



July 2023

HANFORD CLEANUP

DOE Should Consider Including Expedited Nuclear Waste Treatment Alternatives in Upcoming Analysis

Why GAO Did This Study

DOE is legally required to retrieve and treat approximately 54 million gallons of radioactive waste held in 177 aging and leak-prone underground storage tanks, grouped in tank farms, at the Hanford site in Washington State. Due to delays and escalating costs of starting waste treatment, DOE is negotiating with the U.S. Environmental Protection Agency and the State of Washington on alternatives for treating the waste. The selection of an alternative will likely have significant effects on Hanford tank farms plans and management, including schedule and budget.

Senate Report 117-39 includes a provision for GAO to evaluate cleanup efforts at Hanford. This report examines the extent to which DOE has developed specific plans for storing, preparing, staging, and transferring tank waste based on the various waste treatment alternatives DOE is considering and what barriers exist to implementing such plans.

GAO reviewed key DOE planning documents and reports and interviewed agency officials. GAO also examined DOE's tank farms risk management program and reviewed certain DOE analyses to identify tank farms barriers associated with waste treatment alternatives.

What GAO Recommends

GAO recommends that DOE consider, in consultation with the State of Washington, supplementing the scenarios in the next System Plan revision to include those that may allow expedited treatment of tank waste. DOE concurred with GAO's recommendation and plans to implement it by December 31, 2025. View [GAO-23-106151](#). For more information, contact Nathan Anderson at (202) 512-3841 or andersonn@gao.gov.

HANFORD CLEANUP

DOE Should Consider Including Expedited Nuclear Waste Treatment Alternatives in Upcoming Analysis

What GAO Found

The Department of Energy (DOE) has developed plans for storing, preparing, staging, and transferring a portion of the radioactive liquid waste from decades of nuclear weapons research and production held in tanks at DOE's Hanford site. The plans cover the first phase of waste treatment and disposal at Hanford's Low-Activity Waste (LAW) facility, including means of identifying and managing barriers to the plans' implementation. The plans also identify potential cost and schedule effects to the tank waste management and treatment mission from such barriers, which DOE refers to as risks not addressed. The following table shows some of the most likely (i.e., 90 percent chance or greater) and significant risks DOE identified during the first phase of treatment operations.

Selected High Level Risks and Potential Effects on Tank Farms That DOE Considers Very Likely to Occur During the First Phase of Waste Treatment

Facility/system risk	Risk description and potential effect on tank farms	DOE estimated range of costs and schedule impacts
Low-Activity Waste (LAW) facility	The facility might not operate at designed capacity. This risk includes waste processing rates that are lower than expected, facility shutdowns or slowdowns, and other performance-related issues. These issues could delay retrieval of tank waste.	\$338.1 million to \$1.8 billion 9 to 48 months
LAW Facility and waste treatment startup	The LAW Facility might not be ready to receive tank waste when treatment support projects are ready to start operations. Delays could limit tank waste retrieval and extend the cleanup schedule.	\$225.4 million to \$1.6 billion 6 to 42 months
Waste transfer lines	Potential extensive corrosion and moisture in the pipes transferring waste between tanks might cause them to fail.	\$5.8 million to \$10.5 million (per line failure) 3 to 12 months

Source: GAO analysis of Department of Energy (DOE) information. | GAO-23-106151

Note: These are rough order of magnitude estimates based on available information and subjective judgment and should not be interpreted as statistical forecasts.

DOE is considering alternatives for treating the waste remaining after the first phase of waste treatment starts. However, DOE is not planning to evaluate certain alternatives that may shorten the treatment mission in its upcoming revision to its System Plan. This is a required planning document that models and evaluates different scenarios for tank waste management and treatment. DOE expects to issue a System Plan revision in December 2023. According to DOE officials, the revision will include an updated version of the current planning waste treatment scenario, along with several scenarios that include grouting LAW (i.e., immobilizing the waste in a concrete-like mixture) beginning by 2050. However, in other studies, DOE has been analyzing alternatives that would potentially enable it to begin grouting LAW much sooner, as early as 2027. Given the potential cost and schedule implications for managing tank waste associated with this and other expedited treatment alternatives analyzed in DOE studies, the alternatives may merit inclusion in the next revision of the System Plan.

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Abbreviations

DFLAW	Direct-Feed Low-Activity Waste
DOE	U.S. Department of Energy
DST	double-shell tank
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
HLW	high-level waste
LAW	low-activity waste
ORP	Office of River Protection
RCRA	Resource Conservation and Recovery Act of 1976, as amended
SST	single-shell tank
TSCR	Tank-Side Cesium Removal
TPA	Tri-Party Agreement
WTP	Waste Treatment and Immobilization Plant

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July 26, 2023

Congressional Committees

For decades, the Department of Energy’s (DOE) Hanford site in southeastern Washington State produced plutonium and other special nuclear materials for our nation’s nuclear weapons programs.¹ At the Hanford site, approximately 54 million gallons of radioactive and hazardous waste is currently stored in 177 underground storage tanks, grouped together in 18 locations called tank farms. Most Hanford tanks are beyond their design life, and 52 are known or assumed to be leaking. According to the Oregon Department of Energy, leaking storage tanks and unplanned spills added to the contaminated liquids in the soil and resulted in extensive contamination of groundwater beneath the Hanford site.

As part of the cleanup mission, DOE has responsibility for the retrieval and treatment of Hanford tank waste before disposal, according to legal requirements and agreements made with federal and state environmental regulators. To accomplish this mission, for over 20 years, DOE has been constructing a set of treatment facilities—known as the Waste Treatment and Immobilization Plant (or WTP)—to vitrify (immobilize in glass) a large portion of Hanford’s tank waste. In 2016, due to WTP project management and technical challenges, DOE created a program, referred to as Direct-Feed Low-Activity Waste or DFLAW, to begin treating a portion of the least radioactive tank waste. Additionally, due to a number of factors, including the escalating costs of starting and sustaining certain WTP operations, DOE is currently considering alternative approaches for treating other portions of the tank waste. The alternative approaches DOE is considering include constructing additional pretreatment facilities, immobilizing some waste in a concrete-like mixture called grout, and starting all waste treatment by 2033.² Whichever alternative DOE selects may significantly affect Hanford tank farms plans and management, including tank space availability as well as tank integrity, deterioration, and leaks. Various alternatives could also potentially add or save tens of

¹Special nuclear material includes, among other things, plutonium and enriched uranium, which are key components of nuclear weapons.

²Under the terms of an amended Consent Decree between DOE and the state of Washington, DOE is currently required to start treating a portion of the tank waste by August 2025. The Consent Decree is described further below.

billions of dollars in the coming decades, according to DOE reports and officials.³

DOE's Office of River Protection (ORP), within DOE's Office of Environmental Management, manages tank farms cleanup activities at Hanford. In 2008, DOE awarded Washington River Protection Solutions the Hanford Tank Operations Contract, which includes work to modify and construct tank farms infrastructure needed to support waste treatment operations and the retrieval of waste from the tanks.⁴

Senate Report 117-39 includes a provision for GAO to evaluate DOE's environmental cleanup efforts at the Hanford site. This report examines the extent to which DOE has developed specific plans for storing, preparing, staging, and transferring tank waste based on the different waste treatment alternatives DOE is considering and what barriers exist to implementing such plans.

To address our objective, we examined key DOE and contractor planning documents and reports, interviewed DOE officials and contractors, and visited Hanford tank farms facilities. Specifically, we reviewed the tank farms management plans that DOE has developed to support the start of DFLAW operations and evaluated the extent to which they meet certain DOE planning requirements. We also reviewed the barriers to implementing DOE's plans for storing, preparing, staging, and transferring tank waste using different treatment alternatives identified in DOE tank farms management documents and Hanford waste processing reports.⁵ In our examination of barriers to implementing DOE's plans, we analyzed DOE's tank farms risk management program and reviewed key reports and documents that identified barriers associated with various tank waste treatment alternatives.

We also reviewed the 74 risks that DOE identified in the DFLAW Risk Register database as of February 8, 2023, which DOE uses to identify

³Department of Energy, *Final Report: Waste Treatment and Immobilization Plant High-Level Waste Treatment Analysis of Alternatives* (Jan. 12, 2023).

⁴The term for this contract expires in September 2023. On April 13, 2023, DOE awarded a new contract, the Integrated Tank Disposition Contract, for the Hanford Site to Hanford Tank Waste Operations & Closure, LLC (H2C) of Lynchburg, Virginia. Work to be performed under the new contract includes (1) operation of tank farms facilities, including single-shell tank waste retrieval and closure; (2) design, construction, and operation of waste receiving facilities and treatment capabilities; and (3) operation of the WTP.

⁵For the purposes of this report, we generally use the term "barrier" to refer to the potential obstacles and impediments that DOE faces as it proceeds with constructing and operating the facilities and infrastructure needed for managing and treating the Hanford tank waste.

and track project risks. Using this list of risks, we performed the following steps:

- We screened for those that DOE had described as involving the tank farms and had currently assessed as high-level risks with a greater than 90 percent chance of occurring during the life cycle of the project. High-level risks are those risks designated by DOE as high because of the high chances of an adverse event occurring and the high cost or schedule impacts if the adverse event were to occur. This screening resulted in an initial list of 12 risks that present potentially significant impacts to the cost and schedule for starting and operating DFLAW. Several of these risks involve the potential failure of individual waste transfer lines that deliver waste from the tank farms to the treatment facility. We consolidated these into a single risk, resulting in five risks total.
- In addition, we separately screened for other risks that DOE assessed as lower-level risks with less chance of occurring but that DOE assessed could nonetheless result in significant cost or schedule consequences.⁶
- We reviewed DOE's process for developing these ratings and the documentation supporting them, along with responses from officials involved in creating the assessments. We determined that they were sufficiently reliable for our purpose of broadly characterizing significant barriers to tank farms management associated with DFLAW operations and potential alternative treatment options rather than as statistical predictions. Therefore, we present them as rough ranges of approximate impacts rather than as precise statistical forecasts. In addition, we identified potential barriers to, and benefits of, using different approaches assessed in two recent DOE reports: the Hanford High-Level Waste Treatment Analysis of Alternatives and the Savannah River National Laboratory's analysis of alternative approaches to treating Hanford's low-activity waste.⁷

We also interviewed officials from DOE headquarters, DOE's ORP—including the Tank Farms Program Division, and Washington River

⁶According to DOE risk management documentation, significant consequences are those that result in either a 5 to 8 percent increase in the budgeted cost or a delay in the project schedule (between 30 to 60 days) that result in milestone changes.

⁷Department of Energy, *High-Level Waste Treatment Analysis of Alternatives*; and Savannah River National Laboratory, *Follow-on Report of Analysis of Approaches to Supplemental Treatment of Low-Activity Waste at the Hanford Nuclear Reservation*, SRNL-STI-2023-00007, vol. I (Aiken, SC: January 2023).

Protection Solutions officials responsible for executing the Hanford Tank Operations Contract. In addition, we interviewed officials from the Washington State Department of Ecology (Ecology) and the Defense Nuclear Facility Safety Board.⁸

We conducted this performance audit from July 2022 to July 2023, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

Treatment of Tank Waste at Hanford

The WTP was originally designed to treat two waste streams from the tanks: (1) the high-activity portion of tank waste, which DOE estimates will contain about 5 percent of the volume but more than 70 percent of the radioactivity; and (2) the low-activity portion, which will contain about 95 percent of the volume.⁹ At Hanford, DOE often uses the term high-level waste, or HLW, to refer only to the high-activity portion of the tank waste and uses the term low-activity waste, or LAW, to refer to the rest of the

⁸The Defense Nuclear Facilities Safety Board was established by statute in 1988 to provide independent analysis, advice, and recommendations to the Secretary of Energy regarding the adequate protection of public health and safety from DOE's activities conducted at defense nuclear facilities.

⁹We have reported in the past that the high-activity portion of the waste will comprise 10 percent of the volume and 90 percent of the radioactivity. See GAO, *Nuclear Waste Disposal: Actions Needed to Enable DOE Decision That Could Save Tens of Billions of Dollars*, [GAO-22-104365](#) (Washington, D.C.: Dec. 9, 2021). This estimate was based on DOE's prior plan for pretreating the tank waste. Under DOE's current approach, much of the lower activity waste is pretreated, using an approach designed to filter out solids, including cesium, from liquid tank waste. As we discuss later in this report, cesium contains a large percentage of the radioactivity in the tanks' waste. As a result, under this new approach, DOE estimates that less of the radioactivity will remain in the tanks after the lower activity waste is removed. DOE has not yet determined how it will address the cesium and other radionuclides removed from the low-activity waste.

tank waste.¹⁰ LAW is DOE's term for the primarily liquid portion of the tank waste, including dissolved saltcake, which contains low levels of long-lived radionuclides.¹¹

In 2015, due to WTP project management and technical challenges, DOE adopted a phased waste treatment strategy that, if successfully implemented, will allow DOE to begin treating LAW before it resolves all WTP technical issues. During the first phase of the strategy, DOE plans to implement the DFLAW approach, through which DOE plans to treat approximately 60 percent of the LAW stored in Hanford tanks using the WTP LAW facility.¹² To implement this approach, DOE first plans to separate tank waste into LAW and HLW using a pretreatment system to remove cesium. However, DOE has continued to face pretreatment and HLW treatment challenges that are taking longer to resolve than anticipated, as well as escalating costs and delays to beginning waste treatment.

Due to these and other challenges, DOE, the U.S. Environmental Protection Agency (EPA), and Ecology agreed to participate in confidential, mediated negotiations in an effort to develop a "holistic and realistic" approach for retrieving and treating Hanford's tank waste.¹³ As part of these negotiations, DOE, EPA, and Ecology are considering

¹⁰According to DOE officials, as a matter of policy, DOE currently manages all Hanford tank waste as if it is legally "high-level radioactive waste" unless, and until, the waste is formally classified as another waste type. High-level radioactive waste is defined by federal law and subject to specific legal requirements. See 42 U.S.C. § 10101(12). For the purposes of this report, when we refer to "HLW" we are referring only to the approximately 5 percent of the waste that DOE considers to have high radioactivity, not all tank waste that DOE currently manages as if it is legally "high-level radioactive waste."

¹¹Saltcake refers to water-soluble components, such as sodium salts, that crystallize or solidify out of the waste solution to form a moist, sandlike material.

¹²DOE's current plan is to vitrify about 60 percent of the LAW through the DFLAW program and to treat the remaining LAW (which is referred to as supplemental LAW) in a second (not yet built) vitrification facility. DOE is also evaluating alternatives to vitrification, such as immobilizing the waste in a concrete-like grout.

¹³In September 2019, DOE informed Ecology that DOE might be unable to meet certain legally established milestones related to, among other things, the construction of the pretreatment facility. In the same month, DOE agreed to participate in negotiations to identify a new path for treating and disposing of Hanford's tank waste. In October 2018, facing continuing technical challenges and delays on its pretreatment facility at the WTP, DOE began analyzing alternatives for pretreating HLW. As of April 2023, these two efforts were ongoing.

alternative approaches for treating the waste not intended for WTP DFLAW treatment.¹⁴

Hanford Tank Farms and Key Tank Farms Facilities and Infrastructure Required for Managing Tank Waste

There are 177 large, underground waste storage tanks at the Hanford site. Of these tanks, 149 are single-shell tanks (SST), and 28 are newer, double-shell tanks (DST). In total, these tanks contain about 54 million gallons of radioactive and hazardous waste. As we reported in 2014, most of these tanks are operating decades past their original design life.¹⁵ Specifically, the SSTs were built during the 1940s through the mid-1960s (see fig. 1), with a design life of approximately 25 years. The DSTs were built from 1968 through 1986, with a design life ranging from 20 to 50 years. DOE estimates that 52 of the SSTs may have already collectively leaked over 1 million gallons of waste into the ground.

Figure 1: Hanford Single-Shell Tank Farm under Construction



Source: Department of Energy. | GAO-23-106151

The SSTs and DSTs are clustered in 18 tank farms, each containing between two and 18 tanks. The tank farms are divided between the “200 East” and “200 West” Areas of the Hanford site, which are about 8 miles apart. Eleven of the 18 tank farms are in the 200 East Area, which is

¹⁴[GAO-22-104365](#).

¹⁵GAO, *Hanford Cleanup: Condition of Tanks May Further Limit DOE’s Ability to Respond to Leaks and Intrusions*, [GAO-15-40](#) (Washington, D.C.: Nov. 25, 2014).

closest to the DFLAW treatment facilities that DOE is currently constructing. AP Tank Farm, located in the 200 East Area, will provide the initial waste feed for DFLAW operations, according to DOE officials. Seven other tank farms are located in the 200 West Area. DOE has emptied most of the liquid waste from the SSTs and moved it to DSTs, while the more radioactive, solid waste remains in SSTs. In fiscal years 2019 through 2023, DOE spent over \$8 billion to construct waste treatment facilities and systems to maintain, prepare, and modify tank farms facilities and infrastructure to support waste treatment. From fiscal years 2022 to 2078, DOE expects to spend between approximately \$200 billion and \$496 billion on (1) tank farms operations, such as modifications to, and construction of, tank farms infrastructure to support waste treatment operations; and (2) retrieval of waste from, and closure of, tanks, according to a January 2022 DOE report.¹⁶

Several key tank farms facilities and infrastructure are required to support Hanford tank waste treatment. According to DOE officials, some of these are complete and ready to support tank waste treatment, while others are undergoing modification to support the start of DFLAW treatment operations. DOE officials noted that others may be needed to support future waste treatment alternatives under consideration. According to DOE officials we interviewed, these facilities and infrastructure potentially represent single points of failure within the DFLAW operating system such that if one facility or system is not functioning or needs modification, DOE would be unable to begin or sustain waste treatment operations. Key tank farms facilities and infrastructure include

- **222-S Laboratory:** The 222-S Laboratory is a 70,000 square foot analytical facility that handles samples of highly radioactive tank waste for purposes of organic, inorganic, and radio-chemistry analyses. This facility allows DOE to understand the characteristics of waste from different tanks prior to pretreatment and treatment. All waste characterization for waste treatment will occur using the capabilities of this facility;
- **Tank-Side Cesium Removal (TSCR):** To accomplish DFLAW pretreatment, the TSCR system is designed to filter out solids, including cesium 137 and strontium 90, from liquid tank waste. These solids account for 99.9 percent of the radioactivity in the waste

¹⁶Department of Energy, *2022 Hanford Lifecycle Scope, Schedule and Cost Report*, DOE/RL-2021-47 Revision 0 (Richland, WA: January 2022).

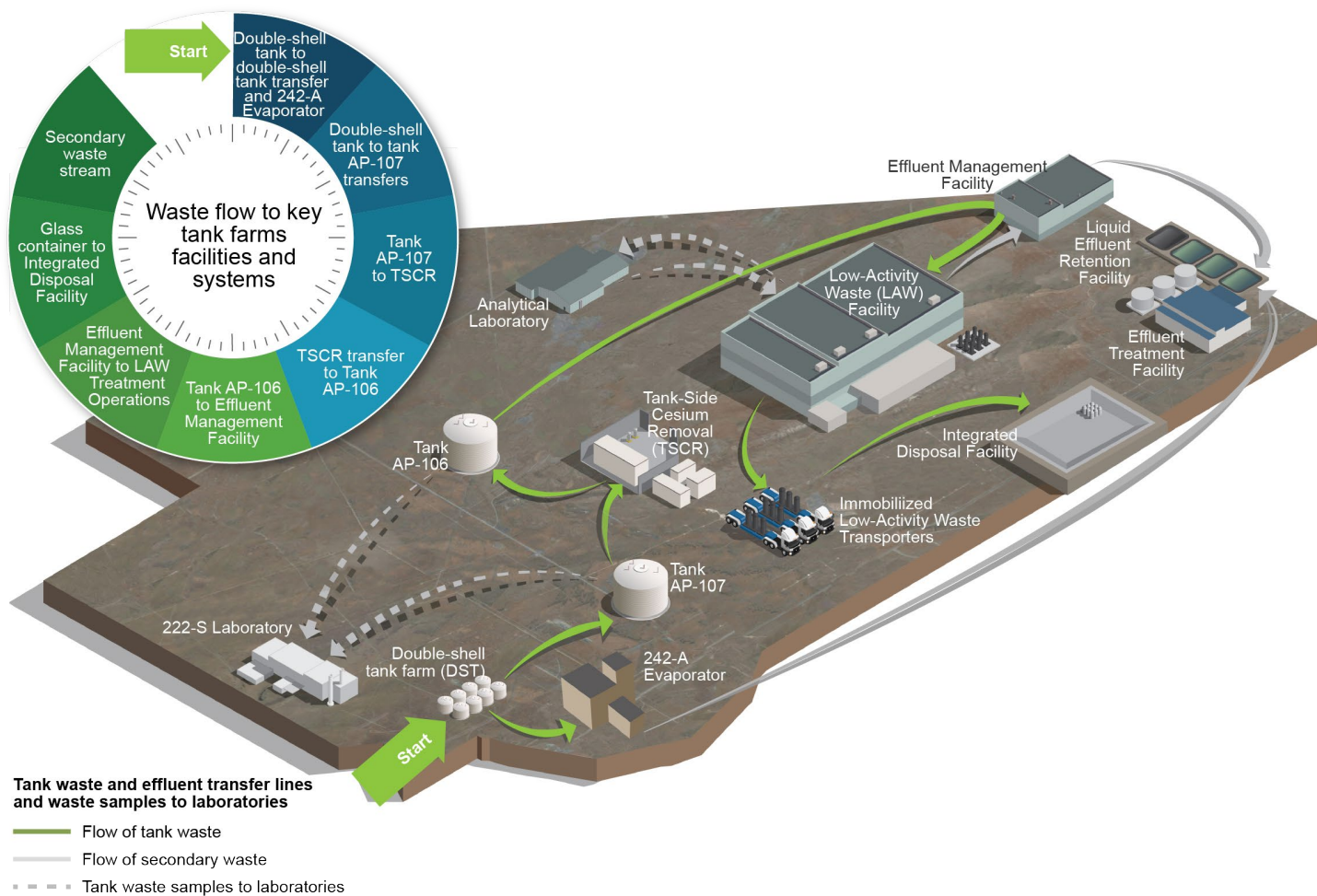
stream. Liquid LAW will then be pumped and staged in a DST for waste treatment at the LAW Facility;¹⁷

- **242-A Evaporator Facility:** The 242-A Evaporator Facility, which is centrally located in the Hanford site's 200 East Area, is used in freeing up tank space. As DFLAW pretreatment and operations start, additional contaminated water will result from processing waste, adding what is known as "secondary waste" to the total volume of waste in the tanks. The 242-A Evaporator boils liquid tank waste to evaporate water in order to reduce the volume of waste stored in Hanford's underground tanks, thereby freeing up capacity for retrievals of waste from SSTs and transfers to DSTs;
- **Tank Waste and Effluent Transfer Lines:** Tank transfer lines are used to transfer waste between tanks, between tank farms, and to facilities for pretreatment and treatment. The lines are also used to transport secondary waste—waste by-products resulting from waste treatment operations—to tanks and effluent treatment facilities, according to DOE officials; and
- **Liquid Waste Processing Facilities:** Hanford liquid waste processing facilities store, treat, and dispose of liquid waste as the last step in the cleanup process before treated liquid resulting from waste treatment and other Hanford operations is discharged to the environment. These facilities include the Liquid Effluent Retention Facility—a set of retention basins designed to store liquid waste until it can be processed at the Effluent Treatment Facility, which is a processing plant where chemical and radioactive contaminants are removed from the liquid waste. Wastewater is eventually processed through the Effluent Treatment Facility, and the treated water is sent to Hanford's state-approved Land Disposal Site for discharge to the environment.

¹⁷According to DOE officials, DOE plans to stage pretreated staged LAW at waste tank AP-106, which has been emptied and repurposed for use during the DFLAW pretreatment stage, and waste tank AP-107 will be used to transfer waste from other DSTs to TSCR. Cesium is one of the relatively short-lived radioactive components of the tank waste. DOE plans to store spent TSCR ion exchange columns containing separated waste at the TSCR storage pad. According to DOE officials, DOE has not yet conducted an analysis of alternatives for the eventual disposal of the waste resulting from TSCR pretreatment waste processing. DOE plans to store this waste on-site until a final repository is established.

Figure 2 illustrates the flow of waste from the 200 East Area tank farms to the key facilities and infrastructure required for DFLAW treatment, along with the Integrated Disposal Facility.¹⁸

Figure 2: Waste Flow from Hanford's Tank Farms to Key Facilities and Infrastructure Required for Direct-Feed Low-Activity Waste Treatment



Source: GAO analysis of Department of Energy document. | GAO-23-106151

¹⁸DFLAW waste treatment utilizes the WTP LAW Facility, Analytical Laboratory, and Effluent Management Facility. Once the vitrified LAW canisters have hardened and cooled, DOE plans to dispose of them at the Integrated Disposal Facility.

Regulatory Framework and Agreements Governing Hanford Tank Waste

As we have previously reported, retrieval, storage, treatment, and disposal of Hanford's tank waste is governed by a range of federal and state laws and regulations, DOE orders, and cleanup agreements.¹⁹ We summarize some of the aspects of the regulatory framework here that are particularly relevant to Hanford tank farms management.

Hanford tank waste contains a complex mix of radioactive and hazardous components. The radioactive components of this waste are regulated primarily by DOE under the Atomic Energy Act of 1954, as amended, and the Nuclear Waste Policy Act of 1982, as amended. The treatment, storage, and disposal of the hazardous components of the tank waste are generally regulated by EPA under the Resource Conservation and Recovery Act of 1976 (RCRA), as amended. EPA has authorized Ecology to administer its own hazardous waste regulatory program in lieu of the federal program.²⁰ Under that program, Ecology has issued DOE a dangerous waste permit that covers construction and operation of the WTP complex, including key DFLAW facilities and infrastructure.

Additionally, tank waste cleanup activities at Hanford are governed by two primary agreements:

- The Hanford Federal Facility Agreement and Consent Order of 1989—also known as the Tri-Party Agreement (TPA)—is an agreement among DOE, EPA, and Ecology that establishes, among other things, a series of legally enforceable milestones for completing major waste treatment and cleanup activities at Hanford. The purpose of the TPA is to ensure that Hanford cleanup activities comply with the applicable requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended; RCRA; and the Washington Hazardous Waste Management Act. The TPA also requires DOE to submit a System Plan to Ecology that describes the disposition of all tank waste managed by ORP and the completion of the treatment mission. The TPA requires DOE to update the System Plan every 3 years and to include an evaluation of scenarios for optimizing tank waste retrieval and treatment. For each

¹⁹See GAO, *Hanford Cleanup: DOE's Efforts to Close Tank Farms Would Benefit from Clearer Legal Authorities and Communication*, [GAO-21-73](#) (Washington, D.C.: Jan. 7, 2021); and [GAO-22-104365](#).

²⁰Under RCRA, EPA may authorize a state to implement its own hazardous waste management program in lieu of the federal program, so long as the state program is equivalent to, and at least as stringent as, the federal program. State programs may be more stringent than the federal program and may have provisions that are broader in scope than the federal program.

scenario, the plan is to include identification of any new equipment, technology, or actions, such as new evaporators or additional DSTs, that would be needed to implement the scenario.²¹

- The Consent Decree of 2010, as amended, was established as a result of litigation that Ecology brought against DOE for missing certain TPA milestones. This judicially enforceable Consent Decree establishes, among other things, milestones for waste retrieval from certain specified tanks and for the treatment of LAW.²²

Finally, certain capital assets required for tank waste management and treatment operations are subject to DOE Order 413.3B, Program and Project Management for the Acquisition of Capital Assets.²³ The order requires preparation of a Project Execution Plan (a key document for project management) for each capital asset project over a certain dollar threshold. This plan is typically developed in coordination with other planning documents, such as a Risk Register and Integrated Master Schedule.

²¹The first System Plan was issued in 2002, and ORP is currently working on Revision 10, which is due to be issued by December 31, 2023. The current version, Revision 9, was issued in October 2020: see Department of Energy, Office of River Protection, *River Protection Project System Plan*, ORP-11242 Revision 9 (Richland, WA: October 2020). System Plan 9 is a computer modeling exercise that evaluates five technical scenarios of different waste treatment alternatives developed collaboratively between DOE and Ecology. The TPA also requires the System Plan to include planning bases for each case, and a description of key issues, assumptions, and vulnerabilities for each scenario evaluated, including a description of how such issues, assumptions, and vulnerabilities are addressed in the evaluation.

²²Under the latest version of the amended Consent Decree, the deadline for commencing LAW treatment is August 1, 2025. See *State of Washington v. Granholm*, Case No. 2:08-cv-05085 (E.D. Wash; Dkt. 59, filed Oct. 25, 2010), as revised in 2016, 2018, 2020, and 2022 by docket nos. 222-23, 231-32, 242, 251, and 259.

²³Department of Energy, *Program and Project Management for the Acquisition of Capital Assets*, DOE Order 413.3B (Change 6) (Washington, D.C.: Jan. 12, 2021).

DOE Developed Plans to Begin Treating Some Tank Waste but Is Not Planning to Evaluate Certain Alternatives That May Expedite Cleanup in Its Upcoming System Plan

DOE has developed plans for managing a portion of Hanford's tank waste in preparation for its treatment and disposal and has identified barriers to implementing these plans. In addition, DOE is evaluating alternatives for treating tank waste not slated for DFLAW. However, DOE does not currently plan to include some alternatives under consideration by the Department that may expedite cleanup in its upcoming System Plan because DOE and Ecology have already agreed to a specific set of alternatives to include in the next revision.

DOE Has Developed Plans for Managing a Portion of Hanford's Tank Waste and Identified Barriers to Implementing the Plans

DOE has developed plans for storing, preparing, staging, and transferring a portion of Hanford's tank waste for treatment. These plans identified potential barriers to their implementation and measures to address them. We examined Hanford tank farms planning documents to support the start of waste treatment and found that the plans met requirements that we analyzed.²⁴

According to DOE's October 2020 System Plan, for near-term planning, DOE continues to focus its efforts on meeting milestones established in the amended Consent Decree related to starting DFLAW operations, including starting the WTP LAW Facility. Key DOE plans to prepare, stage, and transfer Hanford tank waste for the first phase of waste treatment are as follows:

- ***Tank-Side Cesium Removal System Demonstration and Tank Farm Upgrades / Waste Feed Delivery Project Execution Plan (2021)***. This Project Execution Plan defines DOE's overall strategy, objectives, management methods, and organization for the TSCR Demonstration and Tank Farm Upgrades Waste Feed Delivery

²⁴Planning requirements we analyzed include, but are not limited to, requirements outlined in the TPA and DOE Order 413.3B discussed above.

Project.²⁵ DOE plans to begin hot commissioning of DFLAW operations by August 2025, according to DOE officials.²⁶

- **System Integration Management Plan (2022).** This planning document describes the integration of planning processes used by DOE's contractor to maintain the execution of tank farms activities and Hanford mission objectives.²⁷
- **Multi-Year Operating Plan (2022).** This near-term planning document includes an operating plan for DOE's tank space management and includes key facility and system schedules for the execution of planned tank farms activities.²⁸

The key barriers associated with implementing DOE's plans for storing, preparing, staging, and transferring Hanford's tank waste for the first phase of waste treatment are identified and managed through the contractor's tank farms risk management program, according to DOE documents and officials. In keeping with DOE Order 413.3B, the DFLAW Feed Delivery Upgrades Project Execution Plan includes management of risks to implementing plans for storing, preparing, staging, and transferring Hanford's tank waste.²⁹ As part of the identification and

²⁵Washington River Protection Solutions, *Tank-Side Cesium Removal System Demonstration and Tank Farm Upgrades / Waste Feed Delivery Project Execution Plan*, RPP-PLAN-62858, Rev. 7 (Richland, WA: January 2021).

²⁶Hot commissioning generally refers to testing the performance of the treatment facilities and systems using actual radioactive tank waste, according to DOE officials. Under the amended Consent Decree, DOE must achieve the milestone of "LAW Facility Hot Commissioning Complete" by August 2025. The amended Consent Decree defines this milestone as the point at which the LAW facility has demonstrated the ability to produce immobilized LAW glass of acceptable quality. DOE was previously required to meet this milestone for commencing LAW treatment by December 2023, but that deadline was extended to August 2025 in a 2022 amendment to the Consent Decree as a result of the COVID-19 pandemic. However, according to DOE officials, DOE continues to work toward starting the LAW Facility as soon and as safely as possible.

²⁷Washington River Protection Solutions, *System Integration Management Plan*, TFC-PLN-143, Rev. C-1 (Apr. 26, 2022).

²⁸Washington River Protection Solutions, *Multi-Year Operating Plan*, RPP-PLAN-63778, Rev 11 (Sept. 29, 2022). This revision details the current status of DOE's planning efforts for fiscal years 2023-2028.

²⁹The DFLAW Feed Delivery Upgrades Project Execution Plan requires that risk will be managed in accordance with the provisions of TFC-PLN-39, "*Risk and Opportunity Management Plan*," and RPP-PLAN-57024, "*LAWPS Risk and Opportunities Management Plan (ROMP)*," with the objectives of risk management to reduce program and project risk to an acceptable level through the process of risk assessment, analysis, and mitigation.

management of critical technical, performance, schedule, and cost risks, the tank farms contractor developed a Risk Register for the DFLAW–Waste Feed Delivery Upgrades Project. This risk management tool includes the identification of risks, risk mitigation actions, and cost and schedule impact data associated with the project, among other things.³⁰

The DFLAW–Waste Feed Delivery Upgrades Project Risk Register identified 74 risks with widely varying schedule and cost impacts associated with starting and operating the project. Table 1 includes the high-level risks associated with managing the tank farms during DFLAW operations identified by DOE as very likely to occur (i.e., 90 percent chance or greater), along with estimated ranges of their residual cost and schedule impacts after potential mitigation measures.³¹

Table 1: Selected High-Level Risks and Potential Effects on Tank Farms Management That DOE Considers Very Likely to Occur During the Direct-Feed Low-Activity Waste (DFLAW) Project

Facility/system	Risk description	Potential effect on tank farms management	Range of DOE estimated cost & schedule impacts
Low-Activity Waste (LAW) Facility	There is a risk that the facility might not operate at designed capacity. This risk includes waste processing rates that are lower than expected because of changes in the waste feed, unanticipated facility shutdowns or slowdowns due to equipment and system failures, and other performance-related issues.	Failure of the LAW Facility to start treatment operations as scheduled, or failure to operate at planned performance rates would have a significant impact on tank farms operations due to the limited double-shell tank space available. These impacts may include stoppage of activities such as waste retrievals from the single-shell tanks and have a cascading impact on the duration of the cleanup mission.	\$338.1 million to \$1.8 billion 9 to 48 months
LAW Facility and DFLAW startup	The LAW Facility might not be ready to receive treated tank waste when DFLAW support projects are ready to start operations.	Same as above	\$225.4 million to \$1.6 billion 6 to 42 months

³⁰To prepare and evaluate these risks, according to DOE officials, the Hanford tank farms contractor Washington River Protection Solutions conducts operational research modelling studies for the tank farm waste feed delivery system to determine where weaknesses exist.

³¹These ratings and estimates are subjective judgments that the agency uses for planning and risk mitigation and should not be interpreted as statistical forecasts, according to DOE risk management documents. According to DOE officials, these estimates represent a rough order of magnitude estimate based on the information available.

Facility/system	Risk description	Potential effect on tank farms management	Range of DOE estimated cost & schedule impacts
Inadequate spare parts and resources available	The waste treatment operations includes maintaining minimal inventory of spare parts and equipment to support the testing and startup phases of the project. Uncertainty exists whether equipment and resources will be available to support future operations.	If not successfully mitigated, this risk is likely to result in significant facility outages and excessive delays in the ramp-up to sustained full throughput operations.	\$231 million to \$920 million 6 to 24 months
Waste transfer lines	A risk exists that potential extensive corrosion and moisture in several waste piping transfer lines between tanks at the AP tank farm might cause them to fail. This risk is a potential single point failure in the DFLAW operating system.	If the transfer lines are not available, then this would result in delays to the tank retrieval and waste pretreatment operations. This could result in a lower throughput rate than needed to support DFLAW operations as planned and result in site cleanup schedule delays.	\$5.8 million to \$10.5 million (per line failure) 3 to 12 months
AP Tank Farm Electrical Distribution System	There is a risk the tank farm's electrical system could fail. The infrastructure is aging and was not originally designed to support both regular tank farms operations and DFLAW activities.	Waste retrieval and storage activities would be impacted when power outages occur.	\$453,000 to \$1.13 million 3 to 9 months

Source: GAO analysis of Department of Energy (DOE) information. | GAO-23-106151

Note: DOE's DFLAW Risk Register includes a qualitative assessment of each identified risk associated with the project. After specific risks are identified, DOE's assessment includes rating the unmitigated chance of the adverse event occurring and its potential impact on schedule and cost if it were to occur. According to DOE risk management documents, this process involves DOE and contractor subject matter experts initially assigning the approximate chance of the event occurring and potential impacts if the event were to occur to rate its overall risk. To identify the significant risks to tank farms management during DFLAW operations, we used DOE's assessments of current risk level and the chance of the adverse event occurring in the DFLAW Risk Register. We selected those risks that DOE identified as high-level risks with a very likely chance of the event occurring during the life cycle of the project. Risks identified as high by DOE are designated as such because of the high chances of an adverse event occurring and the high cost or schedule impacts if the adverse event were to occur. Risks that DOE has identified as being very likely to occur are those where DOE estimated that the adverse event had a 90 percent or greater chance of occurring. The impact ranges reflect the best- to worst-case scenarios of the estimated residual impact of the risk to cost increases and schedule delays after potential mitigation measures are implemented. According to DOE officials, these estimates represent a rough order of magnitude estimate based on the information available.

DOE's DFLAW Risk Register also identified other potential risks that are assessed as lower risk or less likely to occur but that could still have significant impact on DFLAW operations and tank farms management. For example, there is a risk that DOE may not be able to retrieve waste from the DSTs at a fast enough rate needed to support TSCR operations. This could occur for a variety of reasons, such as complications in preparing the waste to the specifications needed for TSCR operations.

DOE considers this a likely scenario that could increase costs by roughly \$1.1 million to \$1.8 million and could cause a delay of roughly 1 to 2 years. Similarly, there is a risk that TSCR may not be able to provide pretreated waste at the rate needed to support initial DFLAW and WTP operations. This could be due to a failure of the associated pumps and other infrastructure or if DOE runs out of interim storage space for the exchange columns, which could require TSCR to be shut down. While DOE considers this a medium-level risk, DOE also considers it a likely scenario that could increase costs by roughly \$0 to \$50 million and could cause a delay in operations of roughly 0 to 2 months. Such delays have already been realized. In 2022, TSCR pretreatment feed operations were delayed for several months to address unexpected equipment leaks at the facility, according to DOE officials.

DOE Is Considering Alternatives for Treating the Remaining Tank Waste but Is Not Planning to Evaluate Certain Alternatives That May Shorten the Treatment Mission in Its Upcoming System Plan

DOE is considering alternatives for treating the remaining tank waste (i.e., waste not slated for DFLAW), has completed some analyses of different alternatives and potential barriers to implementing them, and is currently updating the System Plan. According to ORP officials, DOE's Office of Environmental Management has not directed ORP or the tank farms contractor to develop plans for storing, preparing, staging, and transferring tank waste based on different treatment alternatives currently under consideration because holistic negotiations among DOE, EPA, and Ecology are ongoing, and a preferred alternative has not been selected. Once an alternative for treating the remaining Hanford tank waste is selected, DOE intends to develop associated plans for storing, preparing, staging, and transferring remaining tank waste for waste treatment.

According to ORP officials, these plans will identify risks and measures to mitigate them. ORP Tank Farms Division officials we interviewed told us that it is difficult for DOE to speculate about particular barriers that may be associated with treatment approaches that have not yet been selected. According to these officials, the fundamental, broader risks associated with storing, preparing, staging, and transferring the remaining tank waste for treatment will largely be the same as those already identified in current tank waste management plans regardless of which approach is selected. However, these officials also stated that some new risks could arise, while other risks already identified could potentially be better mitigated by particular treatment alternatives.

As we reported in July 2022, DOE is exploring treatment alternatives for the remaining waste in the tanks.³² According to DOE officials, this analysis of alternatives includes an analysis of several different tank waste treatment alternatives, including changes to the current baseline plan, such as direct-feed HLW and using grout to treat a portion of the LAW.³³ Such alternatives have potential implications for tank farms infrastructure that may be different than those associated with the current baseline plan that includes vitrifying all tank waste and separating HLW and LAW using a pretreatment facility. The analysis of alternatives, which was completed in January 2023, includes the identification of several potential barriers and risks to implementing future plans to store, prepare, stage, and transfer the remaining waste for which DOE has yet to decide on a treatment approach.³⁴

DOE has issued other reports and documents that have analyzed alternatives for treating supplemental LAW and identified potential barriers to implementing them. For example, in January 2023, DOE's Savannah River National Laboratory issued a report that identified key technical, infrastructure, schedule, and cost risks associated with selecting different alternatives for the treatment of supplemental LAW.³⁵ Some of the key tank waste management barriers and potential benefits of various treatment alternatives identified in these reports include

- **schedule duration and risk of future DST leaks.** Hanford's DSTs store liquid waste and are necessary to support waste retrieval operations and staging prior to waste treatment. Vitrification and

³²GAO, *Nuclear Waste Cleanup: Hanford Site Cleanup Costs Continue to Rise, but Opportunities Exist to Save Tens of Billions of Dollars*, [GAO-22-105809](#) (Washington, D.C.: July 29, 2022).

³³DOE commissioned an analysis of alternatives in 2018 to examine various alternative approaches for treating the HLW at the Hanford site. According to DOE officials, in 2022, Ecology requested that DOE include the treatment of supplemental LAW as part of the analysis of alternatives.

³⁴Department of Energy, *High-Level Waste Treatment Analysis of Alternatives*.

³⁵Savannah River National Laboratory, *Follow-on Report on Supplemental Treatment Approaches*. The William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 directed DOE to enter into an arrangement with a federally funded research and development center to conduct a follow-on analysis with respect to approaches for treating Hanford's supplemental LAW. This was to be a follow-on of a prior analysis of approaches required by the National Defense Authorization Act for Fiscal Year 2017. In response to these mandates, Savannah River National Laboratory has completed a series of two reports examining technologies for treating and solidifying supplemental LAW.

another treatment method, known as steam reforming, require the longest schedule for treating the waste.³⁶ As a result, both approaches involve a high risk of future leaks from aging tanks. However, using grout to immobilize some of the waste could reduce the risks of additional tank leaks and increase available tank space because it would likely allow for emptying the tanks earlier than currently scheduled.³⁷ Emptying existing tanks sooner would also reduce the risks of additional corrosion-related tank leaks. Furthermore, as we reported in December 2021, selecting a waste treatment alternative treating a portion of the LAW using grout immobilization could potentially save between \$10 billion and \$24 billion in the overall cost to clean up the Hanford site;³⁸

- **aging facilities and tank farms infrastructure.** Alternative approaches vary in their reliance on existing infrastructure that may not be able to support the cleanup mission without ongoing maintenance or replacement. For example, alternatives relying on grout could reduce the amount of time that waste processing and the extent that certain tank farms support activities—such as cross-site transfers—are needed. Selecting such an alternative can, therefore, potentially reduce the long-term costs associated with maintaining or modifying these facilities and related infrastructure; and
- **regulatory uncertainty.** DOE and Ecology officials told us that the holistic negotiations among them and EPA are ongoing as they work toward reaching agreement on a path forward for treating Hanford’s tank waste. As these negotiations continue, and as we have previously reported, DOE faces regulatory challenges and legal uncertainty as to whether it can (1) treat tank waste using a method other than vitrification; and (2) classify and manage LAW as something other than high-level radioactive waste, such that it might be able to be disposed of off-site or on-site in a near-surface

³⁶Steam reforming is a process that dries liquid waste into a solid granular material. At Idaho National Laboratory, DOE is currently constructing a facility, called the Integrated Waste Treatment Unit, for this purpose. This first-of-a-kind facility will dry the liquid waste into a solid granular material, and then treated waste will be packaged into stainless steel containers and transported out of state for final disposal.

³⁷As we have previously reported, there is disagreement between DOE and Ecology as to whether a portion of the Hanford tank waste could be treated using grout (rather than vitrification) under applicable regulatory requirements. In light of this disagreement, we have called for Congress to consider action that would facilitate DOE’s ability to continue studying the feasibility of grouting Hanford LAW. See [GAO-22-104365](#).

³⁸See [GAO-22-104365](#).

repository. As we have previously reported, Ecology has expressed opposition to on-site permanent disposal of anything other than vitrified waste and DOE and Ecology disagree as to how waste treatment requirements should apply to supplemental LAW.³⁹ Nonetheless, DOE and Ecology continue to engage in discussions on this topic. In addition, while DOE has identified locations in Texas and Utah as potential off-site disposal sites for grouted LAW, it is possible that these sites may not be available in the future or that DOE could face local opposition to transportation of this waste through communities.

The TPA requires DOE to submit an updated System Plan to Ecology every 3 years. According to DOE officials, ORP is currently updating the System Plan and expects to issue Revision 10 by December 2023. The TPA provides that the System Plan will evaluate scenarios to optimize tank waste retrieval and treatment so that they are completed as quickly as technically feasible.⁴⁰ The TPA further states that the System Plan will take into account results from previous waste retrievals and other waste treatment studies that could, among other things, shorten the time needed to complete tank waste retrieval. In addition, the TPA states that the System Plan will also describe the needed capacity for supplemental treatment to have all tank waste treated as quickly as technically feasible, as well as specific options to treat all LAW.

Under the TPA, 1 year prior to the issuance of the System Plan, DOE and Ecology are to select the scenarios that will be analyzed in the plan. Accordingly, in December 2022, DOE documented the scenarios developed by the parties and selected for evaluation in the next System Plan and transmitted them to Ecology. According to that document and DOE officials we interviewed, Revision 10 will evaluate scenarios, including an updated version of the current baseline planning waste treatment scenario, along with several waste treatment scenarios that include vitrifying HLW starting in 2033 and grouting supplemental LAW by 2050.

However, in other agency studies, such as the 2023 Savannah River National Laboratory follow-on report and the January 2023 analysis of alternatives, DOE has been analyzing alternatives that would potentially

³⁹See [GAO-22-104365](#).

⁴⁰According to DOE officials, the System Plan is not a decision document but is used by DOE and Ecology for planning purposes and provides rough cost and schedule estimates and sensitivity analyses to compare each scenario to the baseline case for completing the tank waste cleanup mission at the Hanford site.

enable it to begin grouting LAW as early as 2027, much sooner than scenarios agreed to for evaluation in the System Plan under development. For example, the Savannah River National Laboratory's January 2023 follow-on report on approaches for treating Hanford's supplemental LAW analyzed four alternatives using three technologies: (1) vitrification, (2) fluidized steam reforming, and (3) grout. The report recommended that DOE expeditiously pursue multiple pathways to begin off-site operations to grout LAW in parallel with DFLAW operations. The report characterized this as an early start approach that would enable DOE to begin supplemental LAW treatment as early as 2027.⁴¹ The report concluded that such an approach may offer DOE the possibility of completing the Hanford cleanup mission earlier than currently planned and reduce the risks of future tank leaks.

As currently agreed to between DOE and Ecology, the scenarios to be evaluated in Revision 10 will not include an evaluation of such alternatives included in the other agency studies. According to DOE officials, in the past, once there was agreement with Ecology on which scenarios to model in the System Plan, they have not subsequently modified or added to those scenarios. However, we did not identify any provision in the TPA that would preclude DOE and Ecology from agreeing to supplement the initially agreed-upon System Plan scenarios prior to submission of the System Plan.⁴² Given the potential cost and schedule implications for managing tank waste associated with certain alternatives analyzed in other DOE studies, they may merit inclusion in the System Plan as options to optimize tank waste treatment and retrieval, as called for by the TPA. Evaluation of such alternatives would include a description of key issues, assumptions, and vulnerabilities for these alternatives and allow for a comparison of the results to other alternatives and their potential implications for tank farms infrastructure and operations. Additionally, because some alternatives in other studies

⁴¹Similarly, in two addendums to DOE's January 2023 High-Level Waste Treatment Analysis of Alternatives, four alternatives were added that would use grout to treat the supplemental LAW and start those operations as early as 2026.

⁴²There is some relevant precedent for adding alternatives for conceptual evaluation in other Hanford waste treatment studies. For example, in December 2021, at the request of Ecology, DOE agreed to modify its analysis of alternatives by supplementing its initial 17 alternatives and performing an analysis of additional alternatives, including the treatment of supplemental LAW, to determine if they could be more efficient and cost effective. Each of the four additional alternatives proposed by Ecology included using grout to treat supplemental LAW and starting those operations as early as 2026. These alternatives are outlined in our recent report, GAO, *Hanford Cleanup: DOE Should Validate Its Analysis of High-Level Waste Treatment Alternatives*, [GAO-23-106093](#) (Washington, D.C.: May 24, 2023).

pertain to how DOE may be able to treat Hanford's supplemental LAW, including them in the System Plan may allow DOE to more accurately describe needed capacity for supplemental treatment, as well as providing additional options for treating all LAW, in keeping with the requirements of the TPA. Including such alternatives in the System Plan by supplementing agreed-upon scenarios would allow for additional computer modeling and could include the development of cost and schedule estimates and sensitivity analyses to facilitate comparison of viable alternatives for completing the cleanup mission at Hanford. Furthermore, evaluating such alternatives in the System Plan could also improve DOE's ability to start the process of developing detailed plans for the storing, preparing, staging, and transferring tank waste in the event that an alternative under consideration in another study is selected.

Conclusions

Since June 2020, DOE, EPA, and the State of Washington have been engaged in confidential mediated negotiations regarding a holistic and realistic path forward for managing Hanford's tank waste. According to DOE officials, DOE plans to select a preferred alternative and request proposals from contractors to begin the next phase of waste treatment, although a timeline for these steps has not been set. The selection of a waste treatment alternative has significant implications for potentially lowering the risks of additional tank leaks, increasing the availability of tank space, and reducing the amount of time that waste processing and tank farms support activities are dependent on aging key facilities and infrastructure. Furthermore, as we reported in December 2021, the selection of a waste treatment alternative that includes grout immobilization and disposal of supplemental LAW could potentially save decades of time and billions of dollars in the cleanup of the Hanford site.⁴³ Given these potential implications, it is important that DOE fully evaluate and report on viable scenarios for optimizing the treatment mission and their effects on tank farms infrastructure and operations.

Recommendation for Executive Action

The Secretary of Energy should direct the Assistant Secretary for Environmental Management to consider, in consultation with the Washington State Department of Ecology, supplementing the scenarios to be evaluated in the Hanford System Plan Revision 10, to include those under serious consideration in other agency studies that may allow the Office of Environmental Management to expedite tank waste retrieval and treatment at Hanford. (Recommendation 1)

⁴³[GAO-22-104365](#).

Agency Comments

We provided a draft of this report to DOE for comment. In its written comments, reproduced in appendix I, DOE agreed with the report's findings and concurred with our recommendation. In its response, DOE described ongoing and planned actions to address our recommendation. In addition, DOE stated that because of the current schedule for completing System Plan Revision 10, they will, in consultation with the Washington State Department of Ecology, consider including scenarios to expedite tank waste retrieval and treatment in System Plan Revision 11. However, System Plan Revision 11 is not scheduled to be completed until December 2026, notably later than December 31, 2023, when System Plan Revision 10 is scheduled for completion.

Given the significant tank farms risks, and schedule and cost ramifications associated with decisions regarding Hanford tank waste treatment alternatives being made now, our recommendation specifically notes supplementing the scenarios to be evaluated in the Hanford System Plan Revision 10. Developing these scenarios in System Plan Revision 10 or through an accompanying document will provide decision makers with a timely description of key issues, assumptions, and vulnerabilities for each scenario evaluated, as well as provide rough cost and schedule estimates and sensitivity analyses to compare each scenario to the baseline case for completing the tank waste cleanup mission at the Hanford site. Waiting to develop this information in System Plan Revision 11, although useful, will not be helpful for informing decisions being made now regarding the selection of waste treatment alternatives.

DOE also provided technical comments, which we incorporated as appropriate.

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

If you or your staff have any questions about this report, please contact me at (202) 512-3841 or andersonn@gao.gov. 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 II.

A handwritten signature in black ink that reads "Nathan J. Anderson". The signature is written in a cursive style with a long horizontal stroke at the end.

Nathan J. Anderson
Director, Natural Resources and Environment

List of Committees

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Subcommittee on Energy and Water Development, and Related Agencies
Committee on Appropriations
House of Representatives

Appendix I: Comments from the Department of Energy



Department of Energy

Washington, DC 20585

July 12, 2023

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

Dear Mr. Anderson:

This letter provides the Department of Energy (DOE) Office of Environmental Management's (EM) response to the U.S. Government Accountability Office (GAO) draft report, GAO-23-106151, *HANFORD CLEANUP: DOE Should Consider Including Expedited Nuclear Waste Treatment Alternatives in Upcoming Analysis*.

EM's largest environmental liability is the retrieval, treatment, and disposition of the 56 million gallons of radioactive and chemical waste stored in underground tanks at Hanford. After decades of support from the workforce, local community, Congress, and others, EM is now treating tank waste at Hanford and final preparations are underway to stabilize that waste in glass using Direct-Feed Low-Activity Waste. While this progress is historic, Hanford tank waste cleanup has decades to go, and multiple viable treatment approaches will likely be necessary to safely complete this mission.

Consistent with the analysis recently completed by the National Academies of Sciences, EM is evaluating multiple pathways for the off-site immobilization of waste in grout and disposal, and investing in targeted research and development to build greater resiliency, leverage lessons learned, increase flexibility, and deploy innovative technologies.

DOE remains fully committed to the successful completion of this important mission at Hanford. The River Protection Project System Plan (System Plan) is an important planning and analysis tool supporting the effective completion of this mission and a deliverable under the Hanford Federal Facility Agreement and Consent Order. The System Plan comprehensively describes the treatment and disposition of tank waste and includes treatment scenarios developed collaboratively with the Washington State Department of Ecology. To achieve deadlines, preparations for developing revisions to the System Plan and the supporting analyses must begin well in advance. The scenarios analyzed in System Plan Revision 10, which will be published later this year, were collaboratively developed and agreed upon in 2022.

Given the current schedule for System Plan Revision 10, EM will, in consultation with the Washington State Department of Ecology, consider including scenarios to expedite tank waste retrieval and treatment in System Plan Revision 11. Therefore, DOE concurs with the recommendation in the report.

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

2

A more detailed response to GAO's recommendation is provided in the enclosure.

If you have any questions, please contact me or Mr. Dae Y. Chung, Associate Principal
Deputy Assistant Secretary for Corporate Services, at (202) 586-9636.

Sincerely,



William I. White
Senior Advisor for Environmental Management

Enclosures

Enclosure 1

**Management Response to
Recommendations GAO-23-106151 GAO Draft Report
*HANFORD CLEANUP: DOE Should Consider Including Expedited
Nuclear Waste Treatment Alternatives in Upcoming Analysis***

Recommendation 1: The Secretary of Energy should direct the Assistant Secretary for Environmental Management to consider, in consultation with Washington State Department of Ecology, supplementing the scenarios to be evaluated in the Hanford System Plan Revision 10, to include those under serious consideration in other agency studies that may allow the Office of Environmental Management to expedite tank waste retrieval and treatment at Hanford.

Management Response: Concur

DOE concurs with this recommendation. The scenarios analyzed in the most recent System Plan Revision 10 were agreed upon in 2022. The plan is being finalized and is scheduled to be published later this year. However, EM will, in consultation with the Washington State Department of Ecology, consider including scenarios to expedite tank waste retrieval and treatment at Hanford in System Plan Revision 11.

There is a selected scenario in System Plan Revision 10 which includes an evaluation to expedite tank waste retrieval and treatment. Further, additional scenarios under consideration that expedite tank retrieval and treatment have been released publicly, and these will be considered when preparing System Plan Revision 11, in coordination with the Washington State Department of Ecology.

Estimated Completion Date: December 31, 2025

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

Enclosure 2

General and Technical Comments

1. Page 20, paragraph 1, line 1 and 2: Delete the text “According to DOE officials,”
Basis: Ecology stated this in a public meeting for the National Academy for
Supplemental LAW. DOE does not speak for Ecology.

Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

Nathan J. Anderson, Director, Natural Resources and Environment, (202) 512-3841 or andersonn@gao.gov

Staff Acknowledgments

In addition to the contact named above, Ned Woodward (Assistant Director), Peter Ruedel (Analyst in Charge), Mark Braza, John Delicath, Claudia Hadjigeorgiou, Michael Meleady, and Sara Sullivan made key contributions to this report.

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