



November 2020

# NUCLEAR WASTE DISPOSAL

## Better Planning Needed to Avoid Potential Disruptions at Waste Isolation Pilot Plant

# GAO Highlights

Highlights of [GAO-21-48](#), a report to congressional committees

## Why GAO Did This Study

DOE's WIPP is the nation's only deep geologic repository for the disposal of defense-related nuclear waste. DOE suspended operations at WIPP after two accidents in 2014 and resumed on a limited scale in 2017. DOE has initiated two projects to improve WIPP's underground ventilation system and allow full disposal operations to resume. However, DOE estimates WIPP's existing physical space will be full around 2025, and DOE faces a statutory limitation on how much waste can be disposed of at WIPP.

Senate Report No. 115-125 accompanying a bill for the National Defense Authorization Act for Fiscal Year 2018 includes a provision for GAO to review DOE's actions to bring WIPP towards full operational status. This report examines DOE's (1) plans to meet needs for physical space at WIPP without exceeding WIPP's statutory capacity, (2) challenges to completing key ventilation projects, and (3) plans for adding physical space at WIPP without interruption to operations.

GAO reviewed DOE documents for project designs, compared schedules to best practices, and interviewed DOE officials at the Carlsbad Field Office.

## What GAO Recommends

GAO is making three recommendations, including that DOE analyze options to address staffing vacancies and improve its schedule for adding physical space at WIPP. DOE agreed with all three recommendations.

View [GAO-21-48](#). For more information, contact Allison B. Bawden at (202) 512-3841 or [bawdena@gao.gov](mailto:bawdena@gao.gov).

November 2020

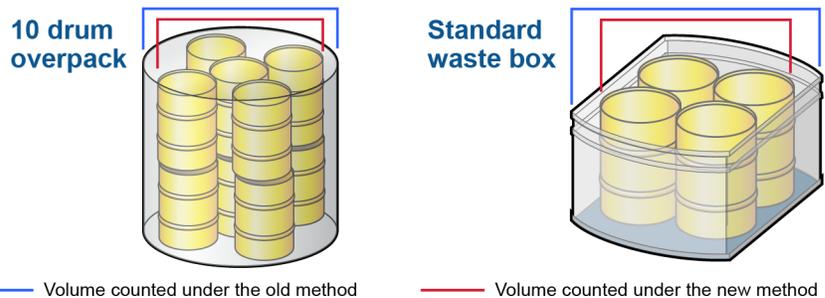
## NUCLEAR WASTE DISPOSAL

### Better Planning Needed to Avoid Potential Disruptions at Waste Isolation Pilot Plant

## What GAO Found

The Department of Energy's (DOE) plans for the Waste Isolation Pilot Plant (WIPP) may ensure sufficient statutory capacity and physical space to meet its disposal needs for the defense-related transuranic (TRU) waste in its current inventory. To reduce the volumes counted against the statutory limit, DOE implemented a new counting method that excludes some of the air space found in certain waste packages (see fig.). The new method has been approved by the New Mexico state regulator. However, DOE may not have sufficient statutory capacity and physical space to meet future TRU waste disposal needs at WIPP if significant volumes of TRU waste are added to DOE's TRU waste inventory, as anticipated, or if the new counting method is successfully challenged in court.

#### Old and New Volume Counting Methods for Certain Waste Containers Disposed of in the Waste Isolation Pilot Plant



Source: GAO presentation of Department of Energy information. | GAO-21-48

DOE officials identified two challenges to completing key ventilation projects needed to return WIPP to full disposal operations: (1) overseeing contractors executing the projects and (2) obtaining regulatory approvals. According to the workforce plan for DOE's Carlsbad Field Office, it may not have sufficient staff to address these challenges. The Carlsbad Field Office is responsible for project oversight, among other things, and 27 of the office's 76 total positions were either vacant or occupied by acting officials as of January 2020. DOE has taken some steps to address these staffing shortages; however, DOE has not fully analyzed options to address the vacancy issue. By doing so, DOE will be in a better position to address the challenges it has identified to effectively completing the projects at WIPP.

DOE does not have assurance that WIPP's planned additional physical space will be constructed before existing space is full, which would result in a potential interruption to disposal operations. GAO assessed DOE's Integrated Master Schedule—which includes DOE's estimate for completing some of WIPP's additional physical space—against best practices for schedule estimating. GAO found that the schedule did not substantially meet all four characteristics of a reliable schedule; to be considered reliable, a schedule must at least substantially meet all four. By improving the schedule, DOE will have greater assurance in the reliability of its estimate for completing additional physical space before existing space is full, thereby avoiding interruptions to disposal operations.

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## Abbreviations

CBFO	Carlsbad Field Office
COVID-19	Coronavirus Disease 2019
DOE	Department of Energy
EPA	Environmental Protection Agency
HEPA	high efficiency particulate air
M <sup>3</sup>	cubic meters
NEPA	National Environmental Policy Act of 1969
NMED	New Mexico Environment Department
NNSA	National Nuclear Security Administration
NQA-1	Nuclear Quality Assurance-1
SSCVS	Safety Significant Confinement Ventilation System
TRU	transuranic
WIPP	Waste Isolation Pilot Plant

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November 19, 2020

Congressional Committees

The United States has only one deep geologic repository for the disposal of nuclear waste. The Waste Isolation Pilot Plant (WIPP), near Carlsbad, New Mexico, is designed to safely dispose of a specific type of defense-related nuclear waste, referred to as transuranic (TRU) waste, generated by the Department of Energy's (DOE) nuclear weapons research and production and cleanup activities at sites across the country.<sup>1</sup> The TRU waste is disposed of in underground "panels," made up of rooms, that are mined out of an ancient salt formation more than 2,000 feet below the earth's surface. In February 2014, two accidents occurred in the underground area, one of which involved the release of radiological material that contaminated portions of the facility. As a result, DOE was forced to halt waste disposal operations while it worked to recover from the accidents.

In January 2017, DOE resumed waste disposal operations at WIPP. However, DOE has been limited to disposing of no more than 10 shipments of TRU waste per week at WIPP due to airflow issues resulting from the 2014 accidents. According to DOE officials, under full disposal operations, DOE is able to dispose of approximately 17 shipments per week at WIPP. We reported in 2017 that having a reduced number of or interruption to shipments to WIPP could impair DOE's ability to meet its cleanup and national security missions, as well as meet regulatory cleanup milestones agreed to with states that host DOE sites.<sup>2</sup>

Because of the radiological contamination resulting from one of the February 2014 accidents, DOE needs to filter the air before it is

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<sup>1</sup>"Transuranic" is used to describe elements that have atomic numbers greater than that of uranium. Transuranic waste is defined in the Waste Isolation Pilot Plant Land Withdrawal Act as waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for (A) high-level radioactive waste; (B) waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the Environmental Protection Agency, does not need the degree of isolation required by the disposal regulations; or (C) waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with part 61 of title 10, Code of Federal Regulations. Pub L. No. 102-579, § 2(20), 106 Stat. 4777, 4779 (1992).

<sup>2</sup>GAO, *Proposed Dilute and Dispose Approach Highlights Need for More Work at the Waste Isolation Pilot Plant*, [GAO-17-390](#) (Washington, D.C.: September 2017).

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exhausted from WIPP's underground area. This filtration significantly reduces the volume of air that flows through the area. The reduced airflow reduces the air quality in the underground area, which limits the number of people that can be in the underground area. It also limits the activities that can be conducted there, such as mine maintenance using diesel-powered equipment, since these activities create fumes and dust that need to be removed.

To address these airflow issues and enable WIPP to increase the number of shipments of waste it can dispose of each week, DOE has initiated two capital asset projects—the Safety Significant Confinement Ventilation System (SSCVS) and the Utility Shaft—that together will act as an entirely new ventilation system. According to officials from DOE's Carlsbad Field Office (CBFO), which is responsible for the management and oversight of WIPP operations, the new system will allow sufficient airflow for simultaneous mining, maintenance, and disposal operations in the underground area while providing the ability to exhaust air containing salt dust from mining operations without filtration.<sup>3</sup> However, DOE has faced challenges in completing recent projects at WIPP within their cost and schedule estimates. For example, as we reported in August 2016, DOE's project to resume waste disposal operations at WIPP after the 2014 accidents was delayed nearly 9 months and experienced \$64 million in cost increases after facing challenges, such as delays in acquiring ventilation components from contractors.<sup>4</sup>

In addition to the operational challenges at WIPP, there are statutory and physical limitations on the amount of TRU waste that can be disposed of at the site. The Waste Isolation Pilot Plant Land Withdrawal Act (hereafter referred to as the WIPP Land Withdrawal Act) established a statutory capacity for WIPP of 175,565 cubic meters (m<sup>3</sup>), meaning that by law,

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<sup>3</sup>According to DOE officials, they want to develop the capability to exhaust air containing salt dust without filtration because it reduces wear and tear on the air filtration systems. DOE officials told us that current plans call for exhausting air without filtration only after the portions of the WIPP underground area that were contaminated in the 2014 accidents are closed and no longer connected to the ventilation system. Officials also said that once this portion of the facility is closed off, air exhausted without filtration is not likely to have the potential to release radiological contaminants.

<sup>4</sup>GAO, *Waste Isolation Pilot Plant Recovery Demonstrates Cost and Schedule Requirements Needed for DOE Cleanup Operations*, [GAO-16-608](#) (Washington, D.C.: August 2016).

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WIPP can only accept up to this amount of TRU waste.<sup>5</sup> We found in September 2017 that WIPP's statutory capacity would likely be exceeded if DOE included additional waste streams that were identified but were not accounted for in its inventory, such as the TRU waste from the National Nuclear Security Administration's (NNSA) Surplus Plutonium Disposition Program.<sup>6</sup> Specifically, we found that including the waste from this program's new dilute and dispose approach in DOE's TRU waste inventory would result in the inventory exceeding WIPP's statutory capacity by approximately 11,000 m<sup>3</sup>.<sup>7</sup> We reported that DOE developed a proposal to change the method for counting TRU waste to address the statutory capacity issue. In December 2018, the New Mexico Environment Department (NMED) approved a permit modification that changed how the volume of TRU waste disposed of at WIPP was calculated.<sup>8</sup>

In 1998, the Environmental Protection Agency (EPA) certified that DOE demonstrated that WIPP, including construction of 10 panels, would comply with EPA's radioactive waste disposal regulations (hereafter, referred to as disposal regulations). As of January 2020, DOE had filled most of the space in seven of the panels, while construction on an eighth panel is expected to be completed in 2021. DOE no longer intends to dispose of TRU waste in the final two panels included in EPA's original certification because of safety issues resulting from the two accidents that

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<sup>5</sup>Pub. L. No. 102-579, § 7(a)(3), 106 Stat. 4777, 4785 (1992).. The act limits WIPP's capacity to 6.2 million cubic feet, which is 175,565 m<sup>3</sup>, of TRU waste. For purposes of consistency, in this report we express all volumes in cubic meters.

<sup>6</sup>DOE's annual TRU waste inventory report is intended to keep track of the TRU waste disposed of at WIPP and to estimate the volumes of TRU waste planned for disposal at WIPP until the facility's closure. DOE officials at WIPP send guidance annually to all DOE sites that generate TRU waste on how each site should develop an updated estimate of the amount of TRU waste it has stored at the site and the amount it anticipates will be generated in the future. TRU waste that has been identified but is not yet planned for disposal at WIPP is not included in DOE's inventory. [GAO-17-390](#).

<sup>7</sup>DOE established the Surplus Plutonium Disposition Program in 1997 to dispose of surplus, weapons-usable plutonium remaining at the end of the Cold War. In 2014, after encountering cost increases in its program to dispose of surplus plutonium by converting it into mixed oxide fuel for use in nuclear reactors, NNSA proposed an alternative disposition approach referred to as dilute and dispose. In this new approach, NNSA would dilute plutonium oxide using an inert material and then dispose of it as TRU waste in WIPP.

<sup>8</sup>As discussed below, this permit modification was challenged in court. As of November 3, 2020, this lawsuit was still pending.

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occurred in 2014.<sup>9</sup> According to DOE estimates, the eighth panel will be full by approximately 2025. However, DOE officials estimate that WIPP will not have reached its statutory capacity at this point, and DOE's current planning assumes WIPP will remain open to accept TRU waste until at least 2050.<sup>10</sup>

To construct the physical space needed to dispose of TRU waste beyond 2025 and up to WIPP's statutory capacity, DOE would first need to develop a design for this capacity. We reported in 2017 that because this design would differ significantly from the original design that was approved in prior certifications, EPA would need to certify that the additional physical space complies with EPA's disposal regulations.<sup>11</sup> NMED would also need to approve a modification to WIPP's Hazardous Waste Facility Permit for DOE to construct and dispose of waste in the additional physical space at WIPP.

DOE began the formal planning process for additional physical space in January 2018 and is conducting the required National Environmental Policy Act of 1969 (NEPA) analysis.<sup>12</sup> DOE officials told us that this analysis is estimated to be complete in February 2021. In its draft *Carlsbad Field Office Strategic Plan 2019-2024*, DOE explained that the objective for the design of the additional physical space at WIPP was to

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<sup>9</sup>Prior to the 2014 accidents, DOE had plans for disposing of TRU waste in the hallways between the eight panels once the panels themselves were full. The hallways that were considered for waste disposal were divided into two areas that were labeled panels 9 and 10. According to DOE officials, as a result of the accidents, they no longer plan to dispose of TRU waste in these hallways, in part because DOE could not conduct sufficient maintenance while operations were suspended after the accidents.

<sup>10</sup>DOE's estimates for filling the available disposal space at WIPP were based on shipping and disposal schedules as of January 2020. According to DOE officials, the rate at which TRU waste is being shipped to and disposed of at WIPP was reduced in March 2020 in response to the Coronavirus Disease 2019 (COVID-19) pandemic, and it is unclear what the full impact of the pandemic will be on future shipping and disposal rates. Furthermore, while DOE officials state that their plans assume that WIPP will accept TRU waste until at least 2050, a draft permit renewal document submitted to NMED in March 2020 stated that DOE planned to continue to operate WIPP until the facility had reached its statutory capacity.

<sup>11</sup>[GAO-17-390](#).

<sup>12</sup>NEPA requires federal agencies to evaluate the likely environmental effects of proposed projects using an environmental assessment or, if the projects likely would significantly affect the environment, a more detailed environmental impact statement evaluating the proposed project and alternatives.

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construct a sufficient number of additional panels to dispose of TRU waste in WIPP up to the facility's statutory capacity.<sup>13</sup>

The Senate Armed Services Committee report accompanying a bill for the National Defense Authorization Act for Fiscal Year 2018 included a provision for us to review DOE's actions taken toward bringing WIPP toward full operational status.<sup>14</sup> This report examines (1) the extent to which DOE's long-term plans for meeting its TRU waste disposal needs include sufficient physical space at WIPP without exceeding the facility's statutory capacity, (2) the challenges DOE has identified to completing the capital asset projects needed to return WIPP to full disposal operations, and (3) the extent to which DOE's plans for adding physical space at WIPP provide assurance that this additional capacity will be completed without an interruption to waste disposal operations.

To address all three objectives, we conducted a site visit to WIPP in June 2019. During the site visit, we obtained documentation and interviewed officials from DOE's CBFO, which manages and oversees WIPP operations under DOE's Office of Environmental Management.

To examine the extent to which DOE's long-term plans for meeting its TRU waste disposal needs include sufficient physical space at WIPP without exceeding the facility's statutory capacity, we reviewed DOE documentation and data on the proposed modification to WIPP's permit to determine how TRU waste volumes would be measured, recorded, and reported under the revised counting method. To assess the impact of the revised counting method on current and projected TRU waste totals, we reviewed data collected for the fiscal year 2018 DOE TRU Waste Inventory Report from DOE's Comprehensive Inventory Database and Waste Data System on the volume and quantities of TRU waste containers already disposed of and expected to be disposed of in the future at WIPP.<sup>15</sup> We assessed the reliability of the data used to develop this report and found it was reliable for the purpose of reporting on the

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<sup>13</sup>Department of Energy, *Carlsbad Field Office Strategic Plan 2019-2024*, DOE/CBFO-19-3605, Revision 0.1, Final Draft for Stakeholder Input (August 2019).

<sup>14</sup>S. Rep. No. 115-125, at 349 (2017).

<sup>15</sup>Information on the volume and quantities of TRU waste containers expected to be disposed of in WIPP are based on waste estimates reported by DOE TRU waste generator sites as of December 31, 2017. These sites were asked to report the most comprehensive TRU inventory estimate available projected through calendar year 2050 and additional estimates beyond 2050, if available.

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change to the volume counting method and determining whether DOE has sufficient statutory capacity for its inventory of TRU waste. We also reviewed DOE documentation on the design and development of the additional physical space at WIPP. We interviewed officials from Sandia National Laboratory's Carlsbad Office regarding their involvement in the design of the additional physical space.<sup>16</sup> In addition, we interviewed officials from DOE's CBFO about the status of DOE's planning and interviewed officials from NMED and EPA regarding their oversight of DOE's efforts to address the statutory capacity and physical space issues at WIPP.

To examine challenges DOE has identified to completing the capital asset projects needed to return WIPP to full disposal operations, we reviewed DOE cost and schedule documents for the two capital asset projects to identify the scope, cost, and schedule estimates. We interviewed DOE officials responsible for managing and overseeing the projects and reviewed project planning documents to understand what the primary challenges to completing each project on time and within budget were and to determine whether sufficient risk mitigation strategies had been identified. We also reviewed documents from other organizations that had identified challenges at WIPP, such as the National Academies of Science and the Defense Nuclear Facilities Safety Board, to determine whether the challenges they identified would impact work on the capital asset projects. To understand how DOE defines full disposal operations, we reviewed information on the quantity of weekly TRU waste shipments to WIPP and interviewed CBFO officials about how they defined limited and full disposal operations. We reviewed DOE's *CBFO 2019 Workforce Analysis and 5-Year Workforce Plan (2020-2024)* to identify staffing trends, whether DOE considers current staffing levels to be sufficient to support the multiple ongoing activities at WIPP, and what strategies DOE is suggesting for addressing workforce gaps at CBFO. Because the workforce plan identified staffing gaps at CBFO, we also reviewed the plan to identify whether DOE had developed hiring strategies, including the use of flexibilities and other human capital strategies and tools, and considered how it could use these strategies to eliminate gaps. We reported in 2003 that developing such a hiring strategy was a key

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<sup>16</sup>Sandia's Carlsbad Office provides certain scientific expertise to DOE's CBFO, most notably by developing the performance assessments that demonstrate to EPA that WIPP's long-term performance remains in compliance with applicable regulations.

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principle for effective strategic workforce planning.<sup>17</sup> In addition, we interviewed DOE officials to determine whether DOE has consistently filled key positions at CBFO, what efforts DOE has made to fill vacant positions, and any future plans they have to address staffing challenges.

To examine the extent to which DOE's plans for adding physical space at WIPP provide assurance that this additional capacity will be completed without an interruption to waste disposal operations, we conducted an assessment of WIPP's Integrated Master Schedule—which integrates the schedule estimates for the capital asset projects, the plans for adding physical space, and ongoing WIPP operations—to determine whether it meets the best practices found in GAO's *Schedule Assessment Guide*.<sup>18</sup> Additionally, we reviewed DOE documentation on the schedule risks that it had identified and any mitigation plans that it had developed to respond to those risks. We also interviewed officials from NMED and EPA to obtain their views on the viability of DOE's schedule for completing additional physical space.

We conducted this performance audit from April 2019 to November 2020 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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## Background

### WIPP's Regulatory Oversight Structure

EPA and NMED both play a role in regulating WIPP. Specifically, EPA regulates the radiological safety of WIPP. As required by the WIPP Land Withdrawal Act, EPA issued final regulations regarding the disposal of TRU waste; these regulations apply to WIPP.<sup>19</sup> The WIPP Land Withdrawal Act also required EPA to certify that WIPP will comply with these disposal regulations and to issue criteria for certifying DOE's compliance with the disposal regulations. EPA issued this criteria as

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<sup>17</sup>GAO, *Human Capital: Key Principles for Effective Strategic Workforce Planning*, [GAO-04-39](#) (Washington, D.C.: Dec. 11, 2003).

<sup>18</sup>GAO, *GAO Schedule Assessment Guide: Best Practices for Project Schedules*, [GAO-16-89G](#) (Washington, D.C.: December 2015).

<sup>19</sup>40 C.F.R. pt. 191, subpts. B,C. The regulations EPA issued also apply to the disposal of spent nuclear fuel and high-level radioactive waste.

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regulations in 1996 and certified WIPP's compliance in 1998. The act also requires EPA to recertify WIPP's compliance with the disposal regulations every 5 years. To support the recertification, DOE prepares a performance assessment, which uses mathematical models and computer calculations to assess cumulative releases of radioactive isotopes under specified scenarios relative to release limits established by EPA. DOE submitted the fourth Compliance Recertification Application for WIPP to EPA in March 2019; EPA is currently reviewing this application and anticipates completing its review by late 2020 or early 2021.

If DOE needs to make changes to activities or conditions at WIPP that differ significantly from the most recent certification, DOE must notify EPA of its intent to make the change.<sup>20</sup> EPA then evaluates the proposed change and makes a determination about whether it differs significantly from what was approved in WIPP's most recent recertification and therefore requires approval. According to EPA officials, there are no defined criteria for "significant" changes, though generally a change is considered to be significant if it affects the design or long-term performance of the facility. According to EPA officials, significant proposed changes may require extensive review, a recalculation of the performance assessment, and—in some cases—a federal rulemaking process that includes public comment.<sup>21</sup> EPA officials told us that for less significant changes, EPA can indicate its approval in an official memo to DOE but may also choose to seek public comment on the change.

NMED has regulatory authority over WIPP because EPA has authorized New Mexico to administer its own hazardous waste management program under the Resource Conservation and Recovery Act instead of the federal program managed by EPA. Pursuant to this authorization, NMED issues the hazardous waste storage and disposal permit for WIPP under the New Mexico Hazardous Waste Act and state regulations. DOE must obtain approval from NMED for any modifications to the WIPP

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<sup>20</sup>40 C.F.R. § 194.4(b)(3)(i). In June 2002, EPA sent a letter to DOE stating that DOE did not need to notify EPA about activities that are part of routine operations and maintenance at WIPP apart from the annual change report required by regulation. The memorandum included examples of routine operations and maintenance, such as periodic roof maintenance and installation of ground control monitoring devices.

<sup>21</sup>According to EPA officials, DOE submits "planned change notifications" for changes it does not consider significant, and "planned change requests" for changes it considers significant. However, these are DOE terms and are not in EPA regulation. EPA makes the final determination of whether a change is significant.

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permit. There are three classes of permit modifications (classes 1, 2, and 3) that vary in terms of the process for review and the amount of supporting documentation required. The type of permit modification required depends on the type of change DOE requests to the permit. In general, NMED officials told us that the Class 3 modifications require the most significant level of review.

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## WIPP's Capital Asset Projects

### 2014 Accidents at the Waste Isolation Pilot Plant

In February 2014, two accidents occurred at the Waste Isolation Pilot Plant that resulted in the suspension of waste disposal operations. First, on February 5, a salt truck caught fire in the underground area, creating substantial smoke and soot that damaged key equipment and facilities. Then, on February 14, a transuranic waste container in the underground area ruptured, ejecting its radioactive contents, combustible gases, and other material into the air and onto adjacent waste containers. The materials and gases ignited and created fire and smoke that were not properly contained by the ventilation system. As a result of the release, portions of the facility's underground area (seen below) and existing ventilation system were radiologically contaminated.



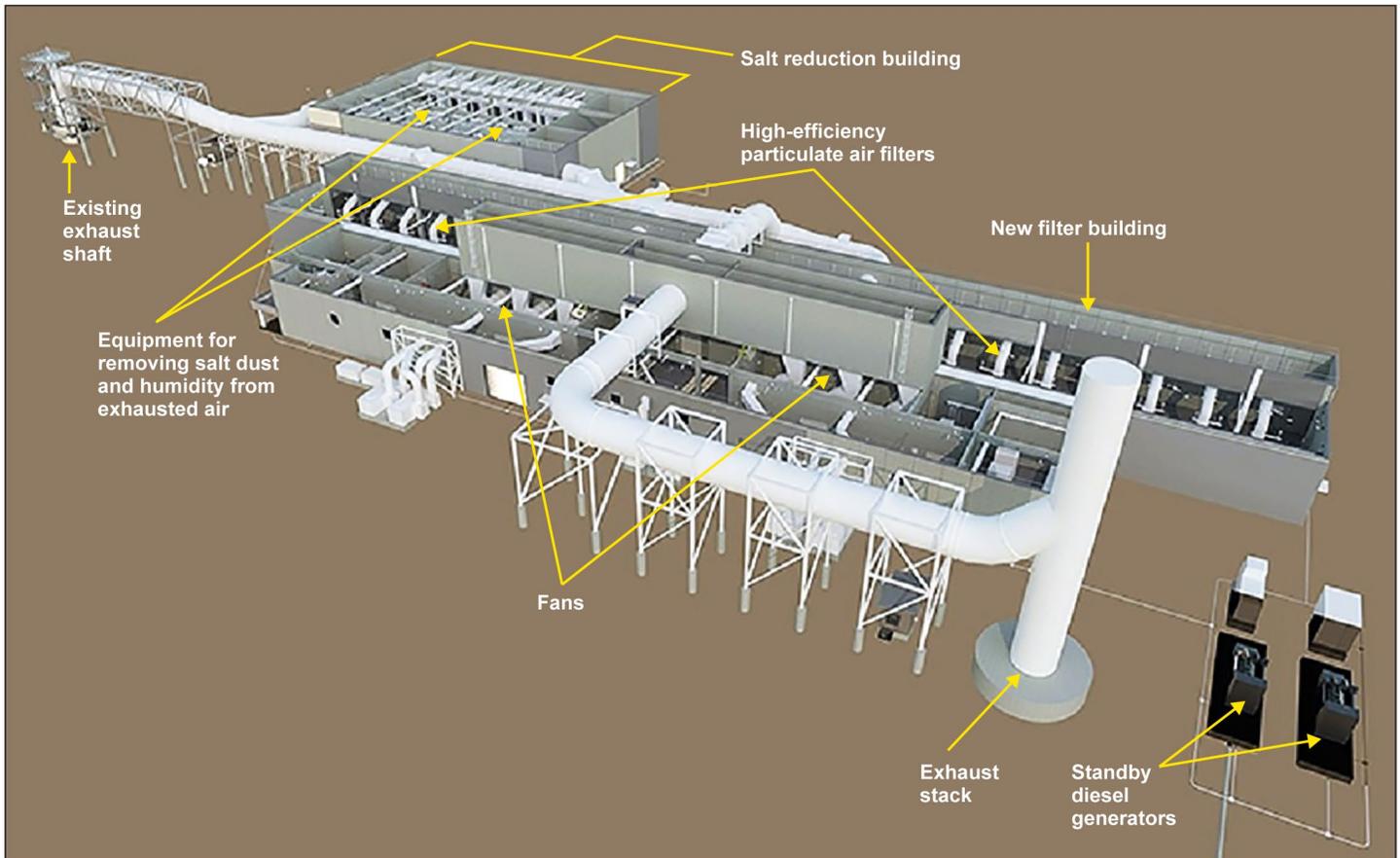
Sources: GAO analysis of DOE information; GAO (photo). | GAO-21-48

To provide the capabilities needed to resume full disposal operations at WIPP, DOE has initiated two capital asset projects—the SSCVS and the Utility Shaft. Together, these projects will act as one complete ventilation system to facilitate the return to full disposal operations and the planned increase in physical space at WIPP—specifically, the mining of additional panels.

The SSCVS project includes the design and construction of high efficiency particulate air (HEPA) filters and fans, a connection to the existing exhaust shaft, standby diesel generators, an exhaust stack, and site support utilities. According to DOE officials, the SSCVS takes advantage of several technological advancements that have occurred since the original ventilation system was built in the 1980s, including increased automation of airflow controls. Once completed, the SSCVS will provide sufficient airflow to support additional personnel and equipment underground. It will allow two modes of operations: filtered and unfiltered.

According to DOE officials, the intent is to return to “clean” operations and be able to operate on unfiltered exhaust during both mining and disposal operations, with the capacity to switch both operations to filtered exhaust in the event of another radiological release in the underground area. When the SSCVS is in operation and the facility is operating in filtered mode, the air exhausted from the underground area will go through a process in which salt dust and humidity are removed, and then the air passes through HEPA filters to remove potential contamination. See figure 1 for an illustration of the SSCVS project. Construction on the SSCVS began in May 2018 and is projected to be completed in 2023 at an estimated total project cost of \$288 million. According to DOE officials, they expect to complete a proposal for changing the cost and schedule baselines for the project later in 2020 to reflect cost overruns and schedule delays that have occurred.

**Figure 1: Draft Conceptual Design for the Department of Energy’s Safety Significant Confinement Ventilation System at the Waste Isolation Pilot Plant**



Source: Department of Energy. | GAO-21-48

As part of the planning process for the ventilation upgrades, in 2015, DOE’s contractor performed an analysis of alternatives to determine whether the project should include an additional exhaust shaft at WIPP, among other things.<sup>22</sup> Based on the analysis, DOE initiated a project to construct an additional shaft and referred to this project as the Exhaust Shaft. In our August 2016 report, we found significant issues with this analysis of alternatives and recommended that DOE include a cost-

<sup>22</sup>An analysis of alternatives is the process of identifying, analyzing, and selecting a preferred alternative to best meet the mission need by comparing the operational effectiveness, costs, and risks of potential alternatives.

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benefit analysis, as is consistent with best practices for conducting analysis of alternatives, or document why the analysis is not needed.<sup>23</sup> DOE concurred with our recommendation and decided to analyze the alternatives again. According to DOE officials, the second analysis identified several key technical flaws in the first analysis, including that the selected location for the new exhaust shaft was too close to the existing underground area and would not meet Mine Safety and Health Administration standards.<sup>24</sup> DOE made changes to this project to address the flaws in the first analysis and changed the name from Exhaust Shaft to Utility Shaft to better reflect its purpose.

Specifically, this project will construct a shaft that will be configured as an air intake shaft to draw fresh air into the planned additional physical space. The Utility Shaft project will complement the SSCVS and, in addition to providing a new air intake source, it will provide supplemental capability for transporting mined salt, equipment, and personnel to and from the underground area. The Utility Shaft will be constructed to the west of the existing repository and will include hallways connecting it to the repository. Once the Utility Shaft is completed, WIPP's existing air intake shaft will be converted to an exhaust shaft, which will provide the capability for exhausting air directly instead of routing it through the SSCVS. To increase worker safety and improve vehicle access to WIPP, the Utility Shaft project also includes a bypass road at the WIPP site to move all non-WIPP-related traffic away from the facility.

Construction of the Utility Shaft began in fiscal year 2020. The estimated date for the project's completion is December 2023 at an estimated total project cost of \$197 million. According to DOE officials, DOE would have preferred to begin construction of both projects concurrently; however, due to funding constraints, the two projects had to be undertaken sequentially. The SSCVS was initiated first because DOE considered it the highest priority.

DOE is managing both of these projects using DOE Order 413.3B, which provides the requirements for managing DOE capital asset projects from

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<sup>23</sup>[GAO-16-608](#).

<sup>24</sup>The WIPP Land Withdrawal Act requires the Mine Safety and Health Administration to inspect WIPP not less than four times each year in the same manner as it evaluates mine sites under the Federal Mine Safety and Health Act of 1977. The Secretary of Energy must take necessary actions to ensure the prompt and effective correction of any deficiency identified in an inspection.

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planning through construction.<sup>25</sup> This order includes requirements for projects, such as the SSCVS and the Utility Shaft, to develop and maintain an Integrated Master Schedule in a manner consistent with methods and best practices identified in GAO's schedule guide. This requirement does not apply for other, non-capital asset DOE projects.

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## Best Practices for Schedule Estimating

GAO's schedule guide compiles best practices corresponding to the characteristics of high-quality and reliable schedule estimates.<sup>26</sup> A high-quality, reliable schedule has four characteristics: it is comprehensive, well-constructed, credible, and controlled.

- **Comprehensive.** A comprehensive schedule captures all government and contractor activities necessary to accomplish a project's objectives. If a schedule is not comprehensive, with all activities accounted for, it is uncertain whether all activities are scheduled in the correct order, resources are properly allocated, missing activities will appear on the critical path, or a schedule risk analysis can account for all risk.
- **Well-constructed.** A well-constructed schedule sequences all activities using the most straightforward logic possible. If a schedule is not well-constructed, it will not be able to properly calculate dates and predict changes in the future, among other things.
- **Credible.** A credible schedule uses data about risks to predict the level of confidence in meeting a completion date, and necessary schedule contingency and high-priority risks are identified based on conducting a robust schedule risk analysis. If a schedule is not credible, it may not accurately capture project risks, among other things.
- **Controlled.** A controlled schedule is updated periodically to realistically forecast dates for activities. If a schedule is not controlled, it may not be able to, among other things, allow for properly measuring the schedule performance or be used for accurate schedule forecasting.

A schedule estimate is considered reliable if each of the four characteristics is assessed as being substantially or fully met. If any of the characteristics are assessed as being not met, minimally met, or partially

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<sup>25</sup>Department of Energy, *Program and Project Management for the Acquisition of Capital Assets*, DOE Order 413.3B (Washington, D.C.: Dec. 20, 2016).

<sup>26</sup>[GAO-16-89G](#).

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met, then the schedule estimate does not fully reflect the characteristics of a high-quality schedule and cannot be considered reliable.

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## DOE's Plans for WIPP May Ensure Sufficient Statutory Capacity and Physical Space to Dispose of Its Inventory of TRU Waste, But the Inventory May Increase in the Future

DOE's long-term plans for WIPP may ensure sufficient statutory capacity and physical space to dispose of its inventory of TRU waste. Specifically, its revised method for counting TRU waste volume may ensure specific statutory capacity, and its plans for additional physical space may ensure sufficient physical space. However, these steps may not be enough to ensure sufficient statutory capacity and physical space if significant volumes of TRU waste are added to DOE's TRU waste inventory or the revised volume counting method is successfully challenged in court.

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## DOE's Revised Method for Counting TRU Waste Volume at WIPP May Ensure Sufficient Statutory Capacity to Dispose of Its Inventory of TRU Waste

In 2018, DOE revised the method it uses to count the volume of TRU waste it disposes of at WIPP against the WIPP Land Withdrawal Act statutory capacity. This revision reduced the combined volume of waste already at and planned for disposal at WIPP by approximately 21 percent (37,515 m<sup>3</sup>). By revising the method for counting TRU waste disposed of at WIPP, DOE increased the likelihood that WIPP will have sufficient statutory capacity to dispose of the volume of waste estimated in DOE's 2018 Annual TRU Waste Inventory Report.<sup>27</sup> DOE pursued this revised counting method after we found in 2017 that DOE's inventory of TRU waste would likely exceed WIPP's statutory capacity of 175,565 m<sup>3</sup> and recommended that DOE determine whether a revision to the method for counting waste volumes could be implemented to address this issue.<sup>28</sup>

How TRU waste is disposed of at WIPP depends on the amount of radiation dose measured at the surface of the waste container. There are two types of TRU waste at WIPP, "contact-handled" and "remote-

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<sup>27</sup>At the time of our analysis, the most current available data on the volumes of waste DOE expected to be disposed of in WIPP were from DOE's 2018 Annual TRU Waste Inventory Report.

<sup>28</sup>See [GAO-17-390](#).

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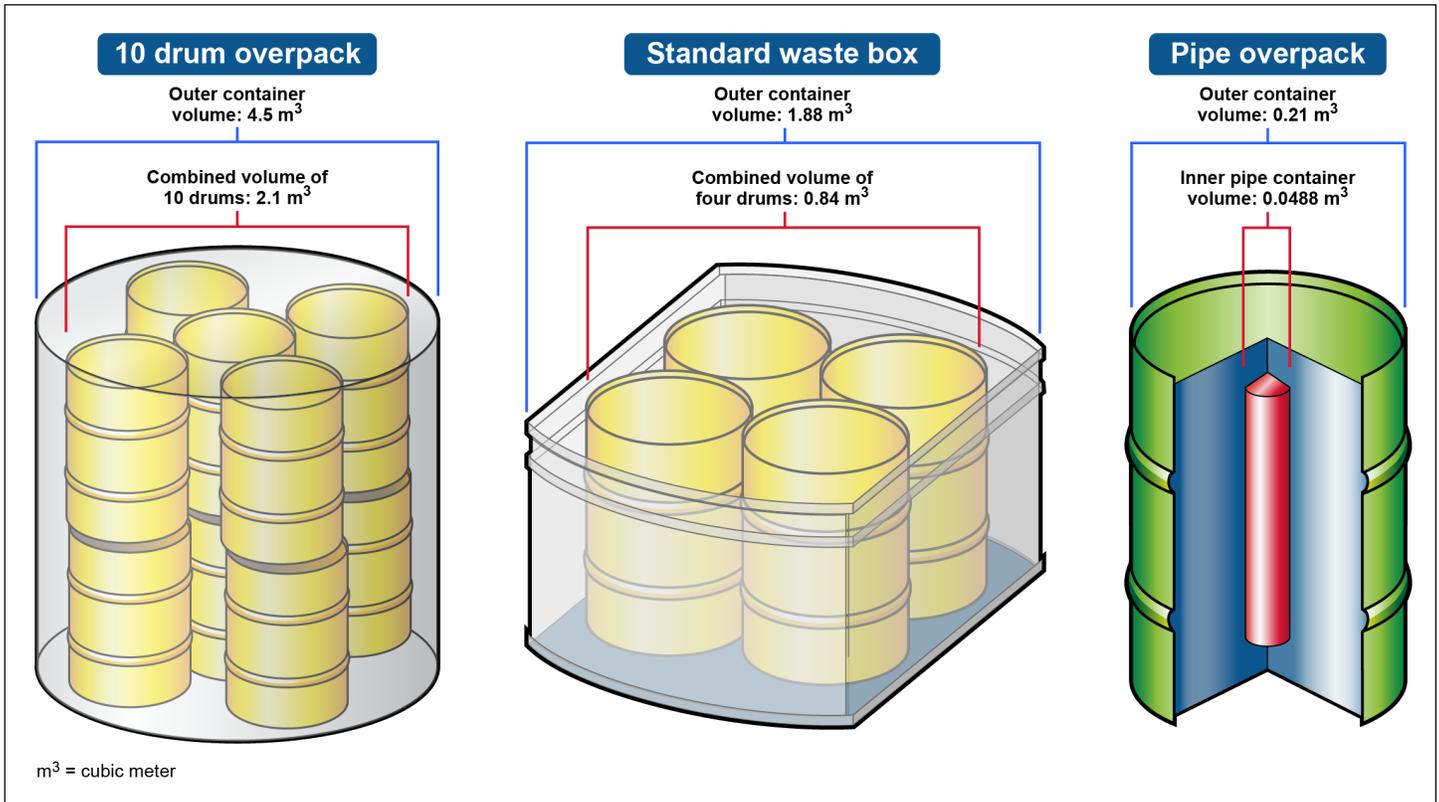
handled.”<sup>29</sup> Contact-handled waste has a lower radioactivity and comprises the vast majority of the TRU waste already disposed of at WIPP, as well as the TRU waste inventory planned for disposal at WIPP. Much of the contact-handled TRU waste disposed of at WIPP is packaged in 55-gallon drums, and some of these drums are subsequently packed inside larger containers, called overpacks, that hold multiple drums. DOE relies on several types of overpacks for the disposal of TRU waste. For example, pipe overpacks are individual drums that contain a pipe in which the waste is placed; this configuration allows the drum to hold a higher concentration of radiological material than a standard drum. See figure 2 for an illustration of the volumes of outer and inner containers for three types of overpacks used for disposing of TRU waste at WIPP. Remote-handled waste is also packaged in canisters or drums; however, because of its higher radioactivity, remote-handled waste must also be transported and disposed through the use of special equipment to shield workers from coming into contact with the waste. When remote-handled waste is disposed of at WIPP, it is either placed into boreholes in the walls of the panels or, if it is packaged into a special shielded container, placed on the floor of the panels as is done with contact-handled waste.<sup>30</sup>

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<sup>29</sup>Contact-handled TRU waste has a radioactive surface dose rate not greater than 200 millirem per hour. Such waste typically emits relatively little gamma (penetrating) radiation, and waste containers can be handled directly by workers. Remote-handled TRU waste has a radioactive surface dose rate of 200 millirem or more per hour. Remote-handled TRU waste emits relatively high levels of gamma radiation, which represents the primary radiological health hazard for workers handling such waste; the waste containers should not be handled directly by workers, and they require heavy container shielding or remote-handling equipment. For the purposes of this report, when we refer to waste or TRU waste, we are referring to the total of contact-handled and remote-handled waste, unless otherwise specified.

<sup>30</sup>Shielded containers were designed to allow certain types of remote-handled waste to be disposed of on panel floors in WIPP, similar to contact-handled waste. These containers are shielded by lead to prevent the radioactivity from the container’s contents from reaching the surface of the container.

**Figure 2: The Volumes of Outer and Inner Containers for Certain Overpacked Transuranic Waste Disposed of in the Department of Energy’s Waste Isolation Pilot Plant**



Source: GAO presentation of Department of Energy information. | GAO-21-48

Until 2018, DOE calculated the volume of contact-handled waste disposed of at WIPP using the volume of the outer container when waste was overpacked, rather than the inner containers holding the waste (i.e., drums or pipes). However, in response to our 2017 recommendation, in January 2018 DOE submitted to NMED a Class 2 permit modification request for WIPP’s permit that would change the way in which DOE counts waste volumes at WIPP for the purposes of counting the waste against the facility’s statutory capacity.<sup>31</sup> Specifically, this permit modification would allow DOE to count only the volume of the inner disposal containers that hold contact-handled TRU waste in overpacked

<sup>31</sup>See [GAO-17-390](#). According to NMED, Class 2 permit modifications involve changes that are significant but are not large technical changes that would be deemed controversial by stakeholders. A public comment period is required but typically there are not public hearings as part of this process.

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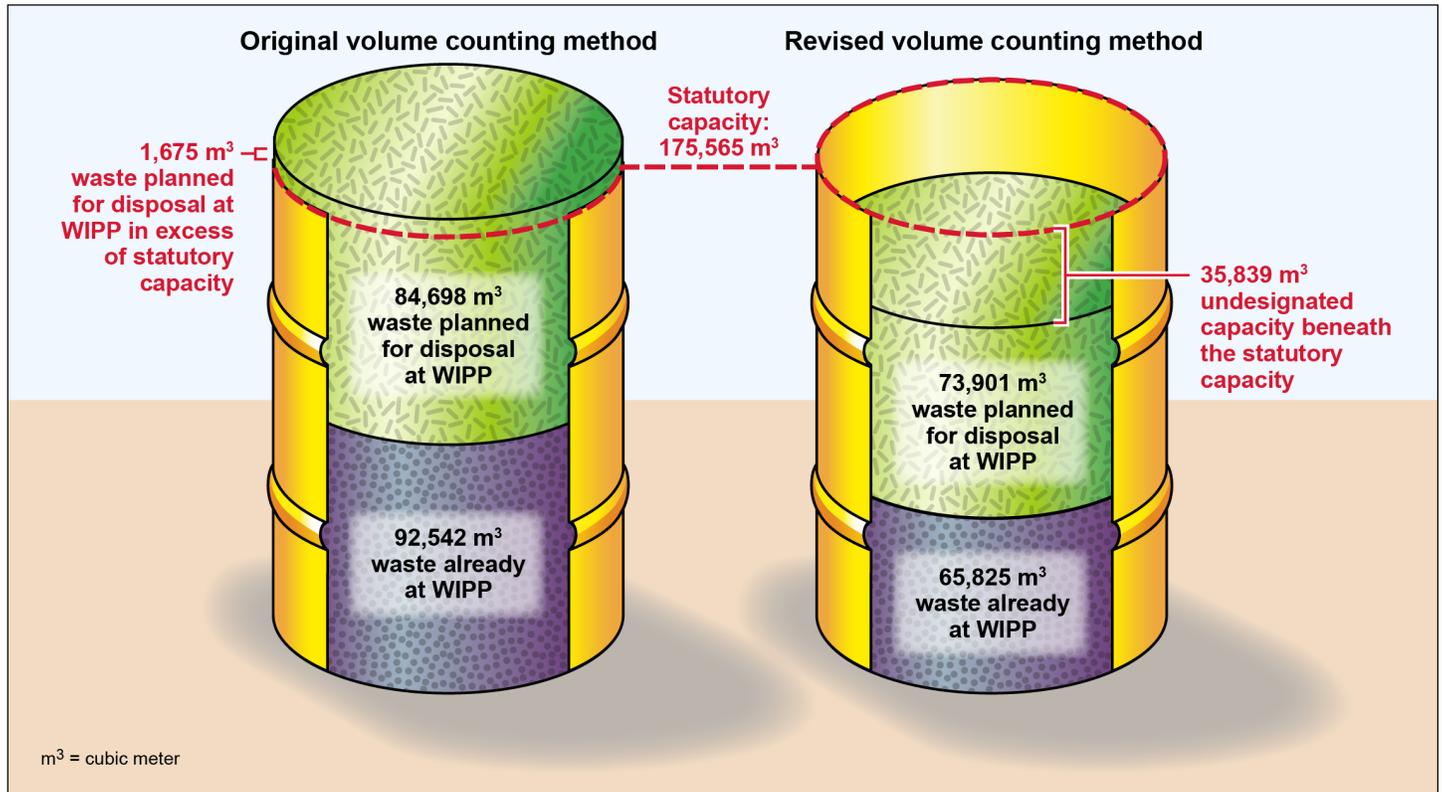
containers. This counting method would apply retroactively to overpacked containers already at WIPP.

The revised counting method, according to DOE, lowers both the volume of TRU waste already disposed of at WIPP and the waste in DOE's TRU waste inventory that is planned to be disposed of in the future and would be counted against WIPP's statutory capacity. The reduction in volume counted against the statutory capacity results in an estimated 35,839 m<sup>3</sup> of undesignated capacity—that is, capacity beyond what is needed for the TRU waste planned for disposal in DOE's 2018 inventory. Figure 3 illustrates the effect of the revised counting method on the volume of TRU waste already disposed of at WIPP and planned for disposal. NMED approved a modification to WIPP's permit that changed the counting method in December 2018.<sup>32</sup>

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<sup>32</sup>According to EPA officials, in June 2018, DOE submitted a planned change notice to EPA for its proposed change to the method for counting TRU waste volumes at WIPP. These officials also stated that they did not believe the change to be a significant change, per EPA's radioactive waste disposal regulations.

**Figure 3: Effect of the Revised Volume Counting Method on the Volume of Transuranic Waste Already at the Waste Isolation Pilot Plant (WIPP) and Planned for Disposal**



Source: GAO presentation of Department of Energy data. | GAO-21-48

Note: The existing and planned volume amounts come from the Department of Energy's 2018 Annual TRU Waste Inventory Report. This figure does not include any wastes that may be under consideration for disposal at WIPP but are not included in the 2018 report. The volumes for the waste planned for disposal at WIPP include 7,263 m³ estimated to be generated by the National Nuclear Security Administration's Surplus Plutonium Disposition program using the now discontinued Mixed-Oxide approach. This volume of waste was removed from the inventory in DOE's 2019 Annual TRU Waste Inventory Report.

### DOE's Plans for Additional Physical Space at WIPP May Be Sufficient to Dispose of Its Inventory of TRU Waste

DOE officials are still in the process of designing and assessing the environmental impact of additional physical space at WIPP. However, the draft design DOE provided to us may be sufficient to dispose of DOE's inventory of TRU waste. As discussed previously, as of August 2020, WIPP is permitted to use eight disposal panels that are projected to be filled by 2025, so DOE is planning for additional physical space. To develop a strategy for adding physical space at WIPP, in January 2018, DOE convened stakeholders for a series of three workshops on physical

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space.<sup>33</sup> The first workshop analyzed the design of additional panels and strategies to mine them; the second, the design and maintenance of the core area of WIPP's underground area; and the third, ways to address the unique disposal challenges of remote-handled waste. During the workshops, officials discussed various aspects of the future design of WIPP, including the number of new hallways needed to support the additional panels and the best location for the additional panels. After the workshops, DOE integrated the results and produced a report outlining its analysis of alternatives for future underground development at WIPP.<sup>34</sup>

During their planning, DOE officials calculated that nine additional panels, using panel designs similar to those of the existing panels, should be sufficient to meet DOE's TRU waste disposal needs as outlined in its 2018 Annual TRU Waste Inventory Report.<sup>35</sup> DOE officials decided that they would construct additional panels up the point at which the volume of TRU waste that could be disposed of in the panels equaled WIPP's statutory capacity. According to DOE officials involved in the planning, DOE used historical data from prior TRU waste disposal efforts at WIPP and the revised volume counting method to determine the average volume of TRU waste that had been disposed of in the existing panels. From there, they calculated that nine additional panels would be sufficient to dispose of the remaining volume of TRU waste allowed for by the statutory capacity (see figure 4 for an illustration of the draft conceptual design for the additional panels).<sup>36</sup> According to DOE officials, this analysis took into account the 34 metric tons of diluted plutonium from NNSA's Surplus Plutonium Disposition Program, even though that waste had not yet been added to DOE's TRU Waste Inventory Report because NNSA had not yet completed the documentation necessary to initiate the

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<sup>33</sup>Stakeholders included miners, waste handlers, geotechnical staff, safety professionals, mining managers, Carlsbad Field Office officials, external mining experts, and officials from Los Alamos National Laboratories and Sandia National Laboratories.

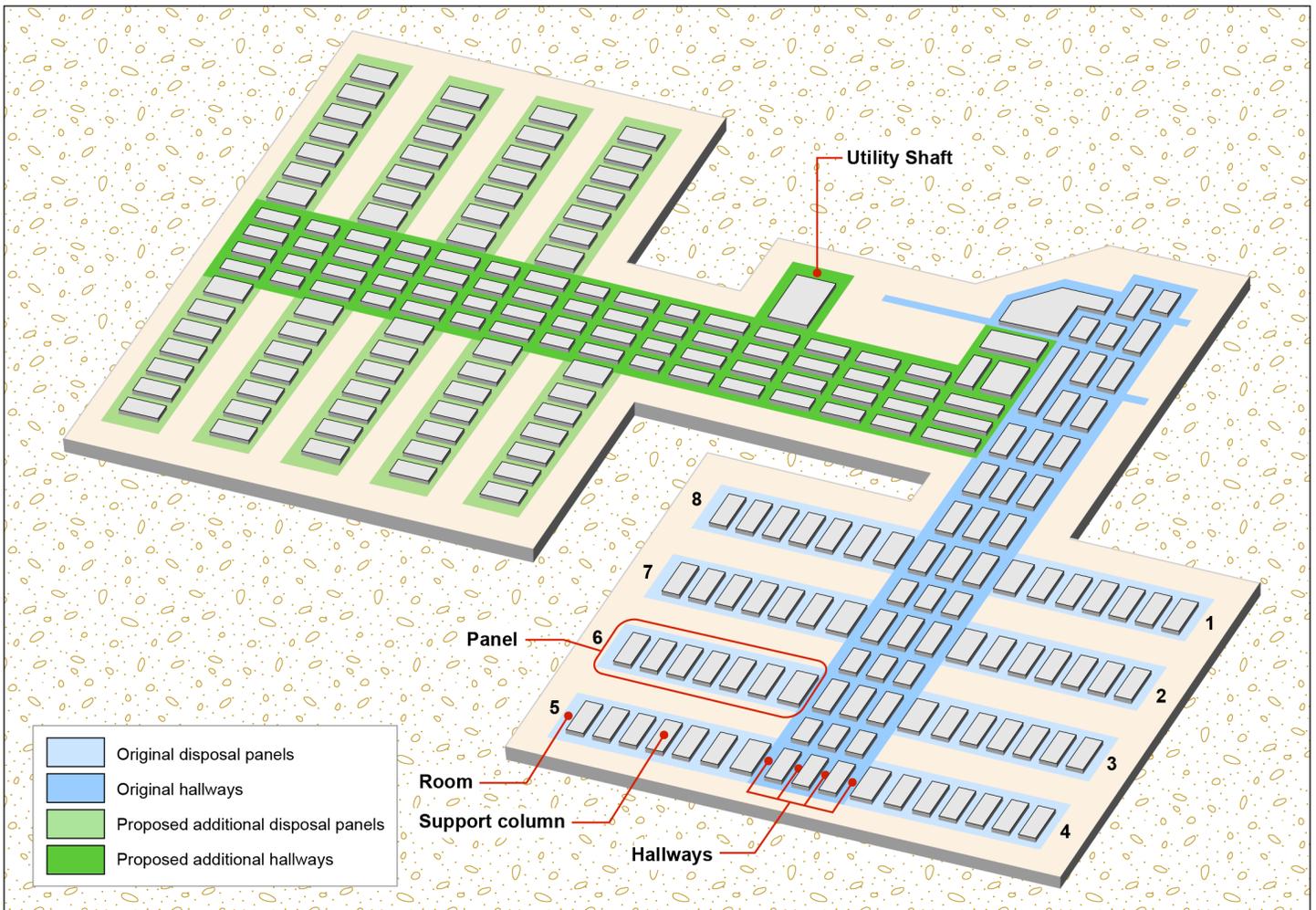
<sup>34</sup>See Department of Energy, *Analysis of Alternatives for Future Underground Development at the Waste Isolation Pilot Plant* (January 2018).

<sup>35</sup>According to DOE officials, their analysis of alternatives concluded that panel designs similar to those of the existing panels would help streamline the regulatory approval process.

<sup>36</sup>DOE did not provide us with the data they used to determine the number of additional panels that would be needed to reach the statutory capacity of WIPP, so we were unable to verify the reliability of their analysis. According to DOE officials, their determination regarding the number and configuration of new panels in the additional physical space is subject to change because the design for additional physical space is still in its conceptual phase.

program. According to DOE officials, it was important to consider this waste because it would create a large number of overpacks with smaller pipe containers holding the diluted plutonium. DOE officials told us that only the volume of the pipes would count against the statutory capacity, so this waste would account for less than 1 percent of WIPP's statutory capacity but, due to the large number of drums, likely would require significant physical space for disposal.

**Figure 4: Draft Conceptual Design for Additional Waste Disposal Physical Space at the Waste Isolation Pilot Plant (WIPP)**



Source: GAO analysis of Department of Energy information. | GAO-21-48

Note: This figure does not include northern portions of the original WIPP underground area, which were mined during DOE's research and development phase for constructing WIPP, because these are not intended for use in transuranic waste disposal. A panel is an area in the underground area that consists of seven rooms where waste is disposed of.

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During the design process for the additional physical space, DOE officials identified several lessons learned from the construction of the original portion of the facility that they intend to incorporate in their construction of the additional physical space. For example, the original portion of WIPP has four hallways, including one hallway for transporting TRU waste for disposal.<sup>37</sup> This transportation hallway is only large enough for one piece of waste disposal equipment to travel at a time, according to DOE officials. To dispose of waste, one piece of waste disposal equipment travels to the panel and back using the single transportation hallway. DOE officials determined that adding a fifth hallway to the design for the purposes of transporting TRU waste would improve the efficiency of movement in the new underground area. DOE officials told us that this additional hallway would allow waste disposal equipment to travel in both directions at the same time; that is, one piece of equipment could travel to the panels to dispose of TRU waste while an empty piece of equipment travels from the panels. The additional transportation hallway would also allow TRU waste disposal to continue if equipment breaks down in one of the transportation hallways. Figure 4, above, shows the proposed five-hallway configuration. Furthermore, DOE officials stated that their plans call for smaller and more frequent support columns to facilitate mining, improve safety during mining, and improve long-term stability.

In the design process, DOE also identified a potential improvement to its process for disposing of remote-handled TRU waste. As previously mentioned, because remote-handled waste has higher radioactivity, there are greater restrictions on how it can be disposed. To date, remote-handled waste has been permitted for disposal primarily in boreholes drilled into the walls in panels 4 through 8. According to DOE officials, some of the boreholes in the walls of panels 4 through 6 were blocked by contact-handled waste containers already disposed of in those panels before the boreholes could be filled with remote-handled waste. Because of the inability to use the boreholes as planned in panels 4 through 6, none of these panels were filled to more than 35 percent of their permitted remote-handled waste volume.

Further, since WIPP resumed waste disposal operations in 2017, DOE has not been able to safely drill boreholes in the walls in panel 7 because the radioactive contamination took place there. Therefore, DOE has only been able to dispose of remote-handled waste in special shielded

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<sup>37</sup>Hallways are the underground areas that connect the panels and are where workers transport TRU waste.

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containers placed on the panel room floor. There are only a limited number of shielded containers available for remote-handled waste disposal; therefore, only a small amount of remote-handled waste has been disposed of in panel 7. To address the problems DOE has faced with disposing of remote-handled waste in the existing panels at WIPP, DOE is looking into expanding its use of shielded containers.

DOE estimated that the majority of the inventory of remote-handled waste could be disposed of in shielded containers on panel room floors rather than in panel-wall boreholes if four new shielded containers were approved and went into use. According to DOE officials, even with the panel design changes to accommodate remote-handled waste in the planned additional physical space, it will still be challenging to dispose of all remote-handled waste in boreholes. When possible, DOE prefers to dispose of remote-handled waste in shielded containers, as it simplifies the disposal process by not requiring the drilling of boreholes and the use of remote-handling equipment in the underground area. DOE originally had only one shielded container design, which was appropriate for limited types of remote-handled waste. To address this limitation, DOE decided as part of its planning efforts for additional physical space to pursue developing four new shielded container designs to increase the amount and types of remote-handled waste that could be placed on the panel room floor like contact-handled waste. The Nuclear Regulatory Commission would need to certify the new containers and determine that they satisfy its quality assurance and other requirements, which DOE officials stated typically takes about 18 months.<sup>38</sup> According to DOE schedule documents, as of January 2020, DOE was in the process of designing the new shielded containers and estimated that it would submit the designs to the Nuclear Regulatory Commission in late 2020.

Following the January 2018 workshops in which DOE and stakeholders began planning for the additional panels, DOE began developing documentation for a NEPA analysis of the environmental impacts of additional physical space at WIPP. DOE officials said that they expect the NEPA process to be complete in February 2021. After the review, DOE will develop a permit modification request to submit to NMED and will submit a notification to EPA of the proposed change to WIPP. According to EPA and NMED officials, DOE will require significant effort to prepare the documentation and obtain approval for the additional physical space

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<sup>38</sup>According to EPA officials, DOE should submit a planned change notice to EPA describing its plans to use different shielded containers prior to their use.

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from each agency. Specifically, the EPA approval process will require extensive modeling efforts by DOE to demonstrate that WIPP will continue to meet EPA regulations with the additional physical space. According to NMED officials, adding panels would likely require a Class 3 permit modification given the complex nature of expanding WIPP; however, no final decision has been made about what class of permit modification is required.

According to DOE officials, their current planning for additional physical space includes design flexibility that would allow them to further increase the physical space through additional panels in the event that a change is made to the facility's statutory capacity and other TRU waste streams are identified and require disposal. However, any additional physical space would have to undergo an additional design and approval process similar to the one that is currently under way.

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### Potential Increases in the TRU Waste Inventory and Legal Challenges Could Result in Insufficient Statutory Capacity and Physical Space at WIPP for DOE's Future TRU Waste Disposal Needs

Despite the revision to the method for counting TRU waste volumes and DOE's plans for additional physical space, DOE may have insufficient statutory capacity and physical space to meet future TRU waste disposal needs at WIPP if (1) significant volumes of TRU waste are added to DOE's TRU waste inventory or (2) the permit modification authorizing the revised volume counting method is successfully challenged in court.

According to DOE officials, it is possible that the volume of TRU waste planned for disposal at WIPP may exceed the facility's statutory capacity and physical space if more waste is added to the TRU waste inventory, although DOE officials noted that compliance with the statutory capacity is closely tracked.<sup>39</sup> A substantial amount of such waste may be added due to increased production of TRU waste. In particular, the production of plutonium pits generates new TRU waste, and federal law requires the Secretary of Energy to ensure the nuclear security enterprise produces not less than 80 war reserve plutonium pits during 2030.<sup>40</sup> According to

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<sup>39</sup>DOE officials emphasized that estimated volumes of TRU waste are uncertain and final volumes of waste can differ significantly from the initial estimates.

<sup>40</sup>50 U.S.C. § 2538a(a)(5). Plutonium pits are critical components of nuclear weapons, and the new production will be used to modernize the current stockpile of pits that were produced during the Cold War from 1978 to 1989. If the Secretary does not make an annual certification that DOE programs and budget will enable the nuclear security enterprise to meet the 80 pit requirement, the Chairman of the Nuclear Weapons Council must submit to congressional defense committees a plan to enable the nuclear security enterprise to meet the requirement.

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NNSA, to meet this requirement, Los Alamos National Laboratory (Los Alamos) would produce approximately 30 pits per year by 2026, and Savannah River Site (Savannah River) would produce approximately 50 pits per year in 2030 (actual production numbers are classified).<sup>41</sup> Based on September 2020 estimates from an NNSA environmental impact statement, producing 30 pits per year at Los Alamos and 50 pits per year at Savannah River could generate 566 m<sup>3</sup> of TRU waste annually (consisting of 107 m<sup>3</sup> at Los Alamos and 459 m<sup>3</sup> at Savannah River). This environmental impact statement assumes that each facility will operate for approximately 50 years.<sup>42</sup> Using this assumption, these facilities could create approximately 28,300 m<sup>3</sup> of TRU waste that was not accounted for in the 2018 annual TRU waste inventory.<sup>43</sup> Using the revised volume counting method, this addition to the inventory would account for approximately 79 percent of the undesignated statutory capacity, leaving limited capacity for TRU waste not accounted for in the 2018 TRU waste inventory unless this or other future waste streams result in less waste than estimated.

In addition to the TRU waste generated through plutonium pit production, DOE officials told us that other waste streams are currently under consideration for disposal at WIPP but are not yet part of DOE's TRU waste inventory because they do not meet the criteria for inclusion in the inventory. Most notably, DOE has not yet added all of the estimated TRU waste for NNSA's Surplus Plutonium Disposition Program, and therefore this waste is not considered when determining whether there is sufficient statutory capacity at WIPP for all future TRU waste. According to NNSA documents, this program will dilute 34 metric tons of surplus plutonium and dispose of it in WIPP. In 2017, we reported that disposing of the waste from this program would require approximately a panel and a half in WIPP. However, an April 2020 report from the National Academies reviewing this program and its potential impact on WIPP noted that the program will likely be responsible for disposing of a total of 42.2 metric

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<sup>41</sup>Department of Energy, *NNSA Final Supplement Analysis of the Complex Transformation Supplemental Programmatic Environmental Impact Statement* (December 2019).

<sup>42</sup>This assumes that Los Alamos will generate waste from 2026 to 2075 and Savannah River will generate waste from 2030 to 2079.

<sup>43</sup>DOE added the volume of TRU waste estimated to be produced during pit production at Los Alamos through 2050 in the 2019 annual TRU waste inventory.

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tons of surplus plutonium in WIPP.<sup>44</sup> The estimated volume of TRU waste for this program was not included in the 2018 Annual TRU Waste Inventory Report because DOE had not yet completed the documentation necessary to initiate the program. In August 2020, DOE issued an amended record of decision titled, “*Supplement Analysis for Disposition of Additional Non-Pit Surplus Plutonium.*” In this record of decision, DOE designated 7.1 of the 34 metric tons of surplus plutonium for disposal at WIPP. DOE officials stated that the estimated volume of TRU waste it will create will be added to the next TRU waste inventory report. According to DOE officials, the remaining surplus plutonium not addressed by this record of decision will need a subsequent record of decision in order to be added to the TRU waste inventory.

Furthermore, several other waste streams are being considered for disposal at WIPP. However, according to DOE, these waste streams need to meet several criteria before they are added to the TRU waste inventory, such as: being officially determined to be defense-related, having required data, and not containing any restricted items. DOE tracks several other waste streams that it considers potentially bound for disposal at WIPP but cannot consider part of the regular inventory because the waste has not yet met all of the criteria for inclusion. Additionally, there are activities that DOE expects will generate TRU waste in the future, but DOE has not begun the planning process that would estimate waste volumes. The waste in these categories include the following:

- **Tank waste and buried waste.** DOE is considering disposing of certain tank waste from Idaho National Laboratory, the Hanford Site, and certain quantities of waste from the West Valley Demonstration Project at WIPP. However, the NMED permit prohibits disposal of waste from certain tanks at Idaho National Laboratory and Hanford at WIPP.<sup>45</sup> In addition, the tank waste is currently classified as high-level radioactive waste and the WIPP Land Withdrawal Act prohibits disposal of such waste at WIPP. Furthermore, DOE considers the waste from West Valley as being prohibited from being disposed of at

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<sup>44</sup>National Academies of Sciences, Engineering, and Medicine, *Review of the Department of Energy’s Plans for Disposal of Surplus Plutonium in the Waste Isolation Pilot Plant* (Washington, D.C.: April 2020).

<sup>45</sup>Specifically, the waste from tanks identified in table C-4 of the NMED permit are prohibited from disposal at WIPP.

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WIPP because it does not classify these wastes as defense TRU waste.

- **Future cleanup activities.** According to DOE officials, they expect to generate more TRU waste in the future from the decontamination and demolition of contaminated facilities at certain sites, such as Los Alamos and Savannah River, and from exhuming additional buried waste.<sup>46</sup> However, DOE has not developed estimates for the volume of TRU waste these activities may produce because the projects are not yet planned. In September 2017, we reported that there were at least 44 facilities at DOE sites that could generate TRU waste during decontamination and demolition or that have buried TRU waste for which no volume estimates have been reported to DOE.<sup>47</sup> According to DOE officials we interviewed in 2020, while DOE has issued guidance to sites requesting that they provide as much information as they can regarding waste expected to be generated from the decontamination and demolition of facilities, there are still facilities for which there are not yet estimates of TRU waste that could be generated.

If some or all of these wastes are added to the inventory of TRU waste planned for future disposal, it is possible that there will be insufficient statutory capacity and physical space at WIPP, even with the recent change to the volume counting method and with the planned additional physical space. Disposal of wastes in excess of WIPP's statutory capacity would require an amendment to the WIPP Land Withdrawal Act or an additional repository for TRU waste disposal. The National Academies' April 2020 report came to a similar conclusion and noted that since DOE management had stated that waste from national security missions would be given priority at WIPP, DOE would need to provide priority to waste from NNSA's Surplus Plutonium Disposition Program. DOE and NNSA officials we spoke with agreed that the WIPP Land Withdrawal Act may need to be evaluated in the 2040 time frame to address potential capacity needs at WIPP beyond 2050 due to waste created by NNSA mission activities.

In addition to the issues posed by waste streams not yet accounted for in the inventory, there is an ongoing legal challenge to DOE's revised

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<sup>46</sup>While certain volumes of TRU waste from Los Alamos and Savannah River expected to be generated in the future are projected out to 2050, Hanford has projected at least one waste stream out to 2062.

<sup>47</sup>[GAO-17-390](#).

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volume counting method. Opposition to the revised volume counting method began after DOE submitted a Class 2 permit modification request to NMED in January 2018 seeking approval for the method. The permit modification request generated significant public interest and concern. This interest and concern, along with the complex nature of the proposed change, led NMED to determine that it was appropriate to process the permit modification as a Class 3 permit modification rather than a Class 2 permit modification.<sup>48</sup> Several members of the public expressed opposition to the revised counting method in comments, asserting, among other things, that it went against the original intent of the WIPP Land Withdrawal Act by not accounting for the air space around the TRU waste. In response to the opposition to the draft permit modification and several requests from the public requesting a hearing, in October 2018, NMED, in conjunction with DOE, met with those who had submitted comments and requests for a hearing in an attempt to resolve issues raised in the comments.

After these meetings, NMED approved the revised counting method in December 2018; however, the approval was appealed in court by a group of nongovernmental organizations in January 2019 on the grounds that the revised counting method is contrary to law, among other things. As of November 3, 2020, the appeal was pending before the New Mexico Court of Appeals. In the meantime, the permit modification for the revised volume counting method is in effect. NMED officials expressed confidence that the permit modification for the revised volume counting method would be upheld by the court, but noted that the National TRU Waste Program is maintaining two sets of records of TRU waste: one using the old volume counting method and the other using the revised volume counting method. Without a valid permit modification for the revised volume counting method, the current inventory of TRU waste would surpass WIPP's statutory capacity, requiring DOE to pursue an amendment to the WIPP Land Withdrawal Act to be allowed to dispose of the waste at WIPP or to pursue an additional repository for TRU waste disposal.

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<sup>48</sup>According to officials from NMED, Class 3 permit modifications are the most complex and are used for the most controversial changes.

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## DOE Identified Two Key Challenges to Completing Capital Asset Projects at WIPP, and It May Not Have Sufficient Staff to Address These Challenges

DOE officials identified two key challenges faced by the two capital asset projects being undertaken—the SSCVS and the Utility Shaft—to provide the ventilation necessary to return WIPP to full disposal operations. Specifically, DOE officials identified challenges in (1) identifying and overseeing specialized contractors and (2) obtaining the needed approvals from NMED to continue with construction. CBFO is responsible for managing these capital asset projects and addressing these challenges, and because of a significant number of vacancies, the office may not have sufficient staff to do so. DOE has not fully assessed the flexibilities it could use to fill staffing gaps.

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## DOE Officials Described Challenges in Identifying and Overseeing Specialized Contractors and Obtaining the Necessary Regulatory Approval for Capital Asset Projects at WIPP

According to DOE officials we interviewed, they face two key challenges in completing the SSCVS and Utility Shaft capital asset projects. First, DOE officials told us they face challenges in identifying and overseeing contractors that meet certain quality assurance requirements that apply to the SSCVS and Utility Shaft projects. According to DOE officials, because WIPP is classified as a Hazard Category 2 nuclear facility, construction contractors and certain components, such as diesel generators and HEPA filters, must meet Nuclear Quality Assurance-1 (NQA-1) requirements—a common set of standards established by the American Society of Mechanical Engineers to ensure safety in nuclear facilities, among other things. These officials told us that it can be difficult to identify contractors that have experience doing construction work following the requirements, or vendors that sell components that have met these requirements. For example, the officials said that DOE had difficulty in identifying vendors of diesel generators and HEPA filters that both met the requirements and could produce the items it needed on a timely basis. In an attempt to mitigate this issue, DOE began the process of acquiring these items early in the project design process.

According to DOE and contractor officials managing the capital asset projects, they have also run into issues with overseeing subcontractors who are performing work on the projects.<sup>49</sup> While a contractor official stated that the contracts include stipulations that NQA-1 requirements are to be followed and that proper documentation needs to be completed,

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<sup>49</sup>In 2016, we found that DOE encountered problems with acquiring components at WIPP during its project to recover the facility and resume operations after the 2014 accidents. In the process of acquiring components for a ventilation system upgrade, some of the components that arrived to the site were found to be damaged. The components had to be returned to the manufacturer for repair, delaying the recovery project by several months. [GAO-16-608](#).

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DOE officials told us that they must frequently remind contractors of these requirements and ensure they are being followed.

Second, DOE officials told us they face challenges in obtaining approval from NMED for the permit modification needed to continue with construction of the Utility Shaft. NMED approved the permit modification covering the work for the SSCVS in March 2018. However, while a draft permit modification was issued for the Utility Shaft in June 2020 for public comment, this permit modification had not been approved as of October 2020. According to NMED officials, the approval process may be slowed because the renewal of WIPP's permit is also ongoing and may take precedence.

To address the potential delay in obtaining approval for the Utility Shaft, DOE requested a temporary authorization from NMED that would allow it to begin work excavating the new shaft.<sup>50</sup> NMED approved this temporary authorization in April 2020; however, later that month, a nongovernmental organization in New Mexico filed an appeal of the NMED order granting the authorization in the New Mexico Court of Appeals. The court dismissed the appeal in June 2020, and the state Supreme Court declined to hear the appeal in September 2020.

These two challenges DOE officials identified have affected the schedules for both projects. The schedule for each project included additional time, referred to as schedule margin, to account for project risks including the challenges posed by NQA-1 requirements and delays in obtaining approvals. According to project schedule documents, 200 days of schedule margin were included in the baseline estimate for the SSCVS, and the project has used 163 of those days due to realized project risks. A contractor official noted that a portion of the delays came from problems with the oversight and management of contractors. DOE officials told us that the cost overruns and schedule delays for the SSCVS are significant enough to require a change to the project's cost and schedule baselines. The process for completing this baseline change was still ongoing as of July 2020.

For the Utility Shaft, the baseline estimate included 106 days of schedule margin, and the project has used 59 of those days. In this case, the contractor official indicated that all of the delays resulted from issues with

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<sup>50</sup>Temporary authorizations allow work for no more than 180 days and may be reissued for up to 180 days if a class 2 or 3 permit modification request for the activity covered by the temporary authorization has been made.

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awarding the contract for shaft construction because DOE has not yet received approval from the state to move forward with the project. In both cases, the projects have used over half of their schedule margin with more than 2 years remaining before the projects are estimated to be complete. According to DOE officials, once the schedule margin is depleted, any further delays are likely to delay the completion date of the project.

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### DOE May Not Have the Staff Needed to Address Capital Asset Project Challenges at WIPP and Has Not Fully Assessed Flexibilities for Filling Staffing Gaps

DOE's field office responsible for directly overseeing the SSCVS and Utility Shaft projects, CBFO, is experiencing significant staffing shortages that may impede its ability to manage the challenges to these projects and remain on schedule. According to human capital data provided by DOE, as of January 2020, 27 of the 76 total full-time positions at CBFO were either vacant or occupied by an acting official who held another position in the office. In particular, in CBFO's Office of Program Management, whose portfolio includes the management and oversight of the SSCVS and Utility Shaft projects, eight of 10 full-time positions were vacant or held by an acting official as of September 2019. The vacancies at CBFO are affecting other WIPP activities, as the Defense Nuclear Facilities Safety Board noted in a May 2020 letter to DOE.<sup>51</sup> The letter, which addressed safety planning at WIPP, raised concerns that because of the vacancies in CBFO's safety programs division, CBFO does not have sufficient qualified and trained staff to conduct the necessary federal oversight of safety planning for WIPP.

DOE officials told us that they historically have had difficulty filling positions at CBFO due to the office's remote location in southeastern New Mexico, hundreds of miles from the closest large cities, including Albuquerque and Santa Fe. DOE data on vacancies at CBFO show that there was a significant increase in the percentage of positions vacant at the office in fiscal year 2015. According to DOE officials, this increase is primarily due to the significant number of new positions that were approved in response to the 2014 accidents at WIPP and the difficulty of filling these positions quickly. Table 1 shows the number of positions at CBFO that were vacant each fiscal year from 2010 through 2020.

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<sup>51</sup>Defense Nuclear Facilities Safety Board, *Waste Isolation Pilot Plant Documented Safety Analysis Review* (Washington, D.C.: May 2020).

**Table 1: Vacancies at the Department of Energy’s Carlsbad Field Office, Fiscal Years 2010-2020**

Fiscal year	Approved positions	Filled positions	Vacant positions
2010	54	48	6
2011	54	55 <sup>a</sup>	-1
2012	60	57	3
2013	59	55	4
2014	52	48	4
2015	77	51	26
2016	77	63	14
2017	77	63	14
2018	70	62	8
2019	73	53	20
2020	76	49 <sup>b</sup>	27

Source: GAO presentation of Department of Energy information. | GAO-21-48

<sup>a</sup>DOE officials told us that they received approval to fill an additional position beyond what was initially approved in fiscal year 2011, which created a surplus that is reflected as a negative number in the vacancy column.

<sup>b</sup>This is the number of filled positions as of January 2020.

CBFO has experienced a large increase in the number of vacancies over the last 2 fiscal years, 2019 and 2020. According to DOE officials, several factors have contributed to the current level of vacancies at CBFO. These officials told us that the primary factor is the significant increase in oil and gas industry activity in the region surrounding Carlsbad. The oil and gas companies in the area are competing to hire staff with skillsets similar to those needed at CBFO and can offer higher salaries. CBFO is included in the “rest of the United States” category of localities under the federal general schedule, meaning that it receives the lowest adjustment to its pay scales for cost of living. This has not only limited CBFO’s ability to attract candidates to fill its vacancies, but has also resulted in existing CBFO staff leaving for positions with the oil and gas industry.

Furthermore, the arrival of oil and gas industry workers has approximately tripled the population of the region around Carlsbad, which has created a shortage of housing and significantly increased the cost of living in the area. CBFO officials cited the high cost of living and lack of available housing as additional factors contributing to the difficulty in attracting candidates to fill vacancies. Finally, CBFO officials told us that the large number of vacancies has required several officials to take on the responsibilities of multiple positions for an extended period of time, which has led to further departures and retirements.

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DOE has taken several actions over the last several years to attempt to fill the vacancies at CBFO. However, officials noted that these actions are unlikely to be enough to fully address the vacancy issue. DOE has, for example, offered hiring pay incentives of up to 25 percent and has offered to cover allowable relocation expenses.<sup>52</sup> However, according to a DOE human capital official, some pay incentives are only available to those being newly hired to federal government positions, but eight of the vacancies, including several senior management positions, are unlikely to be filled by someone new to the federal government. This official also told us that, even for those positions for which the incentives are likely to apply, the incentives are insufficient to attract applicants with the necessary qualifications due to the high cost of living in the area and the comparatively lower salaries.

In late 2019, DOE pursued a new strategy for addressing CBFO's vacancies by approving the opening of a satellite office in Albuquerque, New Mexico. A DOE official said that they believe this office will be able to more readily fill vacancies due to its ability to draw from a larger population base than the Carlsbad region and due to the more available and affordable housing options. DOE officials stated they intend for this satellite office to eventually fill 10 of the 27 vacant positions; however, these officials told us that the new Albuquerque office was intended to fill positions in the National TRU Program—which coordinates with DOE cleanup sites around the nation—but would not fill positions that have responsibilities at the WIPP site. According to CBFO's fiscal year 2019 workforce plan, with the ongoing work of the Utility Shaft and SSCVS projects and with plans to mine additional panels at WIPP, it is important that DOE fill the vacancies at CBFO to address this increasing workload.

In particular, key CBFO positions that are either vacant or filled with an official acting in a temporary capacity have responsibilities associated with addressing the challenges that DOE faces in identifying and overseeing contractors for its capital asset projects. As mentioned above, CBFO's Office of Program Management is responsible for overseeing the SSCVS and the Utility Shaft and has experienced vacancies in key positions. The responsibilities of the director of this office are currently being performed by an official who holds another permanent position at CBFO. The position of risk management and planning specialist is

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<sup>52</sup>After DOE increased the number of positions at CBFO in response to the 2014 accidents, DOE's human capital office issued a memo that allowed CBFO to offer hiring bonuses of up to 25 percent. This memo also approved the offering of relocation expenses.

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vacant. Furthermore, the position of federal project director for both projects was held for nearly a year by an official who had temporarily rotated from another DOE site before a permanent replacement was hired.

In our December 2003 report on the key principles for effective strategic workforce planning, we stated that agencies should develop hiring strategies, including the use of flexibilities and other human capital strategies and tools, and consider how these strategies can be used to eliminate gaps.<sup>53</sup> In its 2019 workforce plan, CBFO reported that current workforce gaps may worsen as the scope of work at the site increases with the return to full operations at WIPP. The plan suggests that DOE should use flexibilities and other human capital strategies to fill vacancies, but the flexibilities it recommends—hiring and relocation incentives—have been ineffective to date.

According to DOE officials, other flexibilities are available to help fill vacancies, such as a change to the locality pay for the Carlsbad area so that the salaries would be more competitive and better compensate for the increased cost of living. A DOE official told us that they are gathering data to support the request for a change to locality pay; however, DOE has not analyzed that flexibility and others to determine whether they could be implemented at CBFO because officials have been focused on other pressing issues at WIPP. By identifying and fully analyzing which additional flexibilities DOE could use to address the vacancy issue at CBFO, DOE will be in a better position to recruit and retain the workforce needed to effectively address the challenges DOE officials identified in managing and overseeing projects at WIPP.

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<sup>53</sup>[GAO-04-39](#).

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## DOE Does Not Have Assurance That Physical Space Will Be Completed without an Interruption to Operations Because Its Schedule Is Not Reliable and Faces Risks

DOE has developed an Integrated Master Schedule that includes an estimate for constructing additional physical space at WIPP before existing space is full and waste disposal operations are interrupted. However, DOE does not have assurance that this additional space will be completed without an interruption to waste disposal operations for two reasons. First, we found that the Integrated Master Schedule was not developed consistent with schedule estimating best practices and therefore did not meet the characteristics of a reliable schedule. Second, there are significant risks that could delay the schedule and DOE did not compensate for these risks by including additional contingency time. Further, DOE's efforts to mitigate these risks may not be sufficient to prevent an interruption to waste disposal operations.

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## DOE's Schedule Estimate for Adding Physical Space at WIPP Is Not Reliable Because It Does Not Substantially Meet All Schedule Estimating Best Practices

DOE has developed a schedule estimate for adding physical space at WIPP before an interruption to waste disposal operations. However, we determined that this schedule estimate was not developed consistent with schedule estimating best practices and therefore did not meet the characteristics of a reliable schedule. According to DOE and contractor officials, DOE developed an Integrated Master Schedule for WIPP in October 2019 that estimated the dates for WIPP's operations and the completion dates for projects through 2025. The Integrated Master Schedule integrates the schedules for three projects: the SSCVS, the Utility Shaft, and general operations at WIPP to manage the facility and dispose of waste. DOE's efforts to construct additional physical space are included as part of general operations. According to Integrated Master Schedule documentation, activities within these projects are frequently dependent on one another so that, for example, delays in activities needed to complete the SSCVS may ultimately delay construction of additional physical space. As of January 2020, the Integrated Master Schedule estimated that the first panel of the planned additional physical space would be completed in June 2025.<sup>54</sup>

To understand whether DOE's estimate for constructing additional physical space is reliable, we assessed the Integrated Master Schedule for WIPP to determine whether it was developed consistent with schedule

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<sup>54</sup>For our evaluation of the Integrated Master Schedule, DOE provided us with a version of the schedule that was updated with the status of all activities as of January 2020. In March 2020, DOE took action to reduce activities at the WIPP site and CBFO due to the COVID-19 pandemic. According to DOE officials, they are in the process of updating the schedule to reflect delays in their projects from these actions.

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estimating best practices identified in our Schedule Assessment Guide and thereby met the four characteristics of a reliable schedule.<sup>55</sup> The full results of our analysis are in Appendix II. According to our analysis, the Integrated Master Schedule substantially met two of the characteristics of a reliable schedule (comprehensive and controlled) and partially met two of the characteristics (well-constructed and credible).<sup>56</sup>

- **Comprehensive:** We found that the Integrated Master Schedule substantially met the best practices for this characteristic. For example, the Integrated Master Schedule followed best practices by including activities for both DOE and its contractors that are necessary to accomplish the program's objectives. In addition, most activities included in the Integrated Master Schedule identified the resources that were needed for completing the activity. We also found that, per best practices, the Integrated Master Schedule generally reflected how long each activity would take and allowed for measurement of the progress of specific activities. For example, all activities had work breakdown structure elements assigned that defined in detail the work necessary to accomplish a project's objectives. However, the work breakdown structure documentation provided did not contain all the elements that were assigned within the schedule.
- **Well-constructed:** We found that the Integrated Master Schedule partially met the best practices for this characteristic. For example, the Integrated Master Schedule followed best practices by including dependencies between most activities that establish how activities are to be carried out. However, we assessed the Integrated Master Schedule to have only partially met best practices for a well-constructed estimate because, for example, two of the three project schedules in the Integrated Master Schedule had questionable critical paths, which is the longest continuous sequence of activities between the program's start and finish. For example, the critical paths for general operations at WIPP and the SSCVS were obscured by long-duration activities. Including long-duration activities on the critical path prevents management from having a clear idea of what specific activities are driving project completion. According to best practices, when possible, long-duration activities should be reevaluated to determine if they can be broken down into more manageable pieces,

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<sup>55</sup>[GAO-16-89G](#).

<sup>56</sup>The ratings for each characteristic are determined by assigning each relevant best practice rating a number and taking the average. For a schedule to be considered reliable, all four characteristics will have been at least substantially met.

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particularly if they appear on the critical path. Additionally, the critical path for the SSCVS was not continuous from the date the schedule was updated to provide a complete picture of the project from start to finish. Without a valid critical path, management cannot focus on activities that will detrimentally affect the key program milestones and deliveries if they slip.

- **Credible:** We found that the Integrated Master Schedule partially met the best practices for this characteristic. For example, the Integrated Master Schedule followed best practices by including a schedule risk analysis to determine (1) a confidence level for achieving the program schedule and (2) how much additional time should be added to the schedule for contingency. However, we assessed the Integrated Master Schedule to have only partially met best practices for a credible estimate because, for example, the contingency for the Integrated Master Schedule was determined based on the impact of risks to activities on or near the critical path. Best practices state that risk analysis should be performed on all work in the schedule because any activity can become critical under some circumstances. In addition, DOE did not include the schedule risk model itself in the documentation it provided. Without the model, we were unable to validate that the correct information was input in the model. Furthermore, we identified issues with the horizontal and vertical traceability of the Integrated Master Schedule. According to best practices, for the schedule to be horizontally traceable, it needs to show the logical relationships between activities and clearly show when different activities hand off from one to the next. We found the Integrated Master Schedule had issues with the sequencing of all activities that could result in the schedule not correctly calculating how delays affect succeeding activities. For the schedule to be vertically traceable, best practices state that lower-level schedules (that is, a schedule that details only a portion of the program but at a higher level of detail) should be able to be rolled up into the high-level program schedule. The Integrated Master Schedule was generally vertically traceable; however, a lower-level schedule we reviewed included completion dates for two activities that were not in the Integrated Master Schedule.
- **Controlled:** We found that the Integrated Master Schedule substantially met the best practices for this characteristic. For example, the Integrated Master Schedule followed best practices by including a process for trained personnel to update the schedule weekly and to report monthly to DOE on schedule progress. Additionally, as outlined in best practices, DOE officials stated that changes to the baseline schedule go through a change control

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process in which management needs to review, approve, and document any changes. However, the Integrated Master Schedule did not fully meet best practices for a controlled estimate because, for example, DOE did not yet have a capability in place for analyzing schedule progress to identify trends. As of February 2020, DOE officials told us that they were in the process of establishing this capability.

According to DOE officials, the degree to which each of the three projects followed schedule estimating best practices depended on whether they were a capital asset project. These officials told us that DOE requirements for schedule estimating allowed them to tailor their approach based on the complexity of each project. The two capital asset projects developed their portions of the Integrated Master Schedule following DOE Order 413.3B. This order establishes the requirements for cost and schedule estimating for capital asset projects and requires that these estimates be developed following best practices. The schedule estimate for general operations at WIPP, however, covers more routine activities and is not subject to Order 413.3B. As a result, the schedule for general operations at WIPP includes less detailed breakouts of specific activities and generally was not developed following all estimating best practices. While best practices indicate that it is appropriate to tailor the schedule estimating approach, because critical elements of the schedule—such as the establishment of a critical path—were not developed following best practices, the Integrated Master Schedule cannot be considered reliable in its current state. By making improvements to the Integrated Master Schedule so that it sufficiently follows best practices to at least substantially meet the four characteristics of a reliable schedule, DOE can better ensure that its estimate for completing additional physical space at WIPP before an interruption to waste disposal operations is reliable.

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## DOE's Mitigation of Key Schedule Risks for Adding Physical Space at WIPP May Not Be Sufficient to Avoid an Interruption to Waste Disposal Operations

### Activities in Response to the Coronavirus Disease 2019 (COVID-19) Pandemic at the Waste Isolation Pilot Plant (WIPP)

On March 16, 2020, the Secretary of Energy instructed all Department of Energy sites, including the Carlsbad Field Office (CBFO), to reduce operations to only essential activities and direct the workforce to telework to the maximum extent possible. As a result, CBFO issued a partial stop work order to its lead contractor for WIPP, Nuclear Waste Partnership LLC., on March 27. According to CBFO officials, essential activities included:

- mission-critical site staffing such as emergency responders, facility operations, and emergency response;
- disposal of transuranic (TRU) waste at a reduced rate, with no more than 5 shipments per week;
- waste characterization and certification activities to support the process of shipping waste from TRU waste generator sites; and
- essential activities to maintain the WIPP underground area, such as roof bolting, that are needed to ensure the underground area remains safe.

CBFO's original stop work order was for 30 days, and it was extended for another 30 days on April 27. Based on direction from the Office of Environmental Management, CBFO has developed a plan for a return to operations in four phases, with a greater number of operations resuming at the site in each phase. On June 1, 2020, CBFO initiated Phase 1, which allows the contractor to resume high-priority work that has a low risk of exposing workers at the WIPP site to COVID-19.

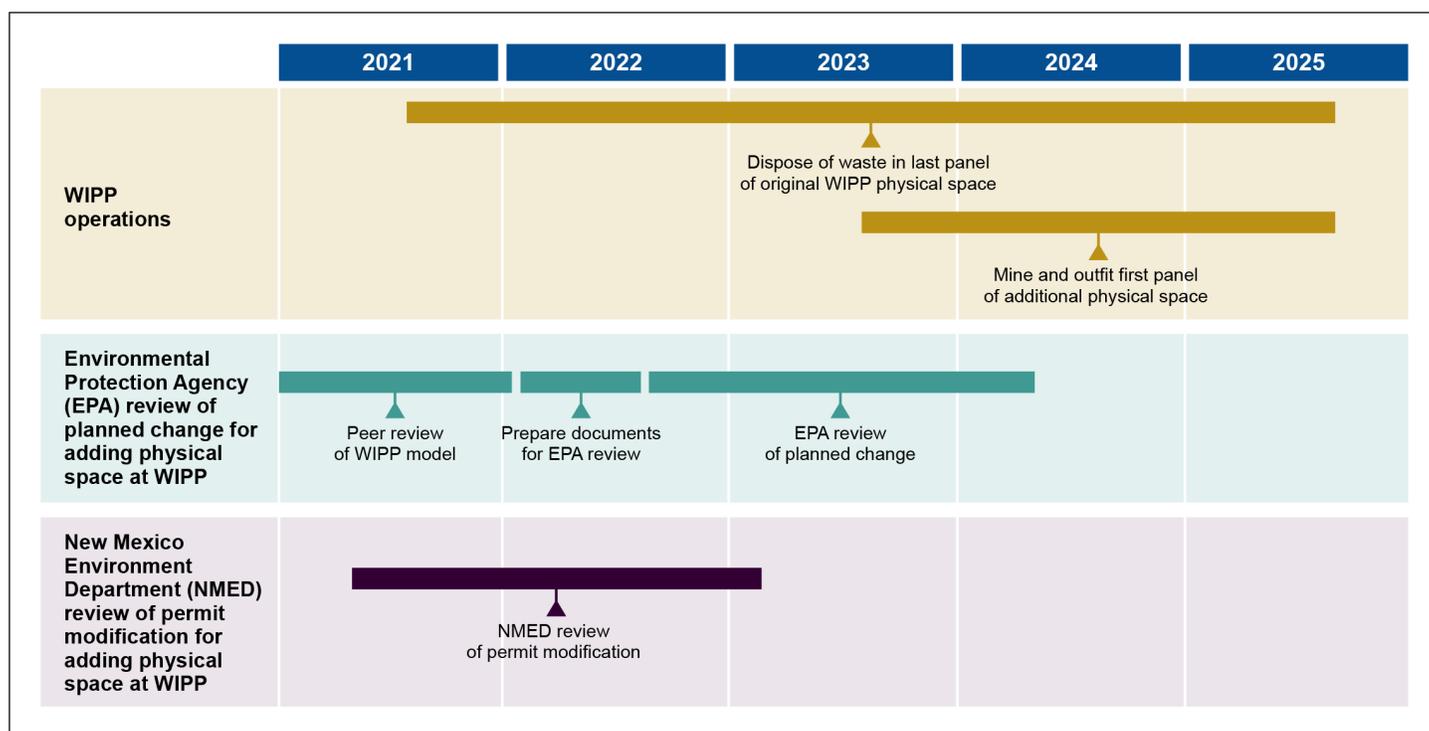
Source: GAO presentation of Department of Energy information. | GAO-21-48

There are several key schedule risks for completing the first new panel of the additional physical space by 2025 that, if realized, could affect DOE's TRU waste cleanup program at multiple sites across the country. For instance, DOE faces risks related to the two capital asset projects. According to DOE officials, DOE needs the capabilities provided by the SSCVS and Utility Shaft projects in order to complete construction of the first new panel of the additional physical space by 2025. As mentioned previously, however, both projects are facing challenges with identifying and overseeing contractors and getting necessary regulatory approvals.

According to DOE officials, these challenges could create delays to the point that the projects can no longer be completed on time.<sup>57</sup> If these delays occur, officials stated that the schedule for completing the first new panel of the additional physical space would also be impacted.

In addition to the risks posed by delays to the capital asset projects, there is a risk that DOE’s efforts to add physical space could be delayed by lengthy regulatory reviews by EPA and NMED. Figure 5 outlines DOE’s estimated timeline for the approval and construction of additional physical space at WIPP based on the Integrated Master Schedule as of January 2020.

**Figure 5: Department of Energy’s (DOE) Estimated Timeline for Adding Physical Space at the Waste Isolation Pilot Plant (WIPP)**



Source: GAO analysis of DOE documents. | GAO-21-48

<sup>57</sup>According to DOE officials, limitations on work at WIPP that began in March 2020 due to the COVID-19 pandemic have resulted in slight delays to the capital asset projects. However, construction work for the SSCVS was deemed an essential activity and has continued.

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As we reported in 2017, EPA officials have indicated that adding physical space to WIPP constitutes a significant change to the original design of the facility and will therefore require EPA review and approval of the proposed design.<sup>58</sup> DOE officials stated in 2017 that they would need to develop an entirely new three-dimensional mathematical model that can assess whether the facility will continue to meet EPA regulatory requirements with the added physical space.<sup>59</sup> However, DOE officials told us in June 2019 that work on the three-dimensional model would not be complete in time to be used for EPA's review and that DOE would instead modify its existing two-dimensional model. Before submitting the proposed design to EPA, DOE will need to submit the modified two-dimensional model for an independent peer review process that takes approximately 9 months to a year, according to DOE officials. DOE officials stated that there is a risk that the model will fail its peer review or will be deemed insufficient to support the submission for the design of the additional physical space during EPA's review. If either of these risks were to be realized, DOE and EPA officials told us that this could delay the approval of the additional physical space by a year or more while the work on the three-dimensional model is completed.

DOE estimated in its Integrated Master Schedule that EPA's review of the design for the additional physical space would take approximately 18 months. EPA officials, however, told us it is possible the review process could take longer than DOE has estimated. EPA officials indicated that they could approve DOE's proposal for additional physical space either through a letter to DOE or through a rulemaking, and the decision on which approach to use will be based on the materials submitted by DOE and direction provided by EPA management. If the additional physical space is approved through a letter, EPA officials stated that it is possible that this process could be completed within the 18-month time frame that DOE had estimated in its Integrated Master Schedule. However, EPA officials noted that this estimate was ambitious and that the process could take approximately 6 additional months if the agency decides to seek public comment before completing the review. If EPA officials determine that a rulemaking is necessary, officials stated that this would likely add

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<sup>58</sup>[GAO-17-390](#).

<sup>59</sup>The model developed by DOE is a simulation that DOE uses to demonstrate to EPA that WIPP will meet the EPA disposal regulations containment requirements for the likelihood of a radiological release over a 10,000-year period.

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up to a year or more beyond DOE's 18-month estimate for the review process.

NMED officials also identified risks that could delay DOE's estimated time frame for approval for additional physical space. They note that for DOE to construct and dispose of waste in a panel in the underground area, that panel must first be approved as a hazardous waste disposal unit by NMED, which would take place through the permit modification process. According to the Integrated Master Schedule, DOE plans to submit a permit modification for additional physical space sometime in late spring to early summer of 2021 and estimates that NMED's review will take approximately 21 months. According to NMED officials, this amount of time is generally a reasonable estimate for reviewing such a permit modification.

However, as mentioned earlier, NMED is already engaged in reviewing the permit modification for the Utility Shaft and in the process of renewing WIPP's permit, and NMED officials stated that these reviews may take longer than estimated.<sup>60</sup> NMED officials told us that if either of these reviews is not complete when DOE submits the permit modification for additional physical space, there may not be sufficient staff resources to conduct these reviews simultaneously, and the review of the permit modification for additional physical space could be delayed. Furthermore, DOE's Integrated Master Schedule indicates that it intends to mine the hallways that would connect the existing WIPP underground areas to the planned additional physical space prior to NMED's review and approval of the additional physical space. According to DOE officials, conducting this mining prior to NMED's approval of the permit modification is necessary in order to complete the additional physical space in time to prevent an interruption to waste disposal operations. However, according to DOE and NMED officials, as of September 2020, discussions are ongoing between the two parties about whether the mining of these hallways can move forward as scheduled or if NMED will need to approve this work by modifying the permit.

DOE is taking steps to mitigate the risk of schedule delays due to lengthy regulatory reviews, although officials stated that it is difficult to do so since the review processes are conducted by other agencies. For example, DOE officials stated that they intend to invite EPA officials to observe the

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<sup>60</sup>DOE officials told us that reviews of the Utility Shaft permit modification and permit renewal have been delayed because NMED officials are prioritizing their responsibilities for managing a portion of New Mexico's response to COVID-19.

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independent peer review of the two-dimensional model so that EPA officials will already be familiar with it when they begin their review. In addition, DOE officials told us that they are communicating frequently with NMED regarding the status of their plans for additional physical space so the agency can anticipate when staff resources will be needed for reviews. EPA officials told us that although they continue to communicate periodically with DOE regarding WIPP, they have not received information on DOE's plans for additional space at WIPP. According to DOE officials, the steps they are taking may help to mitigate the risk of schedule delays due to lengthy regulatory reviews, but they are unable to fully mitigate this risk, and the potential for schedule delays remains. Furthermore, DOE analyzed schedule risks in the Integrated Master Schedule only for the capital asset projects, and the regulatory risk identified above is for the portion of the Integrated Master Schedule scope outside of the capital asset projects. As a result, DOE has not included additional contingency time in the Integrated Master Schedule to address this risk.

DOE officials stated that there could be potential impacts to DOE's TRU waste cleanup program at multiple sites across the country if DOE is not able to complete the first new panel of the additional physical space in time to prevent an interruption to waste disposal operations at WIPP. We reported in 2017 that the slowing or interruption of waste disposal operations at WIPP could impair DOE's ability to meet its cleanup and national security missions as well as cleanup milestones agreed to with states that host DOE sites. A senior DOE official told us in March 2020 that the efforts to resume plutonium pit production at Los Alamos National Laboratory could be negatively impacted by an interruption to waste disposal operations.<sup>61</sup> In a 2019 report on program and project management at DOE, we identified conducting program risk management throughout the life of the program as a leading program management practice.<sup>62</sup> Specifically, we stated that following this leading practice would include actively identifying, monitoring, analyzing, accepting, mitigating, avoiding, or retiring program risks. According to DOE officials, they have not developed a plan for mitigating the potential impacts of the risk to DOE's TRU waste cleanup program because their focus is on

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<sup>61</sup>According to the senior DOE official, TRU waste will be generated by efforts to prepare the facility at Los Alamos where pits will be manufactured and the ongoing work to construct new plutonium pits. This TRU waste will require timely removal from the site and shipment to WIPP.

<sup>62</sup>GAO, *Nuclear Waste Cleanup: DOE Could Improve Program and Project Management by Better Classifying Work and Following Leading Practices*, [GAO-19-223](#) (Washington, D.C.: Feb. 19, 2019).

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executing the projects necessary to avoid an interruption to waste disposal operations. However, by developing a plan for mitigating the potential impacts of the risk to DOE's TRU waste cleanup program posed by a potential interruption to waste disposal operations at WIPP, DOE will be better able to effectively address the consequences if such an interruption occurs.

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## Conclusions

WIPP—the United States' only repository for the disposal of TRU waste generated by DOE's nuclear weapons research and production—has not returned to full disposal operations since accidents in 2014 and faces long-term issues with ensuring sufficient physical space and statutory capacity to dispose of DOE's inventory of TRU waste. DOE has taken steps to address each of these issues, including initiating two capital asset projects, developing plans for adding additional physical space, and revising the method it uses to calculate TRU waste. However, DOE is encountering challenges with completing the two capital asset projects and, because of vacancies, DOE's CBFO may not have sufficient staff to address these challenges. While DOE has attempted to fill vacancies by offering pay and relocation incentives, it has not identified and fully analyzed which additional flexibilities it could use. By identifying and fully analyzing additional flexibilities it could use to address the vacancy issue at CBFO, DOE will be in a better position to recruit and retain the workforce it needs to effectively address the challenges DOE officials identified in managing and overseeing projects at WIPP.

DOE developed an Integrated Master Schedule for WIPP that estimates that the first new panel of its planned additional physical space will be completed prior to an interruption to waste disposal operations. However, the Integrated Master Schedule is not reliable because it does not sufficiently follow best practices to at least substantially meet all four characteristics of a reliable schedule estimate. By making improvements to the Integrated Master Schedule so that it sufficiently follows best practices to at least substantially meet the four characteristics of a reliable schedule, DOE can better ensure that its estimate for completing additional physical space at WIPP before an interruption to waste disposal operations is reliable.

Additionally, DOE faces several key schedule risks for completing the first new panel of the additional physical space at WIPP by 2025, which could impact DOE's TRU waste cleanup program at multiple sites across the country. However, DOE has not developed a plan for mitigating the potential impacts of the risks to DOE's TRU waste cleanup program from an interruption to waste disposal operations. By developing a plan for

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mitigating the potential impacts of the risk to DOE's TRU waste cleanup program posed by a potential interruption to waste disposal operations at WIPP, DOE will be better able to effectively address these impacts if such an interruption occurs.

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## Recommendations for Executive Action

We are making the following three recommendations to DOE:

The Assistant Secretary for Environmental Management should identify and fully analyze what additional flexibilities could be used to address the staffing vacancies at CBFO. (Recommendation 1)

The Assistant Secretary for Environmental Management should ensure that the WIPP Integrated Master Schedule is updated so that it sufficiently follows best practices to at least substantially meet the four characteristics of a reliable schedule. (Recommendation 2)

The Assistant Secretary for Environmental Management should develop a plan for mitigating the potential impacts of the risks to DOE's TRU waste cleanup program posed by a potential interruption to waste disposal operations at WIPP. (Recommendation 3)

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## Agency Comments and Our Evaluation

We provided a draft of this report to DOE and EPA for comment. In its comments, reproduced in appendix III, DOE concurred with our three recommendations, including addressing vacancies at CBFO, updating the WIPP Integrated Master Schedule so that it follows schedule estimating best practices, and preparing a plan in collaboration with TRU waste generator sites to mitigate potential impacts from an interruption to disposal operations at WIPP. EPA did not provide written comments on the draft report, and both DOE and EPA provided technical comments, which we incorporated as appropriate.

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

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If you or your staff have any questions about this report, please contact me at (202) 512-3841 or [bawdena@gao.gov](mailto: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 IV.

A handwritten signature in black ink, appearing to read "Allison Bawden". The signature is fluid and cursive, with the first name "Allison" written in a larger, more prominent script than the last name "Bawden".

Allison B. Bawden  
Director, Natural Resources and Environment

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*List of Committees*

The Honorable James M. Inhofe  
Chairman

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

The Honorable Lamar Alexander  
Chairman

The Honorable Dianne Feinstein  
Ranking Member  
Subcommittee on Energy and Water Development  
Committee on Appropriations  
United States Senate

The Honorable Adam Smith  
Chairman

The Honorable Mac Thornberry  
Ranking Member  
Committee on Armed Services  
House of Representatives

The Honorable Marcy Kaptur  
Chairwoman

The Honorable Mike Simpson  
Ranking Member  
Subcommittee on Energy, Water Development, and Related Agencies  
Committee on Appropriations  
House of Representatives

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# Appendix I: Objectives, Scope, and Methodology

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Our report examined (1) the extent to which the Department of Energy's (DOE) long-term plans for meeting its transuranic (TRU) waste disposal needs include sufficient physical space at the Waste Isolation Pilot Plant (WIPP) without exceeding the facility's statutory capacity, (2) the challenges DOE identified to completing the capital asset projects needed to return WIPP to full disposal operations, and (3) the extent to which DOE's plans for adding physical space at WIPP provide assurance that this additional capacity will be completed without an interruption to waste disposal operations.

To address all three objectives, we conducted a site visit to WIPP in June 2019. During the site visit, we obtained documentation and interviewed officials from DOE's Carlsbad Field Office (CBFO), which manages and oversees WIPP operations under DOE's Office of Environmental Management. To better understand the status of DOE's progress on the capital asset projects and adding physical space, we obtained design documents for the Safety Significant Confinement Ventilation System and the Utility Shaft and DOE's analysis of alternatives for adding physical space at WIPP. We also interviewed representatives from Nuclear Waste Partnership LLC, which is the contractor that manages and operates WIPP for DOE. In addition, we toured the WIPP site and observed ongoing construction of the Safety Significant Confinement Ventilation System and site preparation work for the Utility Shaft.

To examine the extent to which DOE's long-term plans for meeting its TRU waste disposal needs include sufficient physical space at WIPP without exceeding the facility's statutory capacity, we reviewed documentation and data on DOE's revised TRU waste volume counting method and DOE documentation on the development of additional physical space at WIPP. To understand the legal requirements governing TRU waste disposal at WIPP and the facility's statutory capacity, we reviewed the WIPP Land Withdrawal Act and DOE's Annual TRU Waste Inventory Report, which documents how DOE tracks waste volumes against the statutory capacity. We reviewed the documents DOE submitted to the New Mexico Environment Department (NMED) on the modification to WIPP's permit to allow for the change in volume counting to determine how the change would be measured, recorded, and reported under the new counting method. Specifically, to assess the impact of the revised counting method on current and projected TRU waste totals, we reviewed data collected for the fiscal year 2018 DOE Annual TRU Waste Inventory Report from DOE's Comprehensive Inventory Database and Waste Data System on the volume and quantities of TRU waste containers already disposed of at WIPP and expected to be disposed of

there in the future.<sup>1</sup> Specifically, we looked at the number of containers of each type that had been disposed of in WIPP as of December 2017 and volumes of the inner and outer containers for each type of package. Each container type has a standard volume set by DOE. We also performed the same analysis with data on containers of waste estimated by DOE sites that were projected to come to WIPP.<sup>2</sup> Data from the 2018 inventory report was the most currently available at the time of our analysis.<sup>3</sup>

We assessed the reliability of the data used to develop this report by reviewing manuals and procedures for the databases provided by DOE and interviewed DOE officials responsible for managing the databases to understand what procedures they had in place to ensure the data and the output they provided to us was reliable. From these reviews and interviews, we found the data were reliable for the purpose of reporting on the change to the volume counting method and determining whether DOE has sufficient statutory capacity for its inventory of TRU waste. However, we note that the data regarding the estimated volumes of TRU waste expected to come to WIPP in the future have some level of uncertainty. For example, DOE officials stated that the actual volume of waste that is disposed of at WIPP in the future may be higher than their current estimates, in some cases due to circumstances that DOE cannot predict, such as the need to repackage certain stored wastes into multiple containers and thereby increase the total volume of waste. Additionally, a DOE official told us that the actual volume of waste disposed of at WIPP could be lower than what they currently estimate in certain cases because they are working on minimizing the volumes of TRU waste produced in the future by, for example, developing more efficient waste packaging processes. DOE annually updates its estimates on the volume of waste expected to be disposed of at WIPP in the future. On our site visit to WIPP, we interviewed DOE officials responsible for managing WIPP operations to understand how they were implementing the revised TRU

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<sup>1</sup>Information on the volume and quantities of TRU waste containers expected to be disposed of in WIPP are based on waste estimates reported by DOE TRU waste generator sites as of December 31, 2017. These sites were asked to report the most comprehensive TRU inventory estimate available projected through calendar year 2050, and additional estimates beyond 2050, if available.

<sup>2</sup>The 2018 Annual TRU Waste Inventory Report includes estimated volumes for stored and newly generated TRU waste between 2018 and 2062.

<sup>3</sup>We did not evaluate the changes in estimated TRU waste volumes in the 2019 Annual TRU Waste Inventory Report because our data reliability analysis used data from the 2018 report.

waste volume counting method, as well as how this new counting method affects the likelihood that DOE will reach WIPP's statutory capacity in disposing of current and estimated future TRU waste.

To understand DOE's planning for new physical capacity, we reviewed DOE's analysis of alternatives and initial draft conceptual design documentation that outlined its ongoing planning for the additional physical space at WIPP as well as plans for disposing of remote-handled waste at WIPP. We interviewed officials from Sandia National Laboratory's Carlsbad Office regarding their involvement in the design and regulatory approval process for the additional physical space.<sup>4</sup> We also interviewed officials from DOE's CBFO about the status of DOE's planning and officials from NMED and the Environmental Protection Agency (EPA) regarding their oversight of DOE's efforts to address the statutory capacity and physical space issues at WIPP, respectively. In addition, to understand the process for renewing and modifying the hazardous waste disposal and storage permit for WIPP, we spoke to officials from NMED's Hazardous Waste Bureau. We also spoke with EPA officials to understand EPA's process for certification of WIPP as complying with EPA's waste disposal regulations. Furthermore, to understand what wastes were not included in DOE's inventory but may come to WIPP in the future, we (1) reviewed our 2017 report that analyzed this issue, (2) reviewed the National Nuclear Security Administration's Draft Environmental Impact Statement for Plutonium Pit Production at the Savannah River Site in South Carolina, and (3) interviewed CBFO officials regarding whether any additional wastes we had not yet accounted for should be included.<sup>5</sup>

To examine challenges DOE has identified to completing the capital asset projects needed to return WIPP to full disposal operations and the extent to which DOE has the staff necessary to address these challenges, we reviewed DOE documents that established the cost and schedule baselines at Critical Decision 3 for the two capital asset projects to

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<sup>4</sup>Sandia's Carlsbad Office provides certain scientific expertise to DOE's Carlsbad Field Office, most notably by developing the performance assessments that demonstrate to EPA that WIPP's long-term performance remains in compliance with applicable regulations.

<sup>5</sup>GAO, *Proposed Dilute and Dispose Approach Highlights Need for More Work at the Waste Isolation Pilot Plant*, [GAO-17-390](#) (Washington, D.C.: September 2017). National Nuclear Security Administration, *Draft Environmental Impact Statement for Plutonium Pit Production at the Savannah River Site in South Carolina*, (Washington, D.C.: Sep. 2020).

identify the scope, cost, and schedule estimates.<sup>6</sup> We reviewed planning documents for the two capital asset projects and interviewed DOE officials managing the projects to determine the primary challenges and risks to completing each project on time and within budget and to determine whether DOE had identified sufficient risk mitigation strategies. To understand how DOE defines full disposal operations, we interviewed CBFO officials about how they defined limited and full disposal operations, and they told us they based this on weekly TRU waste shipping rates. We then reviewed information from DOE's Integrated Master Schedule that allowed us to understand what the weekly shipping rates had been since 2018 and what DOE was projecting it would achieve in the future.

We reviewed *DOE's CBFO 2019 Workforce Analysis and 5-Year Workforce Plan (2020-2024)* to identify staffing levels at CBFO as of fiscal year 2019, whether DOE considers current staffing levels to be sufficient to support the multiple ongoing activities at WIPP, and what strategies DOE is suggesting for addressing workforce gaps at CBFO. Because the workforce plan identified staffing gaps at CBFO, we also reviewed the plan and interviewed DOE officials to identify whether DOE had developed hiring strategies, including the use of flexibilities and other human capital strategies and tools, and considered how these strategies could be used to eliminate gaps. We reported in 2003 that developing such a hiring strategy was a key principle for effective strategic workforce planning.<sup>7</sup> In addition, we interviewed senior officials at CBFO and DOE headquarters to determine whether key positions at CBFO have been consistently filled, what efforts have been made to fill vacant positions, and any future plans they have to address staffing challenges. We analyzed past data on vacancies at CBFO for fiscal years 2010-2020 to determine staffing levels during this time frame. We selected this time frame because it provided us data on vacancies from prior to the 2014 accidents at WIPP and the subsequent increase in staffing levels at CBFO up to the current fiscal year. We assessed the reliability of this data by interviewing relevant officials and reviewing documentation. We

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<sup>6</sup>Under DOE Order 413.3B, Critical Decision 3 is the point where a project begins construction. Department of Energy, *Program and Project Management for the Acquisition of Capital Assets*, DOE Order 413.3B (Washington, D.C.: Dec. 20, 2016).

<sup>7</sup>GAO, *Human Capital: Key Principles for Effective Strategic Workforce Planning*, [GAO-04-39](#) (Washington, D.C.: Dec. 11, 2003).

determined that the data were reliable for reporting on the number of vacancies at CBFO over the last decade.

To examine the extent to which DOE's plans for adding physical space at WIPP provide assurance that this disposal space will be completed without an interruption to waste disposal operations, we conducted an analysis of WIPP's Integrated Master Schedule—which integrates the schedule estimates for the construction projects, the plans for adding physical space, and ongoing WIPP operations—to determine whether it meets best practices found in our Schedule Assessment Guide.<sup>8</sup> We selected this schedule because it outlines the activities that are necessary to complete additional physical space without an interruption to waste disposal operations. In analyzing a schedule estimate against best practices in GAO's schedule guide, we examined four characteristics, each defined by multiple criteria:

- comprehensive,
- well-constructed,
- credible, and
- controlled.

For this review, we assessed the WIPP Integrated Master Schedule that DOE updated as of January 2020 against each of these four criteria.<sup>9</sup> Additionally, we reviewed DOE documentation on the schedule risks that had been identified and any mitigation plans that had been developed to respond to those risks. We also interviewed officials from NMED and EPA to obtain their views on the viability of DOE's schedule for completing additional physical space.

We conducted this performance audit from April 2019 to November 2020 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

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<sup>8</sup>GAO, *GAO Schedule Assessment Guide: Best Practices for Project Schedules*, [GAO-16-89G](#) (Washington, D.C.: December 2015).

<sup>9</sup>DOE is in the process of updating its schedule based on the impact of Coronavirus Disease 2019 and subsequent reductions in regular operations at WIPP.

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**Appendix I: Objectives, Scope, and  
Methodology**

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the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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# Appendix II: Assessment of DOE's Integrated Master Schedule for WIPP Compared with Best Practices

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Table 2 below summarizes the results of our assessment of the Department of Energy's (DOE) Integrated Master Schedule for the Waste Isolation Pilot Plant (WIPP) compared to industry best practices for developing a schedule estimate published in the GAO Schedule Assessment Guide.<sup>1</sup> A high-quality, reliable schedule has four characteristics: it is comprehensive, well-constructed, credible, and controlled. Overall, DOE's schedule substantially met two of the four characteristics of a high-quality schedule—comprehensive and controlled—and partially met the other two characteristics—well-constructed and credible. A schedule estimate is considered reliable if the assessment for each of the four characteristics are substantially or fully met. If any of the characteristics are not met, minimally met, or partially met, then the schedule estimate does not fully reflect the characteristics of a high-quality schedule and cannot be considered reliable.

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<sup>1</sup>GAO, *GAO Schedule Assessment Guide: Best Practices for Project Schedules*, [GAO-16-89G](#) (Washington, D.C.: December 2015).

**Appendix II: Assessment of DOE's Integrated Master Schedule for WIPP Compared with Best Practices**

**Table 2: Assessment of the Department of Energy's (DOE) Integrated Master Schedule for the Waste Isolation Pilot Plant (WIPP) Compared with Industry Best Practices**

<b>Best practice characteristic and overall assessment</b>	<b>Best practice</b>	<b>Detailed assessment<sup>a</sup></b>
<b>Comprehensive: Substantially Met</b>	Capturing all activities	<b>Substantially Met.</b> The Integrated Master Schedule contains activities for both DOE and its contractor that are necessary to accomplish the program's objectives. The Integrated Master Schedule also contains schedule risk mitigation activities. All activities have a work breakdown structure element assigned, but the work breakdown structure documentation provided did not contain all the elements that were assigned within the schedule.
	Assigning resources to all activities	<b>Fully Met.</b> The Integrated Master Schedule includes the labor, materials, travel, facilities, and equipment resources needed to do the work and depicts when those resources are needed. We found resources were assigned to 93 percent of the activities remaining to be completed. Officials explained that majority of activities within the capital projects and infrastructure projects are performed by subcontractors under firm fixed-price contracts. Therefore, the contractor, Nuclear Waste Partnership, leaves it to the subcontractors to determine how to properly level the resources in the cases where activities are not completed on schedule.
	Establishing the durations of all activities	<b>Substantially Met.</b> DOE has a process in place to ensure that activity durations in the Integrated Master Schedule are realistic and that they allow for discrete progress measurement. However, there were instances in which activities have long durations but were not marked as level-of-effort in portions of the Integrated Master Schedule covering the capital asset projects.
<b>Well-constructed: Partially Met</b>	Sequencing all activities	<b>Partially Met.</b> DOE officials reported that logical relationships between activities have been determined by those executing the program. Further, we found that the majority of activities within the detailed schedules were logically linked, and relationships within the detailed schedules were finish-to-start, meaning that the network logic is generally straightforward. However, we found about 4 percent of remaining activities had dangling logic or logic that is not properly tied to activity start or end dates. In addition, we found instances of high convergence, where activities or milestones have many predecessors. Convergence should be a key program management concern because the risk at the merge point is multiplicative.

**Appendix II: Assessment of DOE's Integrated Master Schedule for WIPP Compared with Best Practices**

Best practice characteristic and overall assessment	Best practice	Detailed assessment <sup>a</sup>
	Confirming that the critical path is valid	<b>Partially Met.</b> The Integrated Master Schedule includes a critical path for each of its three projects. However, we found issues on the paths that may reduce management's ability to monitor key activities that can delay the program. For example, the critical paths for the general WIPP operations project consisted solely of three long-duration activities. According to best practices, long-duration activities should be reevaluated to determine if they can be broken down into more manageable pieces, particularly if they appear on the critical path. In addition, the critical path for the Safety Significant Confinement Ventilation System (SSCVS) schedule does not begin at the status date. The critical path should be a continuous sequence of activities from the schedule status date to the finish milestone to create a complete picture of the project from start to finish.
	Ensuring reasonable total float	<b>Partially Met.</b> The Integrated Master Schedule has a maximum total float of 454 days and a minimum total float of -187 days, with 26 percent of remaining activities having total float greater than 2 working months. DOE officials reported that total float is monitored and management has plans to mitigate negative total float. However, the float levels in the Integrated Master Schedule likely do not represent the actual degree of flexibility in the schedule. Because float dictates the criticality of activities, incorrect float estimates will result in an invalid critical path.
Credible: <b>Partially Met</b>	Verifying that the schedule is traceable horizontally and vertically	<b>Partially Met.</b> We found that the schedule was not fully horizontally traceable because of logic and total float issues. For example, some activities would need to be delayed hundreds of days to affect the dates of successor activities. The schedule is generally vertically traceable—that is, dates were consistent between various levels of the schedule and management documentation. However, we were unable to verify that all key milestones are included in the schedule.
	Conducting a schedule risk analysis	<b>Partially Met.</b> Support documentation shows that a schedule risk analysis was performed to determine the confidence level in achieving the program schedule for the Utility Shaft project, but the SSCVS risk analysis was outdated and analysis was not performed on the general WIPP operations project. Without the analysis models, we were unable to verify that risk inputs are traceable from the documentation to the risk analysis. In addition, if the schedule risk analyses are to be valid, the program's schedule must reflect reliable logic and clearly identify the critical paths. If the schedule does not follow best practices, confidence in the schedule risk analysis results will be lacking.
Controlled: <b>Substantially Met</b>	Updating the schedule with actual progress and logic	<b>Substantially Met.</b> Schedule progress and logic in the Integrated Master Schedule are updated weekly by trained officials and reported monthly to DOE management. At least one activity on the critical path is currently in progress for two of the three projects in the Integrated Master Schedule. However, there is no evidence that a schedule narrative accompanies each schedule status update. Good documentation helps with analyzing changes in the program schedule and identifying the reasons for variances.

**Appendix II: Assessment of DOE's Integrated Master Schedule for WIPP Compared with Best Practices**

<b>Best practice characteristic and overall assessment</b>	<b>Best practice</b>	<b>Detailed assessment<sup>a</sup></b>
	Maintaining a baseline schedule	<b>Substantially Met.</b> The Integrated Master Schedule includes baseline schedules for each of the three projects. DOE officials reported that the schedule margin for the capital projects is managed through a change control process in which changes to the baseline schedules are reviewed and approved according to this process. DOE officials stated that while they had not yet analyzed trends in already completed Integrated Master Schedule activities, they are currently establishing this analysis capability.

Source: GAO analysis of WIPP's Integrated Master Schedule. | GAO-21-48

<sup>a</sup>The ratings we used in this analysis are as follows: "Not met" means DOE provided no evidence that satisfies the best practice. "Minimally met" means DOE provided evidence that satisfies a small portion of the best practice. "Partially met" means DOE provided evidence that satisfies about half of the best practice. "Substantially met" means DOE provided evidence that satisfies a large portion of the best practice. "Met" means DOE provided complete evidence that satisfies the entire best practice.

# Appendix III: Comments from the Department of Energy



## Department of Energy

Washington, DC 20585

October 30, 2020

Ms. Allison Bawden  
Director  
Natural Resources and Environment  
U.S. Government Accountability Office  
441 G Street, N.W.  
Washington, DC 20548

Dear Ms. Bawden:

Thank you for providing a draft copy of the Government Accountability Office (GAO) report, *Nuclear Waste Cleanup: Better Planning Needed to Avoid Potential Disruptions at Waste Isolation Pilot Plant*, GAO-21-48. The Department of Energy has reviewed the draft report and agrees with the GAO's recommendations. Specific responses to the GAO recommendations, as well as technical and general comments, are enclosed.

The Office of Environmental Management (EM) is working to fill staffing vacancies at the Carlsbad Field Office. EM will update the Waste Isolation Pilot Plant (WIPP) Integrated Master Schedule to follow best practices identified by GAO, as appropriate for this project. EM will also develop a plan for mitigating the potential resultant effects to the Department's transuranic waste cleanup program from any potential significant interruption to waste disposal operations at WIPP.

If you have any questions, please contact me or Ms. Nicole Nelson-Jean, Associate Principal Deputy Assistant Secretary for Field Operations, at (202) 586-1426.

Sincerely,

for 

William I. White  
Senior Advisor for Environmental Management  
to the Under Secretary for Science

Enclosures

Enclosure 1

**Response to Report Recommendations**

**Recommendation 1:** The Assistant Secretary for Environmental Management should identify and fully analyze what additional flexibilities could be used to address the staffing vacancies at the CBFO.

***Management Response: Concur***

The Office of Environmental Management (EM) will continue to leverage recent actions (e.g., pay incentives, reimbursement of relocation expenses, etc.) and identify and pursue additional opportunities to address the Carlsbad Field Office (CBFO) staffing vacancies. Priority will be placed on filling vacancies associated with the oversight of the capital asset projects and other key positions.

Estimated Completion Date: January 31, 2021

**Recommendation 2:** The Assistant Secretary for Environmental Management should ensure that the WIPP Integrated Master Schedule is updated so that it sufficiently follows best practices to at least substantially meet the four characteristics of a reliable schedule.

***Management Response: Concur***

The Department of Energy (DOE) will update the Waste Isolation Pilot Plant (WIPP) Integrated Master Schedule following best practices, as appropriate, for a reliable schedule.

Estimated Completion Date: June 30, 2021

**Recommendation 3:** The Assistant Secretary for Environmental Management should develop a plan for mitigating the potential impacts of the risks to DOE's TRU waste cleanup program posed by a potential interruption to waste disposal operations at WIPP.

***Management Response: Concur***

The DOE National Transuranic (TRU) Program will prepare a plan in collaboration with TRU waste generator sites to mitigate potential impacts from potential interruptions of WIPP waste disposal operations. The plan will consider lessons-learned from the interruption of WIPP shipments between 2014 and 2017.

Estimated Completion Date: June 30, 2021

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# Appendix IV: GAO Contact and Staff Acknowledgments

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## GAO Contact

Allison B. Bawden, (202) 512-3841 or [bawdena@gao.gov](mailto:bawdena@gao.gov)

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## Staff Acknowledgments

In addition to the contact named above, Amanda K. Kolling (Assistant Director), Eli Lewine (Analyst in Charge), Whitney Allen, Lauren Mosteller, and Muhammad Safavi made key contributions to this report. Also contributing to this report were Mark Braza, Juaná Collymore, Ellen Fried, Gwendolyn Kirby, Katrina Pekar-Carpenter, Danny Royer, Jeanette Soares, David Trimble, and Doris Yanger.

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