113th-congress/house-report/410/1.

[13] 64 Fed. Reg. 2153 (Jan. 13, 1999).

[14] Donahue Consulting, The Government Contracts Law Report, https://attny.com/gcin/gci02992.html.

[15] History and theory of IDIQs can be found at J.S. Gansler, W. Lucyshyn, and A. Carl, 2012, *An Evaluation of IDIQ Contracts for Service*, Center for Public Policy and Private Enterprise, University of Maryland, January, https://jocexcellence.org/wp-content/uploads/2017/02/UMD_09014_An-Evaluation-of-IDIQ-Contracts-for-Service_January-2012.pdf.

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> The contracting officer must not use the multiple award approach if -
> (1) Only one contractor is capable of providing performance at the level of quality required because the supplies or services are unique or highly specialized;
> (2) Based on the contracting officer's knowledge of the market, more favorable terms, and conditions, including pricing, will be provided if a single award is made;
> (3) The cost of administration of multiple contracts may outweigh any potential benefits from making multiple awards;
> (4) The tasks likely to be ordered are so integrally related that only a single contractor can reasonably perform the work;
> (5) The total estimated value of the contract is less than the simplified acquisition threshold; or
> (6) Multiple awards would not be in the best interests of the Government.

The committee was not able to determine which of these criteria would apply to EM in making the single-award IDIQ in its end-state contracting model.[16]

FINDING AND RECOMMENDATION

FINDING: DOE-EM's rating of contractor performance in Hanford cleanup contracts does not appear to be consistent either across multiple years in the case of a specific contract or across contracts in a specific year.

RECOMMENDATION 7-1: To increase transparency in contractor performance evaluation, the committee recommends that the U.S. Department of Energy's Office of Environmental Management should ensure that the contracts it issues for cleanup work (1) create a consolidated set of unambiguous "subjective" criteria for similar types of cleanup activities, and (2) use these criteria in the evaluation of all contract performance across its portfolio.

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[16] The ESCM is discussed further in Chapter 6.

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8

List of All Recommendations

The recommendations in the report are repeated here, listed by chapter.

PROJECT MANAGEMENT POLICIES, PROCESSES, AND PROCEDURES

RECOMMENDATION 4-1: The committee recommends that the Department of Energy (DOE) confirm, clarify, and expand DOE Order 413.3B to establish its applicability to all capital asset projects (not just construction and major instruments and equipment and certain cleanup projects) and all Office of Environmental Management projects, whether major systems projects or work carried out by a management and operating (M&O) contractor. The committee also makes the following specific recommendations regarding the Order as well:

1. Pending the outcome of the National Nuclear Security Administration pilot project, reduce the threshold value for applicability of Order 413.3B from $50 million to $20 million;
2. Continue applying the requirements of Order 413.3B to M&O contract work on capital asset projects—the latter including construction projects, major items of equipment and cleanup projects;
3. Clarify the definition related to project performance found at Section 3c(4), point 3 to calculate performance on aggregate value and not number of projects; and
4. Shift eligibility for project overruns, currently 10 percent per project, to be applied instead based on the aggregate value.

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RECOMMENDATION 4-2: The Department of Energy should clarify Order 413.3B to incorporate best practices with respect to dispute prevention and resolution, which will be of growing significance as the Office of Environmental Management implements the end-state contracting approach. Sources for such best practices include the Construction Industry Institute.

RECOMMENDATION 4-3: The Office of Environmental Management should apply the requirements for project execution plans equivalent to those in Order 413.3B to those projects that are not formally managed under Order 413.3B.

PROJECT MANAGEMENT METRICS

RECOMMENDATION 5-1: The committee recommends that as the Office of Environmental Management increases its project management (PM) and Office of Project Management responsibilities using indefinite delivery/indefinite quantity (IDIQ) contracts, it should share and compare best PM practices with others across the U.S. government. To implement this, EM should form a "Joint Task Force" or less formal cooperative structure with Naval Facilities Engineering Systems Command (NAVFAC) and other base realignment and closure (BRAC) and formerly used defense sites (FUDS) program management organizations.

RECOMMENDATION 5-2: The Department of Energy Office of Environmental Management (EM) should implement a modification to its earned value management system that captures the project's temporal status more clearly and explicitly. Specifically, EM should immediately require that a revised Schedule Performance Index, SPI(t), which is the ratio of scheduled time of work performed (STWP) and actual time of work performed (ATWP), be reported to accurately track schedule performance.

RECOMMENDATION 5-3: The Department of Energy Office of Environmental Management should explicitly include the percentage of cost overrun or underrun in the project success metrics dashboard, rather than the current "green/yellow/red" metric, to bring more transparency to cost performance.

CONTRACT STRUCTURES

RECOMMENDATION 6-1: The Office of Environmental Management (EM) should establish well-defined, outcomes-based intermediate end states in its 10-year cleanup contracts. Any intermediate outcomes should have clear, measurable metrics to assess site-based (versus task-based) achievement of the defined end states. EM should report progress on these metrics

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across the portfolio of end-state programs on a quarterly basis and such reports should represent a key EM performance measure.

RECOMMENDATION 6-2: The Office of Environmental Management (EM) should structure task orders on a scale that is appropriate for defining intermediate outcomes and award fewer individual tasks. EM should apply to such task orders the same management oversight as currently required for major systems projects exceeding $750 million in total cost.

CONTRACT MANAGEMENT METRICS

RECOMMENDATION 7-1: To increase transparency in contractor performance evaluation, the committee recommends that the U.S. Department of Energy's Office of Environmental Management should ensure that the contracts it issues for cleanup work (1) create a consolidated set of unambiguous "subjective" criteria for similar types of cleanup activities, and (2) use these criteria in the evaluation of all contract performance across its portfolio.

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Appendixes

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A

Committee Biographies

KATHARINE FRASE (*Co-Chair*) retired from IBM after a 30-year career in 2016. Her career spanned positions in manufacturing, product and process development, strategy, research, and business development. Her most recent assignments were in support of IBM's clients and field teams in the government, cities, health care, and education industries, particularly the application of analytics and technologies such as Watson, to provide actionable insights for some of the world's most important challenges. In 2006, she was elected a member of the National Academy of Engineering (NAE). Dr. Frase received an A.B. in chemistry from Bryn Mawr College and a Ph.D. in materials science and engineering from the University of Pennsylvania.

JOSEPH S. HEZIR (*Co-Chair*) is principal with the Energy Futures Initiative, a nonprofit dedicated to advancing a cleaner, safer, more affordable, and more secure energy future. He is also a professor of the practice at the Wilton E. Scott Institute for Energy Innovation of Carnegie Mellon University. From December 2014 to January 2017, he was chief financial officer of the U.S. Department of Energy (DOE) with responsibility for $30 billion in spending authority. He was the cofounder and from 1992 to 2014 managing partner of the EOP Group, Inc., a consulting firm that specializes in federal government regulatory strategy development and budget policy. He previously served 18 years in the U.S. Office of Management and Budget in positions of increasing responsibility, serving for 6 years as deputy associate director for energy and science. He has also served on a number of advisory bodies, including the Advisory Council of the National Aeronautics and Space Administration and the Metropolitan Area Board of Directors for the Red Cross. From Carnegie Mellon University, Mr. Hezir earned a B.S.

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in chemical engineering and an M.S. from the Heinz School of Public Policy. He has previously served on numerous committees of the National Academies of Sciences, Engineering, and Medicine, including the Committee on EPP2010: Elementary Particle Physics in the 21st Century, the Committee on Burning Plasma Assessment, the Committee on Cost of and Payment for Animal Research, and he is a past member on the Board on Physics and Astronomy.

BURCU AKINCI is the Paul Christiano Professor of Civil and Environmental Engineering, Associate Dean for Research for the College of Engineering, director of the Engineering Research Accelerator, and codirector of Pennsylvania Smarter Infrastructure Incubator at Carnegie Mellon University. She earned her B.S. in civil engineering (1991) from Middle East Technical University and her M.B.A. (1993) from Bilkent University at Ankara, Turkey. Subsequently, she earned her M.S. (1995) and her Ph.D. (2000) in civil and environmental engineering with a specialization in construction engineering and management from Stanford University. Her research interests include the development of approaches to model and reason about information-rich histories of facilities, to streamline construction and facility management processes. She specifically focuses on investigating utilization and integration of building information models with data capture and tracking technologies, such as 3D imaging, embedded sensors, and radio-frequency identification systems, to capture semantically rich as-built histories of construction projects and facility operations. Dr. Akinci has one patent, two patent applications, over 60 refereed journal publications, and 80 refereed conference publications. She coedited a book on CAD/GIS integration and another book on embedded commissioning.

JESUS M. DE LA GARZA became professor and chair of the Department of Civil Engineering at Clemson University in early 2019. Previously, he was the Vecellio Professor of Construction Engineering and Management in the Charles E. Via Jr. Department of Civil and Environmental Engineering at Virginia Tech. Dr. de la Garza came to the staff of Virginia Tech in 1988. His areas of interest and courses taught include civil infrastructure systems, highway infrastructure management, interdependences of infrastructure systems, resilient infrastructure systems, information technology, construction engineering and management, design-construction integration, construction performance improvement, cost engineering, and professional and legal issues in engineering. From January 2004 to August 2006, Dr. de la Garza served as the director of the Information Technology and Infrastructure Systems Program within the Civil and Mechanical Systems Division at the National Science Foundation (NSF). He has coauthored more than 60 papers in refereed publications and has received awards for several of his papers, and he has been inducted into the National Academy of Construction. Dr. de la Garza helped spearhead a course that brings industry professionals from such companies as Bechtel, Fluor, duPont, Procter & Gamble, and KBR to Virginia Tech's

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Blacksburg campus to educate students on the best practices being incorporated into the construction field. Dr. de la Garza is a member of the Virginia Tech's Myers-Lawson School of Construction. As director of CHAMPS (Center for Highway Asset Management Programs) he has led efforts to identify innovative ways to measure the efficiency and effectiveness of the performance-based road maintenance contracts that the Virginia Department of Transportation awards. Dr. de la Garza is the chief editor of ASCE's *Journal of Construction Engineering and Management* and the past chair of the academic committee of the Construction Industry Institute. He earned his bachelor's of science in civil engineering from Tecnologico de Monterrey in 1978, and his master's and Ph.D. degrees in civil engineering from the University of Illinois in 1984 and 1988, respectively.

CLIFFORD C. EBY is an independent consultant who is former president of the U.S. transportation sector for WSP | Parsons Brinckerhoff, a global engineering and professional services organization. In that leadership role, he led 4,000-plus planners, engineers, and managers. Previously, as senior vice president for Parsons Brinckerhoff's Technical Excellence Centers, Mr. Eby supported the firm's strategic efforts in rail and infrastructure markets, particularly high-speed rail. He has worked for more than 40 years in the transportation industry, with expertise in rail safety, regulatory practices, transportation policy, and rail infrastructure design. Mr. Eby has also served as acting administrator of the Federal Railroad Administration. He holds a B.S. in civil engineering from Lehigh University and an M.B.A. from George Washington University.

G. EDWARD (EDD) GIBSON, JR., is Professor and Sunstate Chair of Construction Management and Engineering in the School of Sustainable Engineering and the Built Environment at Arizona State University (ASU). Dr. Gibson served as the school director from 2011 to 2018 and before that as programs chair of the Del E. Webb School of Construction from 2009 to 2011. In addition to ASU, he has served on the faculties of North Carolina State University, University of Texas, Austin, and the University of Alabama, Tuscaloosa. Dr. Gibson's educational background includes a B.S. and a Ph.D. in civil engineering from Auburn University and an M.B.A. from the University of Dallas. He has been principal investigator (PI) or co-PI on over $10.8 million of funded research in his career. Dr. Gibson's research and teaching interests include front-end planning, organizational change, asset management, alternative dispute resolution, earned value management systems, and risk management, and he has received several awards for research excellence including the Construction Industry Institute's outstanding researcher twice. Dr. Gibson has authored or coauthored over 240 publications, taught over 210 short courses to industry, and given more than 250 presentations in his career. He has been active on many national committees, among them a National Academies committee investigating project management practices at DOE in the early 2000s, as well as president of the Architectural

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Engineering Institute. He also served as a Fulbright senior specialist in Norway in fall 2004 and as a visiting academic fellow at Cambridge University in spring 2019. Dr. Gibson was awarded the 2016 R.L. Peurifoy Award for outstanding research from the American Society of Civil Engineers. He has several years of industry experience and is a licensed professional engineer in Texas. Dr. Gibson is an elected member of the National Academy of Construction and a distinguished member in the American Society of Civil Engineers and through January 2019 was a member of the National Academies Board on Infrastructure and the Constructed Environment.

GERALDINE KNATZ is professor of the practice of policy and engineering, a joint appointment between the University of Southern California (USC) Price School of Public Policy and the USC Viterbi School of Engineering. Dr. Knatz served as the executive director of the Port of Los Angeles from 2006 to January 2014. Prior to directing the Port of Los Angeles, she served as the managing director of the Port of Long Beach. Dr. Knatz is a past president of the American Association of Port Authorities and past president of the International Association of Ports and Harbors, and currently serves as the founding chair of the World Port Climate Initiative. Dr. Knatz has received numerous awards, including outstanding women in transportation from the *Journal of Commerce*, 2007; woman executive of the year from the *Los Angeles Business Journal*, 2007; Compass Award from the Women's Leadership Exchange, 2008; an honorary Ph.D. from the Maine Maritime Academy, 2009; the Peter Benchley Ocean Award from the Blue Frontier Campaign in 2012; and a lifetime achievement award from Containerization Intermodal Institute in 2014. In 2014, she was elected to the NAE in recognition of her international leadership in the engineering and development of environmentally clean urban seaports. Dr. Knatz serves on the board of directors for Dewberry, a privately held professional services firm headquartered in Fairfax, Virginia. She earned a Ph.D. in biological sciences from the University of Southern California (USC), an M.S. in environmental engineering from USC, and a B.A. in zoology from Rutgers, the State University of New Jersey, New Brunswick.

ROBERT PRIETO is currently Chairman and CEO of Strategic Program Management LLC, focused on improving capital efficiency in large capital construction programs and strengthening engineering and construction organizations. Previously, he was a senior vice president of Fluor focused on the development and delivery of large, complex projects worldwide. Mr. Prieto is author of *Strategic Program Management* and eight other books, over 750 papers and presentations and has four patents. His industry involvement includes the Industry Leaders Council of the American Society of Civil Engineers (ASCE), the National Academy of Construction, and as a fellow of the Construction Management Association of America (CMAA). He serves on a wide range of

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industry award juries and advisory panels, including the Millennium Challenge Corporation Advisory Board, and World Economic Forum Global Strategic Infrastructure Initiative Steering Committee and Global Advisory Council. Mr. Prieto served as one of three U.S. presidential appointees to the Asia Pacific Economic Cooperation Business Advisory Council; cochaired the infrastructure task force in New York after 9/11; and he served as chairman at Parsons Brinckerhoff, one of the world's leading engineering companies. He serves on the advisory board of the New York University Polytechnic School of Engineering Department of Mechanical and Aerospace Engineering and on the Engineering Academic Advisory Council of New York University, Abu Dhabi; he also previously served as a trustee of Polytechnic University. He was appointed as an honorary global advisor for the *PM World Journal* (and its predecessor, *PM World Library*). Mr. Prieto currently serves on the Mott MacDonald Shareholders Committee as an independent member and as a nonexecutive director of the Saudi-based Dar al Riyadh Group.

GEOFFREY ROTHWELL is the Chief Consulting Economist for Turner|Harris, specializing in all aspects of the economics of nuclear power. Between 2013 and 2018 he was the principal economist at the Nuclear Energy Agency of the OECD in Paris, France. From 1986 to 2012 at Stanford University he was the director of Honours Programmes in the Department of Economics and the Public Policy Program, associate director in the Public Policy Program, and a senior lecturer in the Department of Economics and the Public Policy Program. While at Stanford, he advised DOE through the Argonne National Laboratory, Idaho National Laboratory, Lawrence Livermore National Laboratory, Oak Ridge National Laboratory, and Pacific Northwest National Laboratory. Dr. Rothwell has written extensively on energy economics and electricity markets. His book, *Economics of Nuclear Power*, was published in 2016. Dr. Rothwell received his M.A. in Jurisprudence from Boalt Law School, University of California, Berkeley, in 1984, and his Ph.D. in economics from the University of California, Berkeley, in 1985. After a postdoctoral fellowship at the California Institute of Technology, he taught at Stanford University for over 25 years.

HANS A. VAN WINKLE is president of Van Winkle Consulting. He has been an engineer leader for over 40 years. Serving in the U.S. Army's Corps of Engineers (USACE), he culminated his career of over 30 years as the director of civil works and then as the deputy director of USACE, retiring with the rank of major general. As director of civil works, he oversaw the Corps' work building the nation's navigation, flood control, and environmental restoration projects, and as the deputy director of the Corps, he planned, coordinated, and controlled the Corps' $17 billion annual budget. After retirement, he initially worked as the director of the Construction Industry Institute (CII) at the University of Texas. There he oversaw CII's research program, creating best practices for the leading owner

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and industry companies working around the world. Subsequently, he became the president of Hill International, a private company advising on project management practices for companies throughout the nation. Later, he moved to Parsons Brinkerhoff and implemented these best practices in work such situations as the Medupi Power Plant in South Africa, at the time, the world's largest air-cooled power plant, and then as the project manager of the California High Speed Rail project, a $70 billion program designed to link San Francisco and Los Angeles with a high-speed train system. Mr. Van Winkle now works through his firm as a private consultant for a variety of companies.

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B

Committee Activities

MEETING 1: FEBRUARY 24-25, 2020
KECK CENTER OF THE NATIONAL ACADEMIES OF SCIENCES, ENGINEERING, AND MEDICINE

Day One

EM Program History and Overview; *Todd Shrader, Principle Deputy Assistant Secretary (EM-2); Office of Environmental Management (EM)*
Contracting Overview; *Norbert Doyle, Deputy Assistant Secretary, Office of Acquisition & Project Management (EM-5.2)*
Overview of DOE Order 413.3B and EM Project Management Protocol for Demolition Projects; *Rodney Lehman, Director, EM Office of Project Management (EM-5.22)*
Rocky Flats Model Contract; *Len Martinez, LENS*
DOE's Environmental Cleanup Mission: Scope and Growth in DOE's Environmental Liabilities and Challenges to Progress; *Amanda Kolling, Assistant Director, Government Accountability Office*

Day Two

Discussion on expectations of Congress for the study; *Jonathan Epstein, Senate Armed Services Committee*

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MEETING 2
MAY 5-6, 2020; VIRTUAL MEETING

Day One

Closed Session of the Committee.

Day Two

DOE's Environmental Cleanup Mission: Scope and Growth in DOE's Environmental Liabilities and Challenges to Progress; *Amanda Kolling, Assistant Director, Government Accountability Office*

Project Management (PM) Governance, Systems and Training; *Paul Bosco, Director, Office of Project Management (PM)*

NNSA and DOE O 413.3B; *Bob Raines Associate Administrator for Acquisition and Project Management, National Nuclear Security Agency*

Discussion of the Demolition Protocol; *Rodney Lehman, Director, EM Office of Project Management (EM-5.22)*

MEETING 3
JULY 21, 2020; VIRTUAL MEETING

Q&A with DOE; *Rodney Lehman; Director of Project Management, Office of Corporate Services, Office of Environmental Management (EM); and Charles S. "Steve" Trischman; Director, Office of Budget and Planning, Office of Environmental Management*

WEB CONFERENCE CALL
AUGUST 23, 2020; VIRTUAL MEETING

Closed Session of the Committee.

WEB CONFERENCE CALL
SEPTEMBER 28, 2020; VIRTUAL MEETING

Closed Session of the Committee.

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C

Response to Past Studies

OVERIEW

This appendix summarizes external reviews the Department of Energy's (DOE's) Office of Environmental Management (EM) over the past 20 years. It first lays out the National Research Council[1] (NRC) series on "Improving Project Management at DOE," which began in the late 1990s and led to a number of findings and recommendations. It will summarize an external review of EM that occurred in 2011 at the request of the Secretary, and will provide an organized review of U.S. Government Accountability Office (GAO) studies that have looked specifically at EM and EM projects over that 20-year time frame.

All of these reviews and studies will be synthesized into a timeline progression of findings and recommendations unique to EM, which will help lay out issues that seem to have been resolved as well as those that seem to be recurring over the period of assessment. Conclusions will be developed providing the basis for further inquiry.

PAST EXTERNAL REVIEWS OF DOE AND EM

The purpose of this appendix is to give some context to past studies examining project and program management practices and success within DOE's EM organization. The review will briefly cover the past 20 years starting with two NRC study teams beginning in 1998, which looked at the entirety of project and

[1] Effective July 1, 2015, the institution is called the National Academies of Sciences, Engineering, and Medicine. References in this report to the National Research Council are used in an historical context identifying programs prior to that date.

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program management across the DOE capital investment program, including EM. It will summarize an internal independent study commissioned by Secretary Steven Chu in 2011 that looked specifically at EM. It will also summarize GAO reviews of EM's project management and program management practices that have occurred since 1999, with emphasis on a number of recently published documents.

NRC Phase I Study

In 1997, the House Appropriations Subcommittee on Energy and Water was concerned about project performance within DOE and directed DOE to engage a respected entity to review project performance. As a result, the NRC became engaged and released a 1998 report titled *Assessing the Need for Independent Project Reviews in the Department of Energy* (Phase I), which was authored by Lloyd Duscha (member, National Academy of Engineering [NAE]). A study committee was formed, chaired by Dr. Ken Reinschmidt (NAE), the Committee to Assess the Policies and Practices of the Department of Energy to Design, Manage, and Procure Environmental Restoration, Waste Management, and Other Construction Projects. Its charge was to look at policies and practices across all of DOE, including the Office of Science (SC), National Nuclear Security Agency (NNSA), and EM.

Meanwhile, there was essentially an "impound" on spending for DOE project site work pending congressional review of multiple independent project review reports. The House Appropriations Subcommittee on Energy and Water remained engaged, with briefings by the NRC on its deliberations during this period. The committee published its report, *Improving Project Management in the Department of Energy,* in June 1999. In this report, the committee outlined that DOE fell far short of best practices in a number of areas, including:

- Organization-wide project management policy
- Clear definitions of responsibility and accountability
- Control of changes in the scope, cost, and definition of projects
- State-of-the-art project management systems
- Identification, dissemination, and implementation of lessons learned
- Preproject and preconstruction planning
- Scope definition at the project baseline stage
- Assessing and managing project risk
- Setting contingency allowances based on risk
- Cost estimation and scheduling
- Objective performance-based incentives
- Performance measurement and progress reports
- DOE-wide financial reporting systems
- Cost and performance databases and information systems

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- Selection, training, and qualification of project managers
- Project management core competency and organization

Before dissolving, the committee also prepared a primer, *Characteristics of Successful Megaprojects*.

NRC Phase II Study

The FY 1999 Appropriations Act zeroed out the budget for the DOE office that had been handling project and facilities management. DOE moved quickly toward development and publication of Order 413.3 as its project life-cycle management model. Congress also directed additional review to be done by the NRC. This second NRC committee of experts was formed to do a series of reviews and began its work just as Order 413.3 was being finalized by a newly-formed oversight office (Office of Engineering and Construction Management (OECM) and three new Project Management Support Offices (PMSOs)). This committee was again chaired by Dr. Ken Reinschmidt (NAE), the Committee for Oversight and Assessment of Department of Energy Project Management. Meeting from 2000 to 2003, it provided the Deputy Secretary a singular opportunity for independent views of project management practices within DOE to enable best possible decisions. Its scope was to review across all DOE:

- Policies, Procedures, Documentation, and Reporting; including review of Order 413.3, its implementation and OECM
- Project Planning and Controls
- Skills, Selection, and Training of Personnel
- Project Reviews
- Acquisition and Contracting
- Risk Management
- Organizational Structure, Responsibility, and Accountability

The committee was prolific in its work and evaluations, publishing the following documents:

- Interim Letter Report to Secretary Richardson, January 2001
- Progress in Improving Project Management in the Department of Energy: 2001 Assessment
- Interim Letter Report to Secretary Abraham, May 2002
- Progress in Improving Project Management in the Department of Energy: 2002 Assessment
- The Owners Role in Project Management and Preproject Planning, 2002
- Progress in Improving Project Management in the Department of Energy: 2003 Assessment, 2004

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- The Owner's Role in Project Risk Management (in DOE), 2005

Over the course of its 3-year evaluation, it met 14 times, visited DOE headquarters and 10 DOE field sites, met with over 200 DOE and contractor personnel (some multiple times), and reviewed project information from dozens of projects. Its recommendations to DOE, as summarized in the 2003 assessment, were many:

- Develop policies and procedures to define the DOE method of managing projects;
- Create a project management culture across the agency that supports the consistent implementation of policies and procedures;
- Provide leadership that ensures disciplined planning and execution of projects as well as support for continuous process improvement;
- Provide a project management champion at the highest level of the department to ensure that a focus on the importance of project management is established and maintained;
- Develop competence in fulfilling the owner's role in front-end project planning, risk management, and project execution;
- Apply rigorous project reporting and controls that include earned value systems, link day-to-day management data to periodic reporting, forecast time and cost to complete, and maintain historical data with which to benchmark project performance;
- Document processes and performance to support benchmarking and trend analysis;
- Invest in human capital by providing training and career development to ensure an adequate supply of qualified, skilled project directors;
- Continue, refine, and document a program of external and internal project reviews; and
- Employ innovative approaches to capital acquisition and the use of performance-based contracting.

As stated in the 2004 report, "Most of these (suggested) changes relate to inadequate planning, inadequate risk management, and inadequate monitoring and follow-up" (NRC, 2004, p. 70). Perhaps prescient, it wrote, "The concern of the committee is not so much that Order O[rder] 413.3, Manual M 413.3-1, other documents, and the Project Management Career Develop Program (PMCDP) will be rescinded, but rather that they will be circumvented." (NRC, 2004, p. 3). It is clear that the impact of these two committees fundamentally changed the way DOE has approached projects in the past two decades, with many of its recommendations acted on within larger DOE complex.

Perhaps a poignant reminder of the optimism of the early 2000s was in this finding in the 2002 Assessment (NRC, 2002, p. 55).

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Undersecretary Robert Card has enunciated a new strategy for Environmental Management (EM) that stresses earlier completion of site cleanup and remediation and earlier closure of sites or their turnover to private industry. The EM organization is reorganizing to fulfill this new strategy. Although it appears that much of the time reduction will be due to a reevaluation of the necessary end states, which may involve negotiations with stakeholders, the committee considers this initiative an important step toward DOE controlling its projects rather than being controlled by them, as has been the case. To make progress, it is necessary to believe that projects can be controlled and delivered earlier rather than believing that nothing can be done and that the process will require 70 years to complete. It is too early to determine whether the new EM organization will be successful, but the committee considers active attempts to get projects under control, to define strategic directions, and to align projects with strategy to be superior to passivity.

Secretary of Energy EM Review

In 2011, a number of projects in the EM portfolio were underperforming. As a result, DOE Secretary Steven Chu established a DOE committee to perform an external review of EM, with the committee headed by Dan Lehman from SC. The review committee consisted of current DOE employees, retirees, and consultants and was given a short time frame to perform a review and develop report (April-June 2011). The committee met five times over that period, interviewed over 80 individuals, made site visits to EM headquarters in Washington, D.C., Savannah River National Laboratory, Oak Ridge National Laboratory, and Idaho National Laboratory. It also conducted in-depth reviews on four major underperforming EM capital projects at the request of Secretary Chu: the Salt Waste Processing Facility at Savannah River National Laboratory; the Sodium Bearing Waste Treatment Facility at Idaho National Laboratory; and the K-25 and U-233 Projects at Oak Ridge National Laboratory. Note that these four projects were not the only underperforming projects in the portfolio but were deemed representative; the committee was specifically steered away from Hanford. The committee's charge by Secretary Chu was to investigate the following questions:

- Are each of the programs and projects organized and aligned to successfully deliver the project?
- Do the federal and contractor project teams have the requisite experience and expertise to effectively manage all aspects of the project?
- Are the roles and responsibilities of line management for project requirements, contract deliverables, and funding streams documented, well understood, and effectively executed?
- Are mechanisms in place to assure critical, accurate project performance issues/concerns are propagated up and down the chain of command to ensure appropriate and timely corrective action is taken?

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- Is there consistent, credible, independent review of all aspects of project performance to support EM's federal oversight responsibility?
- Would replicating SC's organizational structure, with its program offices and well-defined line management responsibilities and accountabilities, in the EM organization, positively impact EM's project performance?

The findings of this review were distributed across EM via a transmittal memorandum in September 2011 by Daniel Poneman (Poneman, 2011, p. i). The findings of the study were grouped in the following areas:

- *Accountability.* Roles and responsibilities for program and project management are not well understood throughout the EM headquarters and field organizations.
- *Decision-making.* A clear devolution of authority to responsible program line managers is needed to avoid confusion about roles and responsibilities, delays, and rework at the field level.
- *Culture.* Extraordinary efforts are made to report projects as "Green" (on schedule and on budget) regardless of actual project performance indicators. There is pressure "to color a project Green" with a quick fix. In this mode, efforts to "get to Green" can be detrimental to successful project delivery and has had negative consequences for the EM culture.
- *Stability.* Excessive turnover in EM headquarters, and federal and contractor field positions for project management has led to loss of technical capability, program and project leadership skills, and critical project knowledge.
- *Structure.* Delivery of projects is hampered by the lack of appropriately structured and empowered program offices at EM headquarters. These offices, staffed with program managers with line management authority, should provide strategic policy and guidance, resource allocations, project advocacy and oversight, and enable effective sharing of lessons learned across projects and sites.
- *Peer Review.* Independent, external peer review occurs too late in the project development cycle. Reviews have not encompassed all aspects of project performance (technical, schedule, cost, and management). Peer reviewers do not represent the mix of experience and expertise needed to adequately assess all aspects of the project.
- *Alignment.* Lack of well-defined project management roles and responsibilities and lines of communication contribute to a proliferation of EM headquarters data calls and information requests.

As the committee succinctly noted: "Appropriately constituted program offices with empowered program managers; strong line management with well understood roles and responsibilities; effective peer reviews; stability in

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organizational structure and personnel; and a culture of open information sharing could address many of EM's program and project performance issues" (Poneman, 2011, p. 9). In its report, the review committee "….. encourages top management at DOE and EM to adopt a new mode of leadership realizing that real change is imperative" (Poneman, 2011, p. 12). In its recommendations, the committee urged EM to:

- Transform the culture of EM to one of more open sharing, collaborative problem-solving, and transparency so that open and honest results are communicated and acted upon, resulting in continuous improvements being made to EM. This culture should be proactive in its approach to managing programs and projects, rather than reactive.
- Ensure that accountability, responsibility, and authorities for programs and projects are formally documented, effectively communicated, and executed at the right level throughout the EM organization.
- Promote EM-wide (headquarters and field) stability by making every effort to retain experienced, competent, and well-trained staff. Staff turnover at EM Headquarters and the field is problematic and does not allow for stable, consistent, effective decision-making or ownership of the project baselines.
- Ensure that peer reviews are performed for capital asset projects regularly throughout the projects' life-cycle (Critical Decisions 0 through 4). These reviews (tailored to project size/complexity) should be comprehensive, independent project assessments similar to the SC peer review model in scope, including technical, cost, schedule, management; environment, safety and health; and risk evaluations.
- Establish EM headquarters program offices (geographic, site, or product line) staffed by program managers with clearly defined roles and strong accountability, authority, and responsibility in their area. These offices would provide strategic policy development and guidance, resource allocations, and project advocacy and oversight. This would also enable effective sharing of lessons learned across projects and sites.
- Use technical/management independent advisory committees for advice on program and project performance at the program, site, or large project levels. These advisory committees would be in addition to the Environmental Management Advisory Board (EMAB) and Site-Specific Advisory Boards (SSABs), and would give strategic guidance and assistance.
- Reduce and/or eliminate ad hoc or limited-value information requests to only those that are necessary. These EM headquarters information requests should be aligned to the clarified responsibilities, authorities, and accountabilities of the EM headquarters organization requesting the information.
- Establish a stronger partnership relationship with the executing contractors. This would recognize EM's role as a "demanding customer" that

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rewards strong performance with contract incentives, but also that real project success requires mutual respect and trust and open and honest communications.

GAO Reviews

Since 1999 when the first NRC report on DOE project management was published, the GAO has published 56 reports focused on DOE. Of these 56 reports, 36 are directed specifically at EM (or in some cases EM and NNSA). Some of the reports are focused strictly on technical issues surrounding cleanups. Others are focused on management and project management activities as identified by project reviews or review of a series of projects within a portfolio or at a site. It is worth noting that 11 of these reports have been published since 2018. The listing of these reports is provided at the end of this appendix in reverse chronological order.

As an example, in December 2019, DOE reported that it faced an estimated $494 billion in future environmental cleanup costs, with the total liability roughly tripling during the previous 20 years (GAO, 2019). GAO was asked to examine EM's operations activities and made several recommendations including that EM should establish cleanup work classification requirements and revise its cleanup policy to follow program and project management leading practices (GAO-19-223). It pointed out that 77 percent of EM's FY 2019 budget was classified as operations activities and not subject to outside review, while only 18 percent contained requirements for oversight as capital asset projects.

It further pointed out that EM's cleanup policy does not follow any of 9 (GAO) selected program management leading practices or 9 of 12 selected project management leading practices. For example, EM's 2017 cleanup policy does not follow the program management leading practice of conducting risk management throughout the life of a program or the project management leading practice of requiring independent reviews of operations activities.

GAO found that EM's environmental liability does not include the costs of all future cleanup responsibilities. As an example, this liability did not include the cost for completing a known, large waste treatment facility, called the Waste Treatment and Immobilization Plant, at the Hanford site. It pointed out that between "30 to 60 percent" of EM's cleanup budget goes toward recurring activities necessary to maintain the sites such as physical security and infrastructure maintenance, rather than toward reducing EM's environmental liability. It also found that EM officials have not analyzed the root causes of the cost growth of environmental liability between 2011 and 2018, despite it increasing $214 billion (GAO-19-460T). GAO noted that EM does not have a program-wide cleanup strategy and relies primarily on individual sites to locally negotiate cleanup activities and establish priorities, which does not always balance overall risks and costs. For example, it pointed out that the Hanford and Savannah River sites plan

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to treat similar radioactive tank waste differently, with Hanford's efforts possibly costing tens of billions more than Savannah River's. In addition, EM manages most of its cleanup work as operations activities, under less stringent requirements than other environmental remediation projects. Operations activities are not subject to independent oversight outside EM, and therefore DOE cannot hold EM accountable for its performance.

As another example, DOE stated in reports to Congress as early as 2007 that it intended to manage demolition of its three former gaseous diffusion plants (GDPs) in an integrated manner. A Decontamination and Decommissioning (D&D) Fund was established by law to pay for the cleanup costs of the GDP sites, allowing EM to coordinate and make trade-offs in its use of resources among the three GDPs. However, EM has managed the cleanup of the three GDPs as three individual sites. In addition, GAO found that EM was not following relevant leading practices that GAO recommends for managing the cleanup as a program (having a program management plan; a reliable integrated master schedule; and a reliable, integrated, comprehensive life-cycle cost estimate) (GAO 20-63). EM has reported spending a total of about $15.5 billion on GDP cleanup as of fiscal year 2018 with cost estimates of remaining work exceeding the currently allocated $25 billion. It is worth noting that at the present time, EM is asking for relief from following DOE Order 413-3B on the GDP D&D projects.

In February 2019, GAO made two recommendations to EM to review and revise its cleanup policy to include project and program management leading practices related to scope, cost, schedule performance, and independent reviews. DOE agreed with GAO recommendations and responded that it intends to replace its current cleanup policy with two separate project and program management policies that will incorporate leading practices related to scope, cost, schedule, and independent reviews, as appropriate. EM expects to issue the new project management policy in spring 2020 and the new program management policy in fall 2020 (GAO-20-285PR).

In summary, there are a large number of reports that GAO has published over the past 20 years that have been critical of the way that EM is managing its program and portfolio. A number of recent reports, some identified above, have continued to focus on needed improvements that were identified initially in the late 1990s.

Summary

Over the past 20 years a number of studies have analyzed the project and program management practices in EM. It should be noted that some progress has been made. The PMCDP program, for instance, helps with relevant training and career progression, as well as qualifying those who are in project management roles. Order 413-3B has set a process in place to assure that some level of consistency and quality control is followed for capital asset projects. Table C.1

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TABLE C.1 Comparison Trending Over Time

Issue	NRC Reports (1998-2003)	Secretarial Report (2011)	GAO Reports (2019-2020)	References
The need for program management and strategic management *leadership* at headquarters	X	X	X	(NRC, 2004, pp. 47, 75-76, and 94-96) (Poneman, 2011, pp. 6, 11): (GAO 19-460T, pp. 12-13; GAO 19-223, p. 36)
Develop policies and procedures to define the DOE method of managing projects	X		X	(NRC, 2003, pp. 71-74) (GAO 19-107, p. 49)
Create a project management *culture* across the agency that supports the consistent implementation of policies and procedures	X	X	X	(NRC, 2004, p. 97) (Poneman, 2011, p.11) (GAO 20-63, p. 45)
Provide *leadership* that ensures disciplined planning and execution of projects as well as support for continuous process improvement	X	X	X	(NRC, 2004, p. 71) (Poneman, 2011, pp. 4, 5, 6, 9, 11, 12); (GAO 19-460T, p. 12)
Provide a *project management champion* at the highest level of the department to ensure that a focus on the importance of project management is established and maintained	X	X		(NRC, 2004, p. 94) (Poneman, 2011, pp. 4, 8, 11) (*complete*, GAO 19-28, p. 14)
Develop *competence* in fulfilling the owner's role in front-end project planning, risk management, and project execution	X	X	X	(NRC, 2004, pp. 76-78 and 78-82) (Poneman, 2011, p. 10-11) (GAO 19-223, pp. 22, 30; GAO 19-223, pp. 16, 26, 27, 29)
Apply *rigorous project reporting and controls* that include earned value systems, link day-to-day management data to periodic reporting, forecast time and cost to complete, and maintain historical data with which to benchmark project performance	X	X	X	(NRC, 2004, pp. 74-75) (Poneman, 2011, pp. 8, 10, 23) (GAO 19-223, pp. 29, 33, 36)
Document processes and performance to support *benchmarking and trend* analysis	X		X	(NRC, 2004, pp. 83-84) (GAO 19-460T, p. 14)

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Invest in human capital by providing training and career development to ensure an adequate supply of qualified, skilled project directors	X	X		(NRC, 2004, p. 85) (Poneman, 2011, p. 5)
Continue, refine, and document a *program of external and internal project review*	X	X	X	(NRC, 2004, pp. 88-90) (Poneman, 2011) (GAO 19-223, pp. 32, 38)
Employ *innovative approaches* to capital acquisition and the use of performance-based contracting	X		X	(NRC, 2004, pp. 91-94); (GAO 19-28, p. 28; GAO 20-63, p. 45; GAO 19-107, p. 47)

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lays out recommendations from the final National Academies 2003 Assessment report and indicates whether these issues were recurring in the 2011 Secretarial review and other recent GAO reports.

For example, the first item in Table C.1, "the need for program management and strategic management *leadership* at headquarters," elicited the following statements in different reports. "Senior managers should continue to emphasize the importance of improving the project management processes and procedures to assure long-term improvement throughout the organization" (NRC, 2004, p. 96). "In this context, the committee provides its recommendation in the form of a prospectus—a set of aspirations that senior DOE and EM leadership should be focused on to develop a realistic change initiative to make EM a stable, and consistently high-performing organization" (Poneman, 2011, p. 11). EM's cleanup policy does not follow program and project management leading practices (GAO 19-460T, p. 12). In another report it stated "EM has not followed (i.e., has not met, has minimally met, or has partially met) best practices to ensure that these systems are (1) comprehensive, (2) provide reliable data, and (3) are used by EM leadership for decision-making—which are the three characteristics of a reliable earned value management (EVM) system. Moreover, EM has allowed the contractors to categorize a large portion of their work in a way that limits the usefulness of the EVM data …. EM has not ensured that EVM Systems are comprehensive, provide reliable data, or are used by leadership for decision-making" (GAO 19-223, p. 36).

As noted in Table C.1, most of the issues identified in 2003 continue to be issues with project and program management in 2020. Please note that this assessment is not exhaustive, nor representative of all recommendations given by the NRC or GAO. It also does not review responses by EM to these past studies but instead relies on the progression of similar findings over two decades.

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D

Acronyms

A&A	advisory and assistance
ACWP	actual cost of work performed
AE	acquisition executive
AEA	Atomic Energy Act
A/E/C	Architecture/Engineering/Construction
AFO	award fee objective (ex: AFO1-AFO7)
ATC	alternative technical concept
ATWP	actual time of work performed
BAC	budget at completion
BCWP	budgeted cost of work performed
BCWS	budgeted cost of work scheduled
BIM	building information modeling
BNI	Bechtel National, Inc.
BRAC	U.S. Department of Defense Base Realignment and Closure
CAD	computer aided design
CAP	corrective action plan
CD	critical decision (ex: CD-0, CD-1, CD-2, CD-3)
CE	chief executive for project management
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund)
CII	Construction Industry Institute
CPAF	cost-plus-award-fee
CPCC	Central Plateau Cleanup Contract

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CPFF	cost-plus-fixed-fee
CPI	Cost Performance Index
CPIF	cost-plus-incentive fee
CPPC	cost-plus-percent of cost
CR	cost reimbursement/cost reimbursable
CRD	contractor requirements document
D&D	decontamination and decommissioning
DAU	Defense Acquisition University
DFLAW	direct-feed low-activity waste
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE-EM	U.S. Department of Energy's Office of Environmental Management
DOE-LM	U.S. Department of Energy's Office of Legacy Management
DOE-ORP	U.S. Department of Energy's Office of River Protection
DON BRAC	U.S. Department of the Navy Base Realignment and Closure
EAC	estimate at completion
EIA	Electronic Industries Alliance
EM	See DOE-EM
EMAB	Environmental Management Advisory Board
EPA	U.S. Environmental Protection Agency
ERDA	Energy Research and Development Administration
ESAAB	Energy Systems Acquisition Advisory Board
ESCM	end-state contracting model
ETEC	Energy Technology Engineering Center
ETTP	East Tennessee Technology Park
EVM	earned value management
EVMS	earned value management system
FAR	Federal Acquisition Regulation
FFP	firm fixed price
FPD	federal project director
FPEPA	fixed-price economic price adjustment
FPI	fixed-price incentive
FPIF	fixed price incentive fee
FUDS	formerly used defense site
FY	fiscal year
GAO	U.S. Government Accountability Office
GDP	gaseous diffusion plant
Gmax	guaranteed maximum price

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HC	hazard category (e.g., HC-1, HC-2, HC-3)
HMESC	Hanford Mission Essential Services Contract
IDIQ	indefinite delivery/indefinite quantity
IO	Infrastructure Ontario
ISO	International Standards Organization (family of standards regarding "building information modelling (BIM) according to the ISO 19650 series")
JOC	job-order contract
K-25	Manhattan Project
KPI	key performance indicator
KPP	key performance parameter
LAW	low-activity waste
LAWPS	low-activity waste pretreatment system
LM	legacy management (See DOE-LM)
M&O	management and operating
MAC	multiple award contract
MR	management reserve
NA	not applicable
NAVFAC	Naval Facilities Engineering Systems Command
NDAA	National Defense Authorization Act
NNSA	U.S. Department of Energy's National Nuclear Security Agency
NRC	National Research Council
OBS	organizational breakdown structure
OCPMP	Overall Contract/Project Management Performance
OECM	U.S. Department of Energy's Office of Engineering and Construction Management
OMB	Office of Management and Budget
ORP	See DOE-ORP
OTA	Office of Technology Assessment
PARS	Project Assessment and Reporting System
PB	performance baseline
PBI	performance based incentive
PBS	program breakdown structure
PEMP	Performance Evaluation and Measurement Plan
PEP	project execution plan

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PM	project management
PMB	performance measurement baseline
PMCDP	Project Management Career Develop Program
PMI	Project Management Institute
PMIAA	Program Management Improvement Accountability Act
PMIO	program management improvement officer
PMO	program management oversight
PMRC	Project Management Risk Committee
PMSO	project management support office
POP	period of performance
PRC	Plateau Remediation Contract
RCA	root cause analysis
RCRA	Resource Conservation and Recovery Act
RFI	request for information
RFP	request for proposal
RFQ	request for qualifications; request for quote
ROD	record of decision
SC	U.S. Department of Energy's Office of Science
SEA	special emphasis area
SPI	Schedule Performance Index
SRS	Savannah River Site
SSAB	Site-Specific Advisory Board
STWP	scheduled time of work performed
t	time
T&M	time-and-material
TBD	to be decided
TCC	Tank Closure Contract
TOC	Task-Order Contract
TPC	total project cost
TRA	technology readiness assessment
TSCR	tank-side cesium removal
U-233	uranium-233
USACE	U.S. Army Corps of Engineers
WAI	Wastren Advantage, Inc.
WBS	work breakdown structure
WIPP	Waste Isolation Pilot Plant
WRPS	Washington River Protection Solutions, LLC
WTP	Waste Treatment & Immobilization Plant

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