United States Government Accountability Office

Report to Congressional Committees

August 2023

NATIONAL NUCLEAR SECURITY ADMINISTRATION

Assessments of Major Projects

GAO-23-104402

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GAO Highlights

Highlights of GAO-23-104402, a report to congressional committees

Why GAO Did This Study

NNSA—a separately organized agency within DOE—plans to invest tens of billions of dollars in major construction projects to modernize the research and production infrastructure on which the nuclear weapons stockpile depends. Major projects are those with an estimated cost of $100 million or more. House and Senate reports include provisions for GAO to periodically review these projects.

This report assesses (1) the performance of NNSA's portfolio of major projects in the execution phase that have cost and schedule baselines and (2) the development and maturity of project designs and critical technologies for projects in the earlier definition phase that do not yet have cost and schedule baselines. The report also includes individual assessments of the major projects.

GAO collected and analyzed project cost, schedule, design and technology data and documents; reviewed monthly project status reports; reviewed DOE's project management order; and interviewed NNSA officials.

GAO reviewed projects in the definition phase (which takes a project through preliminary and final designs) and those in the subsequent execution phase (which are in construction).

What GAO Recommends

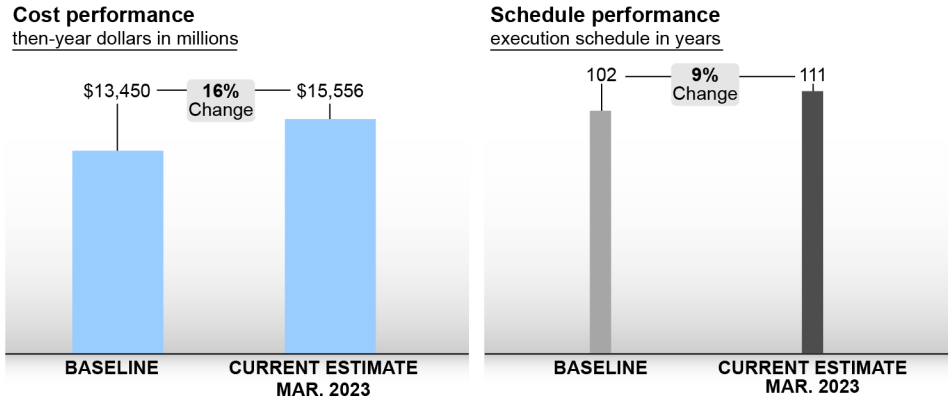
In prior work, GAO made multiple recommendations to improve NNSA's management of its major projects. NNSA agreed with a majority of those recommendations and implemented many changes. However, as of July 2023, NNSA had not fully addressed seven of those recommendations.

View GAO-23-104402. For more information, contact Allison Bawden at (202) 512-3841 or bawdena@gao.gov.

What GAO Found

As of March 2023, the National Nuclear Security Administration (NNSA) estimated that its portfolio of 18 major projects in the execution phase will overrun their collective cost and schedule baselines (see fig.). Cost and schedule baselines are quantitative indicators of performance measured by specific cost and completion date estimates. NNSA is reviewing cost and schedule estimates for four of these projects that had already experienced cost overruns or schedule delays and that could result in additional overruns or delays. For example, two of the four projects are part of the Uranium Processing Facility family of projects (in Tennessee). They are a combined $2 billion over their cost baselines and 6.5 years behind their schedule baselines. These cost increases and schedule delays are due to multiple factors, such as poor management practices by the contractor, lower levels of worker productivity than planned, and impacts from the COVID-19 pandemic (e.g., employee absenteeism due to illness). NNSA and the Department of Energy (DOE) expect to complete reviews of both projects in summer 2023.

Cumulative Cost and Schedule Overruns for NNSA's Portfolio of Major Projects in the Execution Phase, as of March 2023



Source: GAO analysis of National Nuclear Security Administration (NNSA) project documentation and data. | GAO-23-104402

Of the 10 NNSA major projects in the earlier definition phase, six projects are implementing significant design changes, and NNSA plans to put two projects on hold for multiple years. For example, in January 2022, NNSA revised the top-level requirements for the multibillion-dollar Savannah River Plutonium Processing Facility project (in South Carolina). This revision increased its scope in part by adding more processing space and support utilities in the main process building to enable future modifications. Further, NNSA plans to place the High Explosives Synthesis Formulation and Production Facility (in Texas) on hold once the site contractor has completed all design work by September 2023. According to NNSA's fiscal year 2024 budget justification, this hold is a result of cost increases and schedule delays being experienced by many of the agency's construction projects, as well as a decision to focus resources on a reduced number of high-priority projects. In addition, five of the 10 major projects in the definition phase have identified critical technologies, and these projects have generally met milestones for maturing these technologies.

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Abbreviations

ASD	Advanced Sources and Detectors
CMRR	Chemistry and Metallurgy Research Replacement
CNS	Consolidated Nuclear Security
DOE	Department of Energy
ECSE	Enhanced Capabilities for Subcritical Experiments
HESE	High Explosives Science and Engineering
HESFP	High Explosives Synthesis, Formulation, and Production
LANL	Los Alamos National Laboratory
LAP4	Los Alamos Plutonium Pit Production Project
LPF	Lithium Processing Facility
LSI	Laboratory and Support Infrastructure
M&O	management and operation
MPB	main process building
MSTS	Mission Support and Test Services
NNSA	National Nuclear Security Administration
PARS	Project Assessment and Reporting System
PIDAS	Perimeter Intrusion Detection Assessment System
PSF	Process Support Facilities
R&D	research and development
RLUOB	Radiological Laboratory Utility Office Building
SAB	Salvage and Accountability Building
SPD	Surplus Plutonium Disposition
SRPPF	Savannah River Plutonium Processing Facility
TA-55	Technical Area-55
TDC	Training and Development Center
TFF	Tritium Finishing Facility
TLW	Transuranic Liquid Waste
TRA	technology readiness assessment
TRL	technology readiness level
UPF	Uranium Processing Facility
WEPAR	West End Protected Area Reduction

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
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August 17, 2023

The Honorable Jack Reed
Chairman
The Honorable Roger Wicker
Ranking Member
Committee on Armed Services
United States Senate

The Honorable Mike Rogers
Chairman
The Honorable Adam Smith
Ranking Member
Committee on Armed Services
House of Representatives

Over the next 2 decades, the United States plans to spend tens of billions of dollars to modernize its nuclear weapons stockpile, as well as the research and production infrastructure on which stockpile programs depend. The National Nuclear Security Administration (NNSA)—a separately organized agency within the Department of Energy (DOE)—is responsible for managing the efforts to modernize our nation's nuclear stockpile and its related infrastructure. To help meet these responsibilities, NNSA is designing, constructing, or completing closeout activities for 28 capital asset projects that individually have an estimated cost of $100 million or more and collectively could cost over $34 billion to complete.

NNSA's portfolio of major projects[1] includes efforts at sites across the nuclear security enterprise and that vary widely in their purpose and

[1]For the purposes of this report and in accordance with the legislative provisions under which we conducted our review, we define a major project as a capital asset project with an estimated total project cost of $100 million or more. In contrast, DOE's order on project management for capital asset acquisitions defines a "major system" project to be any project with an estimated cost of over $750 million. Department of Energy, *Program and Project Management for the Acquisition of Capital Assets*, DOE Order 413.3B (Washington, D.C.: Nov. 29, 2010) [Updated Jan. 12, 2021]. However, DOE Order 413.3B applies to all projects estimated to cost $50 million or more.

costs.[2] Some projects include in their scopes efforts to identify and mature critical technologies that may make nuclear or high-hazard operations safer or more efficient.[3] For example, NNSA's portfolio of major projects includes

- three multibillion-dollar, one-of-a-kind projects to construct new, or modify existing, uranium and plutonium component production facilities in New Mexico, South Carolina, and Tennessee;
- a $1.8 billion project for a linear accelerator that will be installed 1,000 feet underground in Nevada, along with multiple critical technologies to produce very detailed X-ray images during plutonium experiments; and
- an over $270 million project to build a high explosives laboratory and related facilities in Texas.

NNSA relies on management and operations (M&O) contractors to conduct the majority of the work needed to fulfill NNSA's mission.[4] Historically, DOE and NNSA have had challenges in managing and overseeing their contractors, including completing projects within their performance baselines, which are quantitative definitions of cost, schedule, and technical performance. In 1990, we placed DOE contract management—including project management—on our High Risk list of programs and operations that are vulnerable to waste, fraud, abuse, or mismanagement. In 2013, we narrowed the focus of DOE's high-risk designation to NNSA and DOE's Office of Environmental Management projects with an estimated cost of $750 million or greater and acknowledged that DOE and NNSA had made progress in improving

[2]NNSA's nuclear security enterprise consists of a nationwide network of government-owned, contractor-operated research laboratories and nuclear weapons production facilities. These facilities, generally referred to as sites, provide the research, development, testing, and production capabilities needed to maintain and modernize the nation's nuclear weapons stockpile and the infrastructure on which the stockpile depends.

[3]According to DOE guidance, technologies are considered critical if they are new or novel, or used in a new or novel way, and needed for a system to meet its operational performance requirements within defined cost and schedule parameters.

[4]M&O contracts are agreements under which the government contracts for the operation, maintenance, or support, on its behalf, of government-owned or government-controlled research, development, special production, or testing establishments wholly or principally devoted to one or more of the major programs of the contracting agency. 48 C.F.R. § 17.601.

contract management.[5] In 2023, we updated the title of this high-risk area—from "Contract and Project Management" to "Acquisition and Program Management"—to more accurately represent the full range of challenges that we have identified, including issues such as the full acquisition process, program management, and financial management.[6]

House Report 116-442 accompanying the National Defense Authorization Act for Fiscal Year 2021 included a provision for us to review NNSA capital asset projects with a total cost greater than $100 million, and Senate Report 117-130 accompanying a bill for the National Defense Authorization Act for Fiscal Year 2023 included a provision for us to conduct similar future reviews on a biennial basis.[7] Specifically, this report assesses (1) the performance of NNSA's portfolio of major projects that have cost and schedule baselines and (2) the development and maturity of project designs and critical technologies for projects that do not yet have cost and schedule baselines. This report includes Individual assessments of 23 of NNSA's 28 major projects, which we provide in appendix I.[8]

This is our first biennial report assessing selected NNSA major projects. We included 28 NNSA major projects that had an estimated cost greater than $100 million and identified a specific facility or approach to meet a mission need by January 2022.[9] For the purposes of this report, we divided the major projects into those with approved cost and schedule baselines and those without because we consider them to be in different phases of the acquisition process. For example, projects with cost and schedule baselines have a defined scope and are conducting construction activities. In contrast, projects without cost and schedule

[5]DOE's Office of Environmental Management is responsible for cleaning up legacy nuclear waste from weapons production dating back to World War II.

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

[7]H.R. Rep. No. 116-442 at 306 (2020); and S. Rep. No. 117-149 at 371 (2022).

[8]Five of the 28 projects reached the project completion milestone during the course of our review. Accordingly, we included the five projects in our analysis of the overall performance of NNSA's portfolio of major projects but did not provide individual assessments of these projects in app. I, as these assessments provide information on the status of ongoing projects.

[9]We excluded the Spent Fuel Handling Recapitalization project, managed by NNSA's Office of Naval Reactors, from our scope because the project is managed under a separate set of project management requirements than other NNSA projects, and the project does not report information to DOE's project assessment database.

baselines have a preliminary scope and are primarily conducting design activities.

We focused our initial efforts on identifying, collecting, and analyzing information to develop the individual project assessments provided in appendix I. Specifically, we reviewed information from DOE's project assessment database and standard project documents, such as project execution plans and monthly project status reports. Using this information, we developed a data collection instrument for each project that we then submitted to NNSA's project offices. For the data collection instrument, we prefilled certain parts based on available documentation, such as NNSA's congressional budget justifications, and asked the project offices to corroborate or update the information, while for other parts we asked the project office to provide requested information. We then interviewed NNSA officials responsible for each project to discuss the project's status and the information they submitted in response to our data collection instrument. We then reviewed project documentation—such as updated project execution plans, design management plans, or technology maturation plans—as well as project reviews and NNSA congressional budget justifications to corroborate the information we obtained in the interviews. To assess the reliability of the data, we reviewed related documentation and interviewed knowledgeable agency officials, among other things. We determined that the data were reliable for our purposes.

With an understanding of each individual project, we then made portfolio-wide observations in accordance with our objectives. Specifically, to assess the performance of NNSA's portfolio of major projects that have cost and schedule baselines, we collected cost and schedule information from DOE's project assessment database as of March 2023. We compared this information with the original cost and schedule baselines that NNSA approved for these projects at the baseline approval milestone to calculate the performance against the portfolio's cumulative cost and schedule baselines. We then reviewed relevant documentation, such as monthly project status reports and annual project reviews, and interviewed project officials to identify any cost and schedule challenges.

To assess the development and maturity of project designs for projects that do not yet have cost and schedule baselines, we reviewed relevant project documentation, including projects' design management plans and their most recently completed design reviews. We compared the documentation and findings from the design reviews with DOE and NNSA

requirements, such as those found in DOE's project management order.[10] In addition, we reviewed monthly status reports to see if the project office identified any design issues that occurred between design reviews. We also reviewed documents and interviewed NNSA project officials to determine if any design issues have had, or could have, any effects on project costs and schedules.

To assess the development and maturity of critical technologies for projects that do not yet have cost and schedule baselines, we relied on information about the number of critical technologies for each project and their associated technology readiness levels (TRL) provided by the NNSA project offices. We then reviewed relevant documentation, such as technology readiness assessments (TRA) and technology maturation plans. For projects that identified critical technologies and completed a TRA, we compared the reported TRLs with the technology maturity milestones outlined in DOE's project management order.[11] In addition, DOE's project management order requires the TRA review team to be independent of the project team, but we did not verify that this requirement was met nor did we verify the resulting TRLs. However, we took steps to assess the reliability of the project office-supplied data by, for example, reviewing relevant documentation.

We conducted this performance audit from July 2020 to August 2023 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

This section describes (1) the acquisition process used for NNSA major projects, (2) NNSA's cost and schedule commitments for its projects, (3) DOE and NNSA requirements for design maturity, (4) DOE and NNSA requirements for technology maturity, (5) the sites in the nuclear security enterprise, (6) the NNSA projects we reviewed, and (7) an overview of some of our recent work on NNSA projects.

[10]DOE Order 413.3B

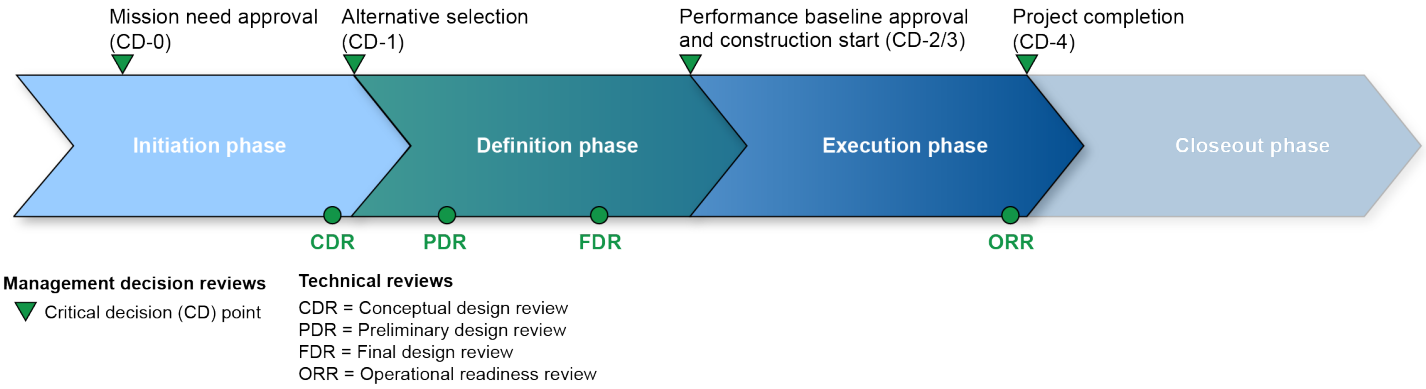
[11]DOE Order 413.3B

Acquisition Process for NNSA Major Projects

NNSA is required to manage the construction of capital asset projects with a total project cost of greater than $50 million, in accordance with DOE's project management order.[12] The life cycle for NNSA major projects consists of three main phases—initiation, definition, and execution. Major projects must get approval from senior NNSA or DOE officials at key decision points—referred to as "critical decisions"—before they can enter each new phase.

For the purposes of our report, we excluded projects in the initiation phase from our scope because NNSA has not yet selected a preferred solution or approved preliminary cost and schedule estimates for these projects. In addition, we defined the definition phase as beginning with the alternative selection milestone and ending with the approval of a project's performance baseline (see fig. 1). We present the major milestones in the acquisition process in the same sequence as DOE's project management order. However, DOE considers both the definition and execution phases to start at earlier points in the acquisition process.[13]

Figure 1: Acquisition Phases for NNSA Major Projects



Source: GAO analysis of Department of Energy (DOE) and National Nuclear Security Administration (NNSA) documentation. | GAO-23-104402

Note: For the purposes of our report, we have defined these phases to make it easier to distinguish projects that are conducting different types of activities (e.g., design work compared with construction work) and have different cost and schedule statuses (i.e., those without performance baselines

[12]DOE Order 413.3B.

[13]DOE defines the initiation phase as ending with mission need approval; the definition phase as occurring between mission need approval and alternative selection; and the execution phase as occurring between alternative selection and project completion. As a result, DOE's definitions make it more difficult to distinguish between projects conducting different types of activities (e.g., design work compared with construction work) or those with different cost and schedule statuses (i.e., those without performance baselines compared with those with performance baselines).

compared with those with performance baselines). In contrast, DOE defines the initiation phase as ending with mission need approval; the definition phase as occurring between mission need approval and alternative selection; and the execution phase as occurring between alternative selection and project completion.

During the initiation phase, a project develops a mission need statement and a rough-order-of-magnitude cost estimate range, which is reviewed and approved by a senior official at the mission need approval milestone. A key feature of the mission need statement is that it should be solution neutral—that is, the mission need statement should not propose the construction of a specific facility but rather should identify a gap in existing capability that can be closed through a variety of potential solutions. After this decision, NNSA conducts an analysis of alternatives and appoints a federal project director to manage the project.[14] The project then develops an acquisition strategy, design management plan, and a technology maturation plan (if applicable), and performs a conceptual design review. This phase culminates in the alternative selection milestone, when a senior official approves the project's scope and preliminary estimates for cost and completion (which are expressed as a range of estimates) for the preferred alternative selected from among those considered in the analysis of alternatives.

During the definition phase, a project continues to refine its design and conducts both a preliminary design review and a final design review. The project finalizes its cost and schedule estimates. In some cases, a project may conduct site preparation activities (e.g., install security fencing and utility lines) or procure specialized equipment (referred to as "long-lead procurement" activities). This phase culminates in a baseline approval and construction start milestone,[15] when a senior official approves the project's scope, cost, and completion date baselines (referred to collectively as the performance baseline).

During the execution phase, a project starts construction and major procurement activities. After completing construction activities, the project conducts a readiness review, which reviews the project's readiness to

[14]The analysis of alternatives process is an analytical study that is intended to compare the operational effectiveness, cost, and risks of a number of potential alternatives to address valid needs and shortfalls in operational capability. This process helps ensure that the best alternative that satisfies the mission need is chosen on the basis of the selection criteria, such as safety, cost, or schedule.

[15]DOE's project management order identifies this milestone as two separate critical decisions (critical decisions 2 and 3). However, NNSA has combined these two milestones into a single milestone in its implementation of DOE's project management order.

operate or maintain the system, facility, or capability. This phase culminates in a project completion milestone, when a senior official verifies that the project has achieved its completion criteria and approves the transition to operations. At this point, the project enters the closeout phase, when it performs any remaining administrative, contractual, and financial activities.

NNSA Cost and Schedule Commitments

A major project's performance baseline includes the cost, schedule, and scope baselines against which the agency's performance on a project is measured. A performance baseline includes (1) the estimated total project cost, consisting of design, procurement, and construction costs, as well as management reserve and contingency to cover cost and schedule risks; (2) an estimate for the date of completion, which represents when construction activities are planned to be complete for the project's transition to operations; and (3) scope, including key performance parameters that define essential characteristics, functions, or requirements associated with the completed facility or capability. The performance baseline represents NNSA's commitment to Congress and is formally tracked in DOE's project management database—the Project Assessment and Reporting System.

In developing the cost and schedule baselines for a project, NNSA conducts an analysis of the risks that might result in cost increases and schedule delays and develops mitigation strategies to lessen or eliminate these risks. A project's cost and schedule estimates include cost and time to cover contingency in case these risks are realized. DOE defines "management reserve" as the costs included for risks for which the contractor is responsible, and DOE defines the time included for such risks as "contractor schedule reserve." The costs and time included to address risks related to factors outside of the contractor's control, which include changes to regulations or funding below expected levels, according to NNSA officials, are referred to as "contingency."

Even with contingency and management reserve, a project may encounter unforeseen or unplanned challenges during the execution phase that affect its ability to meet its performance baseline. In such cases, NNSA must formally approve a change to the project's performance baseline (referred to as "rebaselining" a project or a "baseline change"). Specifically, senior management must approve a new performance baseline for a project in cases where the project cannot meet the cost baseline, schedule baseline, or key performance parameters established at the baseline approval milestone. As part of this process, the contractor will first propose a new cost or schedule estimate.

NNSA project and management officials will review these proposed estimates and conduct an independent project review and cost estimate (or cost review). NNSA project officials will then reconcile these estimates and propose a new cost and schedule baseline to NNSA or DOE senior management (depending on the project's revised cost), which will become the project's new performance baseline, once approved.

In addition, major projects must use earned value management to track their cost and schedule performance after NNSA approves a project's performance baseline. Earned value is the budgeted value of work actually accomplished in a given time and represents the value of work accomplished during the period. DOE requires each project to have an earned value management system that is certified to ensure that it meets the national standard for earned value management systems.[16]

Design Maturity

DOE's project management order requires major projects to conduct the following three design reviews prior to the approval of the performance baseline:

- **Conceptual design review.** This review examines a project's conceptual design, which is the development of a concept and initial specifications for meeting a project's mission needs. The conceptual design provides sufficient detail to evaluate the merits of the project and produce cost and schedule estimate ranges that inform the alternative selection milestone.
- **Preliminary design review.** This review examines a project's preliminary design, which initiates the process of converting concepts to a design appropriate for procurement or construction. The preliminary design must sufficiently define all key performance parameters. In May 2021, NNSA issued a supplemental directive that directs projects to prepare an updated cost estimate on the preliminary design.[17]
- **Final design review.** This review examines a project's final design, which represents the completion of the design effort. The final design results in the approved design documentation necessary to obtain bids and quotes for procurement and construction, as well as

[16]National Defense Industrial Association, *EIAC-748 Earned Value Management System (EVMS) Standard* (Sunnyvale, CA: March 2013).

[17]National Nuclear Security Administration, *Program and Project Management for the Acquisition of Capital Assets*, NNSA Supplemental Directive 413.3 (Washington D.C.: May 18, 2021).

informing the cost and schedule baselines and establishing the process for testing, checkout, and turnover activities.

DOE's project management order requires that these design reviews be conducted by reviewers who are external to the project (i.e., independent) using a formalized, structured approach to ensure that the reviews are comprehensive, objective, and documented. In addition, since 2015 DOE has required its more costly projects (including NNSA's projects) to develop a design management plan, which establishes the anticipated levels of design maturity at each acquisition phase.[18] The design management plan should include a design baseline, which establishes the estimated cost and schedule associated with design activities for the project.

Technology Maturity

A critical technology is a new or novel technology, or technology being used in a new or novel way, that is needed for a system to meet its operational performance requirements within defined cost and schedule parameters. According to NNSA officials, the number of critical technologies identified for potential use in a project can change during the definition phase for multiple reasons, such as changes to the project's design or cost and schedule considerations.

NNSA uses a nine-level scale, called technology readiness levels (TRL), for determining how far a critical technology has matured and to evaluate the technology's readiness to be integrated into a system for inclusion in a facility.[19] This approach is intended to ensure that new technologies are sufficiently mature in time to be used successfully when a project becomes operational and to reduce the technical and cost risks associated with the introduction of new technologies. TRLs progress from the least mature level, in which the basic technology principles are observed (TRL 1), to the highest maturity level, in which the actual system is used successfully in operations (TRL 9). It can take years to

[18]Department of Energy, Secretarial Memorandum, *Project Management Policies and Principles* (Washington D.C.: June 8, 2015).

[19]TRLs were pioneered by the National Aeronautics and Space Administration and have been used by the Department of Defense and other agencies in their research and development efforts. DOE adopted the use of TRLs in response to our recommendation that DOE develop a consistent approach to assessing the extent to which new technologies have been demonstrated to work as intended in a project before starting construction. See Department of Energy, DOE Order 413.3B; *Technology Readiness Assessment Guide*, DOE Guide 413.3-4A (Sept. 15, 2011); and GAO, *Department of Energy: Major Construction Projects Need a Consistent Approach for Assessing Technology Readiness to Help Avoid Cost Increases and Delays*, GAO-07-336 (Washington, D.C.: Mar. 27, 2007).

successfully mature a technology from TRL 1 to TRL 9. (App. III provides DOE's description of each TRL.)

For projects with estimated costs of $750 million or more, or for first-of-a-kind engineering endeavors, DOE's project management order requires that each critical technology must first be validated in a laboratory environment (TRL 4) before the project's alternative selection and cost range are approved (at the alternative selection milestone) and be demonstrated as a prototype in a relevant environment (TRL 7) before the project's performance baselines are approved (at the baseline approval milestone). DOE's order also recommends the achievement of these TRLs for projects with estimated costs of less than $750 million. Moreover, for critical technologies that have not yet met the required level of maturity for a milestone, the order calls for projects to develop maturation plans that detail the steps necessary for developing the technologies to the desired level of maturity.

In addition, DOE's project management order requires an independent review team (outside of the project team) to determine TRLs by conducting a TRA, which is used to inform program and project acquisition decisions and technology maturation planning by providing an objective assessment from subject matter experts of how successfully the technology is maturing. According to our TRA guide, conducting assessments does not eliminate the risk of relying on new technology but can identify concerns and serve as the basis for realistic discussions on how to mitigate potential risks.[20] According to NNSA officials, NNSA generally relies on its M&O contractors to conduct TRAs for its projects, and these review teams generally include subject matter experts who are not involved with the projects they review.[21]

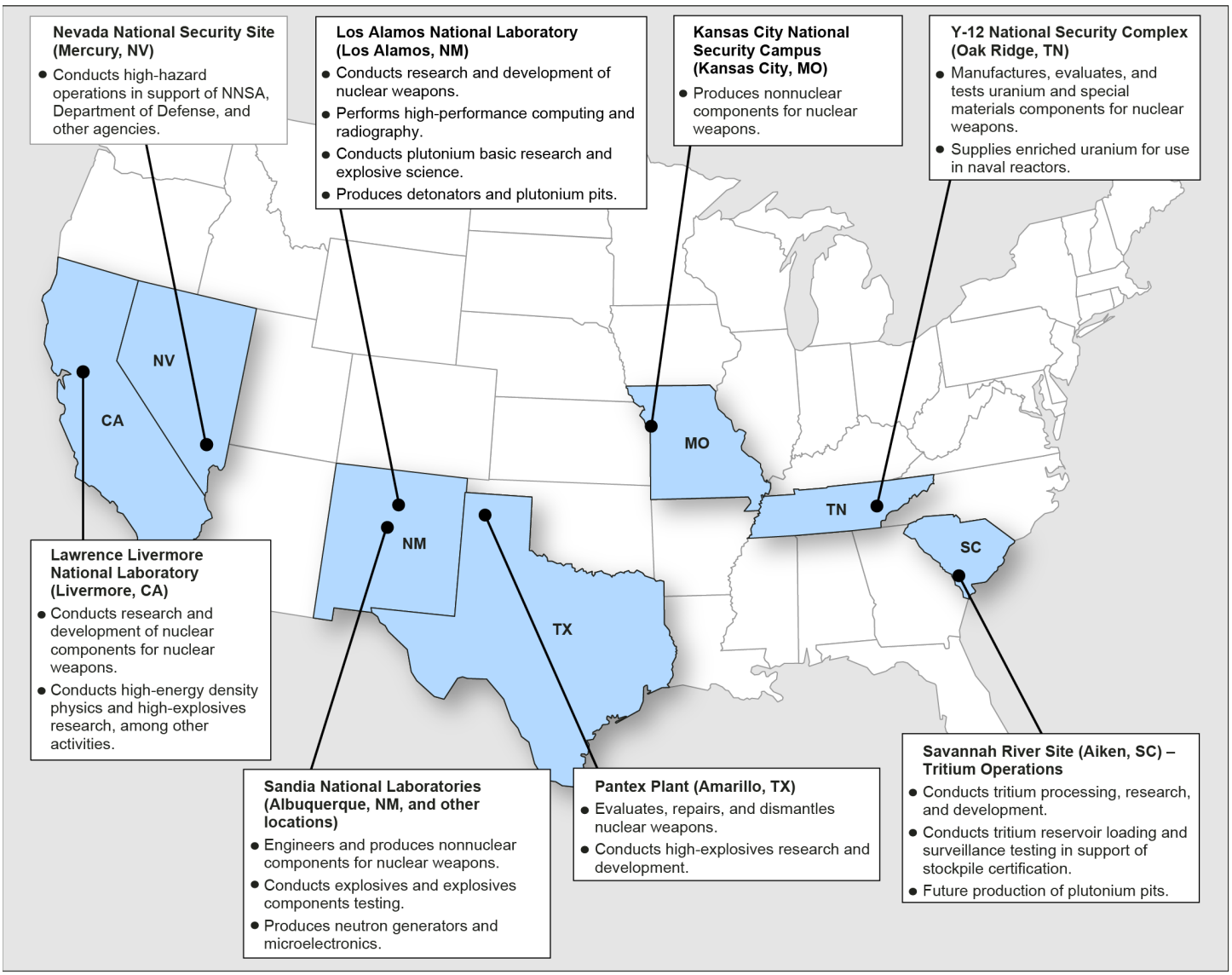
[20]GAO, *Technology Readiness Assessment Guide: Best Practices for Evaluating the Readiness of Technology for Use in Acquisition Programs and Projects*, GAO-20-48G (Washington, D.C.: January 2020).

[21]According to NNSA's policy letter on technology readiness assessments, for projects with estimated costs of more than $750 million, the Director of the Office of Cost Estimating and Program Evaluation is responsible for reviewing the TRA plan, as well as the TRA final report, and documenting the results in an evaluation memo. However, the evaluation memo will not validate a TRA's findings or results. We did not include a review of such evaluation memos in our review. National Nuclear Security Administration, *Technology Readiness Assessments*, NNSA Policy Letter 413.4 (Washington, D.C.: Dec. 22, 2016).

Nuclear Security Enterprise Sites

M&O contractors perform the work at eight government-owned sites that comprise the nuclear security enterprise. As shown in figure 2, each of NNSA's eight sites has specific responsibilities within the nuclear security enterprise.

Figure 2: Sites in the Nuclear Security Enterprise



Sources: GAO presentation of National Nuclear Security Administration information; Map Resources (map). | GAO-23-104402

NNSA Major Projects Reviewed in GAO's Assessment

Table 1 includes a list of all projects included in this report.

Table 1: NNSA Major Projects Assessed by GAO, by Site and Phase

Phase[a]	Site	Project name
Definition	Los Alamos National Laboratory	Chemistry and Metallurgy Research Replacement (CMRR) Plutonium Facility-4 Equipment Installation, Phase 2
		CMRR Re-Categorizing Radiological Laboratory and Utility Office Building to Hazard Category 3
		Los Alamos Plutonium Pit Production Project (LAP4) 30 Reliable Equipment Installation
		LAP4 Training and Development Center
		LAP4 West Entry Control Facility
	Pantex Plant	High Explosives Synthesis, Formulation and Production Facility
	Savannah River Site	Savannah River Plutonium Processing Facility[b]
		Surplus Plutonium Disposition
		Tritium Finishing Facility
	Y-12 National Security Complex	Lithium Processing Facility
Execution	Los Alamos National Laboratory	LAP4 Decontamination and Decommissioning
		LAP4 30 Base Equipment Installation
		Technical Area-55 Reinvestment Project, Phase III
		Transuranic Liquid Waste Facility
	Nevada National Security Site	Enhanced Capabilities for Subcritical Experiments (ECSE) Laboratory and Support Infrastructure
		ECSE Advanced Sources and Detectors Major Item of Equipment
	Pantex Plant	High Explosives Science & Engineering Facility
	Y-12 National Security Complex	Calciner Project
		Electrorefining Project
		Uranium Processing Facility (UPF) Main Process Building
		UPF Process Support Facilities
		UPF Salvage and Accountability Building
		West End Protected Area Reduction Project
Closeout[c]	Kirtland Air Force Base	NNSA Albuquerque Complex Project, Phase II
	Lawrence Livermore National Laboratory	Exascale Computing Facility Modernization Project
	Los Alamos National Laboratory	CMRR Plutonium Facility-4 Equipment Installation, Phase 1
		CMRR Radiological Laboratory Utility Office Building Equipment Installation, Phase 2
	Y-12 National Security Complex	UPF Mechanical Electrical Building

Source: GAO analysis of National Nuclear Security Administration (NNSA) data. | GAO-23-104402

[a]Definition refers to the acquisition phase that occurs after the alternative selection milestone (critical decision 1)—described in the Department of Energy's (DOE) project management order, DOE 413.3B—but prior to the baseline approval and construction start milestones (critical decisions 2 and 3). Execution refers to the acquisition phase that occurs after the baseline approval and construction start milestones (critical decisions 2 and 3) but prior to the project completion milestone (critical decision 4). Closeout refers to the acquisition phase that occurs after the project completion milestone.

[b]In February 2023, NNSA divided this project into six separate projects. For the purposes of our report, we refer to the "overall project."

[c]When we started our work, these projects were in the execution phase. During the course of our work, they reached project completion (critical decision 4).

Most of these projects support production capabilities for NNSA's Production Modernization portfolio, which focuses on different weapon materials or components that are critical to weapon performance. Table 2 describes the different areas within NNSA's Production Modernization portfolio, along with associated programs and related NNSA major projects.

Table 2: NNSA's Ongoing Major Projects and Their Relation to Production Modernization Programs, as of March 2023

Area[a]	Program	Site and project
Primary Capability Modernization—addresses manufacturing capabilities for a weapon's primary, which is the first stage of a nuclear weapon and the initial source of nuclear energy.	Plutonium Modernization	Los Alamos National Laboratory
		Chemistry and Metallurgy Research Replacement (CMRR) Plutonium Facility-4 Equipment Installation, Phase 2; CMRR Re-Categorizing Radiological Laboratory and Utility Office Building to Hazard Category 3; Los Alamos Plutonium Pit Production Project (LAP4) 30 Base Equipment Installation; LAP4 30 Reliable Equipment Installation; LAP4 Decontamination and Decommissioning; LAP4 Training and Development Center; LAP4 West Entry Control Facility; Technical Area-55 Reinvestment Project, Phase III; Transuranic Liquid Waste Facility
		Savannah River Site
		Savannah River Plutonium Processing Facility
	High Explosives and Energetics Modernization	Pantex Plant
		High Explosives Science & Engineering Facility; High Explosives Synthesis, Formulation and Production Facility
Secondary Capability Modernization—addresses manufacturing capabilities for a weapon's secondary, which is the second stage of a nuclear weapon.	Uranium Modernization	Y-12 National Security Complex
		Calciner Project; Electrorefining Project; Uranium Processing Facility (UPF) Main Process Building; UPF Process Support Facilities; UPF Salvage and Accountability Building
	Lithium Modernization	Y-12 National Security Complex
		Lithium Processing Facility

Area[a]	Program	Site and project
Tritium Modernization and Domestic Uranium Enrichment—responsible for producing tritium and supplying unobligated low enriched uranium to support national security needs.[b]	Tritium Modernization	Savannah River Site Tritium Finishing Facility

Source: GAO analysis of National Nuclear Security Administration (NNSA) information. | GAO-23-104402

[a]This table excludes one area generally included in Production Modernization, Non-Nuclear Capability Modernization, because we did not assess any major projects that are related to this area.

[b]Tritium is a key isotope of hydrogen used in nuclear weapons.

Recent GAO Work on Selected NNSA Projects

Over the past 10 years, we have issued multiple reports assessing NNSA's progress in managing specific major projects in more depth.[22] For example:

- In January 2023,[23] we reported that NNSA has not developed a comprehensive schedule for managing its plan to produce 80 plutonium pits—the central core of a nuclear weapon—per year at two sites (Los Alamos National Laboratory and Savannah River Site). These plans include the construction of six of the projects listed in table 1. As a result, we reported that NNSA's pit production schedule did not meet minimum qualifications to be considered an integrated master schedule.[24]
- In August 2021, we reported that NNSA's preliminary cost estimates for the construction of the Lithium Processing Facility at the Y-12 National Security Complex had substantially increased compared with earlier estimates, due in part to changes in the design for the size of the facility.[25] We found that NNSA's preliminary cost estimate was substantially comprehensive, but NNSA did not collect all the data it

[22]See Related GAO Products at the end of this report.

[23]GAO, *Nuclear Weapons: NNSA Does Not Have a Comprehensive Schedule or Cost Estimate for Pit Production Capability*, GAO-23-104661 (Washington, D.C.: Jan. 12, 2023).

[24]We reiterated our existing recommendation, which NNSA has not yet implemented, that NNSA develop an integrated master schedule for its plutonium production activities, originally included in GAO, *Nuclear Weapons: NNSA Should Further Develop Cost, Schedule, and Risk Information for the W87-1 Warhead Program*, GAO-20-703 (Washington, D.C.: Sept. 9, 2020). We also recommended that NNSA develop a life cycle cost estimate that aligns with GAO cost estimating best practices. NNSA has not taken actions to address our recommendations.

[25]GAO, *Nuclear Weapons: Actions Needed to Improve Management of NNSA's Lithium Activities*, GAO-21-244 (Washington, D.C.: Aug. 12, 2021).

needed to fully evaluate the new technology included in the facility design.[26]

- In September 2017,[27] we reported that NNSA had made progress in developing a revised scope of work, cost estimate, and schedule estimate for its project to construct a new Uranium Processing Facility. However, we found that NNSA had not developed a complete scope of work, life cycle cost estimate (i.e., a structured accounting of all cost elements for a program), or integrated master schedule (i.e., encompassing individual project schedules) for the overall uranium program, and it has no time frame for doing so.[28]

NNSA's Portfolio of Major Projects in Execution Faces Cost Overruns and Schedule Delays

NNSA estimates that its portfolio of 18 major projects in the execution phase will overrun their collective cost and schedule baselines.[29] Specifically, and as of March 2023, NNSA's estimate of the total costs for all 18 projects was approximately $15.6 billion, which is $2.1 billion (or about 16 percent) higher than the collective cost baseline of approximately $13.5 billion (see fig. 3). In addition, NNSA's estimate of the schedule for project execution for all 18 projects was 111 years, which is almost 10 years (or almost 9 percent) longer than the collective schedule baseline of 102 years.[30] Furthermore, NNSA was reviewing the cost and schedule estimates of four projects that had already experienced

[26]Among other recommendations, we recommended that the Lithium Processing Facility project collect and assess all key data before completing future TRA assessments and achieving key project milestones. As of May 2023, NNSA had not taken actions to address this recommendation.

[27]GAO, *Modernizing the Nuclear Security Enterprise: A Complete Scope of Work Is Needed to Develop Timely Cost and Schedule Information for the Uranium Program*, GAO-17-577 (Washington, D.C.: Sept. 8, 2017).

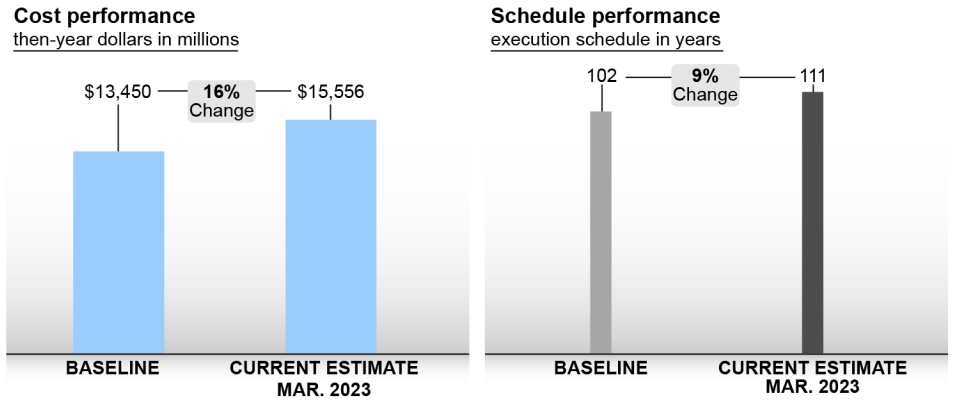
[28]We recommended that NNSA set a time frame for when the agency would (1) develop the complete scope of work for the overall uranium program to the extent practicable and (2) prepare a life cycle cost estimate and an integrated master schedule for the overall uranium program. NNSA has taken multiple actions to address the intent of this recommendation, and we consider the recommendation to be fully implemented.

[29]During the course of our review, five of the 18 projects in execution we reviewed reached the project completion milestone, at which point they transitioned to the project closeout phase. We have included these five projects in our analysis of the performance of NNSA major projects in the execution phase.

[30]The schedule for project execution refers to the duration between the actual date of the baseline approval and construction start milestone and the forecasted or actual date for the project completion milestone.

cost overruns or schedule delays, which could result in additional overruns or delays.

Figure 3: Cumulative Cost and Schedule Overruns for NNSA's Portfolio of Major Projects in the Execution Phase, as of March 2023



Source: GAO analysis of National Nuclear Security Administration (NNSA) project documentation and data. | GAO-23-104402

As shown in table 3, individual projects reported different cost and schedule performance. For additional information on actual and estimated cost and completion dates for all projects we reviewed, see appendix IV.

Table 3: Cost and Schedule Performance of NNSA Major Projects in the Execution Phase, as of March 2023

Project	Baseline cost (dollars in millions)	Changes from original baseline to current assessment		
		Cost (dollars in millions)	Cost (percent)	Schedule (months)
Meeting or underrunning original cost and schedule baselines				
CMRR PF-4 Equipment Installation, Phase 1[a]	394	-110	-28	-15
CMRR RLUOB Equipment Installation, Phase 2[a]	633	-124	-20	-1
Exascale Computing Facility Modernization[a]	111	-9	-8	-10
ECSE Advanced Sources and Detectors[b]	1,800	0	0	0
ECSE Laboratory and Support Infrastructure	560	0	0	0
LAP4 Decontamination & Demolition	529	0	0	-5
LAP4 30 Base Equipment Installation[c]	1,864	0	0	0
Transuranic Liquid Waste Facility	215	0	0	0
Overrunning original cost or schedule baseline				
Calciner	108	42	39	33
Electrorefining[d]	101	14	14	14
High Explosives Science and Engineering Facility[e]	228	50	22	0
NNSA Albuquerque Complex Project, Phase II[a]	175	-6	-3	1
TA-55 Reinvestment Project, Phase III	236	24	10	-4
UPF Mechanical and Electrical Building[a]	284	25	9	6
UPF Main Process Building[e]	4,732	1,572	33	39
UPF Process Support Facilities	140	54	39	12
UPF Salvage and Accountability Building[e]	1,180	537	46	39
West End Protected Area Reduction[e]	160	37	23	3
Total	**13,450**	**2,106**	**N/A**	**112**

Legend: CMRR=Chemistry and Metallurgy Research Replacement Facility; PF-4=Plutonium Facility-4; RLUOB=Radiological Laboratory Utility Office Building; ECSE=Enhanced Capabilities for Subcritical Experiments;LAP4=Los Alamos Plutonium Pit Production Project; TA-55=Technical Area-55; UPF=Uranium Processing Facility

Source: GAO analysis of National Nuclear Security Administration (NNSA) data. | GAO-23-104402

Notes: Data are current as of March 2023. Positive values indicate increases in estimates for cost or schedule. Negative values indicate decreases in estimates for cost or schedule. Baselines refer to the cost and schedule baselines (and associated scope) that NNSA approved at the baseline approval and construction start milestone. Schedule refers to the duration between the actual date of the baseline approval and construction start milestone and the forecasted or actual date for the project completion milestone. All figures are rounded to the nearest whole number.

[a]This project has reached completion since we started our assessment.

[b]NNSA approved this project's cost and schedule baselines in November 2022 and expected to start reporting performance data in April 2023.

[c]NNSA approved this project's cost and schedule baselines in January 2023 and expected to start reporting performance data in April 2023.

[d]In May 2023, NNSA approved a revised baseline that reflects an additional cost increase ($1 million) and schedule delay (1 month) compared with what is reported in this table.

[e]These estimates are under review by NNSA management and are subject to revision under NNSA's baseline change approval process.

As of March 2023, NNSA reported that eight of the 18 major projects in the execution phase are expected to either meet or underrun their original cost and schedule baselines.[31] For example, two completed Chemistry and Metallurgy Research Replacement Facility (CMRR) projects had a combined cost underrun of $234 million and, when combined, achieved project completion 16 months ahead of their schedule baselines. Project documents and NNSA officials attributed these two projects' cost and schedule underruns to multiple factors. For example, early in the projects' execution, NNSA hired and trained experts to support transfer to operations activities, which contributed to less costly and shorter management and safety reviews needed to complete the project.

However, NNSA only recently approved the cost and schedule baselines for two of these eight projects—the Enhanced Capabilities for Subcritical Experiments Advanced Sources and Detectors project in Nevada and the Los Alamos Plutonium Pit Production Project (LAP4) 30 Base Equipment Installation project in New Mexico–and has not yet begun to report actual project performance data that would allow for an assessment of whether the projects are on track. NNSA officials said that it is common for projects to have a time lag between the approval of baselines and the reporting of actual performance data for multiple reasons, including the time needed to collect, review, and load these data into DOE's project assessment database.[32] As a result, NNSA reported these projects' recently approved cost and schedule baselines as their estimated cost and completion date as of March 2023. NNSA expects to begin reporting actual project performance data for the two projects, which both have cost baselines of nearly $2 billion, in April 2023.

As of March 2023, the remaining 10 projects in the execution phase reported cost or schedule overruns for multiple reasons, including poor contractor performance, as well as challenges related to construction,

[31]Collectively, these eight projects have a baseline cost of $6.1 billion and are expected to be completed at a cost of $5.9 billion. In addition, these projects had a collective baseline schedule execution duration of 45 years and are estimated to be completed in 43 years.

[32]According to DOE's project management order, the contractor must start reporting such performance date no later than 3 months after the baseline approval milestone. See DOE Order 413.3B.

supply chain, procurement, and the COVID-19 pandemic.[33] Of these 10 projects, NNSA is currently reevaluating the cost and schedule estimates of four projects, which could result in additional cost overruns or schedule delays. For example:

- **Uranium Processing Facility (UPF) Main Process Building (MPB) and UPF Salvage and Accountability Building (SAB) (Y-12 National Security Complex).** Combined, these two projects are responsible for most of the cost and schedule overruns in NNSA's portfolio. As of March 2023, NNSA estimated that the UPF MPB will cost $6.3 billion (almost $1.6 billion more than its original cost baseline) and be completed in February 2029 (39 months later than the original completion baseline). Further, and as of March 2023, NNSA estimated that UPF SAB will cost $1.7 billion ($537 million more than its original cost baseline) and be completed in February 2029 (39 months later than the original completion baseline). These significant cost increases and schedule delays represent a major decline in project performance since we last reviewed the UPF project in March 2020.[34]

  A January 2023 NNSA root cause analysis identified several problems with the site contractor's management of the projects, such as inadequate cost and schedule forecasting; frequent replanning that masked performance; and not including incentives or penalties for key subcontracted work, resulting in late deliveries of services, materials, and equipment. In addition, the project's primary and ongoing construction challenge is that its actual level of productivity (i.e., the rate at which construction tasks are completed) was lower than planned. According to project documentation, this lower level of productivity was due to multiple causes, including a lack of

[33]Collectively, these projects had a baseline cost of $7.3 billion and are estimated to be completed at $9.7 billion. In addition, these projects had a collective baseline schedule execution duration of 57 years and are estimated to be completed in 69 years.

[34]GAO, *Modernizing the Nuclear Security Enterprise: Uranium Processing Facility Is On Schedule and Budget, and NNSA Identified Additional Uranium Program Costs,* GAO-20-293 (Washington, D.C.: Mar. 11, 2020).

construction supervisors and the effects of COVID-19 (e.g., employee absenteeism due to illness and contact tracing).[35]

NNSA is currently reviewing both projects' March 2023 cost and schedule estimates. DOE's Office of Project Management is conducting independent cost and project reviews, which NNSA expects to be completed in June 2023.[36] On the basis of the results of these reviews, the project office plans to submit revised cost and schedule baselines to the Deputy Secretary of Energy for review and approval.

- **High Explosive Science and Engineering Facility (Pantex Plant).** As of March 2023, NNSA estimated that the project will cost $278 million ($50 million more than its original cost baseline) and be completed in November 2027 (the original completion baseline). These estimates are based on a comprehensive update provided by the site contractor in March 2023 that reflect additional costs to address initial impacts from two ongoing construction challenges. First, in April 2022, the project terminated the subcontractor responsible for completing site preparation activities for poor performance. The project issued multiple subcontracts to complete the remaining site preparation activities, but these subcontracts have higher costs and longer durations than originally planned. Second, in the fall of 2022, the project found that multiple walls designed to resist blast pressures from high explosives testing had insufficient tensile strength. This design error was identified before the construction subcontractor started work on building the walls. Redesign efforts were completed in December 2022, but these efforts pushed the time frame for the construction of the blast resistant walls onto the project's critical path (the longest continuous sequence of activities in a schedule and that defines the project's earliest completion date).

  NNSA officials said that based on their initial review of the contractor's March 2023 estimates, they did not think the project could be completed within its cost baseline. In addition, according to project documentation, a delay in the schedule completion date is possible. According to project documentation, multiple activities along the

[35]According to the root cause analysis, the contractor identified the direct cost impacts from COVID-19 to be $34 million and indirect cost impacts to be in the hundreds of millions of dollars. However, the root cause analysis stated that these indirect costs were not validated by NNSA and were settled as part of the larger M&O contract extension negotiations. As a result, a specific value for the indirect cost impact has not been established.

[36]An independent cost review analyzes the existing estimate's assumptions, quality, and accuracy, as well as certain project risks.

critical path are taking longer than planned, and the specific efforts to address the blast-resistant walls' redesign are expected to extend the critical path by 8 months. The project is in the early stages of reevaluating changes to its cost and schedule baselines, according to project documentation.

- **Calciner Project (Y-12 National Security Complex).** The project experienced significant procurement challenges. The vendor responsible for designing and fabricating the furnace (a key piece of equipment) delivered it in January 2023, which was more than 2 years later than originally planned. According to NNSA officials, multiple factors contributed to this delay, including that the vendor had placed a higher priority on work for other customers and had initially received some components from its suppliers that did not meet quality standards. In February 2023, with the project over 75 percent complete, NNSA approved revised cost and schedule baselines. The revised cost baseline is $150 million (original baseline is $108 million), and the revised schedule baseline for project completion is June 2026 (original baseline is September 2023).

Many Projects Have Encountered Difficulties in Maturing Design, but Those with Critical Technologies Generally Have Reached Maturity Milestones

The 10 NNSA major projects in the definition phase are in different stages of design maturity, and six of these projects have either recently completed or are currently implementing significant design changes, experiencing design challenges, or assessing the cost and schedule impacts from these issues. In addition, five of these 10 projects plan to use critical technologies and have generally reached technology maturity milestones. Three of these five projects must further mature their technologies to meet future milestones. Furthermore, one project is working to address design and integration challenges with a critical technology that has already reached the required technology maturity milestone.

Projects Are at Different Stages of Design Maturity, and Six Projects Are Implementing Significant Design Changes

As of March 2023, the 10 NNSA major projects in the definition phase were in different stages of the design review process, as measured by the

most recent overall design review completed by a project.[37] Table 4 shows the design review status for these projects.

Table 4: Design Review Status for NNSA Major Projects in the Definition Phase, as of March 2023

Status of design review	Site	Project
Conceptual design review completed	Los Alamos National Laboratory	Chemistry and Metallurgy Research Replacement (CMRR) Re-Categorizing Radiological Laboratory and Utility Office Building to Hazard Category 3[a]
		Los Alamos Plutonium Pit Production Project (LAP4) 30 Reliable Equipment Installation
		LAP4 Training and Development Center
		LAP4 West Entry Control Facility
	Savannah River Site	Savannah River Plutonium Processing Facility
		Tritium Finishing Facility[b]
	Y-12 National Security Complex	Lithium Processing Facility
Preliminary design review completed	Savannah River Site	Surplus Plutonium Disposition
Final design review completed	Los Alamos National Laboratory	CMRR Plutonium Facility 4 Equipment Installation, Phase 2[a]
	Pantex Plant	High Explosives Synthesis, Formulation and Production Facility[c]

Source: GAO analysis of National Nuclear Security Administration (NNSA) data. | GAO-23-104402

[a]As of March 2023 and due to recently identified cost concerns, NNSA is in the early stages of replanning these projects' scope. NNSA officials said that there is no time frame for completing this replanning effort.

[b]This project completed its conceptual design review in 2017, but NNSA decided to revise that conceptual design. In March 2023, NNSA stated that it plans to place part of the project—the process buildings subproject—on hold for at least 3 fiscal years after the contractor completes activities to revise the subproject's conceptual design.

[c]NNSA stated that it plans to place the project on hold after the contractor completes all design work in fiscal year 2023. NNSA did not request funding for the project in fiscal year 2024 and stated that it would not seek additional funds in fiscal years 2025 through 2027.

Six of the 10 projects in the definition phase have either recently completed significant design changes, are currently implementing significant design changes, or are currently facing design challenges (as

[37]As part of the normal cycle of design maturity during the definition phase, a project continues to mature its design and build off the results of its technical design reviews as it passes from one stage of design (e.g., conceptual design) to the next (e.g., preliminary design). In addition, some projects use a design approach, where certain portions of the design (e.g., processing operations and specialized equipment) are matured before other portions of the design (e.g., facility structure and support systems). For more information on the cost and schedule estimates to complete design activities for projects in definition, see app. V.

shown in table 5), which may contribute to potentially significant increases to these project's preliminary cost and schedule estimates.

Table 5: NNSA Major Projects in the Definition Phase Implementing Design Changes or Facing Design Challenges, as of March 2023

Site	Project
Los Alamos National Laboratory	Chemistry and Metallurgy Research Replacement (CMRR) Re-Categorizing Radiological Laboratory and Utility Office Building to Hazard Category 3
	CMRR Plutonium Facility 4 Equipment Installation, Phase 2
	Los Alamos Plutonium Pit Production Project 30 Reliable Equipment Installation
Savannah River Site	Savannah River Plutonium Processing Facility
	Surplus Plutonium Disposition
Y-12 National Security Complex	Lithium Processing Facility

Source: GAO analysis of National Nuclear Security Administration (NNSA) data. | GAO-23-104402

For example:

- **LAP4 30 Reliable Equipment Installation Project (Los Alamos National Laboratory).** NNSA officials told us in March 2023 that as the project's design matured, its scope increased significantly. Specifically, the project's equipment list (i.e., the number and type of required processing and supporting equipment) doubled from the number originally identified at the conceptual design review. In addition, NNSA transferred some scope originally planned for the LAP4 30 Base Equipment Installation project to this project to address potential work sequencing concerns within the operating nuclear facilities. This scope increase, as well as other factors (e.g., higher than expected inflation), resulted in a significant cost increase and schedule delay. Specifically, as of March 2023, NNSA reported that the project's preliminary cost estimate is approximately $1.9 billion, which is nearly three times the top end of the cost range established at the alternative selection milestone. The preliminary estimate for project completion is March 2032, nearly 4 years later than the high end of the schedule range established at the alternative selection milestone. NNSA plans to complete all design activities for the project in 2023 in preparation for the planned baseline approval milestone in September 2024.

- **Savannah River Plutonium Processing Facility (Savannah River Site).** This project is implementing key design changes, experiencing design challenges, and revising cost and schedule estimates. NNSA revised the project's top-level requirements in January 2022, which increased the project's scope by adding more empty processing space and support utilities in the main process building to enable future modifications. The project also added scope to install equipment in the nonnuclear training center that is identical to the equipment in the main process building. In addition, the project identified two design challenges. First, according to NNSA's fiscal year 2024 budget justification, the actual number of engineers assigned to the project has been about 75 percent of the planned amount, which NNSA officials said has increased design time. Second, the project is using different subcontractors to design specific parts of the project, these designs are at various levels of maturity, and integrating the designs is a challenge. For example, the subcontractor responsible for designing the gloveboxes and process equipment submitted a preliminary design in July 2022 that NNSA determined lacked key information and details. As a result, the subcontractor responsible for designing the associated supporting infrastructure and facilities could only mature limited portions of its design until such information and details were provided.

  Furthermore, as of March 2023, NNSA was in the early stages of updating the project's preliminary cost and schedule estimates. NNSA's fiscal year 2024 budget justification states that the project's cost may increase by up to 40 percent (from up to $11.1 billion to $15.5 billion), and the schedule could be delayed up to 3 years (from September 2035 to September 2038) compared with the estimates approved at the alternative selection milestone. By February 2024, the site contractor plans to submit to NNSA a revised cost and schedule estimate, and NNSA plans to complete its review of the revised estimate by May 2024.

- **Lithium Processing Facility (Y-12 National Security Complex).** This project recently implemented a significant design change, and the project's cost estimate increased to reflect the initial impacts from this change. The design contractor has divided its overall design effort into two areas: process design and facility design. The project is using a design approach whereby the process design will be matured before beginning detailed facility design. As the preliminary process design was almost complete, the design contractor started work on a more detailed facility design in June 2022. As the facility design matured, the proposed size of the facility increased by almost 85 percent, from about 135,000 square feet to about 250,000 square feet. In October

and November 2022, the project conducted a series of review sessions that validated the facility's size growth and identified multiple reasons for this growth. For example, project documentation states that about 25 percent of the facility size growth is due to the addition of stairways, platforms, or corridors to allow for the safe egress of personnel from the building or certain processing areas.

In November 2022, NNSA added $145 million to the project's overall cost estimate to account for the increased construction costs associated with a larger building. Even with this $145 million increase, the project's cost estimate remained within the range (up to $1.6 billion) approved at the alternative selection milestone. The design subcontractor completed this more detailed facility design in November 2022, and the project office finalized the facility's size in January 2023. However, in its fiscal year 2024 budget justification, NNSA states that the project's total cost could increase by up to 15 percent due to market conditions (e.g., higher than expected inflation, supply chain disruption) and internal challenges (e.g., managing multiple projects at a single site, integrating new construction with aging site infrastructure). The budget justification states that the project office will prepare an updated cost estimate by the end of fiscal year 2023.

In addition to these six projects, NNSA plans to put two projects on hold for multiple fiscal years. Specifically, NNSA stated in March 2023 that it plans to place the High Explosives Synthesis Formulation and Production Facility project on hold once the site contractor completes all design work by September 2023. NNSA also stated in March 2023 that it plans to place part of the Tritium Finishing Facility project—the process buildings subproject—on hold after the site contractor completes multiple design-related tasks, such as completing the subproject's conceptual design. According to NNSA's fiscal year 2024 budget justification, these holds are a result of cost increases and schedule delays being experienced by many of the agency's construction projects, as well as a decision to focus resources on a reduced number of high-priority projects.

Projects in the Definition Phase with Critical Technologies Have Generally Reached Maturity Milestones, and Some Are Working to Further Mature Their Technologies

Five of the 10 projects currently in the definition phase have identified critical technologies. These five projects are High Explosives Synthesis, Formulation and Production; Lithium Processing Facility; LAP4 30 Reliable Equipment Installation; Savannah River Plutonium Processing Facility; and Surplus Plutonium Disposition.

According to NNSA documents and officials, at the time of their alternative selection milestones, four of these five projects had collectively identified 225 critical technologies,[38] which the M&O contractors responsible for these projects had assessed at TRL 4 or higher,[39] in accordance with DOE's maturity milestones.[40] The fifth project—Lithium Processing Facility—was reviewing the potential use of two technologies but had not yet identified any critical technologies at its alternative selection milestone in December 2019. However, in May 2020, NNSA decided to use homogenization in the project and considered it a critical technology. In June 2020, a review team assessed the readiness of this critical technology at TRL 6.

In addition, as of March 2023, the M&O contractors reported that two of the five projects had already assessed all of their critical technologies at TRL 7 or higher.[41] The three remaining projects had identified a total of four critical technologies that need additional maturation to reach TRL 7 by the time of their baseline approval milestones, in accordance with DOE's maturity milestones (see table 6).

[38]At the alternative selection milestone that included all five LAP4 projects, the M&O contractor identified 185 critical technologies applicable to three LAP4 projects. Since that time, NNSA approved the baseline approval milestone for two LAP4 projects (Decontamination and Demolition and 30 Base Equipment Installation). In September 2024, NNSA plans to approve the baseline for the LAP4 30 Reliable Equipment Installation project, which will produce new plutonium pits (the central core of a nuclear weapon) reliably at a rate of 30 per year.

[39]TRL 4 means that a technology has been validated in a laboratory environment—that is, the technology demonstrates that the basic technological components will work together. See Department of Energy, *Technology Readiness Assessment Guide*, DOE G 413.3-4A (Washington, D.C.: Sept. 15, 2011).

[40]We report the results of the TRAs that were conducted by M&O contractors. We did not assess the extent to which these TRAs were conducted by an independent review team from outside the project, which is a requirement in DOE's project management order.

[41]TRL 7 means that a technology has been demonstrated in a prototype in a relevant environment.

Table 6: NNSA Major Projects in the Definition Phase with Critical Technologies Needing Additional Maturation, as of March 2023

Project	Number of critical technologies needing additional maturation[a]
Lithium Processing Facility	1
Los Alamos Plutonium Pit Production Project 30 Reliable Equipment Installation	1
Surplus Plutonium Disposition	2[b]
Total	**4**

Source: GAO analysis of National Nuclear Security Administration (NNSA) data. | GAO-23-104402

[a]According to Department of Energy requirements, these technologies must reach technology readiness level 7 by the time of the baseline approval milestone.

[b]NNSA's Office of Material Management and Minimization is managing the maturation of these two critical technologies, which are related to plutonium measurement and packaging. According to these officials, the project can achieve its planned annual processing rate (e.g., key performance parameter) without the use of these two technologies and, therefore, project success is not dependent on these technologies. NNSA officials said that the Office of Material Management and Minimization plans to continue to mature these technologies because they could reduce the life cycle costs to operate the completed project. NNSA is in the early stages of preparing documentation that would remove these two technologies from the project's scope, according to agency officials.

For these three projects, the M&O contractors developed and are executing plans to mature the four critical technologies to TRL 7. For example:

- **Lithium Processing Facility (Y-12 National Security Complex).** The project identified homogenization as a critical technology, which involves using furnaces at high temperatures in the lithium cleaning and purification phase to remove the effects from pressing and machining lithium and thereby reduces the use of wet chemistry.[42] Use of homogenization may, among other things, (1) make the lithium production process more efficient because processing lithium material using homogenization takes less time than wet chemistry and (2) help reduce exposure to corrosive liquids and processing fumes that are part of the wet chemistry process.[43] In June 2020, the project assessed the homogenization technology at TRL 6. To mature the technology to TRL 7, the project is planning a parallel testing approach to (1) develop a full-scale, production-prototype of the

[42]The term "wet chemistry" refers to a three-step process of lithium purification, lithium production using electrolysis, and treating lithium material with certain gases to produce lithium hydride or lithium deuteride, which are usable for nuclear weapons.

[43]The facility's design includes all space and equipment needed for the current wet chemistry process, as some processing steps require such chemical purification. As a result, the facility may be operated with or without the homogenization technology.

homogenization furnace; and (2) use existing production furnaces to conduct testing. The M&O contractor plans to begin testing using existing production furnaces in April 2023 and achieve TRL 7 by May 2024.

- **LAP4 30 Reliable Equipment Installation Project (Los Alamos National Laboratory).** The project identified a gas metal-arc welder, to be used to weld nonnuclear components to specifications that meet the project's requirements (e.g., leak-tight, weld quality), as a critical technology. In October 2022, the technology was assessed at TRL 6. The project developed a maturation plan to bring the technology to TRL 7 that entails identifying the most reliable and endurable process for using the technology in a specific environment to minimize contamination risks. The maturation efforts are expected to progress concurrently with the project's final design process, according to NNSA documentation, and are expected to conclude prior to the baseline approval milestone projected for September 2024.

In addition to the technology maturation actions discussed above, the multibillion- dollar Savannah River Plutonium Processing Facility project is working to address design development and integration challenges with its material transport system technology, which has already reached DOE's milestone for technology maturity. According to NNSA documentation, the material transport system is the backbone for successful plutonium processing operations in the main process building, as it will move materials, components, plutonium pits, and waste throughout the production line. Specifically:

- In a June 2020 technology readiness assessment, the M&O contractor assessed the technology at TRL 8. NNSA officials said that the selected technology is sufficiently mature to be integrated into the facility and that a similar technology is planned for use in the UPF Main Process Building project.
- However, the June 2020 assessment also found that integrating the material transport system with the gloveboxes that contain the associated processing equipment has challenges. For example, the system must be highly reliable and easy to maintain to limit the amount of radiation that maintenance workers are exposed to. This can be difficult, given the operating environment (e.g., radioactive and inert, oxygen-free) and the limited access to gloveboxes. The June 2020 assessment stated that there is no demonstrated, fully integrated, off-the-shelf system readily available for the project.
- The M&O contractor is currently conducting development, integration, and testing activities, as recommended by the June 2020

assessment. For example, in December 2022, the contractor completed initial testing on a revised prototype, which includes key design changes to the rails on which the system will move that should make the system easier to maintain and operate, according to NNSA officials. Further testing and additional design development work will continue through June 2023, at which point the contractor will begin incorporating the material transport system into the overall design, according to NNSA officials. However, according to project documentation, the timely completion of the material transport system's testing and design development work remains a project challenge.

Agency Comments

We provided a draft of this report to NNSA for review and comment. NNSA provided technical comments, which we incorporated as appropriate.

We are sending copies of this report to the appropriate congressional committees, the Secretary of Energy, the Administrator of NNSA, and other interested parties. In addition, this report is available at no charge on the GAO website at http://www.gao.gov.

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

Allison Bawden
Director, Natural Resources and Environment

Appendix I: Individual Project Assessments

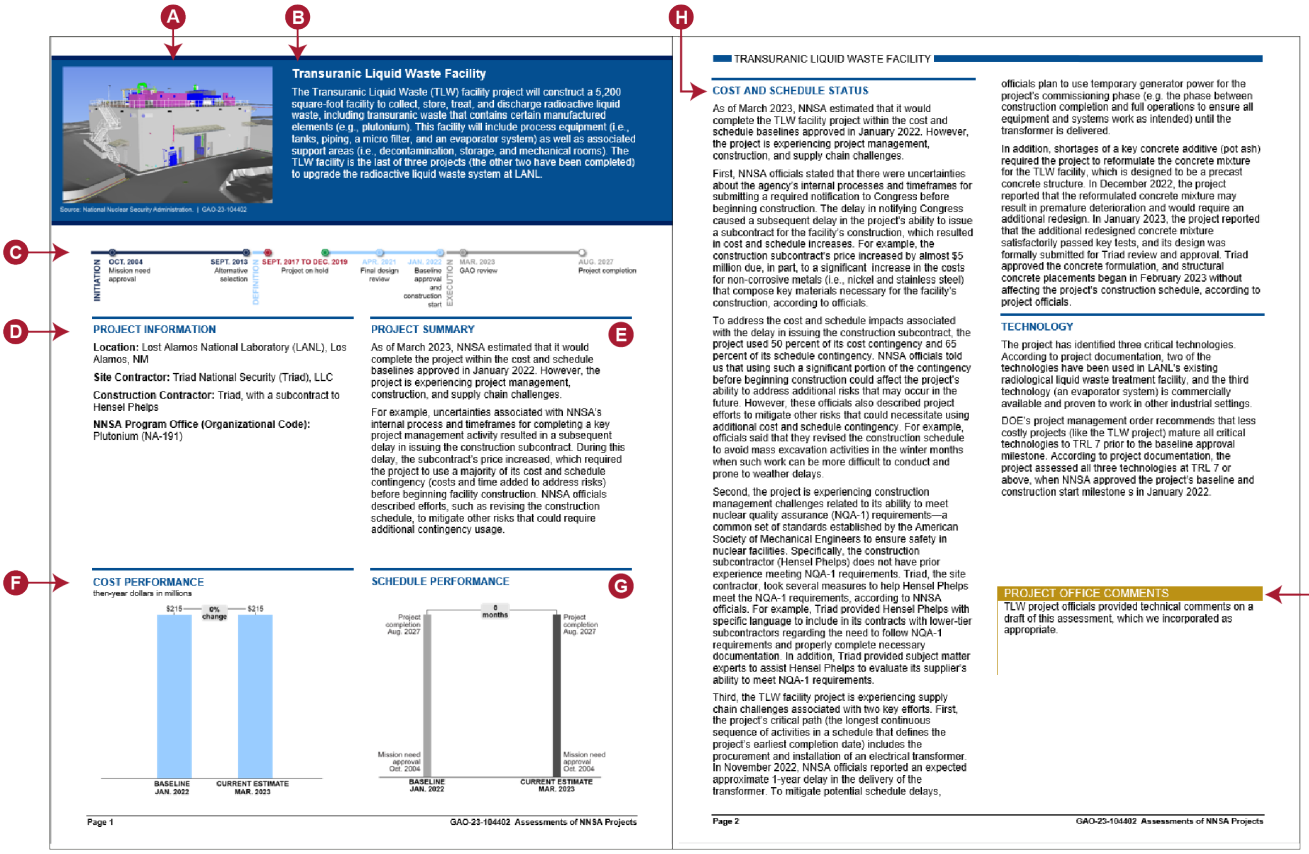
In the following section, we present the individual assessments of the 23 National Nuclear Security Administration (NNSA) major projects ongoing as of March 2023 that we reviewed in a two-page or one-page profiles.[1] Each assessment generally includes a description of the project's objectives, information about location and contractors involved in the project, the project's cost and schedule performance, a timeline identifying key project dates, and a brief narrative describing the current status of the project. Assessments describe the challenges we identified—such as challenges associated with the design and construction of a project or the technology readiness level of critical technologies associated with a project, if applicable—and include an analysis of the challenges. In addition, we outline the extent to which each project faces cost, schedule, or performance risks because of these challenges, if applicable.

The information presented in these assessments and summary was obtained from NNSA and Department of Energy documentation, interviews with NNSA project staff, and data provided by NNSA officials in our questionnaires covering cost and schedule updates and other project details. The assessments also include our analysis of the project cost and schedule information provided. NNSA's project offices were provided an opportunity to review drafts of the assessments and summary prior to their inclusion in this report. The project offices provided both technical corrections and more general comments. We integrated the technical corrections, as appropriate, and summarized the general comments at the end of each project assessment.

See figure 4 for an illustration of a sample assessment layout. See table 7 for a list of the 23 project assessments organized by site.

[1]We did not provide individual assessments of five projects that reached the project completion milestone during the course of our review.

Figure 4: Illustration of a Sample Project Assessment



A Illustration of the building, equipment, or system.

B General description of the project's objectives.

C Timeline identifying key dates for the project including when the project began, selected the alternative, held major design reviews, began execution, and reached completion.

D Project Information: Identifies the project's location, site contractor, design or construction contractor, NNSA program office and organizational code, and related projects.

E Project Summary: Brief narrative describing the current status of the project.

F Cost: For projects in definition, the preliminary cost estimate (or range of costs) approved at alternative selection and latest estimate. For projects in execution, the approved cost baseline and latest estimate.

G Schedule: For projects in definition, the preliminary completion date estimate (or range of dates) approved at alternative selection and latest estimate. For projects in execution, the approved schedule baseline and latest estimate.

H The second page of the assessment presents an analysis of project challenges and the extent to which the project faces cost, schedule, design, technology, or performance risks because of these challenges.

I Project Office Comments: General comments provided by the cognizant project office.

Source: GAO analysis. | GAO-23-104402

Table 7: NNSA Major Projects Assessed by GAO, by Site and Phase

Phase	Project name
Los Alamos National Laboratory	
Definition	Chemistry and Metallurgy Research Replacement (CMRR) Plutonium Facility-4 Equipment Installation, Phase 2
	CMRR Re-Categorizing Radiological Laboratory and Utility Office Building to Hazard Category 3
	Los Alamos Plutonium Pit Production Project (LAP4) 30 Reliable Equipment Installation
	LAP4 Training/Development Center
	LAP4 West Entry Control Facility
Execution	LAP4 Decontamination and Decommission
	LAP4 30 Base Equipment Installation
	Technical Area-55 Reinvestment Project, Phase III
	Transuranic Liquid Waste Facility
Nevada National Security Site	
Execution	Enhanced Capabilities for Subcritical Experiments (ECSE) Laboratory and Support Infrastructure
	ECSE Advanced Sources and Detectors Major Item of Equipment
Pantex Plant	
Definition	High Explosives Synthesis Formulation and Production Capability
Execution	High Explosives Science & Engineering Facility
Savannah River Site	
Definition	Savannah River Plutonium Processing Facility
	Surplus Plutonium Disposition
	Tritium Finishing Facility
Y-12 National Security Complex	
Definition	Lithium Processing Facility
Execution	Calciner Project
	Electrorefining Project
	Uranium Processing Facility (UPF) Main Process Building
	UPF Process Support Facilities
	UPF Salvage and Accountability Building
	West End Protected Area Reduction Project

Source: GAO analysis of National Nuclear Security Administration (NNSA) data. | GAO-23-104402

Los Alamos National Laboratory

Conducts research and development of nuclear weapons.
Performs high-performance computing and radiography.
Conducts plutonium basic research and explosive science.
Produces detonators and plutonium pits.

PRIME CONTRACTOR (MANAGEMENT AND OPERATING)

Triad National Security, LLC

PARTIES TO PRIME CONTRACT

Battelle Memorial Institute

The Texas A&M University System

The Regents of the University of California

PROJECTS IN DEFINITION PHASE

Chemistry and Metallurgy Research Replacement (CMRR) Plutonium Facility-4 Equipment Installation, Phase 2

CMRR Re-Categorizing Radiological Laboratory and Utility Office Building to Hazard Category 3

Los Alamos Plutonium Pit Production Project (LAP4) 30 Reliable Equipment Installation

LAP4 Training/Development Center

LAP4 West Entry Control Facility

PROJECTS IN EXECUTION PHASE

LAP4 30 Base Equipment Installation

LAP4 Decontamination and Decommissioning

Technical Area-55 Reinvestment Project, Phase III

Transuranic Liquid Waste Facility

Source: National Nuclear Security Administration. | GAO-23-104402

Chemistry and Metallurgy Research Facility Replacement (CMRR) – Plutonium Facility-4 Equipment Installation, Phase 2

The CMRR Plutonium Facility-4 Equipment Installation, Phase 2 (PEI2) project is designed to decontaminate and decommission existing, unneeded equipment in the Plutonium Facility-4 building; install new plutonium analysis equipment in the building; and complete multiple supporting infrastructure activities, such as upgrades to existing security posts. This is one of six related projects for transferring and modernizing existing plutonium analysis operations from a 1950s-era building to two newer facilities and constructing new supporting infrastructure for planned workload increases.

INITIATION

- **JULY 2002** Mission need approval
- **AUG. 2014** Conceptual design review
- **NOV. 2015** Alternative selection

DEFINITION

- **SEPT. 2016 TO JUNE 2022** Portions of project on hold
- **OCT. 2022** Preliminary design review
- **DEC. 2022** Final design review
- **MAR. 2023** GAO review
- **TBD** Baseline approval and construction start

EXECUTION

- **TBD** Project completion

PROJECT INFORMATION

Location: Los Alamos National Laboratory, Los Alamos, NM

Site Contractor: Triad National Security (Triad), LLC

Design Contractor: Triad, with design subcontract to Merrick & Company

Related Projects: CMRR Re-Categorizing the Radiological Laboratory/Utility/Office Building to Hazard Category 3 (RC3) and four completed projects

NNSA Program Office (Organizational Code): Plutonium (NA-191)

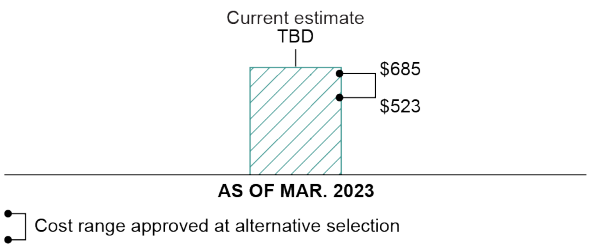
PROJECT SUMMARY

As of March 2023, NNSA was in the early stages of re-planning the project due to cost concerns. In January 2023, Triad submitted an updated estimate that contained a significant increase to the costs for completing the project. NNSA then directed Triad to review the project's scope and prepare options that could be completed within the cost range approved in 2015. In March 2023, NNSA officials said that they held an initial re-planning workshop with Triad, but there is no timeframe for completing the review of the project's scope.

Despite the re-planning effort, the project includes three separate, ongoing site preparation or procurement activities, with a combined cost of about $235 million and scheduled completion dates ranging from fiscal year 2024 to fiscal year 2026. However, in March 2023, due to performance problems, Triad issued a stop work notice to the subcontractor responsible for completing site preparation upgrades to a security post.

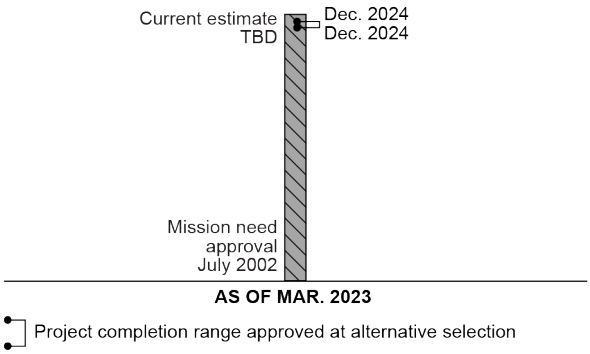
PRELIMINARY COST[a]

then-year dollars in millions



[a]*These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.*

PRELIMINARY SCHEDULE[a]



[a]*These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.*

COST AND SCHEDULE STATUS

As of March 2023, NNSA was in the early stages of replanning the PEI2 project, as well as the other ongoing CMRR project (RC3), due to recently identified cost concerns. In January 2023, in preparation for a planned (but now delayed) PEI2 baseline approval milestone in mid-2023, Triad submitted to NNSA updated cost estimates for the PEI2 and RC3 projects that were significantly higher than the cost range approved in 2015 at the alternative selection milestone. NNSA officials said that there were multiple reasons for the significant cost increase, including price escalation for labor, materials, and equipment.

According to agency officials, NNSA directed Triad to review the scope of the two projects and prepare options that could be completed within the 2015 approved cost range. In March 2023, NNSA officials said that they held an initial replanning workshop with Triad but that the agency does not have a general timeframe for completing its review of the project's scope. According to NNSA's fiscal year 2024 budget justification, NNSA plans to prioritize the scope of the PEI2 project over the RC3 project. In addition, NNSA officials told us in March 2023 that the PEI2 project should obtain its baseline approval milestone no later than September 2024.

Unaffected by the replanning effort, the project has three individual, ongoing site preparation or procurement activities that have a combined cost of about $235 million. First, site preparation activities to decontaminate and decommission unneeded equipment to clear space for the subsequent installation of new equipment were approved in March 2015, paused in September 2017, and restarted in June 2022. The project expects to complete this work in fiscal year 2024, at a cost of about $90 million.

Second, to support an increased number of people (for both short-term construction workers and long-term plutonium processing operators) accessing Plutonium Facility-4, the project approved two activities in February 2021 involving upgrading a security post and expanding the area where workers must change into anticontamination clothing. The project expects to complete work on this security post and clothing change area in fiscal year 2024, at cost of about $90 million.

However, according to project documentation, in March 2023, Triad issued a stop work notice to the security post subcontractor, as its performance was below expectations, which created schedule challenges. Triad plans to finish this work by both hiring a new subcontractor and completing certain construction activities itself.

Third, in December 2022, the project approved an activity to procure gloveboxes (a sealed, protectively lined compartment having holes to which are attached gloves for use in handling plutonium inside the compartment), security equipment, and other items. The project estimates that these procurements will cost about $55 million and be completed in early fiscal year 2026.

DESIGN

NNSA completed the project's final design review in December 2022. This review included project scope for equipment installation, upgrades to an existing security post, and constructing two new vehicle entry ports. Given the ongoing review of the project's scope, it is unclear what, if any, additional or modified design activities will be needed before the project achieves its baseline approval milestone.

TECHNOLOGY

The project has not identified any critical technologies.

PROJECT OFFICE COMMENTS

PEI2 project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.

Source: National Nuclear Security Administration. | GAO-23-104402

Chemistry and Metallurgy Research Facility Replacement (CMRR) Re-Categorizing Radiological Laboratory Utility Office Building to Hazard Category 3

The CMRR Re-Categorizing Radiological Laboratory Utility Office Building to Hazard Category 3 (RC3) project involves revising procedures in the existing laboratory to increase the amount of plutonium that can be analyzed, correcting existing fire protection system deficiencies, installing additional plutonium analysis equipment, and constructing a new office building and warehouse. The RC3 project is one of six related projects for transferring and modernizing existing plutonium analysis operations from a 1950s-era building into two newer facilities and constructing supporting infrastructure for planned workload increases.

PROJECT INFORMATION

Location: Los Alamos National Laboratory, Los Alamos, NM

Site Contractor: Triad National Security (Triad), LLC

Design Contractor: Triad

Related Projects: CMRR Plutonium Facility-4 Equipment Installation Phase 2 (PEI2) and four completed projects

NNSA Program Office (Organizational Code): Plutonium (NA-191)

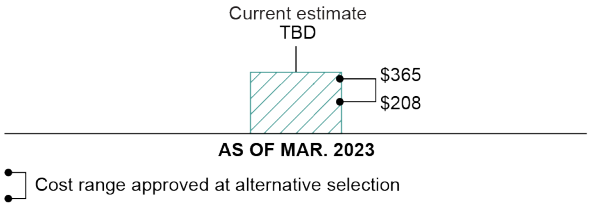
PROJECT SUMMARY

As of March 2023, NNSA was in the early stages of re-planning the project due to cost concerns. In January 2023, Triad submitted an updated cost estimate that was significantly higher than prior estimates. NNSA then directed Triad to review the project's scope and prepare options that could be completed within the cost range approved in 2015. In March 2023, NNSA officials said that they held an initial re-planning workshop with Triad, but there is no timeframe for completing the review of the project's scope.

Despite the ongoing re-planning effort, the project has completed certain portions of the originally planned scope. For example, in early 2023, NNSA approved the existing laboratory's revised safety and operating procedures, which allows the building to begin processing and analyzing an increased amount of plutonium.

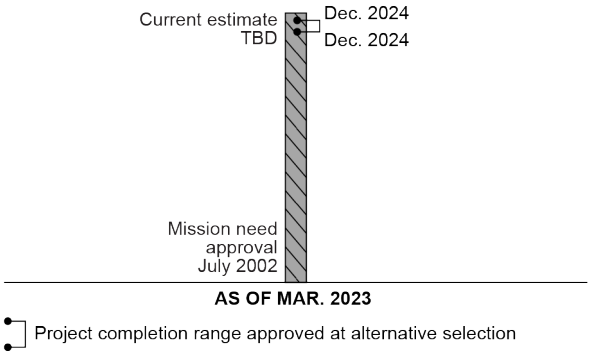
PRELIMINARY COST[a]

then-year dollars in millions



[a]*These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.*

PRELIMINARY SCHEDULE[a]



[a]*These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.*

COST AND SCHEDULE STATUS

As of March 2023, NNSA was in the early stages of replanning the RC3 project, as well as the other ongoing CMRR project (PEI2), due to recently identified cost concerns. In January 2023, Triad submitted to NNSA updated cost estimates for the RC3 and PEI2 projects. The January 2023 cost estimate for both projects was significantly higher than the cost ranges approved in 2015 at the alternative selection milestone. NNSA officials said that there were multiple reasons for the significant cost increase for RC3, including price escalation for labor, materials, and equipment.

According to agency officials, NNSA directed Triad to review the scope of the two projects and prepare options that could be completed within the 2015 approved cost range. In March 2023, NNSA officials said that they held an initial replanning workshop with Triad but that the agency does not have a general timeframe for completing its review of the project scope. However, according to NNSA's fiscal year 2024 budget justification, NNSA plans to prioritize the scope of the PEI2 project over the RC3 project, and NNSA assumes that the RC3 project's cost will be $282 million, which is within the cost range established in 2015.

Despite the ongoing replanning effort, the RC3 project has completed certain portions of the project's planned scope. For example, with respect to the project scope that will increase the amount of plutonium that can be analyzed in the laboratory building, the project approved key safety analysis documentation in October 2020, established new and revised plutonium processing operating procedures in September 2021, and completed multiple reviews in July 2022. However, one of the reviews identified several areas of needed improvement in the safety management program. According to NNSA officials, the project successfully completed all the corrective actions and, in February 2023, received NNSA approval to commence processing and analysis operations with an increased amount of plutonium. According to December 2022 project documentation, all activities related to the increased plutonium scope are estimated to be completed by May 2023—at a cost of $53 million.

In addition, since 2020, the project has completed multiple actions to address deficiencies with portions of the laboratory building's fire protection system, such as replacing fire doors and ensuring proper water pressure to the sprinkler system. NNSA officials told us that ongoing work includes installing an additional early warning smoke detection and notification system. The project estimates that all activities related to the fire protection scope will be completed in fiscal year 2025—at a cost of about $21 million.

DESIGN

The RC3 project continues to advance the design of the equipment installation and office/warehouse scope as design efforts for the other portions of the project's scope (e.g., increased plutonium amount and fire protection) are complete. According to project documents and officials, contractors began equipment design in October 2022, with expected completion by March 2024. Given the ongoing review of the project's scope, it is unclear what, if any, additional or modified design activities will be needed before the project achieves its baseline approval milestone.

TECHNOLOGY

The project has not identified any critical technologies.

PROJECT OFFICE COMMENTS

RC3 project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.

Source: National Nuclear Security Administration. | GAO-23-104402

Los Alamos Plutonium Pit Production Project, 30 Reliable Equipment Installation

The 30 Reliable Equipment Installation (30 Reliable) project intends to design and install new processing equipment needed to ensure the reliable capability (i.e., having no single points of failure) to produce plutonium pits (the fissile core of a nuclear weapon). This project is one of five projects that comprise the overall Los Alamos Plutonium Pit Production Project (LAP4) to modify existing nuclear facilities, construct new nonnuclear training and support facilities, and install equipment and enclosures to enable production of 30 plutonium pits per year at Los Alamos National Laboratory (LANL).

PROJECT INFORMATION

Location: LANL, Los Alamos, NM

Site Contractor: Triad National Security (Triad), LLC

Design Contractor: Triad with design subcontract to Merrick & Company (Merrick)

Related Projects: LAP4 Decontamination and Demolition; LAP4 30 Base Equipment Installation; LAP4 Training and Development Center; LAP4 West Entry Control Facility

NNSA Program Office (Organizational Code): Plutonium (NA-191)

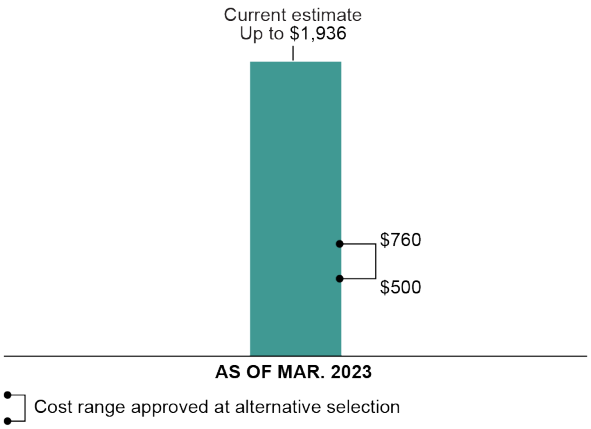
PROJECT SUMMARY

As of March 2023, NNSA estimated that the project may cost up to $1.936 billion—nearly three times the top end of the cost range approved at the alternative selection milestone—and take nearly 4 additional years to complete. The cost increase and schedule delay were caused, in part, by a significant amount of added scope (e.g., equipment) as the project's design matured, according to NNSA officials.

In May 2022, Triad awarded a design subcontract (valued at about $40 million) to Merrick to complete the project's preliminary and final designs. According to NNSA officials, Merrick has dedicated sufficient staff to the project to achieve its baseline approval milestone in September 2024. In addition, the project is working to mature one critical technology before the September 2024 milestone.

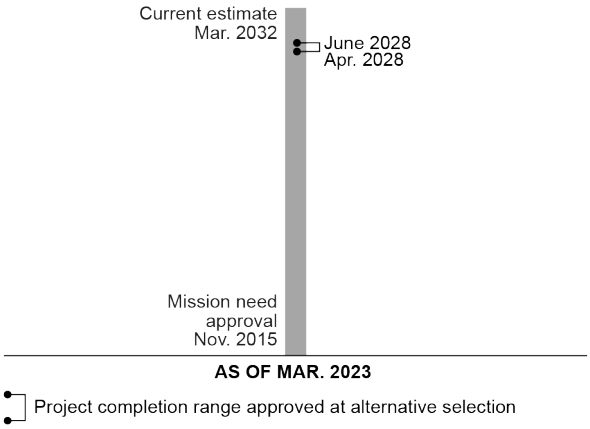
PRELIMINARY COST[a]

then-year dollars in millions



[a]*These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.*

PRELIMINARY SCHEDULE[a]



[a]*These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.*

COST AND SCHEDULE STATUS

As of March 2023, NNSA reported that the project's preliminary cost estimate was up to $1.936 billion, nearly three times the top end of the cost range established at the alternative selection milestone. The preliminary estimate for project completion is March 2032, nearly 4 years later than the high end of the schedule range established at the alternative selection milestone.

NNSA identified multiple reasons for this cost increase and schedule delay, including additions to the project's work scope; engineering and design resource constraints; Triad's focus on other LAP4 projects; and an increase to NNSA cost escalation assumptions, which guide how projects adjust future costs to account for inflation. For example, an NNSA official told us in March 2023 that as the project's design matured, its scope increased significantly. Specifically, the project's equipment list (e.g., the number and type of required processing and supporting equipment) doubled from the number originally identified at the alternative selection milestone.

In addition, NNSA transferred some scope originally planned for the LAP4 30 Base Equipment Installation project to the 30 Reliable project to address potential work sequencing concerns within the operating nuclear facilities. By the end of March 2023, NNSA plans to approve an approximately $100 million long-lead procurement for specialized equipment, enclosures to enable handling hazardous materials, and certain early site preparation work intended to mitigate schedule delays that were caused primarily by insufficient design resources on the project.

Other LAP4 projects may also experience similar cost and schedule delays to the 30 Reliable project. Specifically, NNSA's fiscal year 2024 budget justification states that the cost to complete all five LAP4 projects could increase 30 to 40 percent (from $3.9 billion to up to $5.5 billion) and be delayed 2 to 4 years (from September 2028 to up to September 2032) compared with the estimates approved at the five projects' joint April 2021 alternative selection milestone. The budget justification includes a revised, cumulative cost estimate of $4.7 billion (an $800 million, or 20 percent, increase from the estimate approved in 2021).

DESIGN

Triad awarded a design subcontract to Merrick in May 2022 to develop the project's preliminary and final designs. The design subcontract is valued at approximately $40 million and includes an expected completion date of September 2023. According to an NNSA official, Triad is refining the project's design schedule to align with project milestone dates, and the preliminary design review is planned to be completed in the first half of 2023.

However, Merrick faces challenges in meeting the design schedule due, in part, to competing priorities on other plutonium infrastructure projects at LANL and the Savannah River Site. Triad officials are working with Merrick to mitigate schedule delays by prioritizing design activities for the project's early procurements.

In addition, the project has worked with Merrick to dedicate to the 30 Reliable project the design staff necessary to meet its design schedule. Specifically, project officials reported that, as of January 2023, the project had the design resources needed to achieve the baseline approval and construction start milestones by September 2024.

TECHNOLOGY

The 30 Reliable project and the 30 Base Equipment Installation project have collectively identified 334 critical technologies. DOE's project management order requires that more costly projects (like the 30 Reliable project) mature all critical technologies to TRL 4 prior to the alternative selection milestone and TRL 7 prior to the baseline approval milestone.

In October 2022, Triad assessed 333 out of the 334 critical technologies at TRL 7 or higher. The one technology assessed at TRL 6–a welder–will be used in the 30 Reliable project and is based on similar technology currently in use. According to project documents, the project plans to mature the technology to TRL 7 prior to the baseline approval milestone, which is planned for September 2024.

PROJECT OFFICE COMMENTS

LAP4 30 Reliable project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.

Source: National Nuclear Security Administration. | GAO-23-104402

Los Alamos Plutonium Pit Production Project, Training and Development Center

The Training and Development Center (TDC) project plans to design and construct a facility that supports training on actual nuclear production equipment in a nonnuclear environment, laboratory space for equipment testing, a process improvement area, and a development area, among others. This project is one of five projects that comprise the overall Los Alamos Plutonium Pit Production Project (LAP4) to modify existing nuclear facilities, construct new nonnuclear training and support facilities, and install equipment and enclosures to enable production of 30 plutonium pits (the fissile core of a nuclear weapon) per year at Los Alamos National Lab (LANL).

INITIATION

- **NOV. 2015** Mission need approval
- **DEC. 2020** Conceptual design review
- **APR. 2021** Alternative selection

DEFINITION

- **MAR. 2023** GAO review
- **TBD** Preliminary design review
- **TBD** Final design review
- **MAR. 2025** Baseline approval and construction start

EXECUTION

- **SEPT. 2030** Project completion

PROJECT INFORMATION

Location: LANL, Los Alamos, NM

Site Contractor: Triad National Security (Triad), LLC

Design Contractor: Triad, with a planned design subcontract

Related Projects: LAP4 30 Base Equipment Installation; LAP4 30 Reliable Equipment Installation; and two other LAP4 projects

NNSA Program Office (Organizational Code): Plutonium (NA-191)

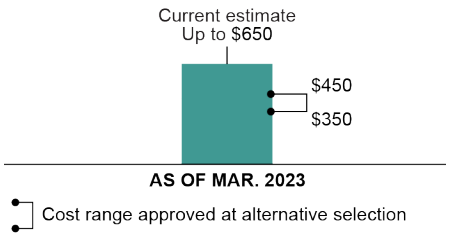
PROJECT SUMMARY

As of March 2023, NNSA estimated that the project may cost up to $650 million, which is $200 million above the high end of the preliminary cost range approved at the alternative selection milestone, and take 2 additional years to complete. NNSA officials identified multiple reasons for the cost increase and schedule delay, such as an intentional delay in starting more detailed design work so that funding could be directed toward other LAP4 projects. In addition, NNSA's fiscal year 2024 budget justification states that the cost to complete all five LAP4 projects could increase 30 to 40 percent (from $3.9 billion to $5.5 billion) and be delayed 2 to 4 years (from September 2028 to September 2032) compared with the estimates approved at the April 2021 alternative selection milestone.

According to March 2023 project documentation, NNSA approved a change in the TDC's location from one area at LANL to another. Subsequently, Triad is in the early stages of evaluating multiple effects on the project's cost, schedule, and risk profile. NNSA officials told us that Triad expects to award an approximately $40 million design subcontract by summer 2023 and that the overall design effort is expected to take 2 years to complete.

PRELIMINARY COST[a]

then-year dollars in millions



[a]*These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.*

PRELIMINARY SCHEDULE[a]

[a]*These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.*

PROJECT OFFICE COMMENTS

LAP4 30 TDC project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.

Source: National Nuclear Security Administration. | GAO-23-104402

Los Alamos Plutonium Pit Production Project, West Entry Control Facility

The West Entry Control Facility (WECF) project plans to design and construct a new, secure worker entry facility to accommodate 800 additional employees who are expected to work inside a restricted area. This facility will include employee identification booths and X-ray machines, as well as space for additional security measures. This project is one of five projects that comprise the overall Los Alamos Plutonium Pit Production Project (LAP4) to modify existing nuclear facilities, construct new nonnuclear training and support facilities, and install equipment and enclosures to enable production of 30 plutonium pits (the fissile core of a nuclear weapon) per year at the Los Alamos National Laboratory (LANL).

INITIATION

- **NOV. 2015** Mission need approval
- **DEC. 2020** Conceptual design review
- **APR. 2021** Alternative selection

DEFINITION

- **MAR. 2023** GAO review
- **JULY 2023** Preliminary design review
- **NOV. 2023** Final design review
- **MAR. 2024** Baseline approval and construction start

EXECUTION

- **SEPT. 2028** Project completion

PROJECT INFORMATION

Location: LANL, Los Alamos, NM

Site Contractor: Triad National Security (Triad), LLC

Design Contractor: Triad, with design subcontract to 3AEGREEN

Related Projects: LAP4 30 Base Equipment Installation; LAP4 30 Reliable Equipment Installation; and two other LAP4 projects

NNSA Program Office (Organizational Code): Plutonium (NA-191)

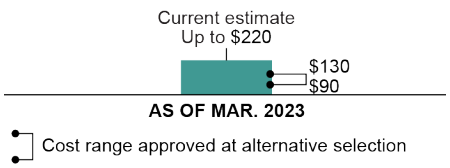
PROJECT SUMMARY

As of March 2023, NNSA estimated that the project may cost up to $220 million, which is $90 million above the high end of the preliminary cost estimate range approved at the alternative selection milestone. NNSA also estimated that the project will take 18 additional months to complete. NNSA officials identified multiple reasons for the cost increase and schedule delay, including delays in starting more detailed design work as stakeholders worked to finalize the project's capabilities and scope, as well as an increase to NNSA cost escalation assumptions, which are used to estimate the future cost of a project. NNSA's fiscal year 2024 budget justification states that the cost to complete all five LAP4 projects could increase 30 to 40 percent (from $3.9 billion to $5.5 billion) and be delayed 2 to 4 years (from September 2028 to September 2032) compared with the estimates at the April 2021 alternative selection milestone.

Triad awarded a design subcontract in July 2022. In September 2022, NNSA modified the project's scope, which included removing the facility's administrative wing. As of March 2023, NNSA expects to complete the overall design effort by December 2023, at a cost of $10 million.

PRELIMINARY COST[a]

then-year dollars in millions



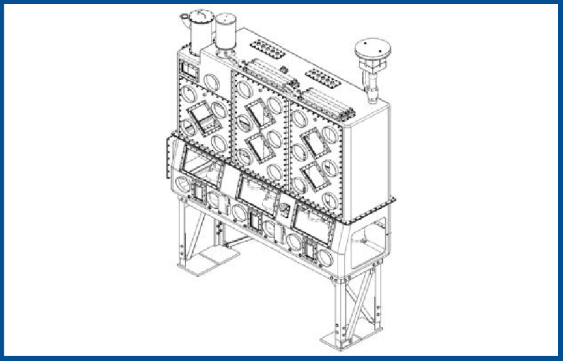
[a]*These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.*

PRELIMINARY SCHEDULE[a]

[a]*These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.*

PROJECT OFFICE COMMENTS

LAP4 WECF project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.



Source: Los Alamos National Laboratory. | GAO-23-104402

Los Alamos Plutonium Pit Production Project, 30 Base Equipment Installation

The 30 Base Equipment Installation (30 Base) project plans to design and install new processing equipment and gloveboxes to ensure the project has a base capability to produce 30 plutonium pits (the fissile core of a nuclear weapon) per year. This project is one of five projects that comprise the overall Los Alamos Plutonium Pit Production Project (LAP4) to modify existing nuclear facilities, construct new nonnuclear training and support facilities, and install equipment and enclosures to enable production of 30 plutonium pits per year at Los Alamos National Laboratory (LANL).

INITIATION

- **NOV. 2015** Mission need approval
- **APR. 2021** Alternative selection

DEFINITION

- **SEPT. 2022** Final design review
- **JAN. 2023** Baseline approval and construction start

EXECUTION

- **MAR. 2023** GAO review
- **AUG. 2030** Project completion

PROJECT INFORMATION

Location: LANL, Los Alamos, NM

Site Contractor: Triad National Security (Triad), LLC

Construction Contractor: Triad

Related Projects: LAP4 Decontamination and Demolition (D&D); LAP4 30 Reliable Equipment Installation; LAP4 Training and Development Center; LAP4 West Entry Control Facility

NNSA Program Office (Organizational Code): Plutonium (NA-191)

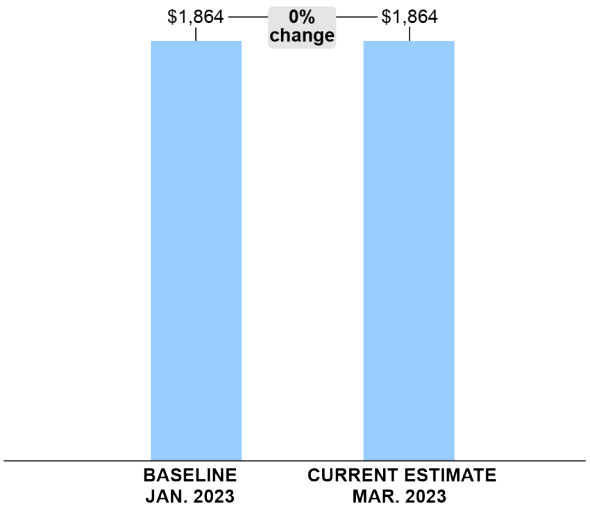
PROJECT SUMMARY

NNSA approved the project's cost and schedule baselines in January 2023, and the agency will begin reporting project performance data in April 2023, according to agency documents.

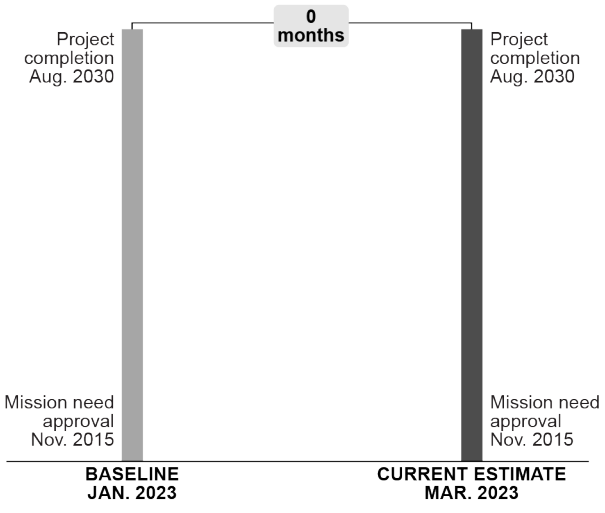
The schedule baseline of August 2030 calls for a 4-year delay in the project completion date compared with the high end of the preliminary date range approved at the alternative selection milestone. According to project documents, this delay is due, in part, to the complexities of coordinating the project in a facility with ongoing plutonium production activities and activities for the LAP4 D&D project. In addition, due to market and internal agency factors, NNSA's fiscal year 2024 budget justification stated that there could be a significant cost increase and schedule delay to complete all five LAP4 projects.

COST PERFORMANCE

then-year dollars in millions



SCHEDULE PERFORMANCE



COST AND SCHEDULE STATUS

NNSA approved the project's cost and schedule baselines in January 2023, and the agency will begin reporting project performance data in April 2023, according to NNSA documents.

However, the baseline project completion date of August 2030 is 4 years later than the high end of the preliminary date range approved at the alternative selection milestone in April 2021 and the statutory requirement to produce 30 pits per year in 2026. The change in the completion estimate was caused, in part, by challenges in coordinating project construction activities with ongoing work in the facility that will house the 30 Base project. Such ongoing work includes the production of up to 10 plutonium pits on existing equipment and executing the LAP4 D&D project.

In response, project officials are developing an integrated schedule that will establish multiple work shifts to try to optimize programmatic and project activities. NNSA officials expect the integrated schedule to improve the project schedule when the process is completed, according to project documents. In March 2023, NNSA officials stated that the integrated schedule development process is ongoing and did not provide an estimated completion date.

In 2022, NNSA approved two separate early procurement packages to obtain gloveboxes, processing equipment, and temporary warehouses. The first procurement, approved in January 2022, includes 13 gloveboxes and 17 pieces of equipment, with an approved value of $72 million and an expected completion date of June 2024. The second procurement, approved in August 2022, is for two temporary warehouses, 13 additional gloveboxes, additional equipment, and site preparation work, with a cost of $43 million and an expected completion date of June 2024. NNSA officials said that the majority of subcontracts have been awarded under both procurements and expect to award the remaining subcontracts by March 2023.

NNSA established interim and final milestones for achieving the capability to produce 30 pits per year, with the projected reliability of production increasing between the interim and final milestone. NNSA officials expect to achieve the interim, or first, milestone in December 2028 by turning over the minimum equipment necessary to produce 30 pits per year so that operations and testing can begin using radioactive material. However, this interim milestone involves a risk of single-point failures in the production process (i.e., equipment breakage that will stop production). NNSA officials expect to achieve the second project completion milestone by August 2030 and increase the reliability of the project's ability to produce 30 pits per year by adding equipment to address single-point failures, according to project documents.

While NNSA approved the 30 Base project baseline, the project identified over 50 risks that could affect the project's overall cost and schedule. For example, NNSA officials recognized that design changes could affect the project's cost and schedule and, therefore, planned to establish a quick response team to resolve design issues efficiently.

Further, the project is working with to control scope changes, which would result in design changes. If both these risks are realized and design changes are needed, the cost increase could be $31 million, and the schedule delay could be over a year. NNSA officials told us in March 2023 that the project has established cost and schedule reserves to address these risks and believe that the project's baseline cost and schedule completion would not be affected, should these risks be realized.

However, NNSA's fiscal year 2024 budget justification states that the cost to complete all five LAP4 projects could increase 30 to 40 percent (from $3.9 billion to up to $5.5 billion) and be delayed 2 to 4 years (from September 2028 to up to September 2032) compared with the estimates approved at the five projects' joint April 2021 alternative selection milestone. This potential cost increase and schedule delay is due, in part, to both market factors (e.g., tight labor market) and internal NNSA factors (e.g., coordinating multiple projects at a single site), according to the budget justification. For the 30 Base project, the budget states that NNSA expects to complete the project within its baseline cost and schedule. Project officials told us, however, that both these market and internal factors may be experienced at LANL by all five LAP4 projects. The budget justification states that NNSA will further assess any cost and schedule impacts associated with these two factors as the planning and design matures for the LAP4 30 Reliable Equipment Installation project, which is scheduled to achieve its baseline approval milestone by September 2024.

TECHNOLOGY

The 30 Base project, along with the 30 Reliable Equipment Installation project, has identified 334 critical technologies. DOE's project management order requires that more costly projects (like the LAP4 30 Base project) mature all critical technologies to TRL 7 prior to the baseline approval milestone. In October 2022, Triad assessed 333 out of the 334 critical technologies planned for insertion for the 30 Base and 30 Reliable projects at TRL 7 or higher. The one technology assessed at TRL 6 will be used in the 30 Reliable project. In January 2023, NNSA approved the project's combined baseline approval and construction start milestone.

PROJECT OFFICE COMMENTS

LAP4 30 Base project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.

Source: National Nuclear Security Administration. | GAO-23-104402

Los Alamos Plutonium Pit Production Project, Decontamination and Demolition

The Decontamination and Demolition (D&D) project is designed to decontaminate and remove legacy plutonium processing equipment and waste from an operating nuclear facility to create space for new equipment that will be installed in subsequent projects. This project is one of five projects that comprise the overall Los Alamos Plutonium Pit Production Project (LAP4) to modify existing nuclear facilities, construct new nonnuclear training and support facilities, and install equipment and enclosures to enable production of 30 plutonium pits (the fissile core of a nuclear weapon) per year at Los Alamos National Laboratory (LANL).

PROJECT INFORMATION

Location: LANL, Los Alamos, NM

Site Contractor: Triad National Security (Triad), LLC

Construction Contractor: Triad

Related Projects: LAP4 30 Base Equipment Installation (30 Base); LAP4 30 Reliable Equipment Installation; LAP4 Training and Development Center; LAP4 West Entry Control Facility

NNSA Program Office (Organizational Code): Plutonium (NA-191)

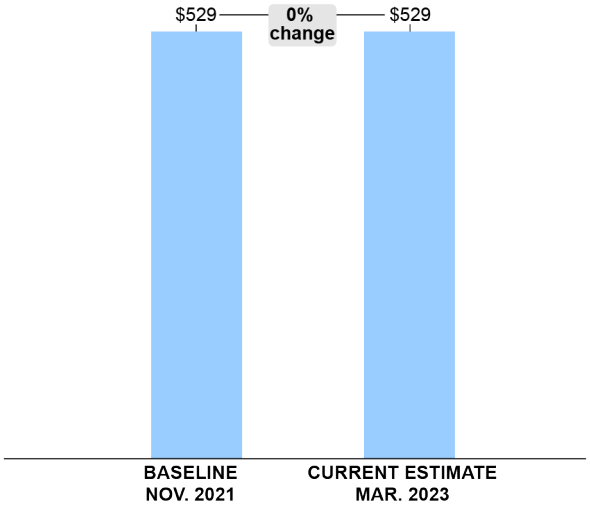
PROJECT SUMMARY

As of March 2023, NNSA estimated that the project will be completed within its cost and schedule baselines. However, the project is experiencing two construction challenges, according to agency documents. For example, NNSA is in the early stages of resequencing the project's construction activities to better coordinate the D&D work with the subsequent 30 Base project that obtained approval to begin construction in January 2023.

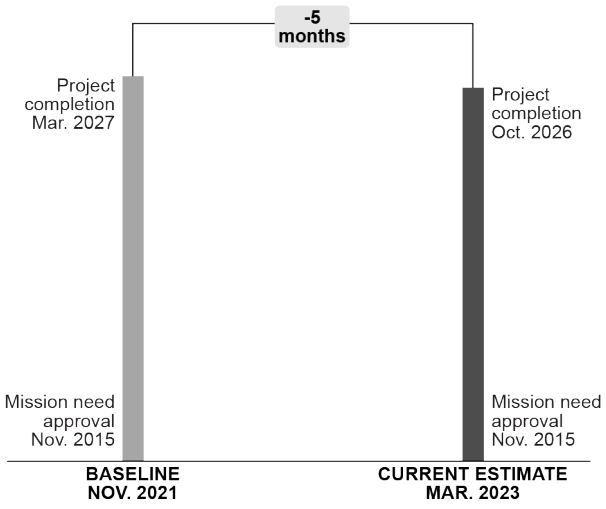
According to NNSA officials, the project has not yet identified time frames for completing the resequencing effort or any effects on the project's' cost and schedule that may result from the effort. In addition, due to multiple factors, NNSA's fiscal year 2024 budget justification stated that there could be a significant cost increase and schedule delay to complete all five LAP4 projects.

COST PERFORMANCE

then-year dollars in millions



SCHEDULE PERFORMANCE



COST AND SCHEDULE STATUS

As of March 2023, NNSA estimated that it would complete the D&D project within the cost and schedule baselines approved in November 2021. However, the project is experiencing two construction challenges, and NNSA is reporting that all five LAP4 projects may cumulatively experience a significant cost increase and schedule delay.

First, the D&D project is facing challenges in integrating its work with the work of the 30 Base project that obtained approval to start construction in January 2023. According to NNSA officials, the two projects must be integrated because both are working in some of the same rooms inside an operating plutonium processing facility, both share some of the same workforce, and certain D&D activities must be completed before some of the equipment installation activities can begin.

However, according to NNSA documents and officials, some work in the 30 Base project is a higher agency priority than some of the D&D project work. In addition, NNSA officials said that as Triad matured the design and planning for the 30 Base project, changes to the D&D project's construction schedule were identified. Specifically, in late 2022, NNSA and Triad began evaluating options to resequence the D&D project's originally planned construction schedule.

According to March 2023 project documentation, NNSA and Triad agreed to a general approach for resequencing the project. However, NNSA officials told us in March 2023 that the resequencing effort was in its early stages and that the time frames for completing the effort, as well as identifying any effects on cost and schedule, were not known.

Second, the D&D project faces challenges in completing all of its waste removal and disposition tasks—which began in late 2022 and are expected to be completed at the end of 2025—as a key LANL waste processing facility is temporarily unavailable. Specifically, according to officials, the project will remove over a dozen oversized items, such as gloveboxes, that are contaminated with plutonium. In general, these oversized items need to be removed, temporarily stored, disassembled, and repacked into 55-gallon drums before they can be shipped to their final location, which is an underground repository located elsewhere in New Mexico. However, LANL cannot currently conduct the storage, disassembly, and repackaging operations because LANL's Waste Characterization, Resizing, and Repackaging Facility is temporarily closed as Triad completes certain repairs and upgrades.

According to NNSA documents, the Waste Characterization, Resizing, and Repackaging Facility is expected to resume operations in mid-2024, but any delays will negatively affect the D&D project's ability to complete its waste removal and disposition work. For example, LANL has the ability to store some waste generated by the D&D project. However, the project may generate more waste than can be stored at LANL, which may affect the project completion date, according to project documents. NNSA officials stated that they are addressing this potential challenge by ensuring that the upgraded waste handling facility is available when needed; using oversized waste boxes to reduce the need for material size reduction; and evaluating the need for additional storage space, among other actions.

In March 2023, NNSA reported that it will cost significantly more and take significantly longer than originally planned to complete all five LAP4 projects. Specifically, NNSA's fiscal year 2024 budget justification included a revised, cumulative cost estimate of $4.7 billion (a $800 million, or 20 percent, increase) and stated that the final project is now projected to be completed in September 2031 (a 3-year delay). Furthermore, the budget justification stated that the cost to complete all five LAP4 projects could increase 30 to 40 percent (from $3.9 billion to up to $5.5 billion) and be delayed 2 to 4 years (from September 2028 to up to September 2032) compared with the estimates approved at the projects' joint April 2021 alternative selection milestone.

For the D&D project, NNSA's fiscal year 2024 budget justification stated that NNSA expects to complete the project within its baseline cost and schedule. However, the budget justification also stated that NNSA continues to assess the cost and schedule impacts of both market factors (i.e., tight labor market and supply chain disruptions) and internal NNSA factors (i.e., coordinating multiple projects at a single site and integrating new work with existing infrastructure). Project officials told us that both these market and internal factors are affecting all five LAP4 projects at LANL. The budget justification stated that NNSA will further assess any cost and schedule impacts associated with the two factors as the planning and design matures for the LAP4 30 Reliable Equipment Installation project, which is scheduled to achieve its baseline approval milestone in September 2024.

TECHNOLOGY

In February 2021, Triad identified almost 80 critical technologies specific to decontamination and demolition activities and assessed those technologies at TRL 7. DOE's project management order recommends that less costly projects (like this project) mature all critical technologies to TRL 7 prior to the baseline approval milestone, which the project achieved in November 2021.

PROJECT OFFICE COMMENTS

LAP4 D&D project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.

Source: Work performed for Department of Energy. | GAO-23-104402

Technical Area-55 Reinvestment Project Phase III

The Technical Area-55 Reinvestment Project Phase III (TRP III) project plans to replace and expand an existing fire alarm system so the system is up to code in both nuclear and nonnuclear facilities located in Technical Area-55—including the 233,000-square-foot Plutonium Facility-4 (PF-4), which is the nation's only fully operational, full-capacity plutonium facility. The project plans to install system components, including area-wide smoke and heat detectors, water flow switches, and audio and visual notification devices throughout PF-4, as well consolidate over 2,000 monitoring devices spread throughout 199 protection zones. The new system will also separate the fire alarm functions of nuclear facilities from nonnuclear facilities.

INITIATION
- **MAR. 2005** Mission need approval
- **JAN. 2021** Final design review
- **MAY 2021** Alternative selection

DEFINITION
- **MAY 2021** Baseline approval and construction start

EXECUTION
- **MAR. 2023** GAO review
- **FEB. 2027** Project completion

PROJECT INFORMATION

Location: Los Alamos National Laboratory (LANL), Los Alamos, NM

Site Contractor: Triad National Security (Triad), LLC

Construction Contractor: Triad (nuclear facilities) with a subcontract to Premier Fire (non-nuclear facilities)

NNSA Program Office (Organizational Code): Plutonium (NA-191)

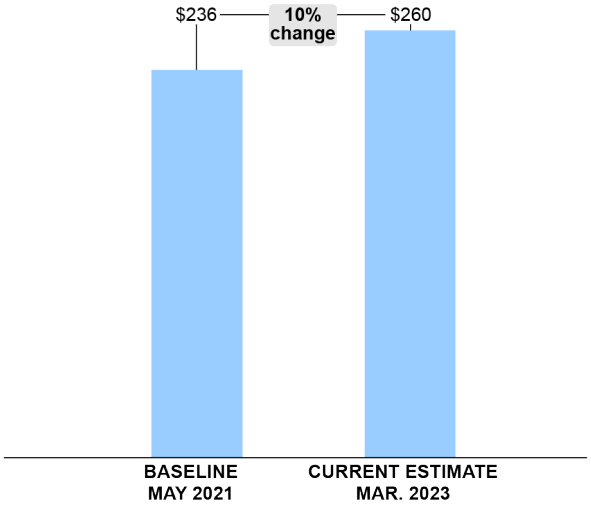
PROJECT SUMMARY

As of March 2023, NNSA estimated that it would complete the project at a cost of $260 million (baseline is $236 million) in February 2027 (baseline is June 2027). However, questions have been raised about the project's ability to be completed within its schedule baseline. Specifically, NNSA's fiscal year 2024 budget justification stated that the completion date could be delayed by up to one year.

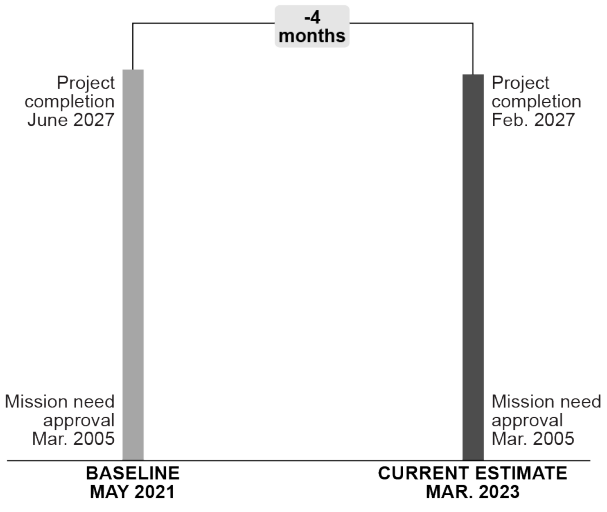
According to project documentation, the project is experiencing two construction challenges. For example, Triad had not provided the project with the planned number of electricians. To address the issue, Triad issued a subcontract in November 2022 to obtain additional electricians for work performed in the nuclear facilities.

COST PERFORMANCE

then-year dollars in millions



SCHEDULE PERFORMANCE



COST AND SCHEDULE STATUS

As of March 2023, NNSA estimated the project's cost at $260 million, which is $24 million over the original baseline of $236 million (approved in May 2021). NNSA's estimated completion for the project is February 2027, while the original baseline was June 2027.

However, a May 2022 peer review, a September 2022 letter from the project's federal contracting officer, and NNSA's fiscal year 2024 budget justification (issued in March 2023) raised concerns about the project's ability to be completed within the schedule baseline. Specifically, the budget justification stated that the completion date could be delayed by up to one year.

According to project documentation, the project is experiencing two construction challenges, and Triad has ongoing actions to address the challenges. First, Triad had not provided the project with the planned number of electricians. The project revised its construction schedule in June 2022 to plan for an average of 31 electricians per day going forward. However, between June 2022 and February 2023, the actual number of electricians averaged six per day, according to NNSA's fiscal year 2024 budget justification.

NNSA officials said that there were multiple reasons why the project had fewer electricians than planned. For example, Triad management deemed the TRP III project to be a lower priority than other ongoing plutonium projects at the laboratory (i.e., the Los Alamos Plutonium Pit Production Project). Triad also had a limited number of electricians with the required security clearances to perform work in the project's nuclear facilities.

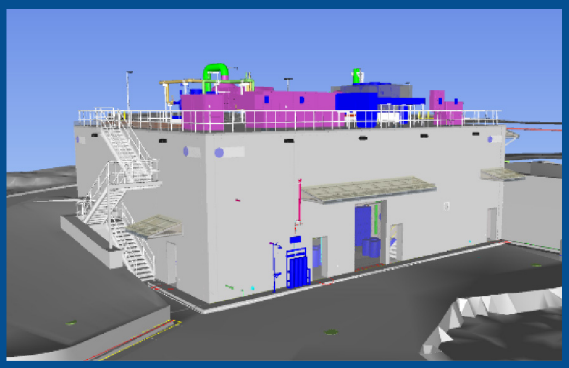
To increase the number of electricians on the project, in November 2022, Triad issued an almost $5 million subcontract to an existing subcontractor currently performing nonnuclear work. According to NNSA officials, the additional electricians will be assigned to work in the nuclear facilities. Officials told us that the additional electricians needed to complete required training before starting work in nuclear facilities. The additional electricians started construction work in the nuclear facilities in December 2022, and officials expect the additional electricians to complete their work in the nuclear facilities by August 2023. Officials told us that they may seek to add additional nuclear work scope, depending on the subcontractor's performance.

Second, the productivity rate achieved by skilled laborers, including electricians, has been less than the planned rate. Specifically, a May 2022 peer review found that the project revised its productivity rate to be 24 percent lower than the original planned rate. The peer review identified several reasons for this, including that on any given day the composition of project work crews varied in terms of number, experience, and skill set. In addition, the peer review stated that the process that workers use to identify and retrieve needed materials, some of which require specialized storage and handling to meet nuclear quality assurance standards, appears cumbersome.

In late 2022, the project implemented multiple changes to its construction execution strategy to address the challenges. For example, the project divided electrician work crews into two specialized teams, with one team focused exclusively on installing electrical conduits, and the other team focused exclusively on pulling wire through the conduits to specific devices in the fire alarm system (e.g., smoke and heat detectors, visual and audio notification mechanism, etc.). NNSA officials said that this should improve work efficiency by making the composition of work crews more consistent and reducing the need to set up new materials and retool equipment. These officials told us that they should know by spring 2023 if the changes to the project's construction execution strategy increased productivity levels.

PROJECT OFFICE COMMENTS

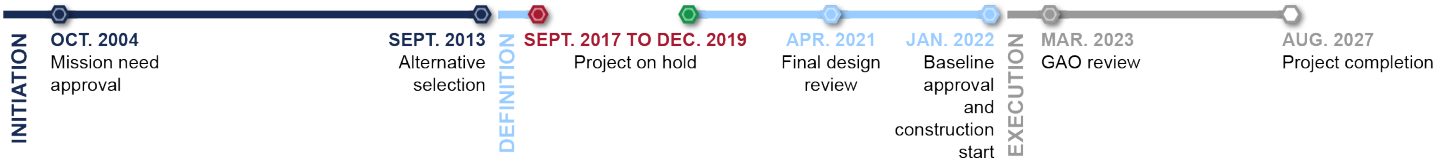
TRP III project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.



Source: National Nuclear Security Administration. | GAO-23-104402

Transuranic Liquid Waste Facility

The Transuranic Liquid Waste (TLW) facility project plans to construct a 5,200 square-foot facility to collect, store, treat, and discharge radioactive liquid waste, including transuranic waste that contains certain manufactured elements (e.g., plutonium). This facility is designed to include process equipment (i.e., tanks, piping, a micro filter, and an evaporator system) as well as associated support areas (i.e., decontamination, storage, and mechanical rooms). The TLW facility is the last of three projects (the other two have been completed) to upgrade the radioactive liquid waste system at the Los Alamos National Laboratory.



PROJECT INFORMATION

Location: Los Alamos National Laboratory, Los Alamos, NM

Site Contractor: Triad National Security (Triad), LLC

Construction Contractor: Triad, with a subcontract to Hensel Phelps

NNSA Program Office (Organizational Code): Plutonium (NA-191)

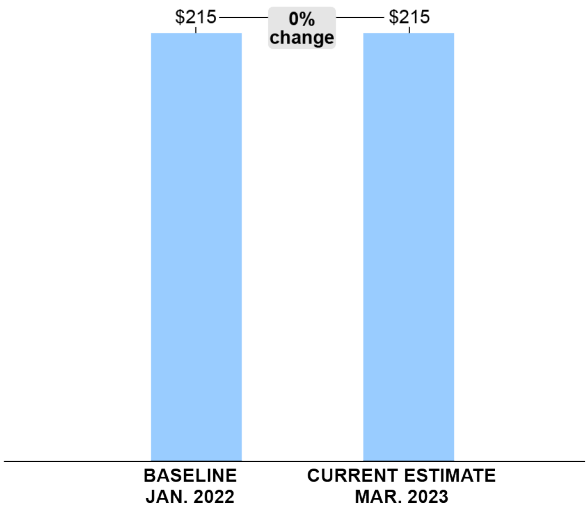
PROJECT SUMMARY

As of March 2023, NNSA estimated that it would complete the project within the cost and schedule baselines approved in January 2022. However, the project is experiencing project management, construction, and supply chain challenges.

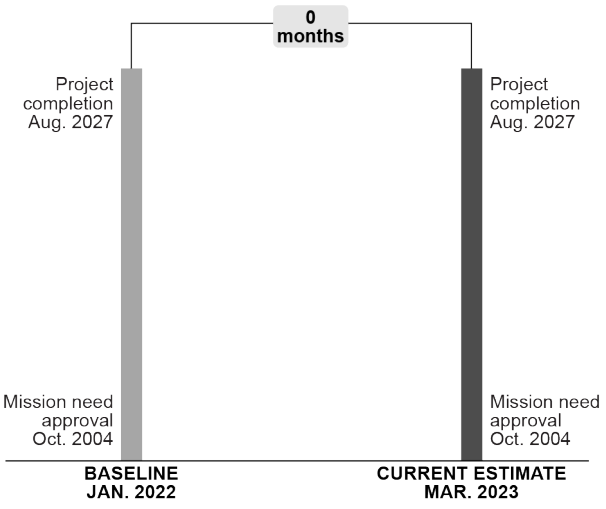
For example, uncertainties associated with NNSA's internal process and timeframes for completing a key project management activity resulted in a subsequent delay in issuing the construction subcontract. During this delay, the subcontract's price increased, which required the project to use the majority of its cost and schedule contingency (costs and time added to address risks) before beginning facility construction. NNSA officials described efforts, such as revising the construction schedule, to mitigate other risks that could require additional contingency usage.

COST PERFORMANCE

then-year dollars in millions



SCHEDULE PERFORMANCE



COST AND SCHEDULE STATUS

As of March 2023, NNSA estimated that it would complete the TLW facility project within the cost and schedule baselines approved in January 2022. However, the project is experiencing project management, construction, and supply chain challenges.

First, NNSA officials stated that there were uncertainties about the agency's internal processes and time frames for submitting a required notification to Congress before beginning construction. The delay in notifying Congress caused a subsequent delay in the project's ability to issue a subcontract for the facility's construction. This resulted in cost and schedule increases. For example, the construction subcontract's price increased by almost $5 million due, in part, to a significant increase in the costs for noncorrosive metals (i.e., nickel and stainless steel) that compose key materials necessary for the facility's construction, according to officials.

To address the cost and schedule effects associated with the delay in issuing the construction subcontract, the project used 50 percent of its cost contingency and 65 percent of its schedule contingency. NNSA officials told us that using such a significant portion of the contingency before beginning construction could affect the project's ability to address additional risks that may occur in the future. However, these officials also described project efforts to mitigate other risks that could necessitate using additional cost and schedule contingency. For example, officials said that they revised the construction schedule to avoid mass excavation activities in the winter months, when such work can be more difficult to conduct and prone to weather delays.

Second, the project is experiencing construction management challenges related to its ability to meet nuclear quality assurance (NQA-1) requirements—a common set of standards established by the American Society of Mechanical Engineers to ensure safety in nuclear facilities. Specifically, the construction subcontractor (Hensel Phelps) does not have prior experience meeting NQA-1 requirements. Triad, the site contractor, took several measures to help Hensel Phelps meet the NQA-1 requirements, according to NNSA officials. For example, Triad provided Hensel Phelps with specific language to include in its contracts with lower-tier subcontractors regarding the need to follow NQA-1 requirements and properly complete necessary documentation. In addition, Triad provided subject matter experts to assist Hensel Phelps with evaluating its suppliers' ability to meet NQA-1 requirements.

Third, the project is experiencing supply chain challenges associated with two key efforts. First, the project's critical path (the longest continuous sequence of activities in a schedule that defines the project's earliest completion date) includes the procurement and installation of an electrical transformer. In November 2022, NNSA officials reported an expected approximate 1-year delay in the delivery of the transformer. To mitigate potential schedule delays, officials plan to use temporary generator power for the project's commissioning phase (e.g., the phase between construction completion and full operations to ensure that all equipment and systems work as intended) until the transformer is delivered.

In addition, shortages of a key concrete additive (potash) required the project to reformulate the concrete mixture for the TLW facility, which is designed to be a precast concrete structure. In December 2022, the project reported that the reformulated concrete mixture may result in premature deterioration and would require an additional redesign. In January 2023, the project reported that the additional redesigned concrete mixture satisfactorily passed key tests, and its design was formally submitted for Triad review and approval. Triad approved the concrete formulation, and structural concrete placements began in February 2023 without affecting the project's construction schedule, according to project officials.

TECHNOLOGY

The project has identified three critical technologies. According to project documentation, two of the technologies have been used in Los Alamos National Laboratory's existing radiological liquid waste treatment facility, and the third technology (an evaporator system) is commercially available and proven to work in industrial settings.

DOE's project management order recommends that less costly projects (such as the TLW project) mature all critical technologies to TRL 7 prior to the baseline approval milestone. According to project documentation, the project assessed all three technologies at TRL 7 or above, when NNSA approved the project's baseline and construction start milestones in January 2022.

PROJECT OFFICE COMMENTS

TLW project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.

Nevada National Security Site

Conducts high-hazard operations in support of NNSA, Department of Defense, and other agencies.

PRIME CONTRACTOR (MANAGEMENT AND OPERATING)

Mission Support and Test Services, LLC

PARTIES TO PRIME CONTRACT

Honeywell International, Inc.

Jacobs Engineering Group, Inc.

HII Nuclear Inc.

PROJECTS IN DEFINITION PHASE

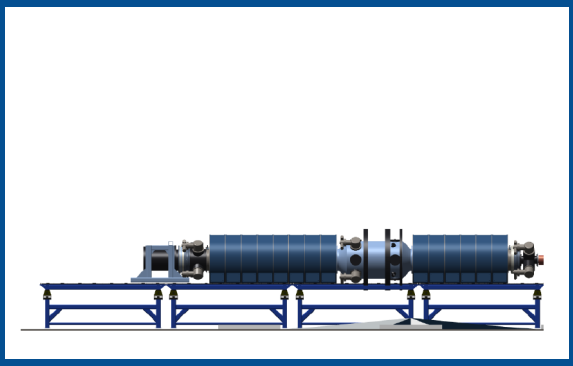
Not applicable

PROJECTS IN EXECUTION PHASE

Enhanced Capabilities for Subcritical Experiments (ECSE) Advanced Sources and Detectors

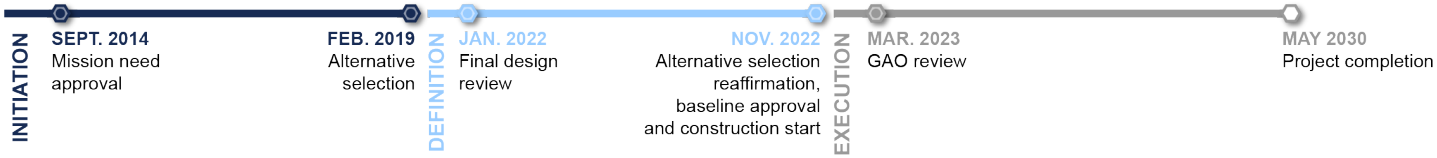
ECSE Laboratory and Support Infrastructure

Enhanced Capabilities for Subcritical Experiments Advanced Sources and Detectors



Source: Work performed for Department of Energy. | GAO-23-104402

Located nearly 1,000 feet underground, the Enhanced Capabilities for Subcritical Experiments (ECSE) Advanced Sources and Detectors (ASD) project plans to design, fabricate, install, and commission a 22-million electron volt accelerator to generate X-ray images of subcritical implosion experiments to measure the dynamic behavior of plutonium under weapons-relevant conditions. The configuration and quantities of high explosives and plutonium are designed to ensure that no self-sustaining nuclear fission chain reaction will occur. The related ECSE Laboratory and Support Infrastructure (LSI) project intends to provide the ASD project with needed utilities, as well as diagnostic and control rooms. NNSA collectively refers to the ECSE ASD and LSI projects as the Scorpius Test Bed.



PROJECT INFORMATION

Location: Nevada National Security Site, Mercury, NV

Site Contractor: Mission Support and Test Services (MSTS), LLC

Construction Contractor: MSTS and site contractors at Lawrence Livermore National Laboratory and Sandia National Laboratories, led and integrated by site contractor at Los Alamos National Laboratory

Related Projects: ECSE LSI

NNSA Program Office (Organizational Code): Experimental Sciences (NA-113)

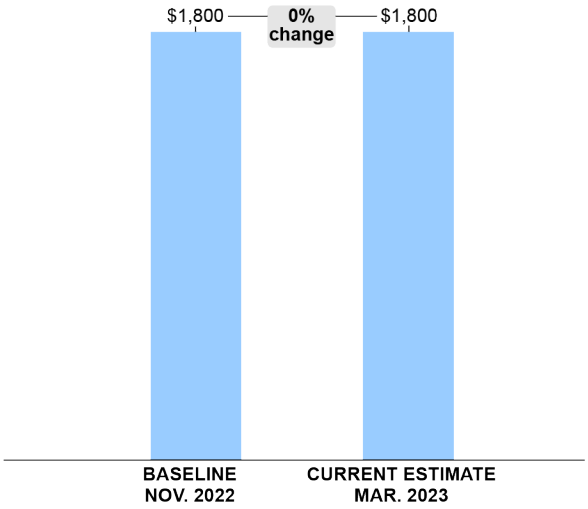
PROJECT SUMMARY

NNSA approved the project's cost and schedule baselines in November 2022. These baselines reflect a $700 million cost increase and 4-year delay in completion compared with the preliminary cost and schedule ranges approved in February 2019. NNSA cited multiple reasons for the cost increase and schedule delay, including revised contractor estimates for missing and underestimated work.

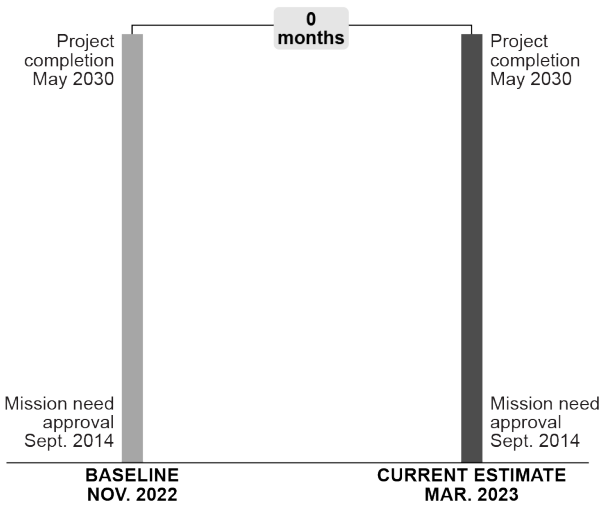
DOE generally requires that critical technologies for more costly projects, such as ASD, must achieve TRL 7 at the baseline approval milestone. In October 2020, the NNSA Administrator approved an exemption to this requirement. In March 2022, an independent group assessed the project's nine critical technologies at TRL 6.

COST PERFORMANCE

then-year dollars in millions



SCHEDULE PERFORMANCE



COST AND SCHEDULE STATUS

NNSA approved the project's cost and schedule baselines in November 2022, and will start reporting actual performance relative to these baselines in April 2023. These baselines reflect a $700 million increase and a 4-year delay in completion compared with the preliminary cost and schedule ranges approved at alternative selection in February 2019.

According to NNSA documents and officials, the cost increase is attributed to three factors: revised contractor estimates for missing or underestimated work, NNSA directed changes to project design and technology, and supply chain issues. For example, revised contractor estimates accounted for about 60 percent of the cost increase, which includes increased costs to procure specialized materials and equipment, as well as the amount of labor required for assembly, installation, and project management activities. The schedule delay reflects an increase to the project's schedule to account for key risks, such as uncertainties in global economic markets. Officials also said that the schedule delay reflects fiscal year 2022 funding constraints that delayed key procurements into fiscal years 2023, 2024, and 2025, which, combined, will delay the start of underground installation activities.

According to the project's schedule, the project has seven key subsystems that generally require separate procurement, assembly, and testing activities before all subsystems can be integrated together. For example, by June 2025, the project expects to complete two separate long-lead procurements that have a combined cost of about $170 million. These procurements include key equipment (e.g., the imaging camera and detector); specialized components (e.g., semiconductors, housings, and vacuum systems); and equipment and materials for the Integrated Test Stand, which is an aboveground location in Nevada where NNSA will assemble and test some subsystems before installing them underground. In March 2023, NNSA reported that these two procurements collectively are about $1 million under budget but about 6 months behind schedule.

TECHNOLOGY

The project has identified nine critical technologies, such as a solid state pulsed power system and the detector itself, which is a key diagnostic tool that converts generated X-rays into visible light that is captured and stored in an imager for later processing.

DOE's project management order requires that more costly projects (like the ASD project) mature all critical technologies to TRL 7 prior to the baseline approval milestone.

However, in October 2020, the NNSA Administrator approved an exemption to this requirement because, according to project documentation, there was no way to achieve TRL 7 without essentially building the entire accelerator. Instead, the NNSA Administrator required that the critical technologies achieve TRL 6 by the time of the combined baseline approval and construction start milestone.

In March 2022, a group of independent subject matter experts assessed all critical technologies to be at TRL 6, and NNSA approved the project's baselines in November 2022.

PROJECT OFFICE COMMENTS

ASD project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.

Source: Nevada National Security Site. | GAO-23-104402

Enhanced Capabilities for Subcritical Experiments Laboratory and Support Infrastructure

The Enhanced Capabilities for Subcritical Experiments (ECSE) Laboratory and Support Infrastructure (LSI) project includes mining new tunnels, modifying existing tunnels in an existing underground experimental complex, constructing power and cooling utilities abovegroud, and constructing diagnostic and control rooms belowground. The LSI project will support the ECSE Advanced Sources and Detectors (ASD) project, which will be installed underground, to analyze subcritical plutonium experiments (i.e., experiments that do not produce a self-sustaining nuclear fission chain reaction). NNSA collectively refers to the ECSE LSI and ASD projects as the Scorpius Test Bed.

INITIATION

- **SEPT. 2014** Mission need approval
- **JULY 2017** Alternative selection

DEFINITION

- **FEB. 2021** Alternative selection reaffirmation
- **FEB. 2022** Final design review
- **JUNE 2022** Baseline approval and construction start

EXECUTION

- **MAR. 2023** GAO review
- **DEC. 2026** Project completion

PROJECT INFORMATION

Location: Nevada National Security Site, Mercury, NV

Site Contractor: Mission Support and Test Services (MSTS), LLC

Construction Contractor: MSTS

Related Projects: ECSE ASD

NNSA Program Office (Organizational Code): Experimental Sciences (NA-113)

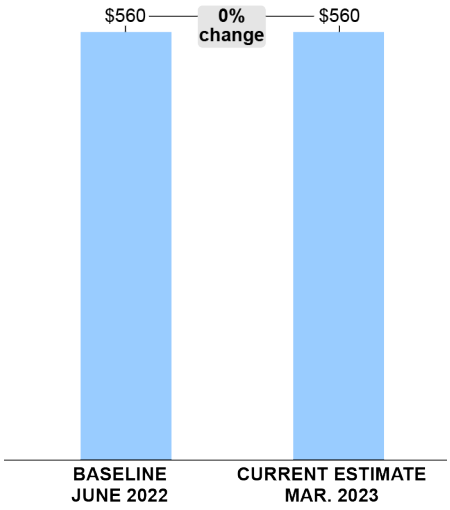
PROJECT SUMMARY

As of March 2023, NNSA estimated that it would complete the project within the cost and schedule baselines approved in June 2022. However, according to NNSA documents and officials, the project was in the early stages of evaluating two recent and ongoing construction challenges with potential cost and schedule impacts.

First, poor ground conditions caused some mining activities to take longer than originally planned, and the concrete in some existing tunnels failed, which has delayed construction work while MSTS makes repairs. Second, due to contract bids that were significantly higher than estimated, the project revised its acquisition strategy for two key activities, according to NNSA officials. For example, MSTS originally planned to issue a single subcontract that would include all procurement and construction activities for the aboveground power and cooling utilities. However, MSTS now plans to procure the needed equipment (e.g., generators and chillers) itself, issue a construction-only subcontract, and furnish the equipment to the subcontractor for installation.

COST PERFORMANCE

then-year dollars in millions



SCHEDULE PERFORMANCE

PROJECT OFFICE COMMENTS

LSI project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.

Pantex Plant

Evaluates, repairs, and dismantles nuclear weapons. Conducts high-explosives research and development.

PRIME CONTRACTOR (MANAGEMENT AND OPERATING)

Consolidated Nuclear Security, LLC

PARTIES TO PRIME CONTRACT

Bechtel National Inc.

Leidos Innovations Corp.

ATK Launch Systems Inc.

SOC, LLC

PROJECTS IN DEFINITION PHASE

High Explosives Synthesis, Formulation and Production Facility

PROJECTS IN EXECUTION PHASE

High Explosives Science and Engineering Facility

Source: National Nuclear Security Administration. | GAO-23-104402

High Explosives Synthesis, Formulation and Production Facility

The High Explosives Synthesis, Formulation, and Production (HESFP) Facility project plans to design and construct five new buildings that total nearly 100,000 square feet. These buildings are to house the following three high explosives capabilities: (1) synthesis, which produces raw explosive molecules; (2) formulation, which combines raw explosive molecules with binding ingredients to form an explosive mixture; and (3) blending, which will blend the formulated mixture. The completed project would allow for large-scale high explosives production currently conducted by a single external vendor that primarily produces high explosives for the Department of Defense.

INITIATION

- **JAN. 2019** Mission need approval
- **JUNE 2020** Conceptual design review
- **FEB. 2021** Alternative selection

DEFINITION

- **AUG. 2022** Preliminary design review
- **JAN. 2023** Final design review
- **MAR. 2023** GAO review
- **OCT. 2023 TO JULY 2027** Project on hold
- **TBD** Baseline approval and construction start

EXECUTION

- **TBD** Project completion

PROJECT INFORMATION

Location: Pantex Plant, Amarillo, TX

Site Contractor: Consolidated Nuclear Security (CNS), LLC

Design Contractor: CNS, with design subcontract to Burns & McDonnell

NNSA Program Office (Organizational Code): High Explosives and Energetics (NA-193)

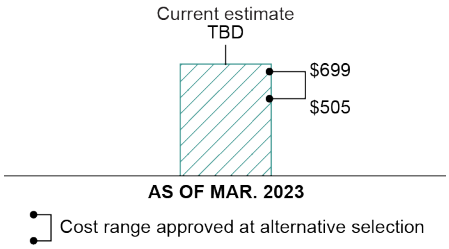
PROJECT SUMMARY

NNSA stated that it plans to place the project on hold after CNS completes all design work in fiscal year 2023. NNSA did not request funding for the project in fiscal year 2024, and stated that it would not seek additional funds in fiscal years 2025 and 2026.

NNSA directed CNS to take two actions while the project is on hold. First, CNS is to conduct an annual review of key project factors (e.g. market conditions, design standards) and identify changes that would affect the project's restart. Second, CNS is to prepare a project restart plan that, when authorized by NNSA, could be executed over a 6-month period. On the basis of NNSA's estimates, CNS could initiate its plan in July 2027 and fully restart the project in January 2028.

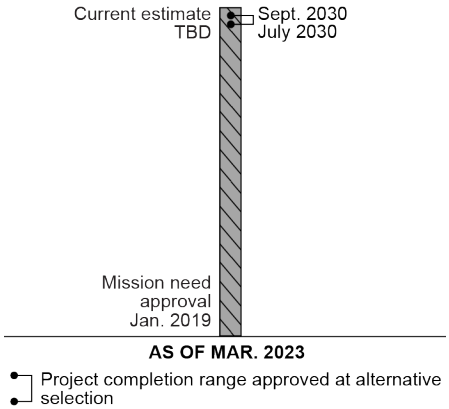
PRELIMINARY COST[a]

then-year dollars in millions



[a]These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.

PRELIMINARY SCHEDULE[a]



[a]These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.

PROJECT OFFICE COMMENTS

HESFP project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.

Source: Burns and McDonnell. | GAO-23-104402

High Explosives Science and Engineering Facility

The High Explosives Science and Engineering (HESE) facility project plans to construct three new interconnected facilities—a high explosives laboratory, a high explosives temporary staging area, and a technology development and deployment laboratory—totaling approximately 70,000 square feet. The HESE facility is designed to increase the amount of high explosives that can be used in the laboratory, reduce inefficiencies in moving high explosives between buildings, and increase the capability to develop diagnostic tools for the evaluation, manufacturing, and testing of materials.

INITIATION
- **NOV. 2011** Mission need approval
- **JAN. 2015** Alternative selection

DEFINITION
- **JULY 2018** Final design review
- **SEPT. 2018 TO JAN. 2020** Project on hold
- **APR. 2022** Baseline approval and construction start

EXECUTION
- **MAR. 2023** GAO review
- **NOV. 2027** Project completion

PROJECT INFORMATION

Location: Pantex Plant, Amarillo, TX

Site Contractor: Consolidated Nuclear Security (CNS), LLC

Construction Contractor: CNS, with construction subcontract to Hensel Phelps

NNSA Program Office (Organizational Code): High Explosives and Energetics (NA-193)

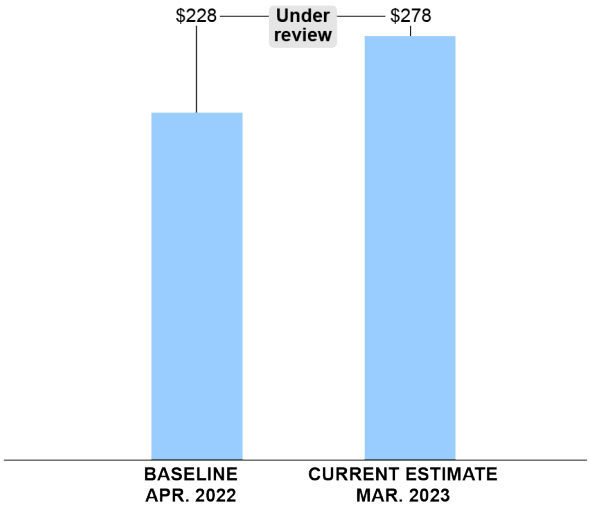
PROJECT SUMMARY

As of March 2023, NNSA estimated that it would complete the project at a cost of $278 million (baseline is $228 million) in November 2027 (the baseline date) due to two ongoing construction challenges first identified in 2022. For example, CNS terminated the subcontractor responsible for completing site preparation activities in April 2022 for poor performance.

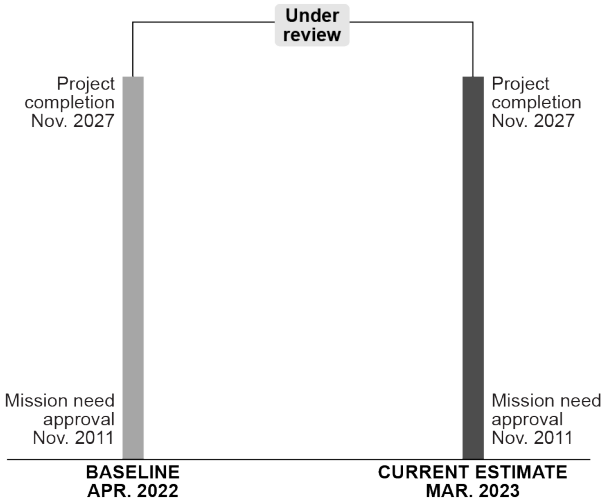
However, NNSA is reviewing these estimates, which are based on data provided by CNS in March 2023. The project is in the early stages of assessing changes to its cost and schedule baselines, according to project documentation.

COST PERFORMANCE

then-year dollars in millions



SCHEDULE PERFORMANCE



COST AND SCHEDULE STATUS

As of March 2023, NNSA estimated the project's cost at $278 million, compared with its baseline of $228 million (approved in April 2022). Its estimate for completion is November 2027, which is the same as the approved baseline.

However, NNSA is reviewing these estimates, which are based on a comprehensive update provided by the contractor in March 2023 and include initial impacts from two ongoing construction challenges.

The first construction challenge relates to CNS terminating the subcontractor responsible for completing site preparation activities (e.g., installing security fencing and utility lines) for poor performance in April 2022. According to NNSA officials, the site preparation subcontractor was scheduled to complete all work within 270 days but took almost 550 days to complete roughly half of the work. CNS issued multiple subcontracts to complete the remaining site preparation activities.

However, project documentation states that the subcontracts have higher costs and longer durations than originally planned. For example, the cumulative subcontract costs are $10 million more than the original estimates, which NNSA officials attributed to a low bid by the terminated site preparation subcontractor and recent market conditions, including supply chain delays and higher than expected inflation. Officials told us that all site preparation work should be completed by August 2023, which is not expected to affect the schedule for constructing the project's three buildings.

Second, in the fall of 2022, the project found that multiple walls designed to resist blast pressures from high explosives testing had insufficient tensile strength. This design error was identified before the construction subcontractor started work on building the walls. NNSA officials said that the time needed to complete the redesign and associated calculations pushed the time frame for the construction of blast resistant walls onto the project's critical path (the longest continuous sequence of activities in a schedule and defines the project's earliest completion date).

NNSA officials said that, based on their initial review of the contractor's March 2023 estimates, they did not think the project could be completed within its cost baseline. In addition, according to project documentation, a delay in the schedule completion date is possible. Specifically, the project is almost 3 months behind its planned schedule for multiple reasons, including weather delays. In addition, multiple activities along the critical path are taking longer than planned, and the specific efforts to address the blast wall challenge are expected to extend the critical path by 8 months. Finally, the project is in the early stages of assessing changes to its cost and schedule baselines, according to project documentation.

PROJECT OFFICE COMMENTS

HESE project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.

Savannah River Site

Conducts tritium processing, research, and development.
Conducts tritium reservoir loading and surveillance testing in support of stockpile certification.
Future production of plutonium pits.

PRIME CONTRACTOR (MANAGEMENT AND OPERATING)

Savannah River Nuclear Solutions, LLC

PARTIES TO PRIME CONTRACT

Fluor Corporation

Newport News Nuclear

PROJECTS IN DEFINITION PHASE

Savannah River Plutonium Processing Facility

Surplus Plutonium Disposition

Tritium Finishing Facility

PROJECTS IN EXECUTION PHASE

Not applicable

Source: Savannah River Nuclear Solutions, LLC. | GAO-23-104402

Savannah River Plutonium Processing Facility

The Savannah River Plutonium Processing Facility (SRPPF) project is intended to produce at least 50 plutonium pits (the fissile core of a nuclear weapon) per year in a main process building, starting in 2036, and construct related capabilities such as a training center, waste handling facilities, and security infrastructure. The project will (a) modify an existing, partially constructed 400,000 square foot nuclear facility into the project's main process building; (b) repurpose existing nonnuclear facilities; and (c) construct new nonnuclear and process support facilities.

PROJECT INFORMATION

Location: Savannah River Site, Aiken, SC

Site Contractor: Savannah River Nuclear Solutions (SRNS), LLC

Design Contractor: SRNS with key design subcontracts to Fluor Federal Services (one of three member companies that comprise SRNS) and Merrick & Company

NNSA Program Office (Organizational Code): Plutonium (NA-191)

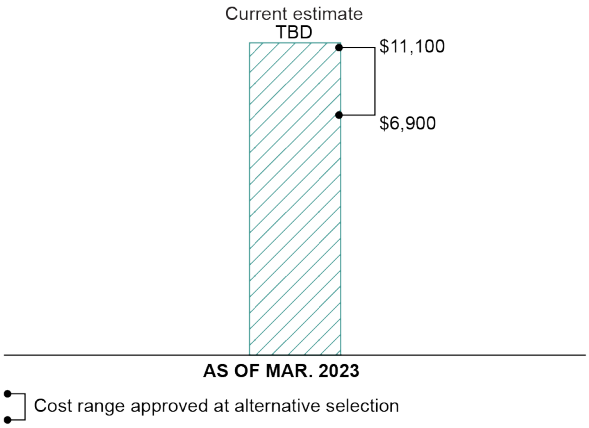
PROJECT SUMMARY

As of March 2023, NNSA was in the early stages of updating the project's preliminary cost and schedule estimates. NNSA's fiscal year 2024 budget justification stated that the project's overall cost may increase by up to 40 percent and be delayed up to 3 years compared with the estimates approved at the alternative selection milestone. SRNS plans to submit revised cost and schedule estimates to NNSA in February 2024.

Furthermore, in April 2023, SRNS plans to submit revised cost and schedule estimates for completing all design work that has experienced staffing shortfalls and integration challenges. Regarding a key technology for the main process building, SRNS completed initial testing of a revised prototype in December 2022, with additional testing scheduled for completion in June 2023.

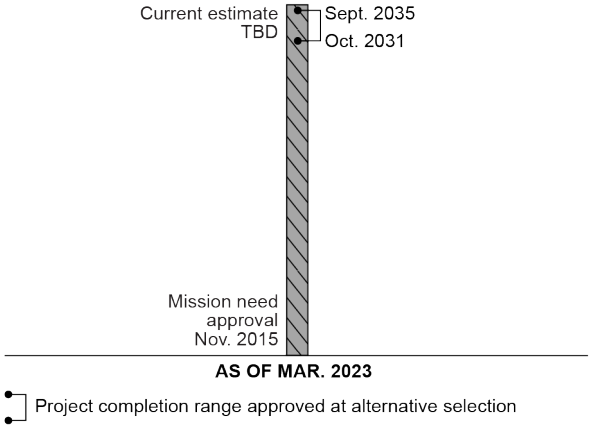
PRELIMINARY COST[a]

then-year dollars in millions



[a]*These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.*

PRELIMINARY SCHEDULE[a]



[a]*These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.*

COST AND SCHEDULE STATUS

As of March 2023, NNSA was in the early stages of updating the project's preliminary cost and schedule estimates. NNSA's fiscal year 2024 budget justification states that the project's cost may increase by up to 40 percent and the schedule could be delayed up to 3 years compared with the estimates approved at the alternative selection milestone. In February 2024, SRNS plans to submit to NNSA a revised cost and schedule estimate, and NNSA plans to complete its review of the revised estimate by April 2024.

According to NNSA documents and officials, there are multiple reasons for the anticipated cost increase and schedule delay. For example, NNSA revised the project's top-level requirements in January 2022, which increased the project's scope by adding more empty processing space and support utilities in the main process building to enable future modifications. Further scope was added to install equipment in the nonnuclear training center that is identical to the equipment in the main process building.

In January 2023, the Deputy Secretary of Energy approved a revised execution strategy that increased the number of subprojects from five to six and the number of unique site preparation or long-lead procurement efforts from three to 12. For example, the project approved one site preparation effort in September 2022 to remove unneeded, existing equipment and structures from the main process building and install temporary construction utilities at an estimated cost of $246 million by September 2025.

Additionally, in 2023, the project plans to approve the first of multiple procurements to obtain 150 gloveboxes (sealed, protectively lined compartment having holes to which are attached gloves for use in handling plutonium inside the compartment) and enclosures needed for the main process building and the training center. NNSA estimates that, cumulatively, these multiple procurements will cost over $1 billion.

DESIGN

NNSA is in the early stages of updating the project's cost and schedule estimates to complete the overall design effort, Specifically, SRNS plans to submit to NNSA a revised estimate in April 2023.

According to NNSA documents and officials, the revised estimate will incorporate the January 2022 top-level requirement changes and the January 2023 execution strategy changes. In addition, the revised estimates will incorporate the cost and schedule effects from design challenges experienced to date. For example, according to the fiscal year 2024 budget justification, the actual number of engineers assigned to the project has been about 75 percent of the planned amount, which has increased design time. NNSA expects to complete its review and the Deputy Secretary of Energy to approve a revised design cost and schedule by August 2023.

The project is using different subcontractors to design specific parts of the project, and these designs are at various levels of maturity. For example, one subcontractor (Merrick) is designing the gloveboxes and process equipment, while another subcontractor (Fluor) is designing the main process building and associated supporting infrastructure and facilities. NNSA officials told us that they are prioritizing the glovebox and process equipment design because it is a key input into the remaining building and infrastructure design.

In July 2022, Merrick submitted its preliminary design, but NNSA and SRNS identified multiple concerns with the design's quality and completeness. Specifically, NNSA officials said that Merrick's design lacked important information to support equipment selection decisions and did not include key design details (i.e., piping and equipment instrumentation diagrams) needed for Fluor to continue to mature its design. Until these concerns are fully resolved, Fluor can only mature limited portions of its design. In March 2023, NNSA officials said that Merrick provided responses to the identified concerns and that SRNS is reviewing the responses. The officials said that all concerns should be fully resolved by April 2023.

TECHNOLOGY

The project has identified 36 critical technologies that will be used mostly in processing operations, such as metal preparation, machining, and assembly. DOE's project management order requires that more costly projects (like the SRPPF project) mature all critical technologies to TRL 4 prior to the alternative selection milestone and TRL 7 prior to the baseline approval milestone. At the alternative selection milestone in June 2021, SRNS assessed all technologies at TRL 4 or above. In August 2022, a national laboratory completed another assessment and determined that all technologies were at TRL 7 or above.

In December 2022, SRNS completed initial testing on a revised prototype of the material transport system technology—a critical technology that is the backbone for successful main process building operations. According to NNSA officials, this revised prototype is a simpler design and will be easier to operate and maintain. Further testing and additional design work will continue through June 2023, at which point SRNS will begin incorporating the material transport system into the overall design.

PROJECT OFFICE COMMENTS

SRPPF project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.

Source: National Nuclear Security Administration. | GAO-23-104402

Surplus Plutonium Disposition

The Surplus Plutonium Disposition (SPD) project is designed to increase NNSA's plutonium dilution capability by (1) installing additional processing equipment into an existing nuclear facility; and (2) constructing a new building that will contain needed processing support systems, such as electrical distribution equipment. The United States has nuclear weapons-usable plutonium that it declared surplus to our national security needs. This plutonium requires disposal. The SPD project intends to dilute 34 metric tons of plutonium oxide, a powder-like substance, with inert material and then temporarily store the diluted plutonium until it is shipped to a permanent underground repository located in another state.

INITIATION

- **OCT. 1997** Mission need approval
- **AUG. 2019** Conceptual design review
- **DEC. 2019** Alternative selection

DEFINITION

- **DEC. 2020** Preliminary design review
- **MAR. 2023** GAO review
- **SEPT. 2023** Final design review
- **APR. 2024** Baseline approval and construction start

EXECUTION

- **SEPT. 2030** Project completion

PROJECT INFORMATION

Location: Savannah River Site, Aiken, SC

Site Contractor: Savannah River Nuclear Solutions (SRNS), LLC

Design Contractor: SRNS with subcontracts to Merrick & Company and Enercon

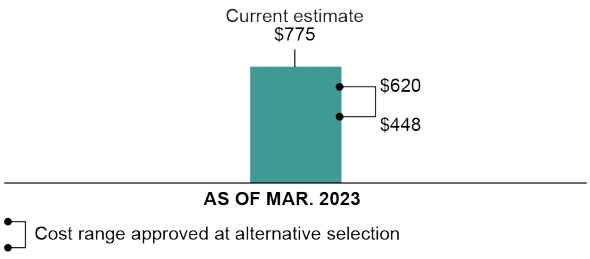
NNSA Program Office (Organizational Code): Material Management and Minimization (NA-233)

PROJECT SUMMARY

As of March 2023, NNSA estimated that the project may cost $775 million, which is $155 million above the high end of the preliminary cost range approved at the alternative selection milestone, and take 2 additional years to complete. However, NNSA may further revise these estimates as a result of (1) the project office's more detailed cost estimate, planned to be completed before the end of 2023; and (2) ongoing design issues with two key safety systems that may be resolved in summer 2023. In addition, the project plans to use three critical technologies, two of which may not achieve the maturation level required for the upcoming baseline approval milestone. However, according to NNSA program officials, the project can achieve its planned annual processing rate without the use of the two technologies. Officials said that the two technologies offer opportunities to reduce the life cycle costs to operate the completed project.

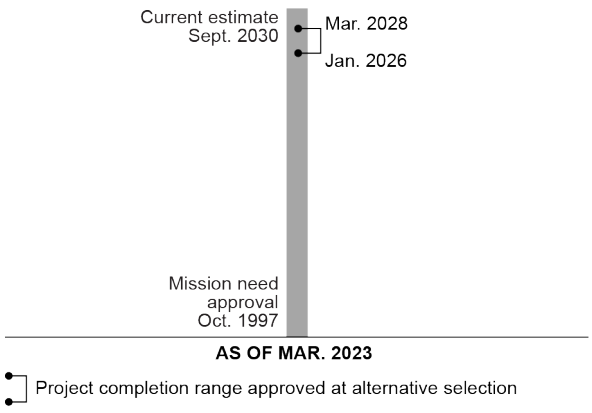
PRELIMINARY COST[a]

then-year dollars in millions



[a]*These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.*

PRELIMINARY SCHEDULE[a]



[a]*These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.*

COST AND SCHEDULE STATUS

As of March 2023, NNSA estimated that the project may cost $775 million, which is $155 million above the high end of the preliminary cost range approved at the alternative selection milestone, and take 2 additional years to complete. The estimate is based on October 2022 SRNS data and NNSA's review and adjustments to those data, which it completed in February 2023.

However, NNSA may revise the estimates for two reasons. First, the estimates do not fully incorporate anticipated costs to complete remaining work but, rather, reflect an increase to the anticipated costs of addressing project risk (i.e., management reserve and contingency). NNSA officials told us that before the end of 2023, the agency plans to conduct a bottom-up estimate, which involves a detailed assessment of the costs to complete all remaining work.

Second, the estimate includes an initial $25 million to address ongoing issues with the project's safety design strategy. The strategy, which is required by DOE's project management order, identifies the major hazards anticipated in the facility and describes how those hazards will be addressed using structures, systems, and components. However, because the strategy is undergoing reevaluation, it is not yet known whether the $25 million will be sufficient.

A February 2022 independent project review raised concerns that two key systems—fire suppression and confinement ventilation—were not adequately developed. In addition, the February 2022 review found that the project selected the specific fire suppression system early in the project's development without fully evaluating alternatives. The project has taken actions to address the February 2022 review's concerns, including maturing the two systems' designs, conducting a follow-up review in February 2023, and incorporating input from key stakeholders, such as DOE's Chief of Nuclear Safety.

In March 2023, SRNS submitted a revised safety design strategy for review, which NNSA plans to complete in July 2023. In addition, SRNS is conducting an analysis of alternatives of the fire suppression system, also planned to be completed in July 2023. NNSA officials said that preliminary results indicate that the previously selected fire suppression system remains a viable alternative. Officials told us that the full effect of these safety-related issues, including any redesign work, will be better understood once both reviews are completed.

DESIGN

In August 2022, NNSA approved significantly higher design costs and a 1-year schedule delay for achieving the baseline approval milestone. Specifically, the project's total design costs increased from $76 million to $184 million, and the schedule for achieving the baseline approval milestone was delayed 1 year, from April 2023 to April 2024. NNSA's fiscal year 2024 budget justification reported a further cost increase for completing all design work, and this cost increase was incorporated into the March 2023 revised estimates.

According to NNSA documentation, the two primary causes for the design-related cost increase and schedule delay were poor performance by SRNS and a redesign of the facility's second floor. Specifically, the project will construct a second floor to house needed safety and support infrastructure, such as high-efficiency particulate air filters. However, an NNSA design review found that the planned SRNS design provided insufficient structural integrity. The project issued a subcontract to an engineering firm to redesign the second floor.

TECHNOLOGY

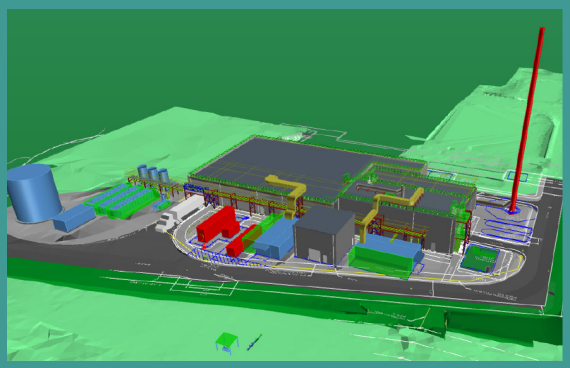
The project plans to use three critical technologies related to plutonium processing, packaging, and material accountability operations (i.e., measurement). DOE's project management order requires that more costly projects (like SPD) mature all critical technologies to TRL 4 prior to the alternative selection milestone and TRL 7 prior to the baseline approval milestone. At the project's alternative selection milestone, SRNS assessed all of the technologies at TRL 4. In December 2022, SRNS determined and NNSA concurred that one technology achieved TRL 7.

NNSA's Office of Material Management and Minimization is managing the maturation of two of the project's critical technologies related to measurement and packaging. In April 2023, NNSA program officials told us that both of these technologies were at TRL 6 and would not achieve TRL 7 until after the project achieves its baseline approval milestone. However, according to NNSA program officials, the project can achieve its planned annual processing rate without the use of these two technologies and, therefore, project success is not dependent on these technologies.

NNSA is planning to prepare documentation that would remove these two technologies from the project's scope, according to agency officials. NNSA program officials said that they plan to continue to mature these technologies because they could reduce the life cycle costs to operate the completed project. For example, a more accurate measurement technology would allow NNSA to increase the amount of plutonium loaded into a single disposal can by 10 percent.

PROJECT OFFICE COMMENTS

SPD project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.



Source: Savannah River Nuclear Solutions, LLC. | GAO-23-104402

Tritium Finishing Facility

The Tritium Finishing Facility (TFF) project consists of two subprojects. The site preparation subproject plans to demolish three existing warehouses, construct a new warehouse, and install new power supply lines. The process buildings subproject plans to construct two new buildings to relocate and replace existing tritium operations currently housed in a 1950s era building. One building is to contain equipment for processing tritium-filled reservoirs, and another building is to contain equipment for needed processing steps, such as inspection and storage activities. Tritium is a radioactive isotope of hydrogen used to enhance the power of nuclear weapons.

PROJECT INFORMATION

Location: Savannah River Site, Aiken, SC

Site Contractor: Savannah River Nuclear Solutions (SRNS), LLC

Design Contractor: SRNS with design subcontract to Fluor Federal Services, which is one of three member companies that comprise SRNS

NNSA Program Office (Organizational Code): Tritium and Domestic Uranium Enrichment (NA-192)

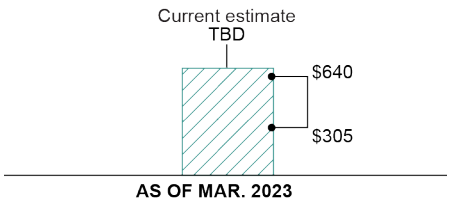
PROJECT SUMMARY

In March 2023, NNSA stated that it plans to place part of the project—the process buildings subproject—on hold after SRNS completes multiple design-related tasks, such as completing activities to revise the subproject's conceptual design. NNSA directed SRNS to provide cost and schedule estimates in May 2023 for completing the specified design tasks. NNSA did not request funding for the project for fiscal year 2024, does not plan to request funding for the project in fiscal years 2025 and 2026, and plans to restart the process buildings subproject in fiscal year 2027, dependent on funding.

However, work on the site preparation subproject is ongoing. In December 2022, NNSA approved the site preparation subproject's cost baseline ($37.3 million) and schedule baseline (completion in March 2025). In early 2023, SRNS issued multiple subcontracts for equipment procurements and warehouse demolition. In March 2023, NNSA stated that the agency expects the subproject to move forward and be completed using carryover funding.

PRELIMINARY COST[a]

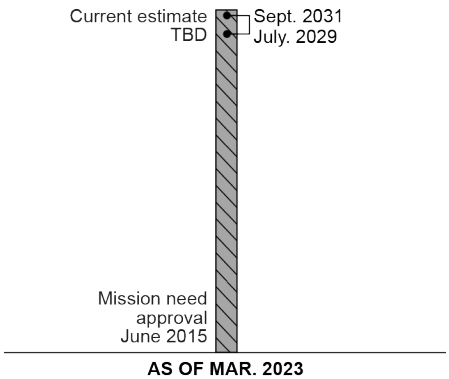
then-year dollars in millions



Cost range approved at alternative selection

[a]These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.

PRELIMINARY SCHEDULE[a]



Project completion range approved at alternative selection

[a]These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.

PROJECT OFFICE COMMENTS

TFF project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.

Y-12 National Security Complex

Manufactures, evaluates, and tests uranium and special materials components for nuclear weapons.
Supplies enriched uranium for use in naval reactors.

PRIME CONTRACTOR (MANAGEMENT AND OPERATING)

Consolidated Nuclear Security, LLC

PARTIES TO PRIME CONTRACT

Bechtel National Inc.

Leidos Innovations Corp.

ATK Launch Systems Inc.

SOC, LLC

PROJECTS IN DEFINITION PHASE

Lithium Processing Facility

PROJECTS IN EXECUTION PHASE

Calciner Project

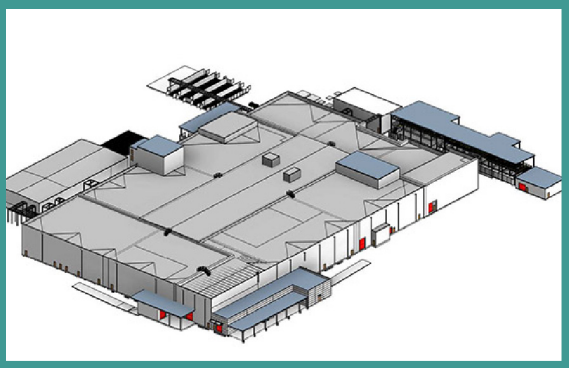
Electrorefining Project

Uranium Processing Facility (UPF) Main Process Building

UPF Process Support Facilities

UPF Salvage and Accountability Building

West End Protected Area Reduction Project



Source: National Nuclear Security Administration. | GAO-23-104402

Lithium Processing Facility

The Lithium Processing Facility (LPF) project plans to construct a new facility to relocate existing lithium operations that are currently conducted in a building that is over 75 years old. Lithium is a key material used in some nuclear weapon components. The LPF will be a nonnuclear facility that includes lithium purification and processing equipment, shipping and storage areas, administrative office space, and exterior storage for bulk chemicals.

INITIATION

- **JUNE 2015** Mission need approval
- **MAR. 2019** Conceptual design review
- **DEC. 2019** Alternative selection

DEFINITION

- **MAR. 2023** GAO review
- **AUG. 2023** Preliminary design review
- **SEPT. 2024** Final design review
- **NOV. 2025** Baseline approval and construction start

EXECUTION

- **SEPT. 2031** Project completion

PROJECT INFORMATION

Location: Y-12 National Security Complex (Y-12), Oak Ridge, TN

Site Contractor: Consolidated Nuclear Security (CNS), LLC

Design Contractor: CNS, with design subcontract to Jacobs Engineering Group, Inc.

NNSA Program Office (Organizational Code): Lithium Modernization (NA-195)

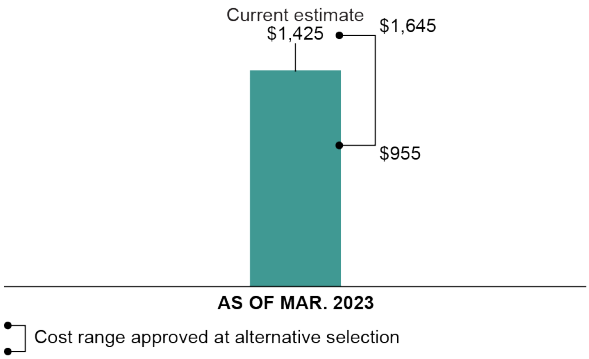
PROJECT SUMMARY

As of March 2023, NNSA estimated that the project would be completed within the cost and schedule ranges approved at the alternative selection milestone. However, NNSA's fiscal year 2024 budget justification stated that, for multiple reasons, the project's cost could increase up to 15 percent, and that the project office would update the cost estimate by September 2023.

Regarding design, in late 2022, the project validated a significant increase in the facility's size and incorporated the associated $145 million increase into the current cost estimate. Regarding the project's single critical technology, the project office is implementing an alternative technology maturation approach approved by the NNSA program office in January 2023.

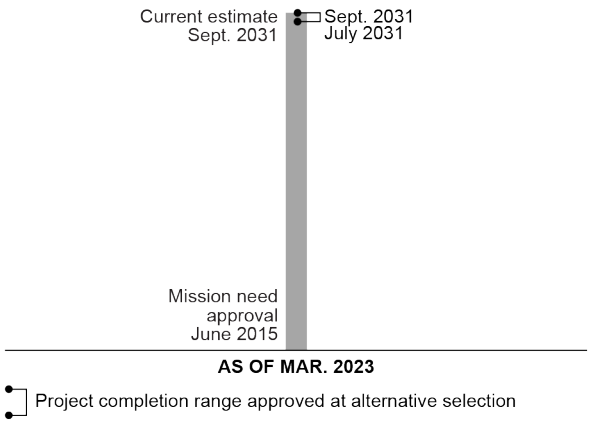
PRELIMINARY COST[a]

then-year dollars in millions



[a]*These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.*

PRELIMINARY SCHEDULE[a]



[a]*These estimates are preliminary as the project is in the definition phase and its design is not complete. NNSA uses these estimates for planning purposes.*

COST AND SCHEDULE STATUS

As of March 2023, NNSA estimated that the project would be completed at a cost of $1.425 billion in September 2031, which is within the cost and schedule range approved at the alternative selection milestone. However, in its fiscal year 2024 budget justification, NNSA stated that the project's total cost could increase by up to 15 percent due to market conditions (e.g., inflation, supply chain disruption) and internal challenges (e.g., managing multiple projects at a single site, integrating new construction with aging site infrastructure). NNSA's budget justification states that the project office will prepare an updated cost estimate by the end of fiscal year 2023.

In August 2022, CNS awarded a subcontract to Kiewit Corporation. Under this subcontract, the subcontractor is to, among other things, conduct constructability reviews—which are technical reviews to determine the extent to which a structure's design facilitates its construction, subject to the facility's overall requirements. According to NNSA documentation and officials, CNS will issue a firm-fixed-price subcontract for construction of the LPF to Kiewit Corporation, following successful implementation of the first subcontract. However, if Kiewit Corporation does not perform as expected in the first subcontract, CNS will issue a separately competed subcontract to another subcontractor, according to NNSA officials.

DESIGN

CNS divided the overall design effort into two areas: process design (lithium purification, production and salvage) and facility design (building structure and various support systems). The project is using a design approach whereby the contractor will mature the process design before beginning detailed facility design.

As the preliminary process design was nearly complete, the design contractor started work on a more detailed facility design in June 2022. As the facility design matured, the proposed size of the facility increased by almost 85 percent, from about 135,000 square feet to about 250,000 square feet. In October and November 2022, the project conducted a series of review sessions that validated the facility's size growth and identified multiple reasons for its growth. For example, project documentation states that about 25 percent of the facility size growth is due to the addition of corridors, platforms, and stairways to allow for the safe egress of personnel from the building or certain processing areas.

In November 2022, NNSA added $145 million to the project's cost estimate to account for the increased construction costs associated with a larger building. The design subcontractor completed this more detailed facility design in November 2022, and the project office finalized the facility's size in January 2023. As of March 2023, there were hundreds of outstanding comments for the design subcontractor to resolve, but NNSA officials stated that addressing these comments will not further affect the facility's size.

As of March 2023, NNSA plans to complete both process and facility preliminary designs by August 2023 and the project's final design by September 2024.

TECHNOLOGY

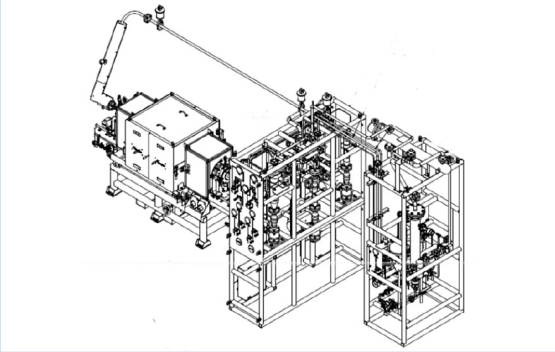
The project has identified a single critical technology—homogenization—which will use a standard furnace technology but apply it in a novel way to heat and purify a specific form of lithium. Homogenization may make certain processing activities safer and more efficient. However, the LPF design includes all space and equipment needed for the current chemical purification process, as some processing steps require such chemical purification. As a result, the LPF may be operated with or without the homogenization technology.

DOE's project management order requires that more costly projects (like the LPF) mature all critical technologies to TRL 4 prior to the alternative selection milestone and to TRL 7 prior to the baseline approval milestone. In December 2019, at the alternative selection milestone, the project was reviewing the potential use of two technologies but had not yet identified any critical technologies. In May 2020, NNSA decided to use homogenization in the project. In June 2020, a review team assessed the readiness of this critical technology at TRL 6.

To achieve TRL 7, CNS recommended in December 2020 that the project procure and test a full-scale, production-prototype homogenization furnace. A March 2022 annual project review concluded that the schedule for achieving TRL 7 using this approach was aggressive, given the multiple steps needing to be completed and the entities involved. In January 2023, the NNSA Lithium Modernization Program Manager approved an alternative testing approach using existing production furnaces at the Y-12 site. According to project documentation, this alternative approach removed TRL 7 testing activities from the project's critical path (the longest continuous sequence of activities in a schedule) for the baseline approval milestone. CNS plans to begin testing using this alternative approach in April 2023 and achieve TRL 7 by May 2024, which would be more than a year before the planned baseline approval milestone in November 2025.

PROJECT OFFICE COMMENTS

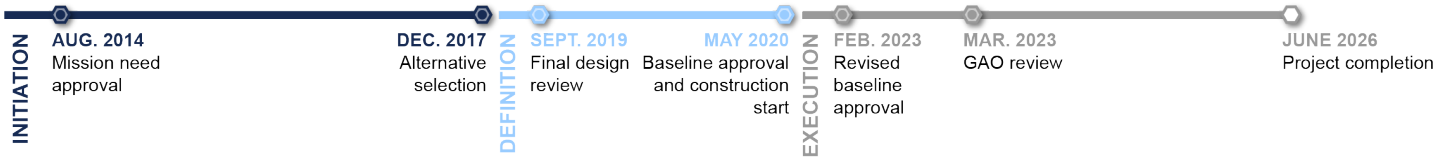
LPF project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.



Source: Consolidated Nuclear Security, LLC. | GAO-23-104402

Calciner Project

The Calciner project intends to procure and install a calciner system in Building 9212, which currently poses the highest nuclear safety risk at the Y-12 National Security Complex because of its age and condition. The calciner system is designed to support the decontamination and shutdown of Building 9212 by processing certain uranium-bearing solutions (e.g., solutions resulting from cleaning out the building's pipes and vessels) into a dry solid oxide that can be stored pending further processing. The project includes new equipment (i.e., furnace and gloveboxes) and new support systems (e.g., storage tanks, pipes, and high-efficiency particulate air filters) that will be integrated into the building's existing processing system.



PROJECT INFORMATION

Location: Y-12 National Security Complex (Y-12), Oak Ridge, TN

Site Contractor: Consolidated Nuclear Security (CNS), LLC

Construction Contractor: CNS

NNSA Program Office (Organizational Code): Secondary Stage Production Modernization (NA-195)

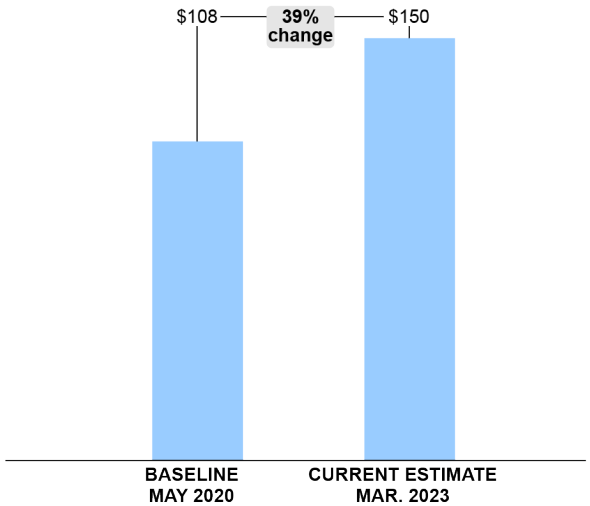
PROJECT SUMMARY

In February 2023, NNSA approved revised cost and schedule baselines that reflected a 39 percent cost increase and a 33-month schedule delay compared with the May 2020 baselines.

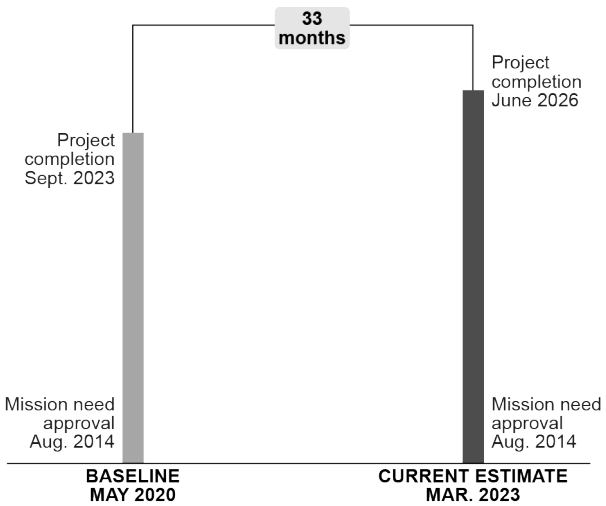
According to NNSA documentation, the cost increase and schedule delay are due to procurement and construction challenges. For example, the vendor responsible for designing and fabricating the furnace delivered the equipment in January 2023, more than 2 years later than originally planned, according to NNSA officials. Procurement delays also created construction challenges, such as needing to maintain work installation crews for longer than anticipated.

COST PERFORMANCE

then-year dollars in millions



SCHEDULE PERFORMANCE



COST AND SCHEDULE STATUS

In February 2023, NNSA approved revised cost and schedule baselines that reflected a 39 percent cost increase and a 33-month schedule delay compared with the May 2020 baselines. The new cost baseline is $150 million (original baseline $108 million), and the new schedule baseline for project completion is June 2026 (original baseline September 2023).

This cost increase and schedule delay are the result of procurement and construction challenges, according to project documents. First, regarding procurement challenges, CNS issued primary subcontracts to two vendors to design and fabricate the project's major pieces of equipment, such as the furnace and process control system. According to NNSA officials, both vendors experienced significant delays. For example, the vendor responsible for designing and fabricating the furnace delivered the equipment in January 2023, more than 2 years later than originally planned, according to NNSA officials. According to NNSA officials, multiple factors contributed to this delay, including that the vendor had placed a higher priority on work for other customers and had initially received some components from its suppliers that did not meet quality standards. In addition, NNSA officials told us that the January 2023 delivery was made possible, in part, because CNS completed some work that was originally planned to be completed by the vendor, including certain inspection and transport-related activities.

Second, equipment procurement delays also caused construction challenges, according to NNSA documentation. Specifically, the project identified over $4 million in labor inefficiencies, including maintaining installation work crews for longer than anticipated, and completing less work than expected. According to NNSA documentation, CNS initiated proactive measures to mitigate the effects of equipment delays by, among other things, resequencing some work activities.

TECHNOLOGY

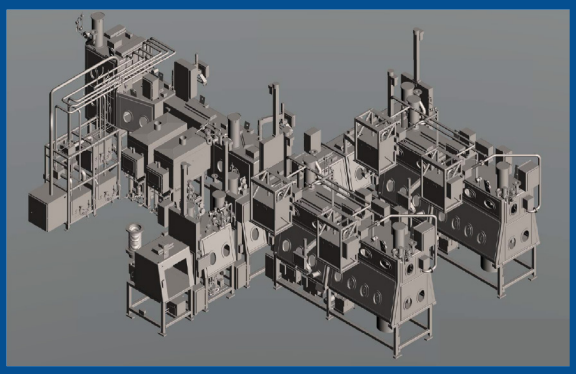
According to agency officials, the project did not formally identify any critical technologies but decided to evaluate the maturity of the calciner system itself. DOE's project management order recommends that less costly projects (like the Calciner Project) mature all critical technologies to TRL 7 prior to the baseline approval milestone.

According to an August 2016 memo signed by the NNSA project management executive, the project did not need to achieve TRL 7 at the baseline approval milestone because, among other reasons, the calciner system was not a first-of-a-kind engineering effort and had been used in another DOE facility for decades. In addition, an April 2020 independent project review concluded that the technology was likely at TRL 7, although it did not conduct a formal assessment.

When the project reached the baseline approval milestone in May 2020, the calciner system remained at TRL 6 (based on a formal assessment conducted in 2015).

PROJECT OFFICE COMMENTS

Calciner project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.



Source: National Nuclear Security Administration. | GAO-23-104402

Electrorefining Project

The Electrorefining project plans to design and install equipment for a new electrochemical refining process to salvage and purify uranium metal from the by-products of manufacturing activities at the Y-12 National Security Complex. Located in Building 9215, the project intends to produce uranium of high purity that can be further processed for a variety of purposes, replace current operations that use hazardous chemicals, and reduce operating costs. The project also includes the design and installation of utility support systems.

INITIATION

- **SEPT. 2014** Mission need approval
- **SEPT. 2015** Alternative selection

DEFINITION

- **JULY 2018** Final design review
- **FEB. 2019** Baseline approval and construction start

EXECUTION

- **OCT. 2022** Revised baseline approval
- **MAR. 2023** GAO review
- **APR. 2024** Project completion

PROJECT INFORMATION

Location: Y-12 National Security Complex, Oak Ridge, TN

Site Contractor: Consolidated Nuclear Security (CNS), LLC

Construction Contractor: CNS

NNSA Program Office (Organizational Code): Secondary Stage Production Modernization (NA-195)

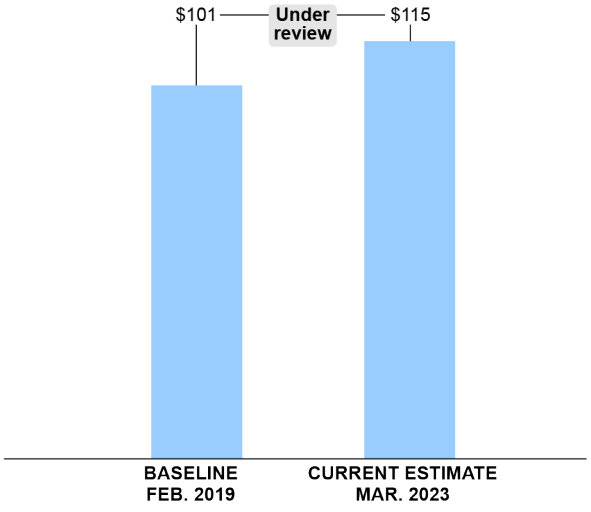
PROJECT SUMMARY

As of March 2023, NNSA estimated that it would complete the project at a cost of $115 million (baseline is $101 million) in April 2024 (baseline is February 2023). These estimates incorporate the revised baselines that NNSA approved in October 2022 to address procurement challenges.

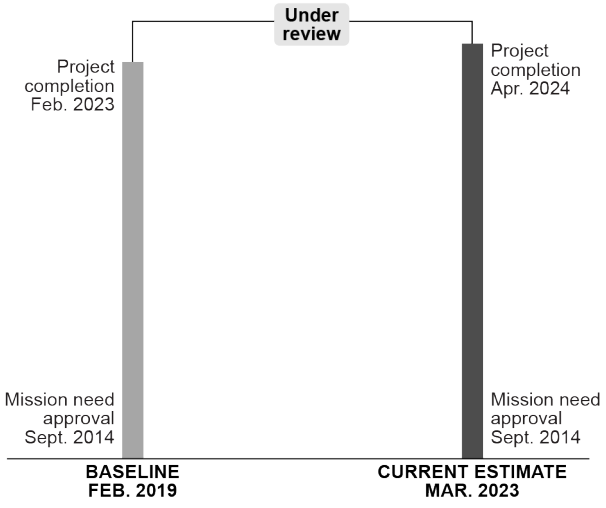
However, these estimates are again under review due to a design error identified in late 2022. To address the error, the project now plans to design and install a new chilled water system. In March 2023, the contractor completed about half of the new system's design, and NNSA officials said that the project is in the early stages of planning for a second revision of the baseline.

COST PERFORMANCE

then-year dollars in millions



SCHEDULE PERFORMANCE



COST AND SCHEDULE STATUS

According to NNSA documentation, as of March 2023, NNSA estimated that the project would cost $115 million compared with its original baseline of $101 million (approved in February 2019). NNSA also estimated that the project would be completed in April 2024, compared with the original baseline of February 2023.

However, these March 2023 estimates are under review. The March 2023 estimates fully incorporated the revised baselines approved in October 2022 to address procurement challenges but reflected only initial cost increases and schedule delays to correct a design error identified in late 2022.

According to project documentation, the cost increase and schedule delay included in the October 2022 revised baselines were primarily the result of procurement challenges with processing equipment and gloveboxes—sealed, protectively lined compartments having holes with attached gloves for use in handling especially dangerous material inside the compartment. According to project documentation, the vendor had previous experience designing and constructing gloveboxes but had not integrated the gloveboxes with all the internal process equipment and external support systems.

NNSA officials told us that the project experienced multiple procurement challenges, including equipment failures and an inability to meet specifications. For example, officials told us that the vendor did not conduct important calculations while designing the integrated glovebox system to determine the amount of heat that processing operations would generate inside the gloveboxes. Additionally, following fabrication and during initial testing, the air purification and cooling systems failed to meet specifications. The vendor completed design changes and rework to add purification and cooling capacity, but this caused delays. In February 2021, the vendor delivered the gloveboxes 16 months late. According to NNSA officials, this delay expended the project's entire schedule contingency and led to project engineering and vendor management costs that were greater than initially estimated.

In late 2022, the project identified a design error that resulted in an insufficient flow of chilled water to the equipment's furnace, which would not support furnace testing or operation, according to NNSA documentation. To address the error, the project planned to design and install a new chilled water system. In March 2023, the contractor completed about half of the new system's design, and the project planned to begin installation activities in July 2023. Also in March 2023, NNSA officials said that the project was in the early stages of planning a second revised baseline that would fully incorporate the additional cost increases and schedule delays associated with the design error.

TECHNOLOGY

The project has identified a single critical technology—the electrorefining system itself. DOE's project management order recommends that less costly projects (like the Electrorefining project) mature all critical technologies to TRL 7 prior to the baseline approval milestone.

According to an August 2018 memo signed by the NNSA project management executive, the project did not need to achieve TRL 7 at the baseline approval milestone because, among other reasons, the electrorefining system had been used at other DOE laboratories and sites. When the project achieved its baseline approval milestone in February 2019, the electrorefining system remained at TRL 6 (based on a formal assessment conducted in January 2016).

However, according to NNSA officials, NNSA's Office of Secondary Stage Production Modernization concluded that it was important to have the technology formally achieve TRL 7 to help ensure it would function as intended. One NNSA official told us that the project team approved TRL 7 for the electrorefining technology in May 2023.

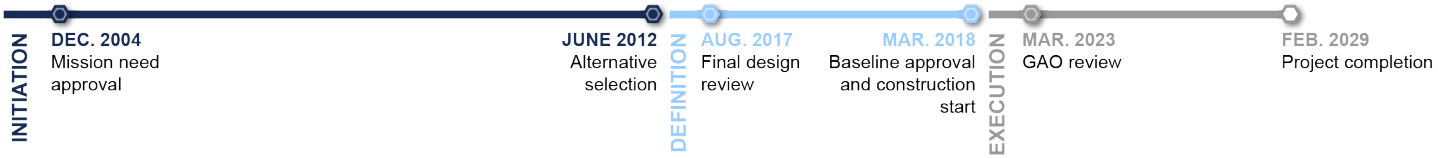
PROJECT OFFICE COMMENTS

Electrorefining project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate. In May 2023, NNSA approved a revised baseline that contained an additional cost increase ($1 million) and schedule delay (1 month) to the March 2023 estimates reported here.

Source: National Nuclear Security Administration. | GAO-23-104402

Uranium Processing Facility Main Process Building

The Uranium Processing Facility (UPF) Main Process Building (MPB) project plans to construct a nuclear facility to house processes for casting enriched uranium into various shapes and producing special uranium oxides. This project is part of the overall UPF project that intends to construct and equip four new facilities to meet the enriched uranium needs for the nation's nuclear weapons stockpile and the U.S. Navy.



PROJECT INFORMATION

Location: Y-12 National Security Complex (Y-12), Oak Ridge, TN

Site Contractor: Consolidated Nuclear Security (CNS), LLC

Construction Contractor: CNS, with a subcontract to Bechtel National Incorporated (Bechtel), which is one of four member companies that comprise CNS

NNSA Program Office (Organizational Code): Secondary Stage Production Modernization (NA-195)

Related Projects: UPF Process Support Facilities (PSF) and UPF Salvage and Accountability Building (SAB)

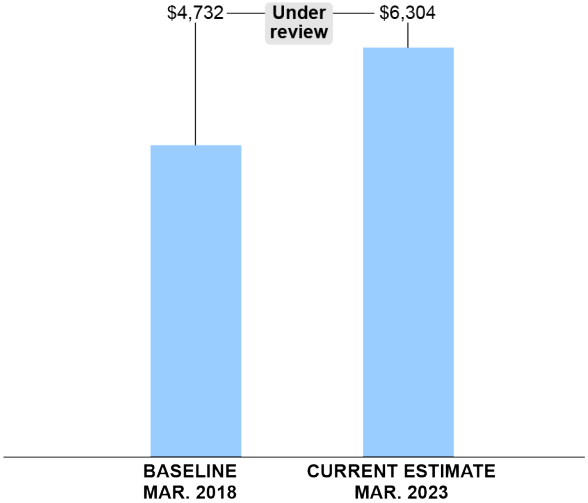
PROJECT SUMMARY

As of March 2023, NNSA estimated that it would complete the project at a cost of $6.3 billion (baseline is $4.7 billion) in February 2029 (baseline is December 2025) due to construction, procurement, and supply chain challenges. For example, the project office identified the need for contractors to improve their performance in performing a significant amount of the remaining construction work, such as installing a combined 2.8 million linear feet of electrical cable in the UPF MPB and UPF SAB by November 2025.

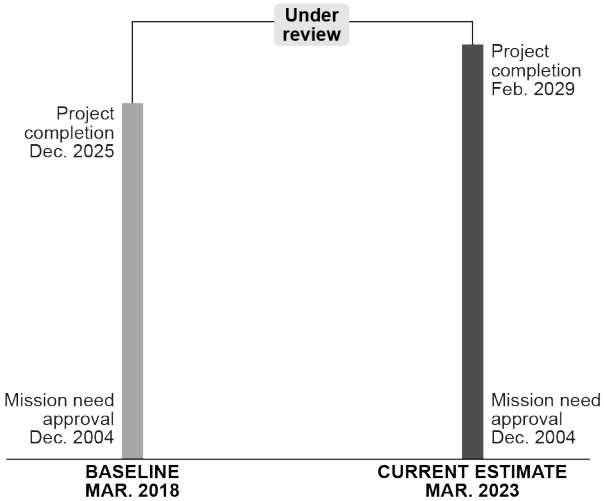
NNSA and DOE are reviewing the project and its cost and schedule estimates. In January 2023, NNSA completed a root cause analysis of the project's performance challenges. In addition, DOE is conducting cost and project reviews that are expected to be completed in June 2023. On the basis of these reviews, the project office plans to submit revised baselines to the Deputy Secretary of Energy for approval.

COST PERFORMANCE

then-year dollars in millions



SCHEDULE PERFORMANCE



COST AND SCHEDULE STATUS

As of March 2023, NNSA estimated that the project would cost $6.3 billion, compared with its original baseline of $4.73 billion (approved in March 2018). NNSA also estimated that the project would be completed in February 2029, compared with the original baseline of December 2025.

The estimates are based on a comprehensive cost and schedule update prepared by CNS in July 2022. According to project documentation, the significant cost increase and schedule delay are due to construction, procurement, and supply chain challenges.

The primary and ongoing construction challenge is that the project's actual level of productivity (i.e., the rate at which construction tasks are completed) was lower than planned. According to project documentation, the lower level of productivity was the result of multiple causes, including a lack of construction supervisors and the effects of COVID-19. NNSA officials told us that Bechtel based its initial productivity level estimates on historical information. However, in March 2022, Bechtel increased the estimated time needed to complete certain tasks.

In June 2022, the NNSA project office identified multiple actions that the subcontractor could take to increase productivity. The subcontractor responded by hiring additional field engineers, quality control personnel, and a manager tasked with coordinating electrical work.

However, in March 2023, the NNSA project office reported that, to prevent further schedule delays, construction contractors needed to improve their performance over the subsequent 3 months. The office also identified the need to improve worker productivity for the remaining construction work, which is significant. For example, as of February 2023, the project office reported that the UPF MPB and UPF SAB projects need to install a combined 2.8 million linear feet of electrical cable by November 2025. To address this challenge for both projects, the project plans to increase the number of electricians from about 600 in March 2023 to over 1,000 in August 2023.

The project's main procurement challenge relates to delays in fabricating, testing, and delivering multiple furnaces that will be used on the production line. In March 2023, the project reported that some of the procurement challenges had resolved, while others were ongoing. For example, the project is procuring four casting furnaces that will use microwave technology to melt and form uranium into various shapes. NNSA officials said that the last of the four furnaces was delivered in February 2023, more than a year later than originally planned. According to NNSA officials, this delay was caused by poor vendor performance and supply chain disruptions for key materials.

In March 2023, the project reported that the delivery of three additional furnaces remains a significant challenge. CNS is implementing multiple mitigation efforts, including conducting site visits to the vendor's fabrication facility.

The project has also faced supply chain challenges and increased delivery times for bulk materials (i.e., piping and electrical conduit) needed to support construction activities. Some of these delays were related to the effects of COVID-19 on suppliers, according to project documentation. NNSA officials told us that the delays did not allow the contractor to complete some of its originally planned construction schedule, which required resequencing construction activities and reassigning skilled laborers. To help mitigate this issue, CNS established delivery centers that include personnel from multiple areas and seek to match supplier production capability with the project's construction schedule.

NNSA and DOE are currently reviewing the project and its cost and schedule estimates. Specifically, the NNSA program office reviewed the project's performance, completed a root cause analysis in January 2023, and developed a corrective action plan with a planned completion date of December 2023. The root cause analysis identified several problems with CNS's management of the project, such as inadequate cost and schedule forecasting, frequent replanning that masked performance, and not including incentives or penalties for key subcontracted work, resulting in late deliveries of services, materials, and equipment.

Among other things, the corrective action plan recommended that NNSA establish a senior management team to increase project oversight and prepare formal lessons learned regarding the effects of frequent replanning and not including incentives or penalties in subcontracted work. In addition, DOE's Office of Project Management is conducting independent cost and project reviews that NNSA expects will be completed in June 2023. On the basis of the results of these reviews, the project plans to submit revised cost and schedule baselines to the Deputy Secretary of Energy for review and approval.

TECHNOLOGY

The project has identified three critical technologies—microwave casting, bulk metal oxidation, and a production calciner. These technologies are intended to enhance the facility's ability to cast, recover, and recycle uranium.

DOE's project management order requires that more costly projects (like the UPF MPB project) mature all critical technologies to TRL 7 prior to the baseline approval milestone. When the project achieved its baseline approval milestone in March 2018, CNS had assessed all three technologies at TRL 7.

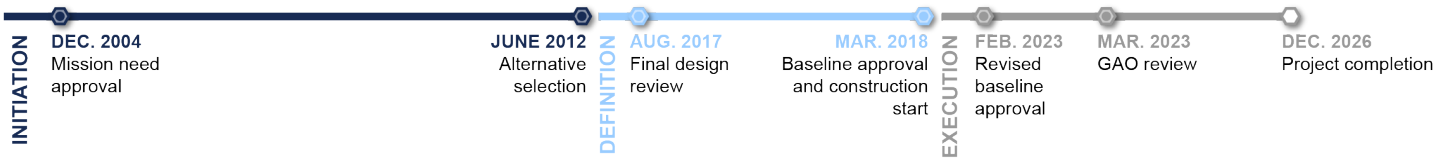
PROJECT OFFICE COMMENTS

UPF MPB project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.

Source: National Nuclear Security Administration. | GAO-23-104402

Uranium Processing Facility Process Support Facilities

The Uranium Processing Facility (UPF) Process Support Facilities (PSF) project plans to construct a building to provide demineralized water and nitric acid for processing activities in the UPF Main Process Building and UPF Salvage and Accountability Building, as well as providing a storage location for chemical and gas supplies. This project is part of the overall UPF project, which will construct and equip four new facilities to meet the enriched uranium needs of the nation's nuclear weapons stockpile and the U. S. Navy.



PROJECT INFORMATION

Location: Y-12 National Security Complex, Oak Ridge, TN

Site Contractor: Consolidated Nuclear Security (CNS), LLC

Construction Contractor: CNS, with a subcontract to Bechtel National Incorporated, which is one of four member companies that comprise CNS

Related Projects: UPF Main Process Building and UPF Salvage and Accountability Building

NNSA Program Office (Organizational Code): Secondary Stage Production Modernization (NA-195)

PROJECT SUMMARY

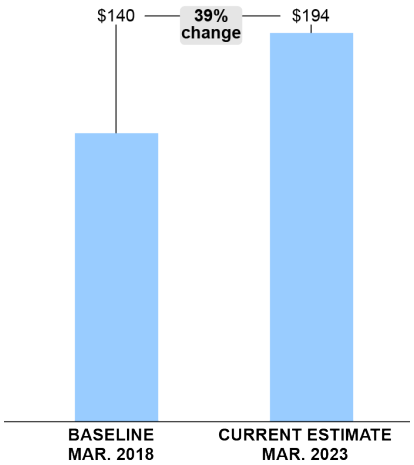
In February 2023, NNSA approved revised cost and schedule baselines that contained a 39 percent cost increase and a 12-month schedule delay (compared with the March 2018 baselines) due to construction and supply chain challenges, according to project documentation.

The project's primary construction challenge is that its actual level of productivity (i.e., the rate at which construction tasks are completed) was lower than planned due to multiple causes, including a lack of construction supervisors and the effects of COVID-19 (e.g., employee absenteeism due to illness and contact tracing). NNSA officials told us that the construction subcontractor (Bechtel) based its initial productivity level estimates on historical information but in March 2022 increased its estimates of the time needed to complete tasks.

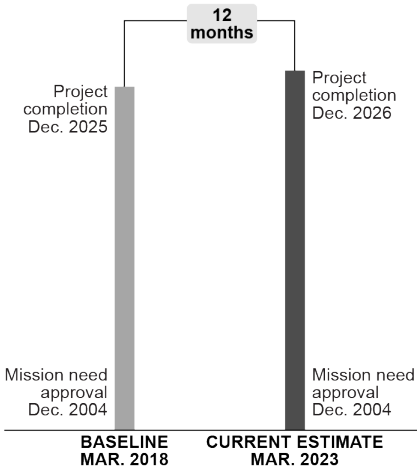
The project's main supply chain challenge is related to items (e.g., electrical distribution panels) that now require long lead times due to the COVID-19 pandemic. According to project officials, these supply chain challenges have mostly been resolved. However, they also said that if the project identifies any deficiencies during start-up testing, supply chain challenges could negatively affect completion of corrective actions in a timely manner.

COST PERFORMANCE

then-year dollars in millions



SCHEDULE PERFORMANCE



PROJECT OFFICE COMMENTS

UPF PSF project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.

Source: National Nuclear Security Administration. | GAO-23-104402

Uranium Processing Facility Salvage and Accountability Building

The Uranium Processing Facility (UPF) Salvage and Accountability Building (SAB) project plans to construct a nuclear facility to decontaminate waste and recover chemicals associated with uranium processing. This project is part of the overall UPF project that intends to construct and equip four new facilities to meet the enriched uranium needs of the nation's nuclear weapons stockpile and the U.S. Navy.

INITIATION

- **DEC. 2004** Mission need approval
- **JUNE 2012** Alternative selection

DEFINITION

- **AUG. 2017** Final design review
- **MAR. 2018** Baseline approval and construction start

EXECUTION

- **MAR. 2023** GAO review
- **FEB. 2029** Project completion

PROJECT INFORMATION

Location: Y-12 National Security Complex (Y-12), Oak Ridge TN

Site Contractor: Consolidated Nuclear Security (CNS), LLC

Construction Contractor: CNS, with a subcontract to Bechtel National Incorporated (Bechtel), which is one of four member companies that comprise CNS

NNSA Program Office (Organizational Code): Secondary Stage Production Modernization (NA-195)

Related Projects: UPF Main Process Building (MPB) and UPF Process Support Facilities

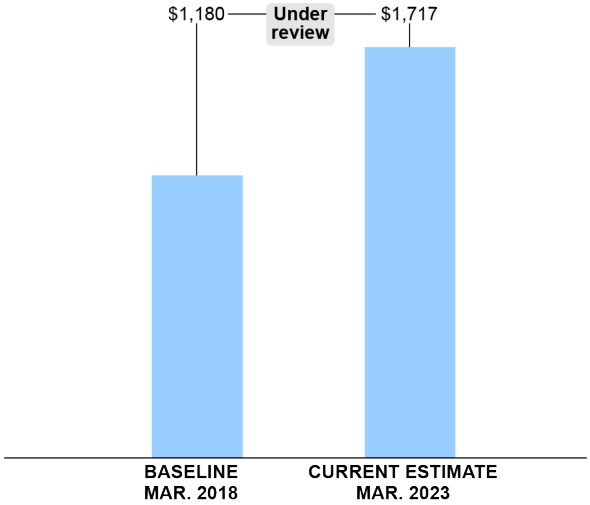
PROJECT SUMMARY

As of March 2023, NNSA estimated that it would complete the project at a cost of $1.72 billion (baseline is $1.18 billion) in February 2029 (baseline is December 2025) due to construction and procurement challenges. For example, the project office identified the need for contractors to improve their performance in performing a significant amount of remaining construction work, such as installing a combined 2.8 million linear feet of electrical cable in the UPF SAB and UPF MPB by November 2025.

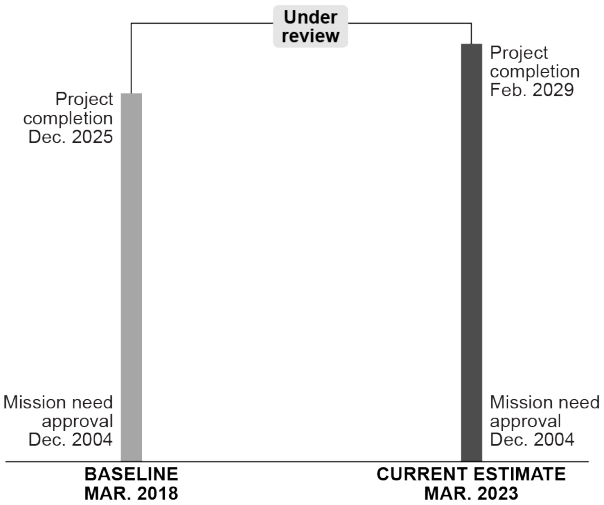
NNSA and DOE are reviewing the project and its cost and schedule estimates. In January 2023, NNSA completed a root cause analysis of the project's performance challenges. In addition, DOE is conducting cost and project reviews, which officials expect to be completed in June 2023. On the basis of these reviews, the project office plans to submit revised baselines to the Deputy Secretary of Energy for approval.

COST PERFORMANCE

then-year dollars in millions



SCHEDULE PERFORMANCE



COST AND SCHEDULE STATUS

As of March 2023, NNSA estimated that the project would cost $1.72 billion, compared with its original baseline of $1.18 billion (approved in March 2018). NNSA also estimated that the project would be completed in February 2029, compared with the original baseline of December 2025.

These estimates are based on a comprehensive cost and schedule update prepared by CNS in July 2022. According to project documentation, the significant cost increase and schedule delay are due to construction and procurement challenges.

The primary and ongoing construction challenge is that the project's actual level of productivity (i.e., the rate at which construction tasks are completed) was lower than planned. According to project documentation, the lower level of productivity was the result of multiple causes, including insufficient numbers of construction supervisors and the effects of COVID-19. NNSA officials told us that Bechtel based its initial productivity level estimates on historical information. However, in March 2022, Bechtel increased the estimated time needed to complete tasks.

In June 2022, the NNSA project office identified multiple actions that the subcontractor could take to increase productivity. The subcontractor responded by, among other things, hiring additional field engineers, quality control personnel, and a manager specifically tasked with coordinating electrical work.

However, in March 2023, the NNSA project office reported that, to prevent further schedule delays, construction contractors needed to improve their performance over the subsequent 3 months. It also identified the need to improve worker productivity for the remaining construction work, which is significant. For example, as of February 2023, the project office reported that the UPF MPB and UPF SAB projects need to install a combined 2.8 million linear feet of electrical cable by November 2025. To address this challenge for both projects, the project plans to increase the number of electricians from about 600 in March 2023 to over 1,000 in August 2023.

In addition, NNSA officials told us that productivity issues continue to delay the work of another subcontractor responsible for applying fire protection coatings to the building's structural steel. Officials told us that this work is now on the project's critical path (the longest continuous sequence of activities in a schedule and that defines the project's earliest completion date) and must be completed before a significant amount of electrical work can begin. According to officials, the subcontractor's productivity has recently improved, in part, because CNS approved wage incentives that helped the subcontractor retain existing workers and hire additional ones.

The project's main procurement challenge relates to delays in fabricating, testing, and delivering the calciner system that will convert impure solutions into a stable, storable condition. NNSA officials said that the procurement delay was caused by design errors, omissions, and changes after fabrication began. According to NNSA officials, the calciner furnace was delivered in October 2022, approximately a year later than originally planned. CNS installed the furnace in another building at the Y-12 plant to undergo qualification testing, which is expected to be completed by October 2023.

The project's initial plan for installing the calciner system required some construction activities to be temporarily suspended. However, the calciner system procurement is no longer on the project's critical path because CNS identified an alternate installation approach that will allow construction activities to continue during the installation of the system, according to project officials.

NNSA and DOE are currently reviewing the project and its cost and schedule estimates. Specifically, the NNSA program office reviewed the project's performance, completed a root cause analysis in January 2023, and developed a corrective action plan with a planned completion date of December 2023. The root cause analysis identified several problems with CNS's management of the project, such as inadequate cost and schedule forecasting, frequent replanning that masked performance, and not including incentives or penalties for key subcontracted work, resulting in late deliveries of services, materials, and equipment.

Among other things, the corrective action plan recommended that NNSA establish a senior management team to increase project oversight and prepare formal lessons learned about the effects of frequent replanning and not including incentives or penalties in subcontracted work. In addition, DOE's Office of Project Management is conducting independent cost and project reviews that NNSA expects will be completed in June 2023. On the basis of the results of these reviews, the project plans to submit revised cost and schedule baselines to the Deputy Secretary of Energy for review and approval.

TECHNOLOGY

The project has identified a single critical technology—a chemical recovery calciner—that will recover enriched uranium with higher levels of impurities than in prior recovery operations. DOE's project management order requires that more costly projects (like the UPF SAB project) mature all critical technologies to TRL 7 prior to the baseline approval milestone. When the project achieved its baseline approval milestone in March 2018, CNS had assessed the technology at TRL 7.

PROJECT OFFICE COMMENTS

UPF SAB project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.

Source: National Nuclear Security Administration. | GAO-23-104402

West End Protected Area Reduction Project

The West End Protected Area Reduction (WEPAR) project intends to complete multiple security efforts to improve the Y-12 National Security Complex's protective system while also reducing its overall security footprint. Specifically, the WEPAR project will construct a new Perimeter Intrusion Detection Assessment System (PIDAS) section and demolish existing PIDAS sections that are no longer needed. This would reduce the site's protected security area by approximately 50 percent. The WEPAR project also plans to construct a new entry control facility (with vehicle access) and complete certain security upgrades (e.g., installing new vaults) for multiple buildings outside of the protected area.

INITIATION
- **SEPT. 2017** Mission need approval
- **DEC. 2018** Alternative selection

DEFINITION
- **JULY 2020** Final design review
- **JAN. 2021** Baseline approval and construction start

EXECUTION
- **MAR. 2023** GAO review
- **OCT. 2025** Project completion

PROJECT INFORMATION

Location: Y-12 National Security Complex (Y-12), Oak Ridge, TN

Site Contractor: Consolidated Nuclear Security (CNS), LLC

Construction Contractor: National Technology and Engineering Solutions of Sandia

NNSA Program Office (Organizational Code): Office of Defense Nuclear Security (NA-70)

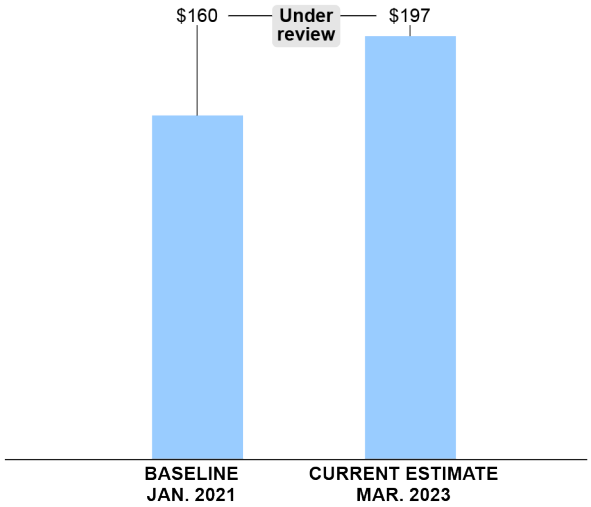
PROJECT SUMMARY

As of March 2023, NNSA estimated that it would complete the project at a cost of $197 million (baseline is $160 million) in October 2025 (baseline is July 2025) due to two ongoing construction challenges, according to project documentation and officials.

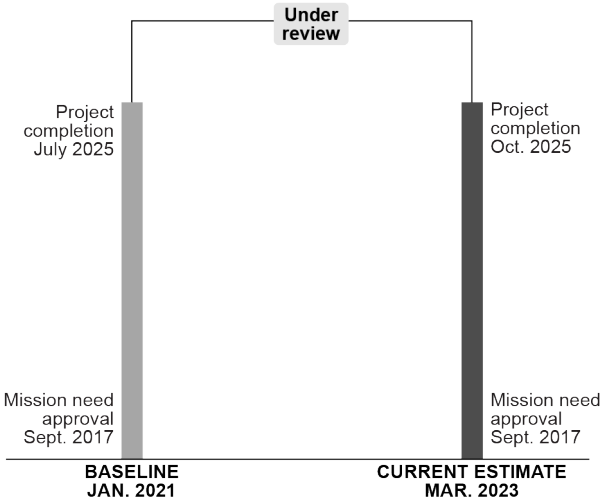
However, NNSA is reviewing these estimates, which were based on its initial review of revised estimates provided by CNS in August 2022. CNS planned to further revise the estimates by April 2023, and DOE) plans to complete independent cost and project reviews in June 2023. On the basis of these results, NNSA officials stated that the agency may approve revised cost and schedule baselines by August 2023 and that the new baselines could include additional cost increases and schedule delays, according to agency documentation.

COST PERFORMANCE

then-year dollars in millions



SCHEDULE PERFORMANCE



COST AND SCHEDULE STATUS

As of March 2023, NNSA estimated the project's cost to be $197 million, compared with its original baseline of $160 million (approved in January 2021). NNSA's estimate for project completion is October 2025, compared with its original baseline of July 2025.

However, NNSA is reviewing the estimates, which are based on its initial review of revised estimates provided by CNS in August 2022. CNS plans to further revise the estimates by April 2023. In addition, DOE's Office of Project Management plans to complete independent cost and project reviews in June 2023. On the basis of these results, NNSA officials said that the agency may approve revised cost and schedule baselines by July 2023, which could include additional cost increases and schedule delays, according to agency documentation. For example, NNSA's fiscal year 2024 budget justification stated that the project's cost could increase up to $240 million and that its schedule completion date could be extended by up to 2 years.

According to project documentation and officials, the proposed cost increase and schedule delay were caused by two ongoing construction challenges.

First, the WEPAR project cannot begin constructing a portion of the PIDAS until a separate effort—managed by a different NNSA program office—to relocate existing utility lines is complete. According to NNSA documentation, the utility relocation effort encountered conditions at the site (e.g., contaminated soil and excessive water) that required additional, unplanned work. NNSA officials currently estimate that the utility relocation effort will be complete in April 2023, 31 months later than planned.

To address the delay, NNSA officials told us that the utility reroute effort contractor provided WEPAR project officials with a revised work execution strategy and schedule in July 2021 that included multiple mitigation efforts, including starting work early in unaffected work areas and delaying work in affected areas.

Second, by March 2022, the project's electrical subcontractor had terminated its contract and stopped work for broader business reasons, not for poor performance on the WEPAR project, according to NNSA documents and officials. The officials said that the contract termination negatively affected the project's ability to bury existing overhead electrical wires, which delayed road work and security perimeter construction in key work areas. The subcontracted electrical work is now the project's critical path (i.e., the longest continuous sequence of activities in a schedule and that defines the project's earliest completion date).

To address this issue, the project team revised the project execution schedule and prioritized work that is not dependent on the electrical work. In October 2022, NNSA awarded a new electrical subcontract. NNSA currently estimates that all electrical work will be completed by August 2023.

PROJECT OFFICE COMMENTS

WEPAR project officials provided technical comments on a draft of this assessment, which we incorporated as appropriate.

Appendix II: Objectives, Scope, and Methodology

This is our first biennial report assessing selected National Nuclear Security Administration (NNSA) major projects, which we define as a capital asset project with an estimated total project cost of $100 million or more (in accordance with the legislative provisions under which we are conducting this review).[1] We included 28 NNSA major projects that had reached the alternative selection milestone by January 2022.[2] We excluded projects in the initiation phase from our scope because NNSA has not selected a preferred alternative or approved preliminary cost and schedule estimates for these projects.

We described the status and assessed the challenges faced by 23 of the 28 NNSA major projects in individual assessments. We did not complete an individual assessment for five projects because they reached the projection completion milestone during our review.[3]

We divided these major projects into those with approved cost and schedule baselines and those without because we consider them to be in different acquisition phases. Specifically, projects with cost and schedule baselines have completed the design process, have a defined scope, are conducting construction activities, and report earned value data[4] to the Department of Energy's (DOE) Project Assessment and Reporting

[1]H.R. Rep. No. 116-442 at 306 (2020); and S. Rep. No. 117-149 at 371 (2022).

[2]We excluded one project (Spent Fuel Handling Recapitalization) from our scope that met both inclusion criteria. The project is managed by NNSA's Office of Naval Reactors, which is responsible for U.S. Navy nuclear propulsion work, including reactor design, operation, and maintenance, as well as waste disposition. We excluded this project for multiple reasons, including that the project is managed under a separate set of project management requirements than other NNSA projects and that the project does not report information to the Department of Energy's project assessment database.

[3]These five projects are Chemistry and Metallurgy Research Replacement (CMRR) Plutonium Facility-4 Equipment Installation, Phase 1; CMRR Radiological Laboratory and Utility Office Building Equipment Installation, Phase 2; Exascale Computing Facility Modernization Project; NNSA Albuquerque Complex Project, Phase II; and Uranium Processing Facility Mechanical Electrical Building.

[4]Earned value management is a project management tool that integrates the technical scope of work with schedule and cost elements for investment planning and control. It compares the value of work accomplished in a given period with the actual cost of the work accomplished and the value of the work planned in that period.

System (PARS) database.[5] In contrast, projects without cost and schedule baselines are still in the design process, have a preliminary scope, may conduct limited site preparation or procurement activities, and do not report earned value data to PARS. Grouping projects into these two groups also allows us to make appropriate observations between projects that are in the same acquisition phase.

In addition to the individual assessments, the objectives of our review were to assess (1) the performance of NNSA's portfolio of major projects that have cost and schedule baselines and (2) the development and maturity of project designs and critical technologies for major projects that do not yet have cost and schedule baselines.

Individual Project Assessments

We developed individual project assessments for 23 projects, each with an estimated cost greater than $100 million. For each assessment, we included a description and image of the project; information concerning the NNSA site, contractors, related projects, and program office involved in the project; the project's cost and schedule performance, when available; key project milestones; and a brief narrative describing the current status of the project. We also provided a detailed discussion of project challenges for selected projects.

To obtain this information, we reviewed project information from PARS, along with standard project documents—such as project execution plans and monthly project status reports. Using this information, we developed a data collection instrument for each project and submitted it to NNSA's project offices. For the data collection instrument, we prefilled certain parts, based on available documentation, such as NNSA's congressional budget justifications, and asked the project offices to corroborate or update the information, while for other parts we asked the project office to provide requested information. In the data collection instrument, we requested each project office to corroborate, update, or provide information on the basic project information; cost estimates; key milestones; schedule estimates; status and specific challenges regarding contractor performance, as well as construction, supply chain, and procurement activities; status of design maturity and results of design

[5]DOE's project management order requires that projects with a total project cost of greater than $50 million report progress and provide documentation in PARS starting after a project receives mission need approval (critical decision 0). This includes key departmental-level project information, such as cost and schedule data and general project performance data. See Department of Energy, *Program and Project Management for the Acquisition of Capital Assets*, DOE Order 413.3B (Washington, D.C.: Nov. 29, 2010); [Updated Jan. 12, 2021].

reviews; and maturity of critical technologies. We also interviewed officials for each project to discuss the information on the data collection instrument and the project's status. We then reviewed project documentation—such updated versions of a project's execution plan, design management plan, or technology maturation plan—as well as project reviews and NNSA congressional budget justifications to corroborate any testimonial evidence we received in the interviews.

To obtain information on, and assess the cost and schedule performance of, projects with performance baselines, we collected cost and schedule information that the project office reports in PARS. According to project documentation and officials, the project office's current cost and schedule estimates are calculated by adding the actual cost of work completed to date to the estimated costs and schedule for completing the remaining work. To assess the reliability of the data, we reviewed related documentation and interviewed knowledgeable agency officials, among other things. We determined that the data were reliable for the purpose of reporting a project's cost and schedule status as of March 2023.

We compared this March 2023 information with the original cost and schedule baselines that NNSA approved for these projects at the baseline approval and construction start milestone, which represents NNSA's formal commitment on the project's cost and schedule. We used the original baseline data when calculating individual project and portfolio performance for the purposes of our analyses. In addition, to assess schedule performance, we tracked the number of months between the start of a project's execution phase (i.e., the date of the baseline approval milestone) and both the estimated completion date approved at the baseline approval milestone and the current estimate of project completion. All cost information in this report is presented in nominal then-year dollars for consistency with budget data.

In addition, for the NNSA major projects with cost and schedule baselines, we determined whether the current key performance parameters—metrics to describe how well a project will perform its functions, expressed in terms such as processing rate or capacity—remain unchanged from when NNSA established the projects' performance baselines. According to DOE's project management order, in aggregate, key performance parameters comprise the scope of a project.

We did not assess the cost and schedule performance of projects in the definition phase because they had not established baselines. For these

projects, NNSA considers the cost and schedule estimates established at the alternative selection milestone to be preliminary and not a formal commitment of the project's cost and schedule. Instead, we collected cost and schedule information for these projects that was current as of March 2023, using project office estimates reported in each project's monthly project status report.[6] According to project documentation and officials, the project office's current cost and schedule estimates are calculated by adding the actual cost of work completed to date to the estimated costs and schedule for completing the remaining work. However, officials told us that cost and schedule estimates for projects without approved baselines can be considered "current working estimates" for various reasons, including that some risks and opportunities (e.g., those related to key procurement and construction activities) have not been realized because the project is earlier in the acquisition process. To assess the reliability of the data, we reviewed related documentation and interviewed knowledgeable agency officials. We determined that the data were reliable for the purpose of reporting a project's cost and schedule status as of March 2023. We also provided information on the range of cost and schedule estimates that NNSA approved at each project's alternative selection milestone, for context.

To obtain and assess information on a project's design maturity, we reviewed relevant project documentation, including a project's design management plan, where available, and the most recently completed design reviews for conceptual design, preliminary design, or final design. We compared the documentation and findings of these design reviews with project activities with DOE and NNSA requirements, as described in relevant DOE and NNSA directives. We also interviewed NNSA headquarters officials responsible for overseeing the agency's design process to gain an understanding of its key policies, procedures, and practices. In the data collection instrument we sent to each project office, we included information on design maturity and design reviews and asked NNSA project officials to corroborate, update, or provide information as appropriate. We then interviewed these officials to fully understand their responses. In addition, we reviewed monthly status reports to see if the project office had identified any emerging design issues that had occurred

[6]We found PARS data to be a less reliable source than the monthly project status report for multiple reasons. For example, the standard practice at NNSA is to report a cost and schedule estimate in PARS that is at the top end of the range approved at the alternative selection milestone. As a result, we found that estimates in PARS did not take into account the views of the project team, current project performance, and any expected or realized risks or opportunities.

between design reviews, and we interviewed project officials to determine if these issues had any cost and schedule impacts.

To obtain and assess information on the maturity of a project's critical technologies, we first identified what projects were planning to use critical technologies. In general, the project office self-reports any critical technologies that it plans to use, along with the associated technology readiness level (TRL), in documentation provided to senior NNSA or DOE officials at the alternative selection or baseline approval milestone. We then reviewed relevant documentation, such as technology readiness assessments and technology maturation plans, and used the data collection instrument to corroborate this information. We focused our review on projects in the definition phase (that had not established cost and schedule baselines) because most key technology maturation activities occur in this phase. For projects that identified critical technologies and completed an assessment of TRLs, we compared the TRLs reported by these projects with DOE's technology maturity milestones, as described in its project management order.[7] We did not validate the independence of the technology readiness assessment review team (a requirement contained in DOE's project management order) or the resulting project assessments of TRLs, but we took steps to assess the reliability of the project office-supplied data and found them to be sufficiently reliable to report on the number of critical technologies and associated TRLs. For example, we compared data from NNSA project offices with relevant documentation and interviewed project officials.

In addition, to assess any challenges facing each project, we reviewed relevant documentation, such as project reviews, and included questions on key challenges—such as construction and procurement activities; status of design maturity and results of design reviews; and maturity of critical technologies—in the data collection instrument that we sent to each project office. We asked NNSA project officials to corroborate any challenges that we identified, and we also interviewed officials for each project to discuss the information on the data collection instrument and the project's status. Our project assessments also highlight key challenges that affected or could affect that project's performance. For this year's report, we generally identified challenges across the projects we reviewed in the categories of cost and schedule, design, and technology. These challenges do not represent an exhaustive or

[7]DOE Order 413.3B

exclusive list and are based on our definitions and assessments, not those of NNSA.

Report Objectives

To assess the performance of NNSA's portfolio of major projects that have cost and schedule baselines, we summarized the information we collected on cost and schedule performance for the major projects with project assessments and approved cost and schedule baselines. We also collected information on the cost and schedule performance for major projects with approved cost and schedule baselines that were completed during the course of our review. Specifically, for these projects, we obtained cost and schedule information from project completion memos signed by senior NNSA officials and corroborated this information with NNSA officials and project documents.

To assess the development and maturity of project designs and critical technologies for major projects that do not yet have cost and schedule baselines, we summarized the information we collected on design maturity, technology maturity, and any challenges related to these issues for the major projects with project assessments that had not reached the baseline approval milestone.

We conducted this performance audit from July 2020 to August 2023 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix III: Technology Readiness Levels

Table 8: Department of Energy Technology Readiness Levels (TRL)

TRL	Definition	Description
1	Basic principles observed and reported	Scientific research begins to be translated into applied research and development (R&D). Examples might include paper studies of a technology's basic properties or experimental work that consists mainly of observations of the physical world. Supporting information includes published research or other references that identify the principles that underlie the technology.
2	Technology concept or application formulated	Once basic principles are observed, practical applications can be invented. Applications are speculative, and there may be no proof or detailed analysis to support the assumptions. Examples are still limited to analytic studies. Supporting information includes publications or other references that outline the application being considered and that provide analysis to support the concept. The step up from TRL 1 to TRL 2 moves the ideas from pure to applied research. Most of the work is analytical or paper studies, with the emphasis on understanding the science better. Experimental work is designed to corroborate the basic scientific observations made during TRL 1 work.
3	Analytical and experimental critical function or characteristic proof of concept	Active R&D is initiated, including analytical studies and laboratory-scale studies to physically validate the analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative tested with simulants. Supporting information includes results of laboratory tests performed to measure parameters of interest and comparison with analytical predictions for critical subsystems. At TRL 3, the work has moved beyond the paper phase to experimental work that verifies that the concept works as expected on simulants. Components of the technology are validated, but there is no attempt to integrate the components into a complete system. Modeling and simulation may be used to complement physical experiments.
4	Component or system validation in laboratory environment	The basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared with the eventual system. Examples include integration of ad hoc hardware in a laboratory and testing with a range of simulants and small-scale tests on actual waste. Supporting information includes the results of the integrated experiments and estimates of how the experimental components and experimental test results differ from the expected system performance goals. TRLs 4-6 represent the bridge from scientific research to engineering. TRL 4 is the first step in determining whether the individual components will work together as a system. The laboratory system will probably be a mix of on-hand equipment and a few special purpose components that may require special handling, calibration, or alignment to get them to function.
5	Laboratory-scale, similar system validation in relevant environment	The basic technological components are integrated so that the system configuration is similar to (or matches) the final application in almost all respects. Examples include testing a high-fidelity, laboratory-scale system in a simulated environment with a range of simulants and actual waste. Supporting information includes results from the laboratory-scale testing, analysis of the differences between the laboratory and eventual operating system/environment, and analysis of what the experimental results mean for the eventual operating system/environment. The major difference between TRL 4 and 5 is the increase in the fidelity of the system and environment to the actual application. The system tested is almost prototypical.

TRL	Definition	Description
6	Engineering/pilot-scale, similar (prototypical) system validation in relevant environment	Engineering-scale models or prototypes are tested in a relevant environment. This represents a major step up in a technology's demonstrated readiness. Examples include testing an engineering-scale prototypical system with a range of simulants. Supporting information includes results from the engineering-scale testing and analysis of the differences between the engineering-scale, prototypical system/environment and analysis of what the experimental results mean for the eventual operating system/environment. TRL 6 begins true engineering development of the technology as an operational system. The major difference between TRLs 5 and 6 is the step up from laboratory scale to engineering scale and the determination of scaling factors that will enable design of the operating system. The prototype should be capable of performing all the functions that will be required of the operational system. The operating environment for the testing should closely represent the actual operating environment.
7	Full-scale, similar (prototypical) system demonstrated in relevant environment	This represents a major step up from TRL 6, requiring demonstration of an actual system prototype in a relevant environment. Examples include testing full-scale prototype in the field with a range of simulants in cold commissioning. Supporting information includes results from the full-scale testing and analysis of the differences between the test environment, and analysis of what the experimental results mean for the eventual operating system/environment. Final design is virtually complete.
8	Actual system completed and qualified through test and demonstration	The technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental testing and evaluation of the system with actual waste in hot commissioning. Supporting information includes operational procedures that are virtually complete. An operational readiness review has been successfully completed prior to the start of hot testing.
9	Actual system operated over the full range of expected mission conditions	The technology is in its final form and operated under the full range of operating mission conditions. Examples include using the actual system with the full range of wastes in hot operations.

Source: Department of Energy | GAO-23-104402

Appendix IV: Estimated Costs and Schedules for the National Nuclear Security Administration's Major Projects Assessed by GAO

In this report, we assessed 28 National Nuclear Security Administration (NNSA) major projects. In this appendix we present cost and schedule information in three tables that reflect the status of the 28 major projects were at the conclusion of our review in March 2023. Table 9 shows the preliminary cost and schedule estimates for projects in the definition phase—which begins when NNSA approves the alternative selection milestone (critical decision 1) and ends when NNSA approves the baseline approval and construction start milestone (critical decisions 2 and 3). Specifically, table 9 shows the preliminary estimates that NNSA approved at the alternative selection milestone, along with NNSA's current estimates (as of March 2023).

Table 9: Preliminary Cost and Schedule Estimates for NNSA's Major Projects in the Definition Phase, as of March 2023

Project (site)	Preliminary cost estimate at alternative selection (dollars in millions)	Current preliminary cost estimate (dollars in millions)	Preliminary completion date at alternative selection	Current preliminary completion date
Los Alamos National Laboratory				
Chemistry and Metallurgy Research Replacement (CMRR) Plutonium Facility-4 (PF-4) Equipment Installation, Phase 2	523-685	To be determined	December 2024	To be determined
CMRR Re-Categorizing Radiological Laboratory and Utility Office Building to Hazard Category 3	208-365	To be determined	December 2024	To be determined
Los Alamos Plutonium Pit Production Project (LAP4) 30 Reliable Equipment Installation	500-760	760-1,936	April 2028-June 2028	March 2032
LAP4 Training and Development Center	350-450	450-650	October 2026- September 2028	September 2030
LAP4 West Entry Control Facility	90-130	130-220	January 2027- March 2027	September 2028
Pantex Plant				
High Explosives Synthesis Formulation and Production Facility[a]	505-699	To be determined	July 2030- September 2030	To be determined
Savannah River Site				
Savannah River Plutonium Processing Facility	6,900-11,100	To be determined	October 2031- September 2035	To be determined
Surplus Plutonium Disposition	448-620	$775	January 2026- March 2028	September 2030

Project (site)	Preliminary cost estimate at alternative selection (dollars in millions)	Current preliminary cost estimate (dollars in millions)	Preliminary completion date at alternative selection	Current preliminary completion date
Tritium Finishing Facility[b]	305-640	To be determined	July 2029- September 2031	To be determined
Y-12 National Security Complex				
Lithium Processing Facility	955-1,645	$1,425	July 2031- September 2031	September 2031

Source: GAO analysis of National Nuclear Security Administration (NNSA) data. | GAO-23-104402

Note: GAO defines major projects as those with a total estimated cost greater than $100 million.

[a]NNSA did not request funding for this project for fiscal year 2024, does not expect to request funding through fiscal year 2027, and directed the site contractor to pause most project activity by April 2023.

[b]NNSA did not request funding for this project for fiscal year 2024, does not expect to request funding through fiscal year 2026, and directed the site contractor to pause most project activity in a March 2023 letter.

Table 10 shows the cost and schedule baselines for projects in the execution phase—which begins when NNSA approves the baseline approval and construction start milestone (critical decisions 2 and 3) and ends when NNSA approves the project completion milestone (critical decision 4). Specifically, table 10 shows the cost and schedule baselines that NNSA approved, along with NNSA's current cost and schedule estimates (as of March 2023).

Table 10: Cost and Schedule Estimates for NNSA's Major Projects in the Execution Phase, as of March 2023

Project (site)	Baseline cost estimate (dollars in millions)	Current cost estimate (dollars in millions)	Baseline completion date	Current completion date
Los Alamos National Laboratory				
Los Alamos Plutonium Pit Production Project (LAP4) 30 Base Equipment Installation	1,864	1,864[a]	August 2030	August 2030[a]
LAP4 Decontamination and Decommission	$529	529	March 2027	October 2026
Technical Area-55 Reinvestment Project, Phase III	236	260	June 2027	February 2027
Transuranic Liquid Waste Facility	215	215	August 2027	August 2027
Nevada National Security Site				
Enhanced Capabilities for Subcritical Experiments (ECSE) Advanced Sources and Detectors Major Item of Equipment	1,800	1,800[b]	May 2030	May 2030[b]

Project (site)	Baseline cost estimate (dollars in millions)	Current cost estimate (dollars in millions)	Baseline completion date	Current completion date
ECSE Laboratory and Support Infrastructure	560	560	December 2026	December 2026
Pantex Plant				
High Explosives Science & Engineering Facility	228	278[c]	November 2027	November 2027[c]
Y-12 National Security Complex				
Calciner Project	108	150	September 2023	June 2026
Electrorefining Project	101	115[d]	February 2023	April 2024[d]
Uranium Processing Facility (UPF) Main Process Building	4,732	6,304[c]	December 2025	February 2029[c]
UPF Process Support Facilities	140	194	December 2025	December 2026
UPF Salvage and Accountability Building	1,180	1,717[c]	December 2025	February 2029[c]
West End Protected Area Reduction Project	160	197[c]	July 2025	October 2025[c]

Source: GAO analysis of National Nuclear Security Administration (NNSA) data. | GAO-23-104402

Note: GAO defines major projects as those with a total estimated cost greater than $100 million. The baseline cost estimate and baseline completion date estimates refer to the original baseline estimates that NNSA approved at a project's baseline approval and construction start milestone.

[a]NNSA approved this project's cost and schedule baselines in January 2023 and expected to start reporting performance data in April 2023.

[b]NNSA approved this project's cost and schedule baselines in November 2022 and expected to start reporting performance data in April 2023.

[c]These estimates are under review by NNSA management and are subject to revision under NNSA's baseline change approval process.

[d]In May 2023, NNSA approved a revised baseline that reflected an additional cost increase ($1 million) and schedule delay (1 month) to what is listed in this table.

Finally, table 11 shows the costs and schedules for projects that reached the project completion milestone (critical decision 4) during the course of our review. Specifically, table 11 shows the cost and schedule baselines that NNSA approved at baseline approval and construction start milestone (critical decisions 2 and 3), along with the final cost and schedule estimates confirmed by NNSA at the project completion milestone.

Table 11: Cost and Schedule for NNSA's Recently Completed Major Projects

Project (site)	Baseline cost estimate (dollars in millions)	Cost (dollars in millions)	Baseline completion date	Completion date
Chemistry and Metallurgy Research Replacement (CMRR) Plutonium Facility-4 (PF-4) Equipment Installation, Phase 1 (Los Alamos National Laboratory)	394	284	April 2022	January 2021
CMRR Radiological Laboratory and Utility Office Building Equipment Installation, Phase 2 (Los Alamos National Laboratory)	633	509	January 2022	December 2021
Exascale Computing Facility Modernization Project (Lawrence Livermore National Laboratory)	111	102	March 2023	May 2022
NNSA Albuquerque Complex Project, Phase II (Kirtland Air Force Base)	175	169	June 2022	July 2022
Uranium Processing Facility (UPF) Mechanical Electrical Building (Y-12 National Security Complex)	284	309	January 2022	July 2022

Source: GAO analysis of National Nuclear Security Administration (NNSA) data. | GAO-23-104402

Note: These projects were completed between January 2021 and July 2022, which was during the course of our review.

Appendix V: Design Costs and Schedules for the National Nuclear Security Administration's Major Projects Assessed by GAO

In this report, we assessed 28 National Nuclear Security Administration (NNSA) major projects. Table 12 shows preliminary estimates of the time to complete design activities and the associated cost (both in millions of dollars and percentage of total project cost) for projects in the definition phase—which begins when NNSA approves the alternative selection milestone (critical decision 1) and ends when NNSA approves the baseline approval and construction start milestone (critical decisions 2 and 3).

Table 12: Preliminary Cost and Schedule Estimates for Design of NNSA's Major Projects in the Definition Phase, as of March 2023

Project (site)	Time to complete design (in years)[a]	Design cost (dollars in millions)	Design cost as percentage of project cost[b]
Los Alamos National Laboratory			
Chemistry and Metallurgy Research Replacement (CMRR) Plutonium Facility-4 Equipment Installation, Phase 2[c]	To be determined	To be determined	To be determined
CMRR Re-Categorizing Radiological Laboratory and Utility Office Building to Hazard Category 3[c]	To be determined	To be determined	To be determined
Los Alamos Plutonium Pit Production Project (LAP4) 30 Reliable Equipment Installation	8	269	14 – 35
LAP4 Training and Development Center	10	84	13 – 19
LAP4 West Entry Control Facility	8	20	15 – 22
Pantex Plant			
High Explosives Synthesis Formulation and Production Facility[d]	To be determined	To be determined	To be determined
Savannah River Site			
Savannah River Plutonium Processing Facility[e]	To be determined	To be determined	To be determined
Surplus Plutonium Disposition	7[f]	184	24
Tritium Finishing Facility[g]	To be determined	To be determined	To be determined
Y-12 National Security Complex			
Lithium Processing Facility	10	388	27

Source: GAO analysis of National Nuclear Security Administration (NNSA) data. | GAO-23-104402

Note: GAO defines major projects as those with a total estimated cost greater than $100 million.

[a]The estimated time to complete design is based on the duration between the mission need milestone (critical decision 0) and completion of the final design.

[b]Design costs are presented either as a point estimate or a range, depending on how NNSA approved the preliminary estimate of total project costs at the alternative selection milestone.

[c]The CMRR portfolio was established in 2004 but has evolved significantly over its history. NNSA first defined the scope of CMRR Plutonium Facility-4 Equipment Installation, Phase 2 and CMRR Radiological Laboratory and Utility Office Building to Hazard Category 3 projects in its fiscal year 2017 budget justification and completed a significant replan of both projects in February 2022. However, as of March 2023, NNSA is in the very early stages of replanning both projects due to recently identified cost concerns. NNSA directed the site contractor to review the scope of the two

projects and prepare options that could be completed within the 2015 approved cost ranges. In March 2023, NNSA officials said that they held an initial replanning workshop with the site contractor but that the agency does not have a general time frame for completing its scope review.

[d]In March 2023, NNSA proposed placing this project on hold for several fiscal years. NNSA directed the contractor to finalize the design prior to placing the project on hold.

[e]As of March 2023, NNSA was in the early stages of updating the project's preliminary cost and schedule estimates. NNSA's fiscal year 2024 budget justification states that the project's cost may increase by up to 40 percent and that the schedule could be delayed up to 3 years, compared with the estimates approved at the alternative selection milestone. In June 2023, the site contractor plans to submit to NNSA a revised cost and schedule estimate, and NNSA plans to complete its review of the revised estimate by August 2023.

[f]The Surplus Plutonium Disposition project started in 1997, but NNSA identified the current alternative, called dilute and dispose, in 2014. NNSA approved this alternative in 2017, and a 2018 conceptual plan identified that the dilute and dispose approach would cost less than half that of the previous approach. For the current alternative, NNSA estimates that the overall design will be completed in 2024.

[g]In March 2023, NNSA proposed placing this project on hold for several fiscal years. As a result, the project will complete its conceptual design, and the cost and duration of the design will be determined upon project restart.

Table 13 shows the time taken to complete design activities and the associated cost (both in millions of dollars and percentage of estimated total project cost, as of March 2023) for projects in the execution phase—which begins when NNSA approves the baseline approval and construction start milestone (critical decisions 2 and 3) and ends when NNSA approves the project completion milestone (critical decision 4).

Table 13: Cost and Schedule for Design of NNSA's Major Projects in the Execution Phase, as of March 2023

Project (site)	Time to complete design (in years)[a]	Design cost (dollars in millions)	Design cost as percentage of project cost
Los Alamos National Laboratory			
Los Alamos Plutonium Pit Production Project (LAP4) Decontamination and Decommission	8	31	6
LAP4 30 Base Equipment Installation	7	272	15
Technical Area-55 Reinvestment Project, Phase II	16	30	11
Transuranic Liquid Waste Facility	17	46	22
Nevada National Security Site			
Enhanced Capabilities for Subcritical Experiments (ECSE) Advanced Sources and Detectors Major Item of Equipment	8	Data not available[b]	Data not available[b]
ECSE Laboratory and Support Infrastructure	8	101	18
Pantex Plant			
High Explosives Science & Engineering Facility	9	20	7
Y-12 National Security Complex			
Calciner Project	5	13	9

Project (site)	Time to complete design (in years)[a]	Design cost (dollars in millions)	Design cost as percentage of project cost
Electrorefining Project	4	7	6
Uranium Processing Facility (UPF) Main Process Building	13	1,903[c]	22[c]
UPF Process Support Facilities	13	Data not available[c]	Data not available[c]
UPF Salvage and Accountability Building	13	Data not available[c]	Data not available[c]
West End Protected Area Reduction Project	3	13	7

Source: GAO analysis of National Nuclear Security Administration (NNSA) data. | GAO-23-1040402

Note: GAO defines major projects as those with a total estimated cost greater than $100 million.

[a]The time to complete design is based on the duration between the mission need milestone (critical decision 0) and completion of the final design.

[b]NNSA did not provide us with data on this project.

[c]NNSA accounted for the design costs for all UPF-related projects under the UPF Main Process Building project.

Table 14 shows the time to complete design activities and the associated cost (both in millions of dollars and percentage of total project cost) for projects that reached the project completion milestone (critical decision 4) during the course of our review.

Table 14: Cost and Schedule for Design of NNSA's Major Projects Completed between January 2021 and March 2023

Project (site)	Time to complete design (in years)[a]	Design cost (dollars in millions)	Design cost as percentage of project cost
Los Alamos National Laboratory			
Chemistry and Metallurgy Research Replacement (CMRR) Plutonium Facility-4 Equipment Installation, Phase 1	15	34	12
CMRR Radiological Laboratory Utility Office Building Equipment Installation, Phase 2	14	49	10
Kirtland Air Force Base			
NNSA Albuquerque Complex Project, Phase II	7	13	7
Lawrence Livermore National Laboratory			
Exascale Computing Facility Modernization	2	6	6
Y-12 National Security Complex			
Uranium Processing Facility (UPF) Mechanical Electrical Building	13	Data not available[b]	Data not available[b]

Source: GAO analysis of National Nuclear Security Administration (NNSA) data. | GAO-23-104402

Note: Data for this table were updated as of March 2023.

[a]The time to complete design is based on the duration between the mission need milestone (critical decision 0) and completion of the final design.

[b]NNSA accounted for the design costs for all UPF-related projects under the UPF Main Process Building project.

Appendix VI: GAO Contacts and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

In addition to the contact named above, Jason Holliday (Assistant Director), Patrick Bernard (Analyst in Charge), Matthew Bond, Antoinette Capaccio, John Delicath, Mick Ray, and Sara Sullivan made key contributions to this report. Also contributing to this report were Pamela Davidson, Anne McDonough, and John Ortiz.

Appendix VII: Additional Source Information for Images and Figures

This appendix contains credit, copyright, and other source information for images, tables, or figures in this product when that information was not listed adjacent to the image, table, or figure.

Appendix I:

Department of Energy/National Nuclear Security Administration (logos for Los Alamos National Laboratory, Nevada National Security Site, Pantex Plant, Savannah River Site, and Y12 National Security Complex).

GAO analysis of NNSA documents (all timeline figures).

GAO analysis of NNSA data (all preliminary cost figures and cost performance figures).

GAO analysis of NNSA data (all preliminary schedule figures and schedule performance figures).

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