



January 2021

# HANFORD CLEANUP

## DOE's Efforts to Close Tank Farms Would Benefit from Clearer Legal Authorities and Communication

Accessible Version



A Century of Non-Partisan Fact-Based Work

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### DOE's Efforts to Close Tank Farms Would Benefit from Clearer Legal Authorities and Communication

#### Why GAO Did This Study

The Hanford site in Washington State contains about 54 million gallons of nuclear waste, which is stored in 177 underground storage tanks. In fiscal years 1997 through 2019, DOE spent over \$10 billion to maintain Hanford's tanks and retrieve waste from them. DOE expects to spend at least \$69 billion more on activities to retrieve tank waste and close tanks, according to a January 2019 DOE report.

Senate Report 116-48, accompanying the National Defense Authorization Act for Fiscal Year 2020, included a provision for GAO to review the status of tank closures at Hanford. GAO's report examines the status of DOE's efforts to retrieve tank waste, challenges DOE faces in its effort to close the C-farm, as well as DOE's approach for closing the remaining tank farms.

GAO toured the site; reviewed DOE documents, laws, and regulations; and interviewed officials and representatives from local, regional, and national entities and tribal governments.

#### What GAO Recommends

Congress should consider clarifying DOE's authority at Hanford to determine, with NRC involvement, whether residual tank waste can be managed as a waste type other than HLW. GAO is also making three recommendations, including that DOE (1) use an independent mediator to help reach agreement with Ecology on a process for assessing soil contamination, including NRC's role and (2) develop a long-term plan for its tank waste cleanup mission at Hanford. DOE concurred with all three recommendations.

View [GAO-21-73](#). For more information, contact David C. Trimble at (202) 512-3841 or [trimbled@gao.gov](mailto:trimbled@gao.gov).

#### What GAO Found

The Department of Energy (DOE) has retrieved nuclear waste from all the tanks at C-farm—the first of 18 tank farms (i.e., groupings of tanks) at DOE's Hanford site in southeastern Washington State. The waste is a byproduct of decades of nuclear weapons production and research. DOE is obligated under agreements with the state's Department of Ecology (Ecology) and the U.S. Environmental Protection Agency to move waste from older, single-shell tanks to newer, more durable, double-shell tanks and ultimately to dispose of it.

#### Example of a Tank and of Waste in a Tank at Hanford



Single-shell tank (left) and waste in a tank (right) at Hanford.

Source: Department of Energy. | GAO-21-73

DOE intends to "close" the C-farm by leaving the nearly empty tanks in place and filling them with grout. However, DOE faces challenges, in part because this approach depends on: (1) DOE's determination under its directives that residual tank waste can be managed as a waste type other than high-level waste (HLW) and (2) Ecology's approval. DOE has started the determination process, but as GAO has previously found, DOE is likely to face a lawsuit because of questions about its legal authority. Ecology has raised concerns that the Nuclear Regulatory Commission (NRC) has not independently reviewed DOE's analysis for this determination. By Congress clarifying DOE's authority at Hanford to determine, with NRC involvement, that residual tank waste can be managed as a waste type other than HLW, DOE would be in a better position to move forward.

Another challenge DOE faces in closing C-farm is how to address contaminated soil caused by leaks or discharges of waste from the tanks. DOE and Ecology officials do not agree on a process for evaluating contaminated soil at C-farm or on what role NRC should play in this process. They interpret their agreement differently, particularly regarding whether NRC must review DOE's analysis of contaminated soil. If the two parties cannot resolve this issue, Ecology may deny DOE a permit for C-farm closure. By using an independent mediator to help reach agreement with Ecology on how to assess soil contamination, including NRC's role, DOE would be better positioned to avoid future cleanup delays.

DOE has not developed a long-term plan for tank-farm closure, in part, because a plan is not required. However, leading practices in program management call for long-term planning. In addition, DOE faces technical challenges that may take years to address as noted by representatives from various entities or tribal governments. For example, an internal DOE document states there is a 95 percent probability DOE will run out of space in its double shell tanks—space needed to continue retrieval operations. Planning for and building new tanks requires years of work. By developing a long-term plan, DOE could better prepare to address technical challenges.

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# Contents

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GAO Highlights	2
Why GAO Did This Study	2
What GAO Recommends	2
What GAO Found	2
Letter	1
Background	6
DOE Has Completed Waste Retrieval and Has Analyzed Contaminated Soil at the C-Farm, and DOE Plans to Complete Retrieval at Two of the Other 17 Farms by 2026	16
DOE Faces Challenges in Managing Residual Tank Waste and Resolving Disagreement with the State of Washington over the Contaminated Soil at C-Farm	23
DOE Has No Long-Term Plan for Closing Most Tank Farms, and Stakeholders Have Concerns about Technical Challenges and Limited Involvement	35
Conclusions	45
Matter for Congressional Consideration	47
Recommendations for Executive Action	47
Agency Comments and Our Evaluation	48
Appendix I: Objectives, Scope, and Methodology	52
Appendix II: Key Differences among Various DOE Processes for Determining that Certain Waste Is Not High-Level Waste	59
Appendix III: Summary of Risks Identified by DOE in Its 2019 Lifecycle Report	61
Appendix IV: Comments from the Department of Energy	64
Text of Appendix IV: Comments from the Department of Energy	67
Appendix V: Comments from the Nuclear Regulatory Commission	71
Text of Appendix V: Comments from the Nuclear Regulatory Commission	72
Appendix VI: GAO Contact and Staff Acknowledgments	73

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Tables

Data table for Figure 4: Regulatory Requirements for Waste Retrieval from C-Farm Tanks and Amount of Remaining Residual Waste in Each Tank (Cubic Feet, ft3)	18
Table 1: Stakeholder Groups Interviewed	57
Table 2: Key Differences among the Waste Incidental to Reprocessing (WIR) Citation; the WIR Evaluation Processes in Department of Energy's (DOE) Order 435.1; and the 2005 National Defense Authorization Act (NDAA) Section 3116	59
Table 3: Summary of Risks to Hanford's Tank-Waste-Retrieval and Closure Mission Identified by the Department of Energy (DOE) in its 2019 Hanford Lifecycle Report	62

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Figures

Figure 1: Structure of Single-Shell and Double-Shell Tanks at Hanford	7
Figure 2: Number and Location of the Tanks and Tank Farms at Hanford	8
Figure 3: Phases of the Tank Waste Cleanup Mission at Hanford	11
Figure 4: Regulatory Requirements for Waste Retrieval from C-Farm Tanks and Amount of Remaining Residual Waste in Each Tank (Cubic Feet, ft3)	18

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**Abbreviations**

DOE	Department of Energy
DST	double-shell tank
Ecology	Washington State Department of Ecology
EPA	Environmental Protection Agency
HLW	high-level waste
LAW	low-activity waste
NRC	Nuclear Regulatory Commission
ORP	Office of River Protection
RCRA	Resource Conservation and Recovery Act of 1976
SST	single-shell tank
TPA	Tri-Party Agreement
WIR	waste incidental to reprocessing
WTP	Waste Treatment and Immobilization Plant

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January 7, 2021

Congressional Committees

The Department of Energy (DOE) is responsible for one of the world's largest environmental cleanup programs: the treatment and disposal of nuclear waste created as a by-product of decades of nuclear weapons production and nuclear research. DOE's Hanford site in southeastern Washington State produced plutonium and other special nuclear materials for the country's nuclear weapons program.<sup>1</sup> At the Hanford site, approximately 54 million gallons of radioactive and hazardous waste is stored in 177 underground storage tanks while it awaits treatment and disposal. The soil surrounding the tanks is contaminated, primarily from tank leaks, accidental spills, and intentional releases into the soil, which occurred primarily during nuclear weapons production.<sup>2</sup>

In fiscal years 1997 through 2019, DOE spent over \$10 billion to maintain Hanford's tanks and retrieve waste from them. DOE expects to spend at least \$69 billion more on activities to retrieve tank waste and close tanks, according to a January 2019 DOE report.<sup>3</sup> Under agreements with the state of Washington and the Environmental Protection Agency (EPA), DOE has been working to retrieve waste from certain tanks at Hanford, called single-shell tanks (SST)—many of which have leaked into the environment—and transfer the waste to newer, more durable double-shell

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<sup>1</sup>Special nuclear material includes, among other things, plutonium and enriched uranium. These are key components of nuclear weapons.

<sup>2</sup>According to DOE documents, over many decades, DOE unintentionally discharged liquid waste from the tanks into the soil through accidental spills, also known as unplanned releases. In addition, DOE intentionally discharged waste into the soil through six sets of cribs (underground structures designed to distribute liquid waste to the soil) and trenches (ditches) during this time frame.

<sup>3</sup>This projection includes (1) base operations, such as laboratory support or evaporating water from the tanks; (2) retrieval of waste from and closure of single-shell tanks; and (3) retrieval and closure of double-shell tanks. DOE also estimated in January 2019 that it will spend about \$240 billion to \$548 billion on its Hanford tank waste cleanup mission, including construction of the treatment facilities. DOE, *2019 Hanford Lifecycle Scope, Schedule and Cost Report*, DOE/RL-2018-45 Revision 0 (Richland, WA: January 2019).

tanks (DST).<sup>4</sup> Eventually, DOE is to retrieve the tank waste from the DSTs, treat it, and dispose of it. However, DOE officials stated that DOE, the state of Washington, and EPA have not yet agreed on how to dispose of, or “close,” the tanks, with the “residual waste” that remains in them after DOE has completed its waste retrieval efforts.<sup>5</sup>

DOE’s Office of River Protection, within DOE’s Office of Environmental Management, manages tank farm cleanup activities at Hanford. DOE is currently working toward retrieval and closure of the first of Hanford’s 18 “tank farms,” which are groupings of two to 18 tanks. This first tank farm, referred to as the C-farm, is considered the easiest farm to clean up, in part because of its relatively low levels of contaminated soil and its proximity to the waste treatment facilities, according to DOE and Washington State Department of Ecology (Ecology) officials. Regulatory documents indicate that the cleanup approach used at the C-farm is meant to serve as a demonstration project for the other 17 tank farms.

The Hanford cleanup involves or affects multiple entities at the federal, state and local level, as well as tribal governments. More specifically, DOE has an agreement with EPA and Ecology, called the Tri-Party Agreement (TPA), which, among other things, lays out a series of legally enforceable milestones for completing major activities. These milestones include retrieving tank waste from the SSTs.<sup>6</sup> In addition, various other entities—including the State of Oregon, county and local government agencies, and citizen and nonprofit groups—and Native American tribes have long-standing interests in Hanford’s cleanup. Many of these entities and tribes are represented on the Hanford Advisory Board.<sup>7</sup> The board is

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<sup>4</sup>According to DOE’s waste tank summary report from September 2020, 68 of DOE’s 149 single-shell tanks at Hanford are assumed to be leaking. DOE’s Hanford site has 177 underground tanks containing radioactive and hazardous waste. One-hundred forty-nine of these tanks have a single carbon steel liner containment system; these are known as single-shell tanks. The remaining 28 tanks have a double carbon steel liner containment system; these are known as double-shell tanks.

<sup>5</sup>Residual waste is waste remaining in the tank after all waste retrieval actions have been completed.

<sup>6</sup>In addition, DOE is retrieving waste from several tanks under a consent decree with the state of Washington. *Washington v. Moniz*, Civ. No. 08-5085 (E.D. Wash.) filed Oct. 25, 2010, as amended.

<sup>7</sup>The Hanford Advisory Board is funded by DOE and chartered under the umbrella of DOE’s Environmental Management Site Specific Advisory Board as a Federal Advisory Committee Act board. This act authorizes federal agencies to establish advisory committees to provide the agencies with advice and recommendations.

a nonpartisan body established by DOE to provide recommendations and advice on major policy issues related to the Hanford cleanup to all three TPA parties—DOE, Ecology and EPA.<sup>8</sup> The board includes three federally recognized tribes that have been designated as affected by Hanford operations under the Nuclear Waste Policy Act of 1982, as amended, because of their treaty rights.<sup>9</sup> DOE's interactions with federally recognized Native American tribes is governed by Order 144.1, which recognizes the government-to-government relationship between tribes and the federal government and acknowledges the need to promote and protect tribal treaty rights.<sup>10</sup> Some national groups, such as Energy Communities Alliance and Natural Resources Defense Council, monitor the cleanup at Hanford.

Senate Report 116-48 accompanying the National Defense Authorization Act for Fiscal Year 2020 (S. 1790) includes a provision for us to review the status of tank closures at the Hanford site. Our report examines:

- the status of DOE's efforts to retrieve tank waste and address contaminated soil at Hanford;
- challenges DOE faces in its efforts to close the C-farm, including addressing residual waste in tanks and contaminated soil; and
- DOE's approach for closing the remaining tank farms and stakeholders' views about this approach.

To inform these objectives, we reviewed various documents, including applicable legal and regulatory requirements, DOE orders, and reports and analyses related to residual waste in tanks or contaminated soil at the C-farm. We also interviewed officials from DOE, EPA, Ecology, and the Nuclear Regulatory Commission (NRC)—which plays a role in

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<sup>8</sup>The Hanford Advisory Board must be a broadly constituted organization consisting of a diverse group of people representing the interests and concerns of the Hanford and regional community. See *Memorandum of Understanding Among the US Department of Energy, the Environmental Protection Agency, and the Washington State Department of Ecology* (June 2008).

<sup>9</sup>These tribes are the Confederated Tribes and Bands of the Yakama Nation, the Confederated Tribes of the Umatilla Indian Reservation and the Nez Perce Tribe of Idaho. A fourth non-federally recognized tribe, the Wanapum People, has been included in consultations on cleanup matters because it resides near Hanford and has strong cultural ties to the site, according to DOE officials.

<sup>10</sup>DOE Order 144.1, *Department of Energy American Indian Tribal Government Interactions and Policy* (Washington, D.C.: January 2009).

reviewing tank waste activities at other DOE sites—regarding residual tank waste and contaminated soil at the C-farm, as well as challenges DOE is facing at the C-farm and in the long term.<sup>11</sup> We visited the Hanford site to tour the tank farms and interview DOE officials. In addition, we visited the Savannah River Site in South Carolina—which must also retrieve tank waste and close tank farms resulting from nuclear weapons production—to tour the tank farms at that site and interview DOE and contractor officials about how they addressed tank waste and contaminated soil at their site.

We also interviewed 23 local, regional, and national entities and tribal governments (from hereon referred to as “stakeholders”) to understand their views on the challenges that DOE faces in its efforts to close the C-farm, including addressing residual waste in tanks and contaminated soil, as well as their views about DOE’s approach to closing the remaining tank farms.<sup>12</sup> We interviewed members of the Hanford Advisory Board because they represent a diverse and relevant set of local and regional stakeholders and have knowledge of the tank waste cleanup mission. Specifically, we interviewed the chair of the board, the chairs of four board committees, and board members from the Tank Waste Committee—which focuses primarily on waste retrieval and tank closure at Hanford. The members we interviewed were either part of the board’s Tank Waste Committee or chaired one of three other committees. We also interviewed officials from the three federally recognized tribes, as well as representatives from four national groups that either have a history of working on Hanford tank waste issues or represent local stakeholders. We also interviewed relevant officials from the Pacific Northwest National Laboratory who conduct research on tank waste retrieval and closure. (See app. I for a full list of groups we interviewed.) The information and perspectives we obtained from these interviews are not generalizable to those stakeholders we did not select and interview. We used a semi-structured approach for our interviews to enhance the consistency of collected information while allowing for flexibility in the interview process.

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<sup>11</sup>The NRC was created by statute in 1974 as an independent agency with responsibility for overseeing commercial nuclear reactor safety, licensing reactors, and establishing regulations and guidelines for radioactive waste disposal for the commercial nuclear industry.

<sup>12</sup>Tribal governments have a unique status because of their treaty rights and tribal sovereignty. However, for methodological purposes and to protect confidentiality, we do not distinguish among stakeholders.

We conducted a content analysis of the information obtained through interviews and reviewed documents received from these stakeholders to understand the challenges stakeholders believe that DOE faces in its efforts to address residual waste in tanks and contaminated soil. We did not include a complete list of themes and comments made by these stakeholders, but we identified the main themes that emerged from the interviews and selected specific comments to include in our report to serve as illustrative examples of the key themes. We used a series of quantifiers to summarize stakeholder comments.<sup>13</sup>

In examining the challenges DOE faces in its efforts to close the C-farm, we evaluated how DOE's and Ecology's authorities work together under different regulatory frameworks—such as the Atomic Energy Act and the Resource Conservation and Recovery Act—that are applied simultaneously at the C-farm. In addition, we examined the TPA's requirements on the process of cleaning up contaminated soil and requirements for the TPA parties to address problems and conflicts that may arise.

We also identified disagreements between DOE and Ecology about these efforts to close the C-farm, and we compared the actions DOE has taken to resolve these disagreements with a memorandum on environmental collaboration and conflict resolution issued by the Office of Management and Budget and the Council on Environmental Quality.<sup>14</sup> In examining DOE's approach for closing the remaining tank farms and stakeholders' views about this approach, we compared DOE's planning with leading practices for program or project management for its operations

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<sup>13</sup>For the purposes of this report, "a few stakeholders" refers to two or three stakeholder groups, "some stakeholders" refers to four or five stakeholder groups, "several stakeholders" refers to six to eight stakeholder groups, and "many stakeholders" refers to nine to 14 stakeholder groups, and "most stakeholders" refers to 15 stakeholder groups or more.

<sup>14</sup>The memorandum notes that such conflicts could include matters related to water and land management. The memorandum further states that with the magnitude of environmental challenges facing the nation, coupled with the need for careful stewardship of tax dollars and budgets, federal departments and agencies should leverage all environmental collaboration and conflict management techniques to improve environmental governance. Office of Management and Budget and the Council on Environmental Quality, *Memorandum on Environmental Collaboration and Conflict Resolution* (Washington, D.C.: Sept. 7, 2012).

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activities. We also compared DOE's approach to stakeholder involvement with our risk-informed framework for making cleanup decisions.<sup>15</sup>

We conducted this performance audit from May 2019 to January 2021 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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## Background

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### Tanks and Tank Farms at Hanford

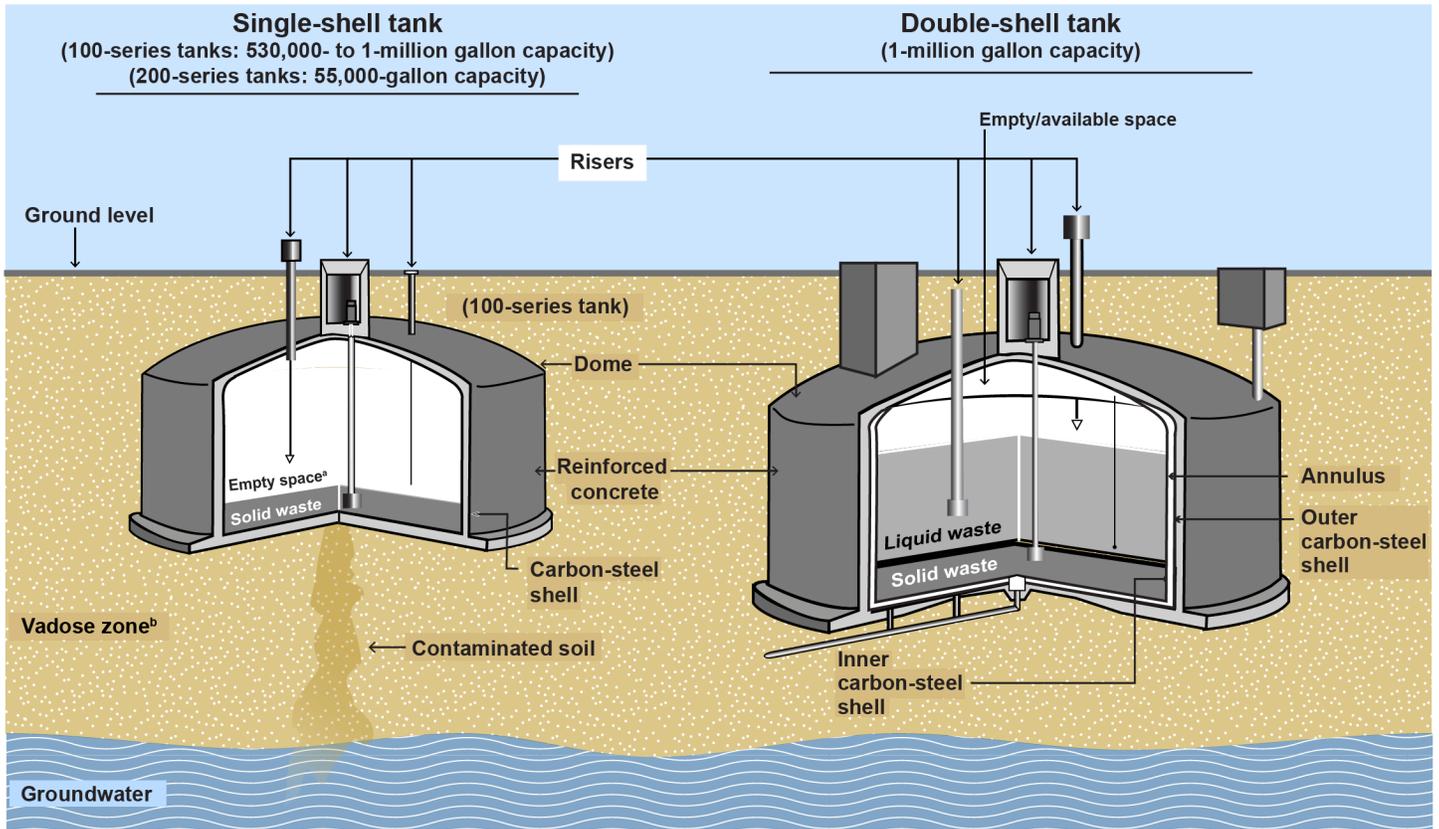
The Hanford site consists of 177 large, underground tanks. Of these tanks, 149 are SSTs and 28 are newer DSTs. In total, these tanks contain about 54-million gallons of radioactive and hazardous waste. As we reported in 2014, most of these tanks are operating decades past their original design life—the SSTs were built from the 1940s through the mid-1960s with a design life of approximately 25 years, and the DSTs were built from 1968 through 1986, each with a design life ranging from 20 to 50 years.<sup>16</sup> DOE estimates that 68 of these SSTs may have already collectively leaked over 1 million gallons of waste into the ground. Figure 1 depicts single-shell and double-shell tanks at Hanford and the structure of each tank type.

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<sup>15</sup>To develop this framework, we conducted a literature review of reports and studies on risk and decision-making in the context of environmental cleanup. After developing a draft framework, we worked with the National Academies of Sciences, Engineering, and Medicine (the National Academies) to select 15 experts and convene a 2-day meeting with those experts to evaluate the draft framework to determine (1) whether the draft framework was logical, reasonable, and a valid representation of risk-informed decision-making; and (2) the applicability of the draft framework to actual cleanup decisions. GAO, *Environmental Liabilities: DOE Would Benefit from Incorporating Risk-Informed Decision-Making into Its Cleanup Policy*. [GAO-19-339](#) (Washington, D.C.: Sept. 18, 2019).

<sup>16</sup>GAO, *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).

Figure 1: Structure of Single-Shell and Double-Shell Tanks at Hanford



Source: GAO analysis of Department of Energy documents. | GAO-21-73

<sup>a</sup>DOE removed liquid waste from all of the single-shell tanks.

<sup>b</sup>The vadose zone is the region of soil between the ground surface and the top of the water table. Over time, contaminants in the vadose zone migrate downward to the underlying groundwater.

The SST and DSTs are clustered in 18 tank farms, each containing between two and 18 tanks. The tank farms are divided between the “200 West” and “200 East” 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 closer to the facilities that DOE is constructing to treat the waste and the remaining seven tank farms are located in the 200 West area. Figure 2 shows the number and location of the tanks and tank farms at Hanford.

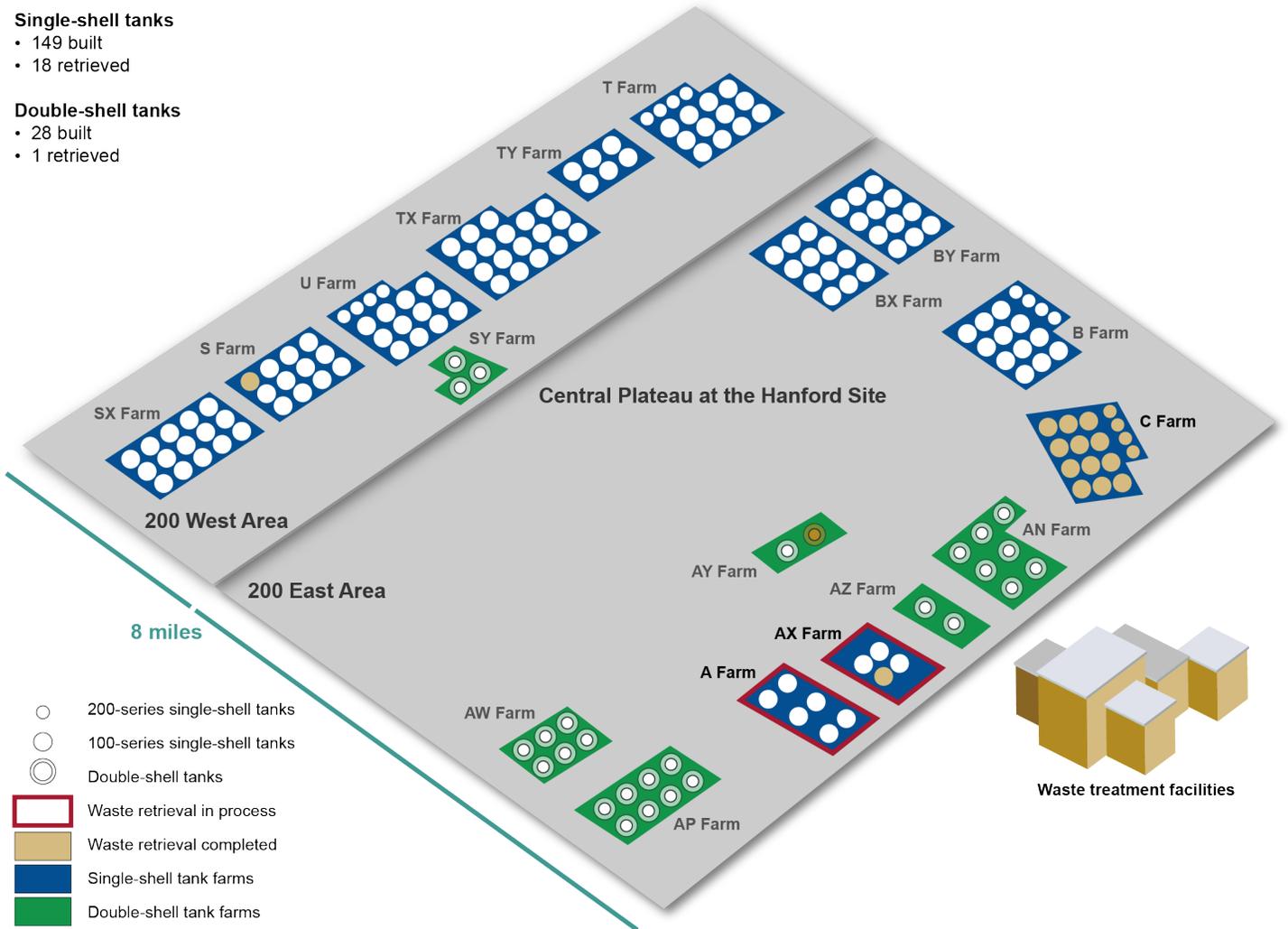
**Figure 2: Number and Location of the Tanks and Tank Farms at Hanford**

**Single-shell tanks**

- 149 built
- 18 retrieved

**Double-shell tanks**

- 28 built
- 1 retrieved



Source: GAO analysis of Department of Energy documents. | GAO-21-73

Note: The 100-series SSTs have a capacity of 530,000 to 1 million gallons, and the 200-series SSTs have a smaller capacity of 55,000 gallons.

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## Composition of Hanford's Tank Waste

Hanford's tanks contain a complex mix of radioactive and hazardous components, known as "mixed waste," in both liquid and solid form.<sup>17</sup>

- **Radioactive component.** About 46 different radioactive constituents—byproducts of chemically separating plutonium from uranium for use in nuclear weapons—account for the majority of the radioactivity in the Hanford site's tanks. The atoms of a radioactive constituent disintegrate, or decay, over time and release their radiation. Some of these constituents decay to a stable (i.e., nonradioactive) form in a relatively short time, while others remain radioactive for millions of years.
- **Hazardous component.** From the 1940s to the mid-1980s, about 240,000 tons of hazardous chemicals were added to the waste in Hanford's tanks. Most were added to neutralize acids in the waste. Others, such as solvents and several organic compounds, were added during various waste extraction operations to help recover selected radioactive constituents (uranium, cesium, and strontium) for reuse. These hazardous wastes are dangerous to human health, and they can remain dangerous for thousands of years.

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## Soil Contamination at Hanford's Tank Farms

The soil at Hanford became contaminated through tank leaks, accidental spills, and intentional releases. In 2018, DOE estimated that 227 billion gallons of waste were discharged into the soil on the Central Plateau—an area that included the tank farms and the facilities that reprocessed plutonium—from 1944 through 2000.<sup>18</sup> Of this amount, approximately 1-million gallons of waste was from tank leaks. In addition, between 1946 and 1958, as much as 120 to 130 million gallons of tank waste were intentionally discharged in the soil to provide more tank space for newly

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<sup>17</sup>Specifically, the term "mixed waste" means waste that contains both (1) hazardous waste subject to the Resource Conservation and Recovery Act or authorized state programs that operate in lieu of the federal program; and (2) source, special nuclear, or byproduct material subject to the Atomic Energy Act of 1954.

<sup>18</sup>DOE, *Hanford Soil Inventory Model (SIM-v2) Calculated Radionuclide Inventory of Direct Liquid Discharges to Soil in the Hanford Site's 200 Areas*, Rev. 0 (May 2018).

generated waste.<sup>19</sup> Moreover, an unknown amount of waste was discharged into the soil through accidental spills, such as from overfilling tanks, piping breaches, and other miscellaneous infrastructure failures.<sup>20</sup> However, these are imprecise estimates, and in a 2012 Environmental Impact Statement, DOE reported that the estimates on soil contamination may vary by approximately 50 to 200 percent.<sup>21</sup>

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### Tank Waste Cleanup Mission at Hanford

The tank waste cleanup mission generally consists of five phases:

1. “characterization” of the waste through sampling and analysis to determine the specific physical, radiological, and chemical components of the wastes in each tank and the surrounding soil;
2. retrieving waste from the underground tanks, addressing contaminated soil, and closing the tanks and tank farms;
3. separating the wastes into high-level waste (HLW) and low-activity waste streams through a process called pretreatment;
4. treating the waste to immobilize the constituents; and
5. disposing of the waste.<sup>22</sup>

Figure 3 depicts the tank waste cleanup mission.

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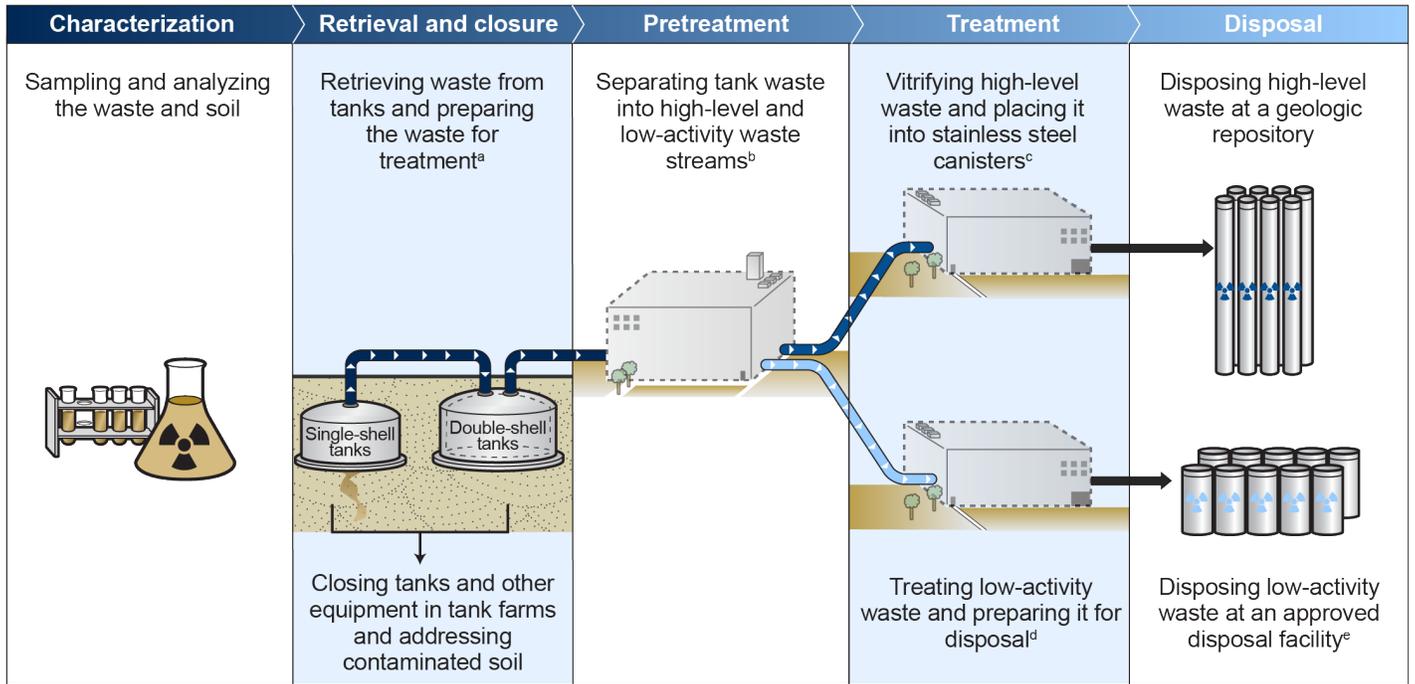
<sup>19</sup>Pacific Northwest National Laboratory, *A Short History of Hanford Waste Generation, Storage, and Release* (Richland, WA: October 2003).

<sup>20</sup>DOE estimated that about 903 million gallons of accidental spills occurred across the entire Hanford site. DOE, *Hanford Soil Inventory Model*, Rev. 0 (2005).

<sup>21</sup>DOE, *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*, DOE/EIS-0391 (Benton County, WA: November 2012).

<sup>22</sup>High-level waste is defined by the Atomic Energy Act and the Nuclear Waste Policy Act as (1) the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations, and (2) other highly radioactive material that NRC, consistent with existing law, determines by rule requires permanent isolation. Reprocessing separates the plutonium from the uranium and other radioactive materials in the spent nuclear fuel used in nuclear power reactors.

**Figure 3: Phases of the Tank Waste Cleanup Mission at Hanford**



Source: GAO analysis of Department of Energy documents. | GAO-21-73

<sup>a</sup>DOE is moving the waste from aging single-shell tanks to more durable double-shell tanks and has not yet started pretreating or treating the waste.

<sup>b</sup>DOE is analyzing options for how pretreatment will be conducted; options include using a mobile pretreatment unit at the tanks, using one pretreatment facility, or using multiple facilities. See GAO, *Hanford Waste Treatment Plant: DOE is Pursuing Pretreatment Alternatives, but Its Strategy is Unclear While Costs Continue to Rise*, GAO-20-363 (Washington, D.C.: May 12, 2020).

<sup>c</sup>Construction of the high-level waste treatment facility has been on hold since 2012, and DOE is analyzing how options for pretreatment of high-level waste could affect how the high-level waste treatment facility is used.

<sup>d</sup>DOE is nearing completion of a facility to vitrify about one-third to one-half of the low-activity waste at the Hanford site, but DOE has not determined how it will treat the remaining portion of the low-activity waste. DOE plans to start this facility by December 2023.

<sup>e</sup>DOE plans to dispose of about one-third to one-half of Hanford's low-activity waste at an onsite landfill; DOE has not determined how it will dispose of the remaining portion of the low-activity waste.

The phase in the waste cleanup mission that this report focuses on is retrieval and closure:

- **Retrieval:** Retrieval is the process of removing waste from the tanks by pumping it out, transferring it to more durable storage tanks, and ultimately transferring it to treatment facilities. DOE uses a variety of technologies to retrieve the waste, including high-pressure sprays to break up hardened waste on the tank bottom and vacuum systems to suck the waste out. DOE has emptied most of the liquid waste from

the SSTs and moved it to DSTs, while the more radioactive, solid waste remains. DOE has removed the solid waste to the extent practical from one tank farm, and it plans to continue retrieving the remaining solid waste in the other SSTs at a later date, as we will discuss below.<sup>23</sup>

- **Closure:** Closure is the process of identifying and carrying out appropriate methods: (1) for disposing of the tanks themselves and ancillary equipment after waste has been retrieved from them and (2) for addressing contaminated soil at the tank farm.<sup>24</sup> DOE proposed two potential methods it could consider for closure:<sup>25</sup>
  - **Landfill closure** would generally involve filling the tanks with grout<sup>26</sup>—a concrete-like mixture—and leaving them in place. It would also involve grouting certain ancillary equipment, removing some ancillary equipment and near-surface contaminated soils, placing a surface barrier over the tank farms, and monitoring the closed tank farm post-closure for 100 years, according to DOE's 2012 Environmental Impact Statement.<sup>27</sup>
  - **Clean closure** would generally involve exhuming the SSTs, as well as the ancillary equipment, for disposal at an alternate location. Clean closure may also involve removing contaminated soil.

DOE's ability to continue retrieving waste from SSTs depends on the existence of operational waste treatment facilities. However, as we have

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<sup>23</sup>The Hanford tanks generally contain three forms of waste: supernate, saltcake, and sludge. Supernate refers to liquids composed of water and dissolved salts. Saltcake refers to water-soluble components, such as sodium salts, that crystallize or solidify out of the waste solution to form a moist sandlike material. Sludge is a denser, water-insoluble component of the waste that generally settles to the bottom of the tank to form a thick layer that has the consistency of peanut butter.

<sup>24</sup>Ancillary equipment refers to a complex waste-transfer system of pipelines (transfer lines), diversion boxes, vaults, valve pits, and other miscellaneous structures.

<sup>25</sup>DOE, *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*, DOE/EIS-0391 (Benton County, WA: November 2012).

<sup>26</sup>Grout immobilizes waste in a concrete-like mixture. According to DOE's 2013 Record of Decision, DOE chose to fill the tanks with grout to stabilize the tanks. 78 Fed. Reg. 75913 (Dec. 13, 2013).

<sup>27</sup>DOE, *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*, DOE/EIS-0391 (Benton County, WA: November 2012).

previously reported, DOE has faced challenges and delays in constructing the Waste Treatment and Immobilization Plant, which consists of multiple facilities intended to separate HLW from low-activity waste and then treat the HLW and a portion of the low-activity waste.<sup>28</sup> We reported in May 2020 that construction of the pretreatment facility has been on hold since 2012 due to technical challenges, and DOE is analyzing how alternate options for the pretreatment of waste could affect how the HLW treatment facility is used.<sup>29</sup> Regarding low-activity waste, according to DOE officials, DOE is nearing completion of a facility—Direct-Feed Low-Activity Waste Facility—and plans to begin vitrifying about one-third to one-half of the low-activity waste by December 2023.<sup>30</sup> As we found in 2017, DOE has not yet determined how it will treat the remaining portion of the low-activity waste,<sup>31</sup> but it contracted with a national laboratory to analyze three possible alternatives for treatment.<sup>32</sup> We have also found that Hanford may have insufficient DST space available for current and future waste transfers, in particular if the Waste

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<sup>28</sup>GAO, *Hanford Waste Treatment: DOE Needs to Evaluate Alternatives to Recently Proposed Projects and Address Technical and Management Challenges*, [GAO-15-354](#) (Washington, D.C.: May 7, 2015); *Hanford Waste Treatment Plant: DOE Needs to Take Further Actions to Address Weaknesses in Its Quality Assurance Program*, [GAO-18-241](#) (Washington, D.C.: April 24, 2018); and *Hanford Waste Treatment Plant: DOE is Pursuing Pretreatment Alternatives, but Its Strategy Is Unclear While Costs Continue to Rise*, [GAO-20-363](#) (Washington, D.C.: May 12, 2020).

<sup>29</sup>[GAO-20-363](#).

<sup>30</sup>On May 21, 2020, DOE submitted a proposal to Ecology to amend the consent decree for schedule extensions due to force majeure events. As described in the proposal, consent-decree-related work, including the start of Direct-Feed Low-Activity Waste facility, has been interrupted since March 23, 2020, because of the Coronavirus Disease 2019 (COVID-19) pandemic. DOE proposed an extension by an additional day for each day that elapses between March 23, 2020, and the date upon which DOE is able to resume normal operations.

<sup>31</sup>GAO, *Nuclear Waste: Opportunities Exist to Reduce Risks and Costs by Evaluating Different Waste Treatment Approaches at Hanford*, [GAO-17-306](#) (Washington, D.C.: May 3, 2017).

<sup>32</sup>Under Section 3134 of National Defense Authorization Act for the Fiscal Year 2017, Congress directed DOE to contract with a Federally Funded Research and Development Center to analyze at least three potential treatment technologies and to report on its findings. Section 3134 further directed DOE to contract with the National Academies of Sciences, Engineering, and Medicine (the National Academies) to conduct a review of this report. The National Academies released its report in 2020. National Academies of Sciences, Engineering, and Medicine 2020. *Final Review of the Study on Supplemental Treatment Approaches of Low-Activity Waste at the Hanford Nuclear Reservation: Review #4* (Washington, D.C.: 2020).

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Treatment and Immobilization Plant is further delayed or if there are additional tank leaks.<sup>33</sup>

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## Regulatory Framework of the Tank Waste Cleanup Mission at Hanford

Tank waste retrieval and closure at Hanford are governed by a number of federal and state laws, state permits, and cleanup agreements among DOE, EPA, and Ecology that implement these laws, including but not limited to:

- **Atomic Energy Act of 1954, as amended**, authorizes DOE to regulate the radioactive component of mixed high-level waste.
- **Nuclear Waste Policy Act of 1982, as amended**, establishes procedures for the evaluation, selection, and approval of deep geologic repositories for the disposal of HLW.
- **Resource Conservation and Recovery Act of 1976 (RCRA), as amended**, governs the treatment, storage, and disposal of hazardous waste and the non-radioactive hazardous waste component of mixed waste. EPA has authorized Ecology to administer its own hazardous-waste regulatory program. Ecology has issued several permits relevant to Hanford, including a site-wide hazardous waste management permit for the Hanford facility.
- **Comprehensive Environmental Response, Compensation and Liability Act of 1980** under which EPA has established procedures for cleaning up releases of hazardous substances in the National Contingency Plan.
- **Hanford Federal Facility Agreement and Consent Order of 1989 (or Tri-Party Agreement) (TPA)** is an agreement between DOE, EPA and Ecology that lays out, among other things, a process and a series of legally enforceable milestones for completing major Hanford cleanup.<sup>34</sup>

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<sup>33</sup>[GAO-15-40](#).

<sup>34</sup>One purpose of the TPA is to ensure that the environmental effects associated with past and present activities at the Hanford site are thoroughly investigated and appropriate response action taken as necessary to protect the public health, welfare, and the environment. Another is to promote an orderly, effective investigation and cleanup of contamination at the Hanford Site and to avoid litigation between the parties.

- **Consent decree of 2010, as amended in 2016 and 2018** was established as a result of litigation brought against DOE by Ecology for missing certain TPA milestones. This judicially enforceable consent decree establishes, among other things, specific milestones and procedures for waste retrieval from 12 SSTs at the C-, A-, and AX-tank farms. The TPA procedures apply again for the remaining tanks and tank farms.

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### DOE's Order 435.1 on Radioactive Waste Management and Its Waste Incidental to Reprocessing Determination Process

In July 1999, DOE issued Order 435.1 setting forth procedures for the management of its radioactive wastes in a manner that is protective of worker and public health and safety, and the environment. Under the manual associated with this order, DOE has a process for determining that waste is "incidental to reprocessing," and therefore the waste can be managed as non-HLW. DOE calls this the waste incidental to reprocessing (WIR) process. DOE will manage waste classified under the WIR process as transuranic or low-level waste, which are less expensive to manage than high-level waste.<sup>35</sup>

Under Order 435.1 and its associated manual, DOE currently uses either a WIR evaluation process or WIR citation process to determine whether the waste is WIR.

- **WIR evaluation process.** Under the WIR evaluation process, both the relevant DOE site and DOE headquarters conduct in-depth evaluation of the characteristics and proposed management of the residual waste to determine if the waste can be safely managed as either transuranic or low-level waste.<sup>36</sup>

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<sup>35</sup>Transuranic radioactive waste is waste that contains manmade elements heavier than uranium on the periodic table. It is produced during nuclear fuel assembly and nuclear weapons research and production and during the reprocessing of spent nuclear fuel. Low-level waste is radioactive waste that is not HLW, spent nuclear fuel, transuranic waste, by-product material (as defined in section 11e (2) of the Atomic Energy Act of 1954, as amended), or naturally occurring radioactive material.

<sup>36</sup>An implementation guide associated with DOE's Order 435.1 recommends that DOE consult with NRC on waste incidental to reprocessing evaluations in certain situations.

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- **WIR citation process.** The WIR citation process is less stringent with a determination made only at the DOE site level. Waste incidental to reprocessing by citation includes spent nuclear-fuel-reprocessing plant wastes that meet the description included in a 1969 Federal Register notice.<sup>37</sup> These radioactive wastes are the result of reprocessing plant operations, such as, but not limited to, contaminated job wastes including laboratory items such as clothing, tools, and equipment.

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## DOE Has Completed Waste Retrieval and Has Analyzed Contaminated Soil at the C-Farm, and DOE Plans to Complete Retrieval at Two of the Other 17 Farms by 2026

DOE has completed waste retrieval from all 16 tanks and has analyzed the contaminated soil extensively at the C-farm, but it has not finished retrieval or fully characterized the contaminated soil at any other tank farms. DOE plans to complete waste retrieval at two more of the remaining farms by 2026.

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## DOE Announced It Has Completed Waste Retrieval from All 16 Tanks at the C-Farm but Has Not Finished Retrieval at Any Other Tank Farms

According to a DOE document, DOE has completed waste retrieval from all 16 tanks at the C-farm. Specifically, DOE officials stated that it transferred about 1.8 million gallons of waste from the SSTs in C-farm to DSTs located in other nearby tank farms at the site, so the total amount of tank waste remaining at Hanford is about 54 million gallons. DOE completed retrieval of these tanks:

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<sup>37</sup>Specifically, wastes that are eligible for the WIR citation process include spent nuclear fuel reprocessing plant wastes that meet the description included in 34 Fed. Reg. 8712 (June 3, 1969) Paragraphs 6 and 7. This notice from the Atomic Energy Commission proposed the adoption of a statement of policy concerning the siting of commercial fuel reprocessing plants and related waste management facilities.

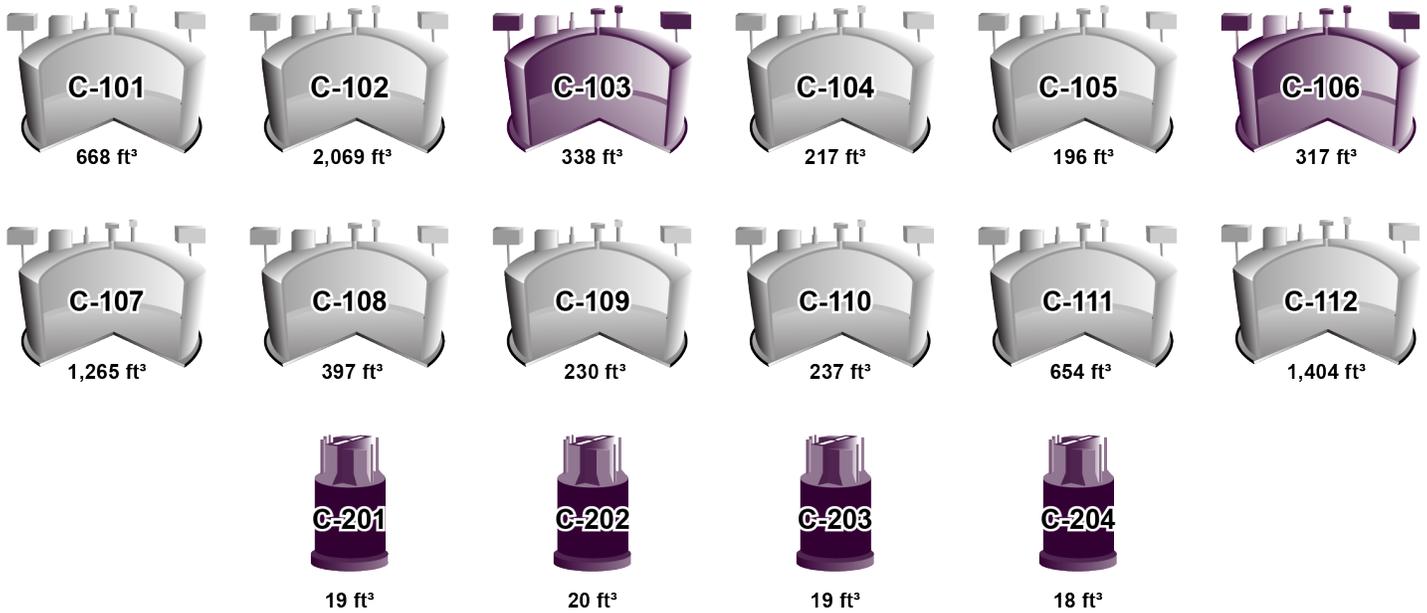
- by removing more than 99 percent of the tank waste volume (leaving less than 360 cubic feet of residual waste in the tank) as required under the TPA for six tanks, and
- by using at least two different technologies as required under the Consent Decree for the other 10 tanks.<sup>38</sup>

About 62,000 gallons (or about 8,000 cubic feet) of residual waste (or 4 percent of the original waste) remains in the 16 tanks at the C-farm. Figure 4 depicts the regulatory requirements for waste retrieval from C-farm tanks and the amount of remaining residual waste in each tank.

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<sup>38</sup>Under the TPA, DOE is required to retrieve as much waste as technically practicable, with residual waste of no more than 360 ft<sup>3</sup> remaining in the larger (100-series) tanks and 30 ft<sup>3</sup> in the smaller (200-series) tanks. In addition, for the tanks that are regulated under the Consent Decree, DOE must identify two technologies that can be deployed in an effort to reach the volume-based retrieval goal in the TPA. For these tanks, retrieval is complete if this volume-based criterion is met with either or both of the two deployed technologies. For a tank that does not meet the retrieval criterion under the TPA, DOE may seek a waiver for an exception to the waste retrieval criteria in a process outlined in appendix H of the TPA. For a tank that does not meet the retrieval criterion under the Consent Decree, DOE must modify its retrieval work plans to deploy a third technology or DOE may request a waiver from Ecology to forego the deployment of a third technology if DOE believes implementing such technology is not practicable.

**Figure 4: Regulatory Requirements for Waste Retrieval from C-Farm Tanks and Amount of Remaining Residual Waste in Each Tank (Cubic Feet, ft<sup>3</sup>)**



**Regulated and compliant under:**

- Consent Decree (Retrieval considered complete once DOE applies three waste retrieval technologies or obtains a waiver from the state regulator to forego a third technology)
- Tri-Party Agreement (Retrieval considered complete once the residual waste in the tank is less than 360 ft<sup>3</sup> for 100-series tanks and 30 ft<sup>3</sup> for 200-series tanks)

Source: GAO analysis of Department of Energy documents. | GAO-21-73

**Data table for Figure 4: Regulatory Requirements for Waste Retrieval from C-Farm Tanks and Amount of Remaining Residual Waste in Each Tank (Cubic Feet, ft<sup>3</sup>)**

Tank	Residual Waste (in ft <sup>3</sup> )	Regulated Under	TPA Compliant? (residual waste less than 360/30 cubic feet)	Consent Decree Compliant? (DOE applied 3 technologies or approved to forego 3rd technology or TPA compliant)
C-101	668	Consent Decree	N/A	Yes
C-102	2,069	Consent Decree	N/A	Yes
C-103	338	TPA	Yes	N/A
C-104	217	Consent Decree	N/A	Yes
C-105	196	Consent Decree	N/A	Yes
C-106	317	TPA	Yes	N/A
C-107	1,265	Consent Decree	N/A	Yes
C-108	397	Consent Decree	N/A	Yes
C-109	230	Consent Decree	N/A	Yes

Letter

Tank	Residual Waste (in ft <sup>3</sup> )	Regulated Under	TPA Compliant? (residual waste less than 360/30 cubic feet)	Consent Decree Compliant? (DOE applied 3 technologies or approved to forego 3rd technology or TPA compliant)
C-110	237	Consent Decree	N/A	Yes
C-111	654	Consent Decree	N/A	Yes
C-112	1,404	Consent Decree	N/A	Yes
C-201	19	TPA	Yes	N/A
C-202	20	TPA	Yes	N/A
C-203	19	TPA	Yes	N/A
C-204	18	TPA	Yes	N/A

Notes: The 100-series SSTs at C-farm are larger tanks with an operating capacity of 535,000, and the 200-series SSTs are smaller tanks with a capacity of 55,000 gallons.

About 62,000 gallons (or about 8,000 cubic feet) of residual waste (or 4 percent of the original waste) remains in the 16 tanks at the C-farm.

Ecology has confirmed that DOE has retrieved waste from all 16 C-farm tanks in accordance with relevant provisions of the TPA and the consent decree. According to DOE and Ecology officials, DOE also completed retrieving waste from the sixteenth tank, tank C-106. Beginning in 2004, DOE sought an exemption under the TPA for tank C-106, which DOE determined contained 370 cubic feet of residual waste (10 cubic feet over the limit in the TPA). There followed a lengthy back and forth among DOE, Ecology, and the NRC. These exchanges culminated in DOE's submitting a second waiver request in 2018.<sup>39</sup> Ecology denied this waiver request in 2019, stating that DOE had not met the waiver criteria in the TPA. Specifically, Ecology said that DOE did not comply with the TPA requirement to establish an interface with the NRC and reach formal agreement on the retrieval and closure actions for SSTs with respect to how much residual waste is permitted to remain in the tank and soil column. DOE disagrees with Ecology's position, stating that it has consulted extensively with NRC regarding the C-farm closure and that it is not required to establish a formal agreement with NRC with respect to the

<sup>39</sup>For a history of the interaction of these agencies concerning tank C-106, see 19-NWP-101, Re: Director's Determination on United States Department of Energy Request for a Waiver of Single-Shell Tank Retrieval Criteria (June 26, 2019), accessed September 2020, <https://pdw.hanford.gov/download/40904b12-a6e1-46fc-9aae-0ee2d097121b>.

contaminated tank farm soil.<sup>40</sup> In July 2019, DOE appealed Ecology's denial to the Washington State Pollution Control Hearings Board to resolve this disagreement.<sup>41</sup>

In January 2020, DOE notified Ecology that because the liquids evaporated over time from the residual waste in the tank and because of improvements in residual waste measurement technology since the last measurement in 2004, DOE had found that the waste remaining in this tank was only 317 cubic feet, which is less than the required 360 cubic foot limit. Therefore, DOE informed Ecology a waiver was no longer needed under TPA requirements. According to DOE officials, once DOE completes this step, it does not need approval or confirmation from Ecology that retrieval is complete. DOE subsequently withdrew its appeal, and the board dismissed the case in April 2020.

In September 2020, Ecology officials confirmed to us that retrieval from this tank was complete and a waiver was no longer needed based on DOE's recent re-calculation of the volume of residual waste remaining in the tank. However, Ecology officials noted that they have reserved the right to require additional retrieval if deemed necessary to meet the closure performance standard under state regulations. According to these officials, while Ecology does not anticipate finding that additional tank retrieval is necessary for closing the C-farm, such a determination can only be made through the formal permitting process.

DOE plans to complete waste retrieval from all 10 tanks in the A- and AX-farms—which are also close to the treatment facilities—by September

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<sup>40</sup>DOE, *Formal Submittal Of Written Statement Of Dispute: Denial Of The United States Department Of Energy -Office Of River Protection Request For Waiver To Hanford Federal Facility Agreement And Consent Order Waste Retrieval Criteria For Single-Shell Tank 241-C-106* (Mar. 21, 2019), accessed September 2020, <https://pdw.hanford.gov/download/1943fe9e-aa20-4279-a120-c0878c9bf5c9>.

<sup>41</sup>According to the TPA, parties to the agreement must first try to solve disputes among themselves. If this is not possible, DOE may file an appeal, at DOE's discretion, in either the Washington Pollution Control Hearings Board or in the courts. The board hears appeals from orders and decisions made by Ecology and other agencies and is not affiliated with Ecology or any other state agency. The court process takes much longer, according to DOE officials.

2026,<sup>42</sup> as directed by the consent decree, as amended in 2018.<sup>43</sup> According to DOE officials, DOE has built the infrastructure necessary to complete retrieval at these two tank farms, infrastructure such as the installation of ventilation systems, retrieval equipment, control equipment, and transfer lines. DOE officials told us that DOE has completed retrieval of the AX-102 tank in January 2020,<sup>44</sup> and plans to retrieve waste from all tanks in the AX-farm first before moving to the A-farm. DOE officials also stated that DOE will move the waste from the AX-farm to one DST in the AZ-farm and the waste from the A-farm to a DST in the AP-farm. In 2016, DOE applied to Ecology for an environmental air permit, which, according to DOE officials, would allow DOE to triple the air exhauster's flow rate to prevent fogging, which limits the operator's visibility in the tank and results in shutdowns until visibility returns. According to DOE officials, approval of this application is necessary for tank retrievals to proceed as planned. Even without this permit, DOE retrieved waste from the AX-102 tank under a lower capacity level to maintain its retrieval schedule, but according to DOE officials, fogging in the tank resulted in slower retrieval rates. DOE officials said that, as of September 2020, DOE has not yet received the permit, but they expected to receive it in the not-too-distant future as a result of a mediated agreement with Ecology regarding this and other modeling of ambient air permits. In a letter to Ecology in March 2019, DOE officials expressed concern that DOE might miss the 2026 retrieval deadline because of this delay in permitting.

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<sup>42</sup>On May 21, 2020, DOE submitted a proposal to Ecology to amend the consent decree for schedule extensions due to force majeure events. The proposal stated that consent-decree-related work, including the retrievals in A- and AX-tank farms, has been interrupted since March 23, 2020, due to the Coronavirus Disease 2019 (COVID-19) pandemic. DOE proposed an extension by an additional day for each day that elapses between March 23, 2020 and the date upon which DOE is able to resume normal operations.

<sup>43</sup>According to DOE officials, DOE, Ecology, and EPA considered the following attributes when they decided in August 2011 to choose the A- and AX-farms for retrieval next: (1) waste volume and/or amount of radiation present in the tank, (2) risk to the environment if not retrieved, (3) previous leaks, (4) risk of future leaks, (5) viability of waste as feed for Waste Treatment and Immobilization Plant, (6) ability to retrieve, (7) co-location with other chosen tanks, (8) infrastructure or ability to get infrastructure, (9) receipt tank available, and (10) complexity of the retrieval.

<sup>44</sup>DOE officials told us that DOE has completed retrieval of this tank to the limits of two technologies and is currently evaluating the need to deploy a third technology.

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## DOE Has Analyzed the Contaminated Soil More Extensively at the C-Farm Than at Other Farms

DOE has done extensive soil characterization at the C-farm, but it has not yet fully characterized the contaminated soil at the other 17 tank farms.<sup>45</sup> Under Ecology's hazardous waste regulations, DOE is generally required to include steps for sampling and removing contaminated soil in its tank farm closure plan.<sup>46</sup> According to DOE documents, as part of C-farm's closure planning process, DOE has conducted soil characterization through sampling and modeling analysis to estimate the long-term effect of the contaminated soil on the environment and public health. DOE officials explained that DOE would conduct such analysis for other farms when they go through the closure process for each of those tank farms. For example, DOE has sampled soil at the A- and AX- tank farms and is in the process of completing soil characterization and subsequent analysis. In the meantime, DOE officials stated that they have based their soil characterization for the other farms on historical data, information on possible tank leaks, and modeling, and that they have not conducted much direct soil sampling.

Some stakeholders we interviewed expressed concern about DOE's modeling of soil contamination because, among other things, they said DOE has not taken into account the potential lateral movement of the waste in the soil underneath the tanks. This soil is part of the vadose

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<sup>45</sup>According to DOE officials, soil characterization is the process of assessing the extent of radioactive and hazardous contamination in the soil.

<sup>46</sup>Specifically, Ecology's regulations state that the plan must include "a detailed description of the steps needed to remove or decontaminate all dangerous waste residues and contaminated containment system components, equipment, structures, and soils during partial and final closure, including, but not limited to, procedures for cleaning equipment and removing contaminated soils, methods for sampling and testing surrounding soils, and criteria for determining the extent of decontamination required to satisfy the closure performance standard." WAC 173-303-610(3)(a)(v). The regulations provide that if the owner or operator demonstrates that not all contaminated soils can be practicably removed or decontaminated, then the owner or operator must close the tank system and perform post-closure care in accordance with the closure and post-closure care requirements that apply to landfills. WAC 173-303-640(8)(b).

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zone.<sup>47</sup> DOE officials told us that they fixed the modeling system to address this concern and that the modeling system is based on conservative assumptions and includes analysis of the worst-case scenarios.<sup>48</sup> DOE officials also noted that DOE needs to better educate the public on its modeling assumptions and the measures it has taken to ensure the modeling is sound.

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## DOE Faces Challenges in Managing Residual Tank Waste and Resolving Disagreement with the State of Washington over the Contaminated Soil at C-Farm

DOE faces challenges in its efforts to (1) manage the residual tank waste under existing legal requirements and (2) resolve disagreements with Ecology over the contaminated soil at the C-farm. Specifically, DOE's tank farm closure plan depends on DOE's ability to manage the residual tank waste as a waste type other than high-level waste and to obtain Ecology's approval to leave the tanks in place. However, DOE is likely to face legal and regulatory challenges if it determines that residual tank waste can be managed as a waste type other than HLW. In addition, DOE and Ecology do not agree on a process for evaluating the contaminated soil at the C-farm or on whether NRC should play a role in this process.

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## DOE's Tank Farm Closure Plan Depends on Managing Residual Tank Waste as Other Than High-Level Waste

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<sup>47</sup>The vadose zone is the region of soil between the ground surface and the top of the water table. According to DOE officials, contaminants in the vadose zone often migrate downward to the underlying aquifer over time. Waste in the soil typically moves in two directions: (1) laterally via direction of groundwater and (2) vertically from high to low concentration through the vadose zone.

<sup>48</sup>DOE officials stated that they conducted an analysis at the request of Ecology to address tribal and public concern with lateral movement. The analysis incorporated information provided by the Nez Perce Tribe and parameters selected by Ecology. The resulting analysis confirmed that DOE's scenario was conservative and was presented to the public in multiple meetings.

## and Obtaining the State’s Approval to Leave the Tanks in Place

DOE’s plan for closure of the C-farm is to leave the tanks containing residual waste in place after filling them with grout; this process is referred to as landfill closure. This approach requires (1) managing the residual waste in tanks as a waste type other than HLW and (2) obtaining approval from Ecology by demonstrating that removing the tanks is impracticable, as explained below.

- **Managing the residual waste in tanks.** DOE may use the WIR evaluation process under the manual associated with DOE Order 435.1 to determine that the remaining residual waste in tanks and ancillary equipment can be managed as a waste other than HLW, and therefore need not be vitrified and sent to a deep geologic repository.<sup>49</sup> In 2018, DOE began this process for C-farm and asked NRC to provide “consultative advice” on DOE’s analysis related to the residual waste and ancillary equipment. In May 2020, NRC reported that it had found that DOE had met the criteria under 435.1 for residual waste in tanks and ancillary equipment at the C-farm,<sup>50</sup> except for plugged pipelines—that is, the pipes filled with residual waste, that connect tanks in the farm.<sup>51</sup> NRC recommended that DOE characterize the plugged pipelines to determine the concentration of radionuclides and the amount of liquids that are present. However, NRC specified that its conclusions and recommendations are only for DOE’s consideration and that they “do not represent any regulatory

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<sup>49</sup>The ancillary equipment at the C-farm consists of a waste transfer system of waste transfer lines or pipelines, seven diversion and valve boxes, four vault tanks, one catch tank, valve pits, and other miscellaneous structures constructed to support the transfer and storage of waste within the tanks at the C-farm.

<sup>50</sup>NRC, *Technical Evaluation Report for the Draft Waste Incidental to Reprocessing Evaluation for Closure of Waste Management Area C at the Hanford Site* (Washington, D.C.: May 2020).

<sup>51</sup>Under the three criteria set forth in DOE’s manual associated with Order 435.1, DOE must demonstrate that: (1) the residual waste in tanks at the C-farm has been or will be processed to remove key radionuclides to the maximum extent that is technically and economically practicable, (2) residual waste will be managed to meet safety requirements comparable to the performance objectives set forth in CFR Part 61, Subpart C, Performance Objectives, and (3) residual waste will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste as set out in 10 CFR § 61.55, Waste Classification.

authority related to DOE's waste determination process."<sup>52</sup> According to DOE officials, it is not feasible to characterize the plugged pipelines, given their location, access and other factors, such as the worker safety risks associated with the excavation necessary to characterize the pipelines.<sup>53</sup> DOE plans to make a WIR evaluation determination for the tanks and ancillary equipment in 2021.

- **Obtaining approval from Ecology.** Even if DOE determines that the residual tank waste can be managed as other than HLW, this waste is still considered mixed waste under RCRA and therefore the hazardous waste component is regulated by Ecology. Consequently, DOE must obtain Ecology's approval of its plan to grout the tanks and certain ancillary equipment containing residual waste and leave them in place. As explained above, under RCRA, an operator generally must close hazardous waste storage tanks by exhuming them. However, the state regulator may determine that the tanks can be closed in place if the operator—in this case, DOE—demonstrates that exhuming them would be impracticable. In 2014, DOE provided Ecology with an analysis demonstrating that exhuming the tanks would be impracticable.<sup>54</sup> In September 2015, DOE provided Ecology a system-wide plan for landfill closure—called a tier 1 closure plan—to grout and leave in place all 149 SSTs at Hanford;<sup>55</sup> DOE must obtain Ecology's approval for this plan as part of its C-farm closure

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<sup>52</sup>NRC also noted that DOE's analysis and the NRC staff review do not address other facilities or systems, waste removed from the waste tanks and ancillary structures, or the contaminated soil and groundwater from any previous leaks or releases at C-farm.

<sup>53</sup>DOE officials stated that the analysis NRC reviewed conservatively assumed that all the known pipelines were plugged in order to model potential exposures to inadvertent human intruders. These officials said that there was no known mechanism that would allow the pipelines to become as extensively plugged as assumed in the DOE analysis.

<sup>54</sup>DOE, *Clean Closure Practicability Demonstration for the Single-Shell Tanks*, DOE/ORP-2014-02 (Richland, WA: May 2014). DOE, *Supplemental Information to the Clean Closure Practicability Demonstration for the Single-Shell Tanks*, DOE-ORP-2014-02-Supp 1 Revision 0 (Richland, WA: August 2018).

<sup>55</sup>Washington River Protection Solutions, Contractor for DOE Office of River Protection, *Tier 1 Closure Plan – Single-Shell Tank System*, RPP-RPT-58858 Revision 1 (Richland, WA: September 2015).

decision.<sup>56</sup> Ecology has not yet approved the plan, but Ecology officials told us that they anticipate most of the tanks on site will be grouted and left in place. Ecology officials explained that if an individual tank in a tank farm has substantial effects that exceed safety limits to the long-term environment and public health, then Ecology may require DOE to clean close, or exhume, that individual tank. According to Ecology officials, final decisions on how to close tank farms and individual tanks will be determined when DOE submits farm-specific—called tier 2 closure plans—and tank-specific—called tier 3 closure plans—to Ecology for approval. DOE officials agreed with this approach.

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### DOE Will Likely Face Legal and Regulatory Approval Challenges If It Determines That the Residual Tank Waste Can Be Managed as Other Than High-Level Waste

If DOE makes a WIR determination under its Order 435.1 that determines that the residual tank waste can be managed as a waste type other than high-level waste, DOE will likely face legal challenges. In 2002, DOE's authority to apply its Order 435.1 to certain tank waste was challenged in a lawsuit that eventually failed on procedural grounds.<sup>57</sup> In response, in 2004, Congress passed legislation (Section 3116 of the National Defense Authorization Act for Fiscal Year 2005) that provides DOE authority to

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<sup>56</sup>The TPA establishes a tiered planning structure for tank farm closure. The highest-level plan (tier 1) documents requirements pertaining to closure of all the SST tank farms and is referred to as the "Framework Plan." Mid-level plans (tier 2) document requirements pertaining to each of the tank farms, while the lowest level plan (tier 3) documents requirements pertaining to the closure of individual single-shell tanks and ancillary equipment. DOE and Ecology agree that all three plans must be approved before the closure of C-farm is completed. As part of the tier 1 closure plan for all SST tank farms, DOE proposed that all tanks at Hanford be closed by grouting the tanks and leaving them in place. DOE has submitted the Tier 1, 2 and 3 plans for approval, but Ecology has not yet approved them.

<sup>57</sup>*Natural Resource Defense Council v. Abraham*, 271 F.Supp.2d 1260 (D. Idaho 2003), reversed 388 F.3d 701 (9th Cir. 2004). The federal district court held that the relevant provisions of DOE's Order 435.1 and its manual were inconsistent with the Nuclear Waste Policy Act, but a federal appeals court reversed that decision on procedural grounds in October 2004 and ordered dismissal of the suit without ruling on the underlying claim.

manage certain waste as other than HLW, in consultation with NRC.<sup>58</sup> However, the legislation does not apply to Hanford. As we previously reported, DOE could be open to further legal challenges if it attempts to use Order 435.1 to manage tank waste as a waste type other than HLW at Hanford.<sup>59</sup> We have also previously reported that if DOE lost a challenge to its authority, it could be forced to exhume Hanford's tanks—including any residual waste inside them—and dispose of them in a geologic repository.<sup>60</sup> A few stakeholders we interviewed told us that they plan to sue DOE if it determines that the tanks and residual waste can be managed as other than HLW, on the grounds that DOE does not have the authority to do so.

In addition, DOE will also likely face regulatory approval challenges. Specifically, Ecology has the regulatory authority to approve of DOE's plan to leave the tanks in place or compel DOE to exhume the tanks. Ecology officials and other stakeholders raised concerns that DOE's analysis related to the pending WIR evaluation determination is not sufficient because it has not been formally and entirely reviewed by an independent entity with radiological expertise.<sup>61</sup> Ecology officials explained that:

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<sup>58</sup>Section 3116 of the National Defense Authorization Act for Fiscal Year 2005 authorizes the Secretary of Energy, in consultation with NRC, to determine that certain waste from reprocessing is not HLW if it meets the criteria set forth in that section that the waste: (1) does not require disposal in a deep geologic repository, (2) has had highly radioactive radionuclides removed to the maximum extent practical, and (3) meets concentration limits and/or dose-based performance objectives for near-surface disposal of radioactive waste set out in subpart C of part 61 of title 10, Code of Federal Regulations, and will be disposed of pursuant to a state-issued permit or state-approved closure plan. This legislation specifically covered the Savannah River and Idaho sites. Pub. L. No. 108-375, Div. C, Title XXXI, § 3116, 118 Stat. 2162 (2004).

<sup>59</sup>GAO, *Nuclear Waste: Opportunities Exist to Reduce Risks and Costs by Evaluating Different Waste Treatment Approaches at Hanford*, [GAO-17-306](#) (Washington, D.C.: May 3, 2017); *Nuclear Waste: Uncertainties and Questions about Costs and Risks Persist with DOE's Tank Waste Cleanup Strategy at Hanford*, [GAO-09-913](#) (Washington, D.C.: Sept. 30, 2009); and *Nuclear Waste: Challenges to Achieving Potential Savings in DOE's High-Level Waste Cleanup Program*, [GAO-03-593](#) (Washington, D.C.: June 17, 2003).

<sup>60</sup>[GAO-09-913](#).

<sup>61</sup>This analysis is called a performance assessment. A performance assessment is intended to provide a comprehensive analysis of the long-term effects of both radiological and non-radiological contaminants remaining in a closed tank farm on the environment and human health.

- DOE contracted with NRC only in a consultative role to provide advice on DOE's analysis, and
- this NRC review was insufficient because NRC only reviewed a portion of this analysis that included the radiological risk associated with residual waste inside the tanks and that excluded risks posed by existing contaminated soil, because this approach is what DOE asked NRC to review.

Ecology officials also explained that DOE is not required to implement NRC's recommendations. Furthermore, in its consultative capacity, Ecology officials explained that NRC does not currently have a long-term monitoring role over the Hanford site and NRC reports to DOE rather than directly to Congress.

Ecology officials told us that they believe DOE has a conflict of interest in both performing the analysis and making a final determination. Ecology officials noted that because radioactive components of mixed waste are outside of Ecology's direct regulatory authority, DOE is effectively self-regulating the cleanup of its own radioactive contamination without the requirement of any independent review and approval process. Ecology officials stated that they would like NRC—which, according to Ecology, is a neutral, trusted entity with the requisite expertise—to independently and formally review all of DOE's data and analysis concerning radionuclide risks before DOE and Ecology agree to leave tanks, ancillary equipment, and contaminated soils in place at Hanford's tank farms. Ecology officials stated that, if NRC expressed concern that DOE has not removed enough waste from the tanks, it may lead to Ecology compelling DOE to exhume the tanks. For example, if DOE does not adequately address NRC's comments and recommendations and NRC has outstanding concerns that not enough waste has been removed from the tanks and/or ancillary equipment, then Ecology may not be able to approve a landfill closure decision due to the prohibition, under RCRA, of the land disposal of high-level radioactive waste that has not been vitrified. Moreover, many stakeholders we interviewed echoed Ecology's concerns about the lack of independent review of DOE at Hanford, and many favor having NRC play a formal oversight role. EPA officials also told us that involving NRC would be helpful because NRC is thorough and has experience evaluating radionuclide risks.

In 2014, DOE estimated that exhuming all SSTs at Hanford would cost \$18 billion more than grouting the tanks and leaving them in place and

would pose many risks.<sup>62</sup> For example, in a supplemental 2018 document provided to Ecology, DOE stated, among other things, that exhuming the tanks would pose health risks for workers, require 60 percent more land use for disposal, and generate 60 percent more low-level waste and five times more mixed-level radioactive waste by volume than grouting the tanks and leaving them in place.<sup>63</sup> In addition, according to the document, exhuming the tanks could take 50 years longer than grouting the tanks and leaving them in place, and DOE is uncertain whether exhuming the tanks is technically feasible due to the depth of contamination, difficulty and high cost of soil excavation, and technical issues associated with removing the tank structures.

Ecology officials we interviewed stated that one way to resolve this regulatory challenge would be to apply a legislative framework at Hanford analogous but not identical to Section 3116 in the 2005 National Defense Authorization Act provision that is now in place for the Savannah River and Idaho sites. DOE officials stated that they are generally following the process under section 3116 for the Hanford tanks even though they are not required to do so to ensure consistent processes across the sites. However, Section 3116 includes a formal consultation role for NRC in the determination process.<sup>64</sup> By Congress clarifying, in a manner that does not impair the regulatory authorities of EPA and the state of Washington, DOE's authority at Hanford to determine, with NRC involvement, that residual tank waste can be managed as a waste type other than HLW, DOE will be in a better position to avoid a lawsuit, obtain necessary Ecology approvals, and potentially save billions of dollars.

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<sup>62</sup>DOE, *Clean Closure Practicability Demonstration for the Single-Shell Tanks*, DOE/ORP-2014-02 (Richland, WA: May 2014).

<sup>63</sup>DOE, *Supplemental Information to the Clean Closure Practicability Demonstration for the Single-Shell Tanks*, DOE/ORP-2014-02-Supp1Revision0 (Richland, WA: August 2018). According to this document, a large volume of the additional waste would be generated from excavation of the tanks, equipment, and contaminated soils from the vadose zone.

<sup>64</sup>Section 3116 also requires NRC to monitor DOE's disposal actions once implemented and to notify Congress if its monitoring indicates disposal action does not comply with performance objectives.

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## DOE and Ecology Do Not Agree on the Process for Evaluating the Contaminated Soil at the C-Farm or Whether NRC Should Play a Role

In addition to the challenges outlined above, DOE faces challenges coming to an agreement with Ecology about how to address contaminated soil at the C-farm. Specifically, DOE and Ecology do not agree (1) on a process for evaluating contaminated soil at the C-farm or (2) on whether NRC should play a role in this process.

- **Process for evaluating soil contamination.** DOE and Ecology disagree about what process DOE should use to evaluate contaminated soil at the C-farm. Specifically, DOE used the less stringent WIR citation process to evaluate the contaminated soil at Hanford tank farms. However, Ecology officials told us that Ecology has advocated for a more rigorous process, such as the WIR evaluation process or the process called for in Section 3116 of the National Defense Authorization Act for Fiscal Year 2005 to be applied to the contaminated soil. In 2008, DOE made a determination using the WIR citation process that the soil contaminated with tank waste at Hanford would be classified as low-level waste.<sup>65</sup> DOE made this determination at the Hanford site-level without external consultation or public notice, which DOE officials stated was in accordance with its WIR citation process.

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<sup>65</sup>DOE officials told us that DOE has not applied the WIR citation process related to contaminated soils that have been contaminated in the past by leaks, intentional releases or accidental spills. They stated that the 2008 WIR citation determination is restricted specifically to active cleanup of soils from recent spills—if they occur—that meet the requirements set forth in the Hanford WIR citation procedure. DOE officials said that DOE has communicated to the HAB and the public numerous times that this WIR citation determination has not been, nor will it be, used for past soil contamination at the Hanford tank farms. Additionally, according to these officials, DOE has publicly stated that contaminated soil and groundwater will be addressed under CERCLA. However, DOE wrote in a 2010 plan describing the radioactive waste determination process for the C-farm that soils contaminated with tank waste have already been classified as low-level waste by the Hanford site using the 2008 WIR citation process. DOE, Radioactive Waste Determination Process Plan for Waste Management Area C Tank Waste Residuals, RPP-PLAN-47325, Revision 0 (September 2010).

DOE reaffirmed this decision most recently in January 2020.<sup>66</sup> In a 2018 letter to DOE, Ecology officials stated that the WIR citation process cannot be used for contaminated tank farm soil, and Ecology asserted that DOE should use a more rigorous process, such as the WIR evaluation process, to evaluate contaminated soil as it does for residual tank waste.<sup>67</sup> In January 2020, Ecology officials revised their position and proposed a process that they believe is even more rigorous than the WIR evaluation, in part because of concerns related to DOE's proposed interpretation of the high-level waste definition outlined in Federal Register notices in 2018 and 2019.<sup>68</sup> Ecology officials said they prepared draft bill language for Congress in which Ecology proposed legislation for the Hanford site analogous to Section 3116 of the National Defense Authorization Act for Fiscal Year 2005. According to Ecology officials, this approach would provide greater oversight of DOE's analyses and decisions related to radiological risk than the WIR evaluation process, both for residual tank waste and contaminated soil.

DOE officials believe that the requirements of section 3116 should not be applied to the contaminated soil around the tanks, because DOE does not believe that the waste in soil is high-level waste. According to DOE officials, considering the radioactive waste in the soil to be high-level waste could have tremendous cost implications, potentially

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<sup>66</sup>DOE Office of River Protection, *Waste Incidental to Reprocessing (WIR) Determinations*, ESQ-EM-IP-M435.1-1-10 Revision 0 (Richland, WA: September 2008). DOE Office of River Protection, *Waste Incidental to Reprocessing Determinations*, DOE-ORP-PPD-EM-50168 Revision 2 (Richland, WA: January 2020).

<sup>67</sup>Letter from Ecology to DOE, *Ecology Comments on the United States Department of Energy Draft Waste Incidental to Reprocessing Evaluation for Closure of Waste Management Area C at the Hanford Site, DOE/ORP-2018-01, Draft D (Draft WIR Evaluation) submitted for the June 4 through November 7, 2018, Comment Period*, 18-NWP-181 (Richland, WA: Nov.6, 2018).

<sup>68</sup>In October 2018, DOE issued a Federal Register Notice stating that DOE interprets the statutory definition of HLW mentioned in the Atomic Energy Act and Nuclear Waste Policy Act to mean that certain reprocessing wastes may be classified as non-HLW and therefore may be disposed of in accordance with their radiological characteristics. 83 Fed. Reg. 50909 (Oct. 10, 2018). DOE updated this notice in June 2019. 84 Fed. Reg. 26835 (June 10, 2019). DOE stated that it will make subsequent decisions on how this interpretation will apply to existing wastes and whether these wastes may be managed as non-HLW on a case-by-case basis. DOE officials told us that DOE does not currently intend to use this interpretation for the waste in the tanks at Hanford in the near future, but DOE could apply it in the future. However, Section 3121 of the National Defense Authorization Act for Fiscal Year 2020 prohibited DOE from applying this interpretation at Hanford for Fiscal Year 2020. The House version of the National Defense Authorization Act for Fiscal Year 2021 would extend this prohibition through fiscal year 2021.

costing hundreds of billions of dollars, if DOE were required to remove large volumes of soil.<sup>69</sup> DOE officials also noted that this could set a costly precedent for other cleanup activities at Hanford and at other DOE sites. DOE officials acknowledged that their estimate of hundreds of billions of dollars is not based on an actual analysis, and it will cost that much only if DOE actually had to remove all of the soil and treat and dispose of it as HLW. DOE officials stated that DOE did not have an estimate for the costs associated with going through either the WIR or the Section 3116 process. See appendix II for more information on the key differences between the WIR citation process, the WIR evaluation process, and Section 3116 of the National Defense Authorization Act for Fiscal Year 2005.

- **NRC consultation.** DOE and Ecology do not agree on the role NRC should play in addressing soil contamination within the C-farm. DOE's position is that NRC should not play a role in reviewing and monitoring contaminated soil, but Ecology has advocated for NRC to have a formal role in these areas. The disagreement between DOE and Ecology stems in part from different interpretations of the TPA regarding NRC's role in reviewing contaminated soil. According to Ecology officials, the TPA does not establish the extent to which contaminated tank farm soil must be remediated as part of closure. Ecology officials stated that appendix H of the TPA requires DOE to reach a formal agreement with NRC as to the allowable waste residuals to be left in the soil, under which the NRC would independently review DOE's assessments of radiological contamination in the soil caused by past releases.<sup>70</sup> DOE officials stated, however, that a different portion of the TPA, appendix I, governs cleanup of the tank farm soils and that this provision makes no mention of NRC. DOE officials told us that giving NRC a formal role in reviewing DOE's cleanup decisions regarding the tank farm soil

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<sup>69</sup>According to DOE officials, DOE considers the radioactively contaminated soil to be contaminated environmental media that DOE has not determined to be waste. According to these officials, DOE plans to manage the contaminated soil as contaminated environmental media under the Comprehensive Environmental Response, Compensation and Liability Act. DOE officials stated that EPA has regulatory authority for radionuclides in soil under this Act.

<sup>70</sup>As noted above, Ecology has expressed a similar desire to have NRC review DOE's WIR determination concerning residual tank waste.

would increase the costs of the cleanup mission.<sup>71</sup> DOE does have an interagency agreement with NRC that provides for NRC to review and consult on DOE's analyses with respect to the residual waste in the tanks under the WIR evaluation process; however, the agreement is silent with respect to contaminated soil. EPA officials told us that it is important for NRC to be involved in reviewing data not only on residual waste in tanks but also on soil contamination. NRC officials we spoke to said that the contaminated soil at Hanford should be reviewed—whether by NRC, an independent contractor, or another party—because the radionuclides in the soil may pose a risk to the site in the long term.

According to Ecology officials, if DOE does not reach a formal agreement with NRC regarding the contaminated soil, Ecology may deny DOE the permit needed to close C-farm under RCRA, until DOE reaches formal agreement with NRC. In addition, Ecology officials explained that regardless of DOE's determination of how to address radionuclides in the soil under Order 435.1, under the RCRA process, Ecology approval is required for tank farm closure. According to Ecology officials, Ecology will require DOE to conduct a cumulative impact analysis of both residual tank waste and contaminated soil as part of the RCRA process.<sup>72</sup> DOE and Ecology officials stated that while they disagree over the role of NRC in reviewing analyses and decisions related to soil cleanup, they agree that failure to resolve this long-standing disagreement will further stall

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<sup>71</sup>DOE officials provided other reasons why NRC should not be involved in reviewing DOE's cleanup decisions regarding the tank farm soil. For example, DOE officials stated that it could potentially create conflicting regulatory direction between NRC and EPA. In addition, DOE officials noted that the three TPA agencies are already involved at Hanford, and including another agency in the cleanup process would create complications. Moreover, DOE officials are concerned that the TPA parties do not currently have an agreement on a process NRC would use to evaluate contaminated soil.

<sup>72</sup>Specifically, Ecology has stated that under RCRA it needs an analysis addressing all contamination as long as it poses a potential hazard to human health and the environment. Letter from Ecology to DOE *Re: Department of Ecology Concerns with the Cumulative Impacts Evaluation Approach*, 19-NWP-034 (Feb. 25, 2019).

closure of the C-farm and subsequent tank farms, where progress depends on resolution of the ongoing disagreement at the C-farm.<sup>73</sup>

The TPA requires DOE to close all SST tank farms, including cleaning up contaminated soil. Though both DOE and Ecology base their positions regarding contaminated soil on portions of the TPA, no provision in the TPA specifically defines the parameters of soil cleanup or clearly specifies NRC's role with respect to the contaminated soil. According to a September 2012 *Memorandum on Environmental Collaboration and Conflict Resolution* issued by the Office of Management and Budget and the Council on Environmental Quality, departments and agencies should increase the appropriate and effective use of third-party assisted environmental collaboration, as well as environmental conflict resolution, to resolve problems and conflicts that arise in the context of environmental, public lands, or natural resource issues.<sup>74</sup> In 2019, DOE, Ecology, and EPA agreed to engage a mediator from the Federal Mediation and Conciliation Service to help resolve long-standing areas of disagreement related to retrieval and closure, among other topics. The first mediation session was held in June 2020. However, according to DOE officials, addressing contaminated soil was not part of the initial set of broad topics agreed upon for negotiations. According to DOE officials, as of October 2020, the topic of NRC's role on contaminated soil was not part of the agenda. By using an independent, third-party mediator, either during these ongoing negotiations or in separate discussions, to work toward agreement with Ecology on a process for assessing the contaminated soil—particularly regarding what process DOE should use to evaluate the contaminated soil and NRC's role in evaluating the contaminated soil—DOE would be in a better position to achieve regulator concurrence on these issues and avoid future cleanup delays.

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<sup>73</sup>Ecology has a long history of expressing concerns about the contaminated soil in the tank farms. For example, in commenting in 2003 on a draft DOE plan for closing the tank farms, Ecology faulted DOE for "only promising to consider" closure actions with respect to contaminated tank farm soils. Ecology cited the state's hazardous waste regulations, which require the removal or decontamination of all waste, residues, contaminated containment systems components, contaminated soils, and structures and equipment contaminated with waste. Ecology has reiterated in 2015, 2016, and 2018 the need to address contaminated soil and groundwater cleanup in DOE's plan for closing the tank farms.

<sup>74</sup>Office of Management and Budget and the Council on Environmental Quality, *Memorandum on Environmental Collaboration and Conflict Resolution* (Washington, D.C.: Sept. 7, 2012).

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## DOE Has No Long-Term Plan for Closing Most Tank Farms, and Stakeholders Have Concerns about Technical Challenges and Limited Involvement

DOE is planning future tank farm closures on a sequential farm-by-farm basis, rather than developing a comprehensive long-term plan as called for by leading practices. Stakeholders have raised concerns about DOE's approach and the absence of a comprehensive plan to close the remaining farms given that technical challenges have already been identified, some of which may require years of preparation to address. Moreover, stakeholders noted that they believe DOE will continue to face challenges in the future because, under its current approach to this mission, DOE does not (1) involve stakeholders in a meaningful way in its decision-making process, (2) communicate with stakeholders in a way that addresses their concerns regarding technical challenges, and (3) share information transparently with them.

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## DOE Has Plans for Closing the Next Two Tank Farms but Does Not Yet Have a Plan for the Remaining Tank Farms

Out of the 17 tank farms remaining after C-farm, DOE has developed detailed plans for the closure of two—the A- and AX-farms. DOE has not yet developed a plan for the order of future tank farm closure beyond the A- and AX-farms. DOE officials told us that long-term planning is difficult, in part because of uncertainties about when treatment facilities will be operational and the long time frames of the cleanup mission. In addition, they explained that DOE's approach is to negotiate future tank-farm closure plans on a farm-by-farm basis.<sup>75</sup> DOE officials also stated that having a long-term plan is challenging to DOE, in part because DOE's cleanup mission is highly complex and depends on incorporating lessons learned from prior tank retrieval and farm closures, addressing problems as they arise, and funding.

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<sup>75</sup>TPA milestone M-045-85 requires DOE and Ecology to initiate negotiations by January 31, 2022, to establish interim milestones for closure of the remaining SSTs and farms, including final closure dates for each SST farm.

DOE has agreed in the TPA on end dates for completing certain retrieval and closure activities, such as finishing waste retrieval from all SSTs by 2040, closing all SSTs by 2043, and closing all DSTs by 2052. However, in its 2019 lifecycle cost estimate, DOE postponed the time frames for finishing waste retrieval and closing all SSTs and DSTs until at least 2069; the TPA has not been updated to reflect this new end date.<sup>76</sup>

DOE is not required by its own directives to have a long-term plan because it manages the tank waste mission as an operations activity, rather than a project.<sup>77</sup> As we found in February 2019, DOE does not follow leading program or project management practices for its operations activities.<sup>78</sup> Such leading practices include having a long-term plan, a reliable lifecycle cost estimate, and an integrated master schedule, as well as conducting risk management throughout the life of the mission. In February 2019, we recommended that DOE review and revise its 2017 cleanup policy applicable to operations activities to include program and project management leading practices related to planning, scope, cost, schedule performance, and independent reviews.<sup>79</sup> In November 2020, DOE established the Environmental Management Program Management Protocol, which requires that each site create a site program plan to document and prioritize what DOE would like to accomplish over the next 10 years to support EM's strategic vision.<sup>80</sup>

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<sup>76</sup>DOE, *2019 Hanford Lifecycle Scope, Schedule and Cost Report*, DOE/RL-2018-45 Revision 0 (Richland, WA: January 2019).

<sup>77</sup>DOE requires long-term planning only for capital assets projects under Order 413.3B, but these requirements do not apply to operations activities. DOE's policy defines operations activities as reoccurring facility or environmental operations, as well as activities that are project-like, with defined start and end dates. DOE manages most of its cleanup of nuclear waste (77 percent of its fiscal year 2019 budget) as operations activities, which use less stringent requirements than capital asset projects.

<sup>78</sup>GAO, *Nuclear Waste Cleanup: DOE Could Improve Program and Project Management by Better Classifying Work and Following Leading Practices*. [GAO-19-223](#) (Washington, D.C.: Feb. 19, 2019).

<sup>79</sup>[GAO-19-223](#).

<sup>80</sup>DOE, *Environmental Management Program Management Protocol* (Washington, D.C.: Nov. 6, 2020).

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## Stakeholders Are Concerned about Technical Challenges That May Require Long-Term Planning

Stakeholders we interviewed raised concerns about DOE's approach of executing its tank farm closure efforts without a long-term plan, particularly given questions regarding how DOE will address potential complex technical challenges over the long term.<sup>81</sup> Stakeholders identified four major technical challenges.

- **DST space.** Several stakeholders and Ecology officials we interviewed said they are concerned that DOE may run out of DST space needed to continue waste retrieval and farm closure activities in the event of additional delays in building treatment facilities, and many stakeholders were in favor of DOE's building additional DSTs.<sup>82</sup> EPA officials told us that, based on past perspectives, they estimate it would take at least 7 years to build new DSTs. Given the length of time needed to construct additional tanks, in 2018 the Hanford Advisory Board advised DOE and Ecology that DOE should immediately begin preparatory work in the likely event that new tank capacity is deemed to be necessary.<sup>83</sup> DOE officials agreed that building more DSTs could be time-consuming but said that doing so is not necessary since DOE plans to begin treating certain tank waste in 2022, which will create more DST space.<sup>84</sup> However, DOE estimated in an internal tank-farm risk register document that there is a 95 percent chance it will run out of DST space. Moreover, DOE identified insufficient DST space as the top risk to its retrieval and closure

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<sup>81</sup>As noted earlier, stakeholders we interviewed included local, regional and national entities and tribal governments. Tribal governments have a unique status because of their treaty rights and tribal sovereignty. However, for methodological purposes and to protect confidentiality, we do not distinguish among stakeholders.

<sup>82</sup>Ecology officials noted that Ecology is in favor of DOE's building any RCRA-compliant storage capacity, and has suggested possible alternative designs to the existing DSTs. Ecology officials said DOE is still opposed to this option and has not considered tank design alternatives.

<sup>83</sup>Hanford Advisory Board, HAB Consensus Advice #298 to DOE and Washington State Department of Ecology (Richland, WA: Sept. 20, 2018).

<sup>84</sup>DOE, Response to HAB Consensus Advice #298 (Richland, WA: January 2019).

mission.<sup>85</sup> (See app. III for a summary of risks to the Hanford waste retrieval and tank closure mission that DOE identified in a 2019 report required by the TPA.) Furthermore, DOE's Office of the Inspector General found in September 2020 that DOE may have insufficient DST space available to store waste from additional DST leaks. For example, the Office of Inspector General found that DOE does not have enough usable DST space to store waste in the 200 West area should one DST in that area fail before the treatment facility starts operating.<sup>86</sup>

- **Tank corrosion.** Some stakeholders and Ecology officials we interviewed said they are concerned about the integrity of existing tanks at Hanford, noting that the tanks are already past their design life and that the likelihood of tank failure will increase as tanks continue to age, a situation that could affect DOE's ability to retrieve waste. For example, Ecology officials raised concerns that using existing DSTs for preparing waste for treatment would make DSTs more susceptible to failure, such as leaks. One stakeholder also told us that he believes DOE should take preventive measures against tank corrosion. A 2018 DOE analysis found that all DSTs present various levels of risk to their integrity.<sup>87</sup> DOE officials acknowledged that DSTs will continue to deteriorate over time and told us that DOE is working to extend the life of the DSTs to complete the mission.<sup>88</sup> They explained that DOE has a program to monitor for and prevent corrosion,<sup>89</sup> including through visual inspections, ultrasonic

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<sup>85</sup>DOE estimated in its risk register that not having enough DST space may potentially delay the tank waste retrieval mission by 8 years and cost an additional \$1.3 billion should this risk be realized.

<sup>86</sup>DOE Office of Inspector General, *Tank Waste Management at the Hanford Site*, DOE-OIG-20-57 (Washington, D.C.: September 2020).

<sup>87</sup>DOE, *Double-Shell Tank Integrity Risk Assessment Results*, RPP-ASMT-61284 Revision 0 (Richland, WA: September 2018).

<sup>88</sup>According to DOE officials, the SSTs are no longer at a high risk of leaking because most of the waste remaining in them is not liquid.

<sup>89</sup>According to DOE officials, DOE has presented this program to Ecology, the Hanford Advisory Board, and in public meetings on numerous occasions over several years. Furthermore, according to these officials, program information and technical documents are available to the public online.

inspections, corrosion probes, and chemical controls.<sup>90</sup> According to the 2018 analysis, DOE believes that this program would provide a sound basis for reducing the risk of removing another DST from service. In September 2020, DOE's Office of Inspector General found that DSTs are at risk of corrosion on the bottom of the tank and thinning of the secondary liner.<sup>91</sup> Moreover, the Office of Inspector General reported that DOE has inadequately evaluated the effects of multiple DST failures and recommended that it develop plans to evaluate and address these effects.

- **Infrastructure.** According to some stakeholders we interviewed, DOE will need to build new waste retrieval infrastructure to complete cleanup activities. In addition, a few stakeholders mentioned that DOE would need to replace transfer lines to pump waste between tanks to and from treatment facilities. DOE officials agreed that infrastructure must be in place at each tank farm before DOE can retrieve the waste, and they noted that building such infrastructure is time-consuming and costly. For example, DOE officials stated that DOE spent \$1.5 billion to build the infrastructure for the A- and AX-farms.<sup>92</sup> In addition, one stakeholder told us that the existing transfer line between the West and East areas needs to be replaced because it may not receive approval from Ecology. DOE's Office of Inspector General also reported in September 2020 that DOE has not maintained operability of the transfer line between West and East areas and recommended that DOE update this transfer line to make it operable.<sup>93</sup> DOE officials acknowledged to us that DOE would need to upgrade the existing transfer line to obtain approval from Ecology (see app. III for more information).

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<sup>90</sup>According to a 2018 DOE analysis, DOE conducts visual inspections of the DSTs every 3 years and ultrasonic inspections every 8-10 years. DOE, *Double-Shell Tank Integrity Risk Assessment Results*, RPP-ASMT-61284 Revision 0 (Richland, WA: September 2018).

<sup>91</sup>DOE Office of Inspector General, *Tank Waste Management at the Hanford Site*, DOE-OIG-20-57 (Washington, D.C.: September 2020).

<sup>92</sup>DOE officials explained that they applied many lessons learned from C-farm in building the retrieval infrastructure for the A- and AX-farms, such as building most of the connecting pipes underground. DOE officials stated that they will continue to apply lessons learned from prior tank farms as they build the retrieval infrastructure for the remaining farms.

<sup>93</sup>DOE Office of Inspector General, *Tank Waste Management at the Hanford Site*, DOE-OIG-20-57 (Washington, D.C.: September 2020).

- **Inadequate retrieval technology.** A few stakeholders we interviewed said they are concerned that the current tank waste retrieval technology may not be appropriate for future tank farm retrievals, including the A- and AX-farms, especially since these tank farms may be more challenging to close than the C-farm because of the tank structures and waste composition at these farms. DOE officials told us that, depending on the conditions of the tanks, there are different technologies DOE may pursue or continue to evaluate to retrieve waste from tanks. According to these officials, DOE's ongoing technology research and development efforts focus primarily on upgrading existing technologies and developing a waste retrieval technology that will not use water and enable retrieval of waste from tanks that have been identified as being potentially leaking tanks.<sup>94</sup> For example, DOE developed one dry-retrieval technology to break down and recover hard wastes from tanks. Tests to analyze the effectiveness of this technology, completed in July 2018, found that this dry-retrieval technology is a potentially viable alternative for tank waste retrieval. As of May 2019, DOE was finalizing design and fabrication of this technology for final testing.

Several stakeholders told us that they believe DOE should have a long-term plan, given that these technical challenges may take years to address. Stakeholders identified several reasons to have a long-term plan. For example, one stakeholder stated that a long-term plan would allow DOE to better communicate its overall intentions and goals to the public, potentially leading to less reactionary responses when DOE announces decisions. Another stakeholder also noted that having a long-term plan would allow contractors to better plan for what equipment will be needed in future waste retrieval efforts and would allow DOE to prepare for long-term challenges and avoid work stoppages and more cleanup delays. Another stakeholder expressed concern that if DOE does not develop a long-term plan, Congress may appropriate less funding or terminate the work.

Ecology officials also told us they would prefer for DOE to develop a long-term plan that includes the sequence of tanks from which DOE plans to retrieve waste. Ecology officials noted that having such a long-term plan

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<sup>94</sup>DOE currently uses waste retrieval technologies that use water to dislodge the waste from tanks. On the other hand, according to DOE officials, dry retrieval technologies would be useful for tanks that may be potentially leaking because such technologies avoid creating additional liquid waste that could leak into the soil. In fiscal year 2019, according to contractor officials, DOE spent about \$2.9 million for developing new retrieval technologies at the Hanford site.

is required as part of RCRA closure and could additionally allow DOE to conduct retrieval and closure more efficiently because DOE could be more strategic in developing appropriate retrieval technologies and could work on multiple tank farms simultaneously. EPA officials also stated that it would be beneficial for DOE to have a long-term plan. As noted earlier, DOE is not required under its internal policies to have a long-term plan because it manages the tank waste mission as an operations activity, rather than a project. We have previously recommended that DOE review its cleanup policy to incorporate program management leading practices, including long-term planning. As noted earlier, DOE has developed a policy covering operations activities that DOE stated incorporates GAO's program and project management leading practices.<sup>95</sup> However, this policy does not require a longer-term, specific plan for each operations activity, such as tank waste cleanup. Nonetheless, as we reported in February 2019, a leading project management practice is to have a long-term plan. By developing a long-term plan for its waste retrieval and tank closure mission at the Hanford site, DOE could better prepare to address the many complex technical challenges affecting Hanford's tank waste retrieval and closure mission in a timely manner and foster public support by setting clear expectations for the future of the mission.

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### Stakeholders Have Raised Concerns about Limitations in DOE's Stakeholder Involvement, Communication, and Transparency

Stakeholders we interviewed noted that DOE's approach to closing the remaining tank farms will continue to face challenges because DOE's approach does not (1) involve stakeholders in a meaningful way in its decision-making process, (2) communicate with stakeholders in a way that addresses their concerns regarding technical challenges, and (3) share information transparently with them.<sup>96</sup>

- **Stakeholder involvement.** Some stakeholders we interviewed told us that DOE is not engaging them in a meaningful way in its decision-making process. DOE officials stated that DOE offers public comment

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<sup>95</sup>DOE, *Environmental Management Program Management Protocol* (Washington, D.C.: Nov. 6, 2020).

<sup>96</sup>As noted earlier, stakeholders we interviewed included local, regional and national entities and tribal governments. Tribal governments have a unique status because of their treaty rights and tribal sovereignty. However, for methodological purposes and to protect confidentiality, we do not distinguish among stakeholders.

periods for its decisions, but stakeholders said that their feedback is sometimes solicited after DOE has already made its decision, leaving them limited opportunities for real input. For example, according to Ecology officials, in June 2018, DOE released two key documents related to its WIR evaluation for residual tank waste concurrently—a portion of the C-farm performance assessment analyzing whether the residual waste in the tanks meets DOE’s radiological performance objectives and its draft WIR evaluation.<sup>97</sup> Ecology officials noted that DOE’s approach did not allow the public meaningful opportunity to provide feedback on any perceived deficiencies in the performance assessment before it was used to inform the draft WIR evaluation. Ecology officials expressed concern that this may set a precedent for future tank farms.<sup>98</sup> DOE officials told us that DOE has not issued a final WIR evaluation or made a WIR determination for the tanks, ancillary equipment, and the residual waste in the C-farm, and that it plans to explain how it addressed the public’s concerns about the draft WIR evaluation at the same time as making the final determination. DOE officials also added that, for the actual draft WIR evaluation, DOE has provided many opportunities for stakeholder involvement, such as by providing an extensive public comment period on its draft WIR evaluation and by holding numerous public meetings.

- **Communication.** A few stakeholders we interviewed stated that DOE does not address their concerns regarding technical challenges but rather only wants to communicate with stakeholders about what DOE finds important. For example, Ecology officials told us that DOE has not communicated why it does not want to build additional storage tanks when, according to stakeholders, all the signs show it is needed, thus putting the cleanup mission at risk. Ecology expressed concern that, if DOE does not have adequate DST space for waste treatment, DOE could face schedule delays. DOE officials told us that DOE has communicated in writing and in multiple public meetings its reasons for not building new DSTs. DOE officials stated that they told stakeholders that it would cost \$1.5 billion to build 4 million gallons of additional DST space. DOE believes this money would be better spent on processing waste for final disposal, since DOE will free up space through the operations of the Direct-Feed Low-Activity Waste facility and the use of the evaporator. A few stakeholders also stated

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<sup>97</sup>Washington State Department of Ecology, Letter to Department of Energy (Letter 18-NWP-181) dated November 6, 2018.

<sup>98</sup>Washington State Department of Ecology, Letter to Department of Energy (Letter 18-NWP-181) dated November 6, 2018.

that DOE has not communicated with them about tank integrity challenges, such as how long tanks can be expected to last or DOE's backup plans should a tank fail. For example, one stakeholder stated that DOE has not sufficiently communicated information about tank inspections and data sources. DOE officials stated that DOE communicated with stakeholders about DOE's tank integrity program, and program results are available online.<sup>99</sup>

- **Transparency.** A few stakeholders also raised concerns regarding the transparency of DOE's decision-making process, including DOE not providing sufficient information pertaining to the rationale behind major decisions. For example, the Hanford Advisory Board noted that, as discussed earlier, DOE used the WIR citation process to determine that contaminated soil at Hanford is classified as low-level waste without external public notice. The Hanford Advisory Board also said that DOE had not provided a clear response regarding how this WIR citation determination will apply to waste that has already leaked from tanks. In comments to DOE regarding the draft WIR evaluation, the Hanford Advisory Board and Ecology noted that DOE has made public comments that contradict the language in the citation, such as DOE's commenting in a public meeting that the WIR citation determination applies only to soils contaminated by spills that occurred during retrievals and not to prior spills.<sup>100</sup> The Hanford Advisory Board noted that DOE had not provided a clear response on whether DOE would then intend to conduct a separate WIR evaluation process for contaminated soils at the C-farm resulting from prior spills.<sup>101</sup> In its response to the Hanford Advisory Board's letter, DOE did not address the board's comments on this topic.<sup>102</sup>

According to a few stakeholders, DOE's limitations in these three areas undermine stakeholder confidence in DOE's ability to complete the tank

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<sup>99</sup>DOE officials stated that DOE communicated this information during meetings with Ecology, Hanford Advisory Board and the public, and in newspaper articles, among other things.

<sup>100</sup>Washington State Department of Ecology, Letter to Department of Energy (Letter 18-NWP-181) dated November 6, 2018.

<sup>101</sup>Hanford Advisory Board, *HAB Consensus Advice #299 to DOE and Ecology* (Richland, WA: Sept. 20, 2018) and DOE, *Response to HAB Consensus Advice #29918-HAB-0191* (Richland, WA: Dec. 6, 2018).

<sup>102</sup>DOE officials subsequently told us that DOE made several comments publicly and in published fact sheets that clarify the scope and limitations of the WIR evaluation process, which excludes contaminated soil.

waste cleanup mission in a timely, cost-effective, and safe manner and have led to systemic distrust of DOE. Stakeholders noted that this situation is detrimental to public support for the tank waste cleanup mission at Hanford and leaves DOE open to litigation. Likewise, EPA officials noted that, if TPA parties do not take public input into account, the likelihood increases for expensive and time-consuming legal battles.

DOE officials told us that DOE is not required to include these stakeholders in the decision-making process.<sup>103</sup> From 2003 until 2011, DOE had a policy on public participation and community relations; the policy stated that effective public participation is at the core of good community relations and is essential for DOE sites to achieve their missions.<sup>104</sup> Further, the policy stated that public participation benefits stakeholders by creating an opportunity to provide input on decisions that affect their communities and our nation. The policy, among other things, established the expectation that DOE conduct periodic reviews of its public participation and community relations efforts. This policy was canceled in 2011, and the cancellation notice did not provide a reason for doing so or note a replacement to the policy.

DOE officials also said that they regularly communicate with stakeholders, such as at public meetings, but that some stakeholders have unrealistic expectations, do not consider the difficulties DOE is facing, and are not open to dialogue or to changing their position. However, DOE, EPA, and Ecology all acknowledge in their TPA Public Involvement Plan that involving stakeholders in the decision-making process would be valuable in allowing the agencies to consider public values and concerns before making decisions and would decrease the likelihood of public criticism and challenges of cleanup decisions, and help maintain public support for Hanford cleanup.<sup>105</sup>

In September 2019, we outlined a risk-informed framework for making cleanup decisions and recommended that DOE's Office of Environmental

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<sup>103</sup>For example, according to DOE documents, there are no provisions in Order 435.1 requiring that DOE seek Congressional, state, tribal, or public involvement in its WIR determinations.

<sup>104</sup>DOE P 141.2. *Public Participation and Community Relations* (Washington, D.C.: May 7, 2003).

<sup>105</sup>DOE, EPA, and Washington State Department of Ecology. *Hanford Public Involvement Plan* (Richland, WA: 2017).

Management incorporate this framework into its cleanup policy across the entire DOE complex.<sup>106</sup> According to our framework, one of the goals of engaging stakeholder groups in a risk-informed cleanup decision should be to seek their acceptance of the decision-making process as transparent and legitimate, rather than to obtain their concurrence with the final decision.<sup>107</sup> According to our framework, agencies should seek stakeholders' buy-in to the decision-making process by providing meaningful opportunities for engagement early in the process; communicating throughout the process; and providing transparent, understandable information about the science and rationale behind the final decision. In addition, a 2008 National Academies' report on public participation in environmental decision-making noted that agencies' failing to pay attention to legitimate interests and stakeholder concerns could result in a loss of legitimacy.<sup>108</sup> By assessing DOE's efforts to involve stakeholders in the Hanford tank closure process to ensure that it does so in a manner consistent with our risk-informed decision-making framework, DOE could have better assurance that stakeholders will perceive its decision-making process as transparent and legitimate.

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## Conclusions

DOE has the challenging mission of retrieving millions of gallons of radioactive and hazardous waste from 177 underground storage tanks in 18 tank farms across its Hanford site, treating and disposing of the waste, and closing those tank farms. DOE has completed waste retrieval from all 16 tanks at the first tank farm, and it has analyzed the contaminated soil extensively at this farm.

However, some residual waste remains in the tanks after completion of DOE's retrieval efforts, and DOE faces difficulties in managing this waste under existing legal requirements. Specifically, DOE's closure plan for C-farm depends on DOE's ability to manage the residual tank waste as a waste type other than high-level waste and to obtain Ecology's approval to leave the tanks in place. By Congress clarifying, in a manner that does

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<sup>106</sup>[GAO-19-339](#).

<sup>107</sup>Experts who participated in developing our framework generally told us that achieving consensus from these stakeholder groups about a cleanup decision is typically unrealistic because their interests are diverse and often conflicting.

<sup>108</sup>National Research Council of the National Academies, *Public Participation in Environmental Assessment and Decision Making* (Washington, D.C.: 2008).

not impair the regulatory authorities of EPA and state of Washington, DOE's authority at Hanford to determine, with NRC involvement, that residual tank waste can be managed as a waste type other than HLW, DOE would be in a better position to ensure stakeholder acceptance of its analyses and determination and to obtain necessary Ecology approval for C-farm closure and avoid potential litigation.

DOE's tank farm closure efforts have been further complicated by DOE's and Ecology's disagreement on a process for evaluating contaminated soil at the C-farm and on whether NRC should play a role in this process. Ecology and DOE officials acknowledged that failure to address this long-standing disagreement would result in further delays in cleanup efforts, which have been ongoing since DOE began waste retrieval in 2002. By obtaining the assistance of an independent, third-party mediator to help reach agreement with Ecology on a process for assessing the contaminated soil—particularly regarding what process DOE should use to evaluate the contaminated soil and NRC's role in evaluating the contaminated soil—DOE would be in a better position to achieve concurrence on these issues and avoid future cleanup delays.

Additionally, DOE faces a number of risks and technical challenges in its tank waste retrieval and closure mission in the long term; such challenges include the limited availability of DST space and inadequate infrastructure for waste retrieval and treatment efforts. However, DOE does not have a long-term plan for the closure of all the tank farms at Hanford even though DOE and stakeholders have identified significant technical challenges that will require planning and years of preparation to resolve. By developing a long-term plan for the waste retrieval and tank closure mission at the Hanford site, DOE could better prepare to address the many complex technical challenges affecting Hanford's tank waste retrieval and closure mission in a timely manner, and foster public support by setting clear expectations for the future of the mission.

DOE also faces challenges in its engagement of stakeholders, including local, regional and national entities, as well as tribal governments. According to stakeholders, public trust in DOE's decision-making process has eroded and led to decreased public support of DOE's tank waste retrieval and closure mission overall. DOE will be making many major decisions regarding the tank waste cleanup mission in the coming years, including decisions on what tank farms to close next and how to treat and dispose of the waste. These decisions would benefit from public trust in

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the decision-making process.<sup>109</sup> According to our risk-informed framework for making cleanup decisions, as previously mentioned, agencies should seek stakeholders' buy-in to the decision-making process by providing meaningful opportunities for engagement early in the process; communicating throughout the process; and providing transparent, understandable information about the science and rationale behind the final decision. By assessing DOE's efforts to involve stakeholders in the Hanford tank closure process to ensure that DOE does so in a manner consistent with our risk-informed decision-making framework, DOE could have better assurance that stakeholders will perceive its decision-making process as transparent and legitimate.

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## Matter for Congressional Consideration

Congress should consider clarifying, in a manner that does not impair the regulatory authorities of EPA and the state of Washington, DOE's authority at Hanford to determine, with NRC involvement, that residual tank waste can be managed as a waste type other than HLW.

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## Recommendations for Executive Action

We are making the following three recommendations to DOE:

The Secretary of Energy should direct the Assistant Secretary of the Office of Environmental Management to obtain the assistance of an independent, third-party mediator to help reach agreement with the State of Washington's Department of Ecology on a process for assessing the contaminated soil and what role NRC should play in this process.  
(Recommendation 1)

The Secretary of Energy should direct the Assistant Secretary of the Office of Environmental Management to develop a long-term plan for DOE's waste retrieval and tank closure mission at the Hanford site.  
(Recommendation 2)

The Secretary of Energy should direct the Assistant Secretary of the Office of Environmental Management to assess DOE's efforts to involve

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<sup>109</sup>Experts who participated in developing our framework generally told us that achieving consensus from these stakeholder groups about a cleanup decision is typically unrealistic because their interests are diverse and often conflicting.

stakeholders in the Hanford tank closure process to ensure that DOE engages them in the decision-making process, communicates with them throughout the process in a way that addresses their concerns regarding technical challenges, and provides them with transparent information about the science and rationale behind decisions. (Recommendation 3)

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## Agency Comments and Our Evaluation

We provided a draft of this report to DOE, NRC, and EPA for review and comment. In its comments, reproduced in appendix IV, DOE concurred with all three of our recommendations. DOE stated that its actions already satisfied one of our recommendations and that it is implementing and will continue to implement the other two recommendations. However, as discussed further below, we believe further action is needed to address all of our recommendations. DOE also provided technical comments, which we incorporated as appropriate. NRC provided a letter, reproduced in appendix V, stating that it reviewed the draft report and had no comments. EPA indicated by email that it reviewed the draft report and had no comments.

In response to our matter for Congressional consideration about clarifying DOE's authority that residual tank waste can be managed as a waste type other than HLW at Hanford, DOE stated that the process outlined in Section 3116 of the National Defense Authorization Act for fiscal year 2005 has worked well in South Carolina and Idaho. DOE also stated that, as a result, DOE is making gains toward environmental remediation at its sites in those states. We believe that by Congress clarifying, in a manner that does not impair the regulatory authorities of EPA and the state of Washington, DOE's authority at Hanford to determine, with NRC involvement, that residual tank waste can be managed as a waste type other than HLW, DOE will be in a better position to avoid a lawsuit, reduce certain risks to the environment, and potentially save billions of dollars.

In response to our recommendation about obtaining the assistance of a third-party mediator, DOE stated that it has engaged in mediated negotiations with EPA and Ecology since June 2020 and that these current actions satisfy our recommendation. DOE also stated that soil is managed under the Comprehensive Environmental Response Compensation and Liability Act and the Resource Conservation and Recovery Act. However, we believe that DOE has not yet satisfied this recommendation. According to DOE officials, as of October 2020,

addressing contaminated soil was not part of the initial set of broad topics agreed upon for negotiations nor was the topic of NRC's role on contaminated soil. DOE must still resolve the significant disagreement with Ecology regarding how to address contamination in the soil under the TPA, including what role NRC should play, regardless of the process DOE must follow under CERCLA.

In response to our recommendation about developing a long-term plan, DOE stated that it has already engaged in long-term planning through the milestones incorporated in the TPA, the Consent Decree, and regulatory closure documents submitted to Ecology. In addition, DOE stated that it developed a System Plan that identifies the approaches to be taken for sequencing tank retrievals and closures. However, we believe that DOE must take further action to address this recommendation. DOE's current documents provide high-level milestones but do not constitute a long-term plan that will allow DOE to anticipate and manage the many significant challenges the tank waste mission is facing. Furthermore, as we noted in this report, DOE's System Plan states that it is not intended as a decision or budget document, and DOE officials told us that DOE does not use the system plan as a planning tool.

In response to our recommendation about DOE assessing its efforts to involve stakeholders in the Hanford tank closure process, DOE stated that it recognizes the importance of stakeholder engagement in critical decision-making and that stakeholders are included in the decision-making process in a transparent way, using existing, well-established processes. DOE also provided some examples of how it engages with stakeholders. However, the actions DOE cited do not constitute an assessment of its efforts to involve stakeholders, and we believe that DOE must take further action to address this recommendation.

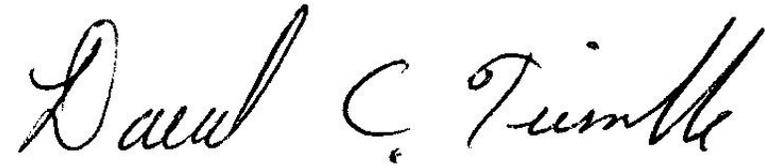
We are sending copies of this report to the appropriate congressional committees, the Secretary of Energy, and other interested parties. In addition, this report is available at no charge on the GAO website at <http://www.gao.gov>.

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

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Letter

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A handwritten signature in black ink that reads "David C. Trimble". The signature is written in a cursive style with a large, looped 'D' and a distinct 'C'.

David C. Trimble  
Director, Natural Resources and Environment

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*List of Committees*

Chair  
Ranking Member  
Committee on Armed Services  
United States Senate

Chair  
Ranking Member  
Subcommittee on Energy and Water Development  
Committee on Appropriations  
United States Senate

Chair  
Ranking Member  
Committee on Armed Services  
House of Representatives

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

## Appendix I: Objectives, Scope, and Methodology

Our report examines (1) the status of the Department of Energy's (DOE) efforts to retrieve tank waste and address contaminated soil at Hanford; (2) challenges DOE faces in its efforts to close the C-farm, including addressing residual waste in tanks and contaminated soil; and (3) DOE's approach for closing the remaining tank farms and stakeholders' views about this approach.

To examine the status of DOE's efforts to retrieve tank waste and address contaminated soil at Hanford, we reviewed various documents related to: the regulatory framework at Hanford, including the Hanford Federal Facility Agreement and Consent Order—also called the Tri-Party Agreement (TPA)—the TPA action plan, and a relevant consent decree; DOE's decision-making documents, such as the 2012 Environmental Impact Statement and its associated 2013 Record of Decision;<sup>1</sup> DOE documents submitted to Ecology as part of its regulatory process, such as Tiers 1, 2, and 3 closure plans; correspondence between DOE and the Washington State Department of Ecology (Ecology) detailing the decisions and negotiations related to retrieving waste and closing tank farms; documents related to DOE's retrieval and closure plans, such as its System Plan 8<sup>2</sup> and the Multi-Year Operating Plan;<sup>3</sup> and documents from DOE and other sources related to the level of soil contamination, such as DOE's Soil Inventory Model. We also visited the Hanford site and interviewed DOE and Ecology officials regarding the work done to date on retrieving waste from tanks and addressing soil contamination. In

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<sup>1</sup>DOE, *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*, DOE/EIS-0391 (Benton County, WA: November 2012).

<sup>2</sup>DOE Office of River Protection, *River Protection Project System Plan*, ORP-11242 Revision 8 (Richland, WA: October 2017). System Plan 8 is a computer modeling exercise, which evaluates a set of 11 technical scenarios and provides rough cost and schedule estimates for completing the tank waste retrieval and closure mission at the Hanford Site. DOE stated in this System Plan 8 that it is not intended as a decision or budget document, and DOE officials stated DOE does not use the system plan as a planning tool.

<sup>3</sup>The Multi-Year Operating Plan is a near-term operations plan, which shows projected operations activities through Fiscal Year 2026.

addition, we visited the Savannah River Site in South Carolina—which must also retrieve tank waste and close tank farms resulting from nuclear weapons production—to tour the tank farms at that site and interview DOE and contractor officials regarding how they addressed residual tank waste and contaminated soil there to understand the issues DOE is facing at Hanford.

To examine challenges DOE faces in its efforts to close the C-farm, including addressing residual waste in tanks and the contaminated soil, we reviewed various documents, including applicable legal and regulatory requirements, DOE's Order 435.1 performance assessment, DOE's draft Waste Incidental to Reprocessing (WIR) evaluation,<sup>4</sup> Ecology and Hanford Advisory Board responses to the draft WIR determinations, the Nuclear Regulatory Commission's (NRC) request for additional information and DOE's responses related to the WIR determinations, NRC's Technical Evaluation Report of DOE's Draft Waste Incidental to Reprocessing Determination for C-farm,<sup>5</sup> DOE's 2019 high-level waste interpretation, DOE's studies and analysis related to residual waste in tanks or contaminated soil at the C-farm, correspondence between DOE and Ecology, the TPA, and Section 3116 of the National Defense Authorization Act for fiscal year 2005. We also interviewed officials from DOE, EPA, Ecology and NRC—which plays a role in reviewing tank waste activities at other DOE sites—regarding residual tank waste and contaminated soil at the C-farm, as well as challenges DOE is facing at the C-farm.

In examining the challenges DOE faces in its efforts to close the C-farm, we also evaluated how DOE's and Ecology's authorities work together under different regulatory frameworks—such as the Atomic Energy Act and the Resource Conservation and Recovery Act—that are applied simultaneously at the C-farm. In addition, we evaluated TPA's requirements on the process of cleaning up contaminated soil and for the TPA parties to address problems and conflicts that may arise. We also reviewed the September 2012 *Memorandum on Environmental*

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<sup>4</sup>DOE Office of River Protection, *Waste Incidental to Reprocessing (WIR) Determinations*, ESQ-EM-IP-M435.1-1-10 Revision 0 (Richland, WA: September 2008). DOE Office of River Protection, *Waste Incidental to Reprocessing Determinations*, DOE-ORP-PPD-EM-50168 Revision 2 (Richland, WA: January 2020).

<sup>5</sup>NRC, *Technical Evaluation Report for the Draft Waste Incidental to Reprocessing Evaluation for Closure of Waste Management Area C at the Hanford Site* (Washington, D.C.: May 2020).

*Collaboration and Conflict Resolution* issued by the Office of Management and Budget and the Council on Environmental Quality that contains guidance on third-party assisted environmental collaboration and environmental conflict resolution, to resolve problems and conflicts that arise in the context of environmental, public lands, or natural resource issues.<sup>6</sup>

To examine DOE's approach for closing the remaining tank farms and stakeholder views about this approach, we reviewed DOE documentation, such as DOE's 2019 lifecycle report,<sup>7</sup> DOE's Multi-Year Operating Plan and information received from DOE from its risk register on what DOE considers top risks for waste retrieval and tank closure at Hanford. We examined DOE's planning practices for its operations activities in comparison to leading practices for project and program management that we identified in our prior work.<sup>8</sup> We interviewed DOE officials and officials from the Pacific Northwest National Laboratory that conduct research on tank waste retrieval and closure on risks facing the waste retrieval and tank closure mission at Hanford. To examine DOE's approach to stakeholder involvement, we reviewed the Hanford Public Involvement Plan.<sup>9</sup> We also interviewed DOE, EPA, and Ecology officials regarding DOE's public interaction approach. We compared DOE's approach to stakeholder involvement with our risk-informed framework for

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<sup>6</sup>The memorandum notes that such conflicts could include matters related to water and land management. The memorandum further states that with the magnitude of environmental challenges facing the nation, coupled with the need for careful stewardship of tax dollars and budgets, federal departments and agencies should leverage all environmental collaboration and conflict management techniques to improve environmental governance. Office of Management and Budget and the Council on Environmental Quality, *Memorandum on Environmental Collaboration and Conflict Resolution* (Washington, D.C.: Sept. 7, 2012).

<sup>7</sup>DOE, *2019 Hanford Lifecycle Scope, Schedule and Cost Report*, DOE/RL-2018-45 Revision 0 (Richland, WA: January 2019).

<sup>8</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.: Mar. 5, 2019).

<sup>9</sup>DOE, EPA, and Washington State Department of Ecology. *Hanford Public Involvement Plan* (Richland, WA: 2017)

making cleanup decisions, which outlines benefits of including stakeholders in the decision-making process.<sup>10</sup>

In addition, we interviewed 23 local, regional, and national entities and tribal governments (referred to as “stakeholders” in this report) to understand their views on the challenges DOE faces in its efforts to close the C-farm, including addressing residual waste in tanks and contaminated soil, and their views on DOE’s approach for closing the remaining tank farms.<sup>11</sup> We selected stakeholders to interview who (1) were knowledgeable about the tank waste retrieval and closure mission at Hanford and (2) represented a diversity of perspectives. Therefore, we primarily selected members of the Hanford Advisory Board because the board is comprised of representatives of diverse organizations that are affected by DOE’s Hanford site cleanup activities. The board is a nonpartisan body established by DOE to provide recommendations and advice on major policy issues related to the Hanford cleanup to all three TPA parties—DOE, Ecology and EPA. Specifically, we interviewed the chair of the board, the chairs of 4 board committees,<sup>12</sup> and board members from the Tank Waste Committee—that focuses primarily on waste retrieval and tank closure at Hanford.

We also interviewed officials from the three federally recognized tribes, as well as representatives from four national groups that either have a history of working on Hanford tank waste issues or represent local stakeholders. To identify national organizations, we selected organizations that either (1) have a history of researching or working on tank waste issues at Hanford or (2) represent local groups in Hanford cleanup matters and thus are knowledgeable of both tank waste issues and the affected local parties. During interviews, we asked for suggestions to identify additional key relevant groups to interview to ensure we heard from a diverse set of stakeholders. We interviewed these other groups if (1) they were mentioned by two or more initial interviewees and (2) our own review of the recent information published

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<sup>10</sup>GAO, *Environmental Liabilities: DOE Would Benefit from Incorporating Risk-Informed Decision-Making into Its Cleanup Policy*. [GAO-19-339](#) (Washington, D.C.: Sept. 18, 2019)

<sup>11</sup>Tribal governments have a unique status because of their treaty rights and tribal sovereignty. However, for methodological purposes and to protect confidentiality, we do not distinguish among stakeholders.

<sup>12</sup>We interviewed chairs from the following committees: (1) Tank Waste Committee, (2) River and Plateau Committee, (3) Public Involvement and Communication Committee, and (4) Health, Safety and Environment Protection Committee.

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

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by these groups determined that they discussed any relevant information pertaining to our engagement.<sup>13</sup> The information and perspectives that GAO obtained are not generalizable to those stakeholders we did not select and interview. The stakeholder groups we interviewed are listed in table 1 below.

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<sup>13</sup>As a result, we did not interview any new groups that were not represented on Hanford Advisory Board.

**Table 1: Stakeholder Groups Interviewed**

<b>National Groups</b>
• Consortium for Risk Evaluation with Stakeholder Participation
• Energy Communities Alliance
• National Academies of Sciences, Engineering, and Medicine
• Natural Resources Defense Council
<b>Groups on the Hanford Advisory Board</b>
<b>Native American Tribes</b>
• Confederated Tribes and Bands of the Yakama Nation
• Confederated Tribes of the Umatilla Indian Reservation
• Nez Perce Tribe
<b>State of Oregon</b>
• Oregon Department of Energy
• Oregon Hanford Cleanup Board
<b>Other Hanford Advisory Board Organizations</b>
• Benton County
• Benton-Franklin Public Health Department
• Columbia RiverKeeper
• Hanford Atomic Metal Trade Council
• Hanford Challenge
• Hanford Communities
• Hanford Watch
• Non-Union, Non-Management Employees
• Public-at-Large Members
• Richland Rod & Gun Club
• The City of Kennewick
• The City of Richland
• Tri-Cities Industrial Development Council
• University of Washington

Source: GAO. | GAO-21-73

We conducted semi-structured interviews to enhance the consistency of information collected while allowing for flexibility in the interview process. We developed a standard set of questions that we asked all parties about their views on specific topics related to DOE’s waste retrieval and tank closure plans and challenges. We also asked these parties to identify other views and challenges if they were not already included in our questions. We also asked questions regarding DOE’s interactions with affected parties. We asked affected parties to answer only those questions on topics on which they are knowledgeable. We pretested the questions with a few parties: a tribe, a nonprofit organization, a state

agency, and a national/academic organization, and made changes to improve our question format and include an additional question related to mission cost.

We conducted a content analysis of information obtained through interviews with these stakeholders to understand the challenges DOE faces in its efforts to address residual waste in tanks and contaminated soil, as well as stakeholders' views on DOE's approach to closing the remaining tank farms. We analyzed interviews with stakeholders to characterize the stakeholders' responses and to identify major themes. To do this, we developed categories for coding that corresponded to (1) challenges DOE faces in closing the C-farm, including residual waste in tanks and contaminated soil, and (2) challenges related to DOE's approach in closing the remaining tanks farms. Two analysts separately reviewed interview documentation and coded the contents under these categories. One analyst reviewed each interview fully to find and code data for each category. A second analyst then reviewed the coding results for accuracy and relevance. The first coder then made adjustments as needed.

For reporting purposes, we did not include a complete list of themes and comments made by the stakeholders, but we identified the main themes that emerged from the interviews and selected specific comments to include in our report to serve as illustrative examples of the key themes. We used a series of quantifiers to summarize stakeholder comments. For the purposes of this report, "a few stakeholders" refers to two or three stakeholder groups; "some stakeholders" refers to four or five stakeholder groups; "several stakeholders" refers to six to eight stakeholder groups; "many stakeholders" refers to nine to 14 stakeholder groups; and "most stakeholders" refers to 15 stakeholder groups or more.

We conducted this performance audit from May 2019 to January 2021 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives

**Appendix II: Key Differences among Various DOE Processes for Determining that Certain Waste Is Not High-Level Waste**

## Appendix II: Key Differences among Various DOE Processes for Determining that Certain Waste Is Not High-Level Waste

DOE can use one of three processes to determine that certain waste from reprocessing is not HLW and therefore can be considered waste incidental to reprocessing (WIR). WIR can then be managed as either transuranic or low-level waste. Two of the three processes fall under DOE's Order 435.1—the WIR citation process and WIR evaluation processes—and the third process is under federal law, Section 3116 of the National Defense Authorization Act for Fiscal Year 2005. Table 2 below demonstrates the key differences in authority, application, and oversight role between the three processes.

**Table 2: Key Differences among the Waste Incidental to Reprocessing (WIR) Citation; the WIR Evaluation Processes in Department of Energy's (DOE) Order 435.1; and the 2005 National Defense Authorization Act (NDAA) Section 3116**

<b>Topic</b>	<b>WIR citation process</b>	<b>WIR evaluation process as modified by DOE ORP procedure</b>	<b>Section 3116 of the National Defense Authorization Act for Fiscal Year 2005 (not applicable at the Hanford site)</b>
Source of DOE authority	DOE Order 435.1 <sup>a</sup>	DOE Order 435.1 <sup>a</sup>	NDAA 2005
DOE's use at Hanford tank farms	Contaminated soil <sup>b</sup>	Residual waste in tanks	N/A
State role	No direct involvement required	State and public involvement in waste classification determinations are recommended but are required only under certain circumstances. State and public involvement in disposal action would occur with processing of required state closure plans/permits and NEPA/SEPA documents. <sup>c</sup> State monitors using information generated through state-approved closure plan and permit.	Waste disposal must be conducted pursuant to a state-approved closure plan or state-issued permit State coordinates with the Nuclear Regulatory Commission (NRC) on waste disposal monitoring
NRC role	No direct involvement required	NRC consultation is recommended but required only under certain circumstances.	Requires DOE consultation with NRC on waste determinations, as well as NRC disposal monitoring in perpetuity
Congressional role	No direct involvement required	No direct involvement required	NRC notifies Congress if its monitoring indicates disposal action is not in compliance with performance objectives

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**Appendix II: Key Differences among Various  
DOE Processes for Determining that Certain  
Waste Is Not High-Level Waste**

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Source: GAO analysis of DOE information. | GAO-21-73

<sup>a</sup>DOE officials stated that the agency bases Order 435.1 on authority contained in the Atomic Energy Act of 1954.

<sup>b</sup>While DOE could use the WIR citation process for other contaminated materials, this table only mentions contaminated soil as this is relevant to this report.

<sup>c</sup>NEPA refers to the National Environmental Policy Act of 1969. SEPA refers to the State Environmental Policy Act.

## Appendix III: Summary of Risks Identified by DOE in Its 2019 Lifecycle Report

In the January 2019 lifecycle cost estimate, DOE listed 25 key risks to its tank waste cleanup mission—including retrieval, closure, and treatment activities—that were mostly technical challenges.<sup>1</sup> DOE estimated that these risks could add about \$304 billion in costs to the tank waste cleanup mission.<sup>2</sup> Some of these risks—including in the table below—directly relate to the tank waste retrieval and closure mission.<sup>3</sup> DOE also listed two of these risks—insufficient double-shell tank space and inadequate evaporator availability—in risk register documentation provided to GAO as the top risks for retrieval and closure mission. Table 3 below summarizes the risks related to Hanford’s tank waste retrieval and closure mission identified by DOE in its 2019 Hanford life-cycle report.

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<sup>1</sup>DOE, *2019 Hanford Lifecycle Scope, Schedule and Cost Report*, DOE/RL-2018-45 Revision 0 (Richland, WA: January 2019). DOE is required by the Tri-Party Agreement to submit a report to EPA and Ecology setting out the lifecycle scope, schedule, and cost for completing the Hanford site cleanup mission.

<sup>2</sup>According to DOE’s analysis, the risks that add the most to this amount are not necessarily related to retrieval and closure but related to the facilities for treating low-activity and HLW after waste has been retrieved. DOE did not specify how much was specifically attributed to each one of the risks identified. In prior work, we identified many challenges with these facilities. Our most recent report discussing some of these challenges is GAO, *Hanford Waste Treatment Plant: DOE Is Pursuing Pretreatment Alternatives, but Its Strategy Is Unclear While Costs Continue to Rise*. [GAO-20-363](#) (Washington, D.C.: May 12, 2020).

<sup>3</sup>DOE identified many other risks not related to retrieval and closure, such as risks related to pretreatment and treatment facilities. For example, DOE identified the risk of mission extension resulting in the need for facility replacements and upgrades and the pretreatment facility becoming nonfunctional because of major system failures.

**Appendix III: Summary of Risks Identified by  
DOE in Its 2019 Lifecycle Report**

**Table 3: Summary of Risks to Hanford’s Tank-Waste-Retrieval and Closure Mission Identified by the Department of Energy (DOE) in its 2019 Hanford Lifecycle Report**

<b>Risks Identified by DOE</b>	<b>DOE’s Description of the risks<sup>a</sup></b>
Inability to maintain adequate double-shell tank (DST) space	The management of DST space, until all waste treatment facilities have reached their full net capacities, is critical to maintaining the progress of single-shell tank (SST) retrievals. Modeling results showed that after the retrieval of C-farm, minimal DST space is available to support additional SST retrievals. The available DST space is distributed among several tanks and is not always directly usable without a series of waste transfers. As the DST system nears capacity, it is increasingly difficult to conduct SST retrieval, evaporator, and feed staging operations. DST containment failures, aging tanks, and unexpected conditions may contribute to this difficulty. If DST space is not available, then SST retrieval production rate will be reduced and delivery of feed to the Waste Treatment and Immobilization Plant could be delayed.
DST availability to perform mission functions is less than adequate	DSTs were constructed between 1968 and 1986. AY-102, the oldest DST, has leaked waste into the annulus—the approximately 3-foot space between the inner and outer shell of a DST—but not to the environment. With the length of the mission, other DSTs may leak, too. With the limited level of currently available DST space, any additional tank leaks, particularly in the next 10 years, may have substantial effects on DST operations. If the DST availability for the mission function is less than adequate, then SST retrievals and waste feed delivery may be affected, increasing schedule duration and/or cost.
Inadequate evaporator availability	The primary mission of the evaporator is to support tank farm waste storage by reducing dilute waste volume. Evaporator availability is essential to the success of the Hanford waste retrieval and closure mission to continue SST waste retrievals, adjust the sodium levels to meet feed requirements for the Waste Treatment and Immobilization Plant, manage return flows to the tank farms, and other additions such as flush water. The DSTs are near their total waste capacities, and the evaporator is needed to make space for additional SST retrievals. AY-102 condition has placed additional pressure on available DST space. The evaporator is an aging facility, and many facility upgrades have recently been completed or are planned to allow the continued use of the evaporator to support the RPP mission. General facility degradation or catastrophic failure may reduce the Evaporator availability. If the Evaporator is not available when required, then planned SST retrieval schedules and/or waste feed delivery schedules to the Waste Treatment and Immobilization Plant may be delayed.
SST retrieval systems performance does not meet requirements due to unexpected conditions	Issues that are outside management’s ability to anticipate and control cause uncertainty in waste retrieval performance and may include, but are not limited to: unexpected weather delays, natural hazards, new stakeholder requirements, unanticipated tank leaks, unanticipated tank conditions, etc. If SST retrieval system performance is less than planned due to unexpected conditions, then retrieval duration and cost will increase.
Cross-site transfer system startup is delayed	Over half of the SSTs are located in the 200 West area and, once retrieved, the waste will be transferred cross-site to the 200 East area DST system to be staged for feeding into the Waste Treatment and Immobilization Plant. These waste transfers require the use of a cross-site transfer system, which was built in the 1990s and includes the cross-site slurry transfer line. The cross-site transfer system slurry piping has not been approved to operate. The capability to transfer slurry across the site is required to treat all the high-level waste at the Waste Treatment and Immobilization Plant and currently does not exist. It is unknown whether the slurry line installed during the cross-site transfer system replacement in the 1990s will meet the system requirements. A number of actions have been recommended before approval can be obtained to use the slurry line, including an operational readiness review, assessment of integrity of primary piping, corrosion testing, and repair.
Availability of Hanford site infrastructure, utilities and services is less than adequate	Due to the age and/or repair/upgrade of site utilities and infrastructure (e.g., air, water, electrical, power, fire protection) and the long Hanford tank-waste-retrieval and closure mission duration, the availability of necessary services is uncertain. Upgrades will be needed throughout the mission. If the infrastructure and services are not available or insufficient to support SST retrievals, waste feed delivery, treatment, and immobilization, then the mission cost and schedule will increase.

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**Appendix III: Summary of Risks Identified by  
DOE in Its 2019 Lifecycle Report**

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<b>Risks Identified by DOE</b>	<b>DOE's Description of the risks<sup>a</sup></b>
Facilities and equipment become obsolete	The Hanford waste retrieval and closure mission is predicted to last for several decades beyond the design life of facilities and equipment; however, there is no plan for facility replacements. Treatment facilities have 40-year design lives. Facilities are projected to operate between 35 and 40 years. Life extension programs may be able to extend their safe operation for an additional 20 years. In addition, circumstances may arise where facility systems catastrophically fail that require major upgrades or facility replacements. These costs are not uniquely captured in current baseline planning. However, if the mission extends beyond this timeframe (i.e., due to funding constraints, increased maintenance requirements, etc.), these facilities may have to be completely replaced at significant cost. If a facility or equipment is operated beyond its design life, or suffers from catastrophic failure, a number of risks may increase such as: environmental, safety, operability, and availability.

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Source: DOE's 2019 lifecycle report and information provided by DOE officials. | GAO-21-73

<sup>a</sup>The information in the description column was not included with the list of risks in the 2019 lifecycle report. We obtained this information by following up with DOE officials.

# Appendix IV: Comments from the Department of Energy



**Department of Energy**

Washington, DC 20585

December 10, 2020

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

Dear Mr. Trimble:

This letter provides the Department of Energy's (DOE) response to the United States Government Accountability Office (GAO) draft report, "*HANFORD CLEANUP DOE's Efforts to Close Tank Farms Would Benefit from Clearer Legal Authorities and Communication*" (Report).

DOE concurs with the recommendations and notes that the Department is already taking, and will continue to take, appropriate actions to address the recommendations. DOE remains committed to safely and effectively completing the Hanford tank closure mission, in a manner that provides extensive and meaningful opportunities for stakeholder input and feedback.

There are, however, portions of the Report that reflect invalid assumptions or contain factual inaccuracies which should be corrected. These, and other issues, are described in the enclosed DOE Management Response and Technical Comments.

The Report also states that Congress should consider clarifying that residual tank waste can be managed as a waste type other than high-level radioactive waste. According to the Report, this clarification, with Nuclear Regulatory Commission involvement, should be accomplished in a manner that does not impair the regulatory authorities of the U.S. Environmental Protection Agency and the state of Washington. DOE notes that the process outlined in Section 3116 of the *Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005* has worked well in South Carolina and Idaho, and, as a result, DOE is making gains towards environmental remediation at the Savannah River site in South Carolina and the Idaho National Laboratory site in Idaho. DOE continues to take actions, in accordance with applicable regulatory requirements, to further the tank closure mission at Hanford in the most safe, timely, and cost effective manner possible.

Sincerely,

A handwritten signature in blue ink, appearing to read "William I. White".

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

Enclosures

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

**Management Response**

Government Accountability Office Draft Report, *"HANFORD CLEANUP DOE's Efforts to Close Tank Farms Would Benefit from Clearer Legal Authorities and Communication"*

**Recommendation 1:** The Secretary of Energy should direct the Assistant Secretary of the Office of Environmental Management to obtain the assistance of an independent, third-party mediator to help reach agreement with the State of Washington's Department of Ecology on a process for assessing the contaminated soil and what role the Nuclear Regulatory Commission (NRC) should play in this process.

**Management Response:** Concur

Since June 2020, the Department of Energy (DOE), Environmental Protection Agency (EPA), and State of Washington's Department of Ecology (Ecology) have been engaged in mediated negotiations, which are intended to identify a mutually agreeable path forward on the Hanford tank waste mission that is affordable and achievable. DOE's current actions satisfy the Government Accountability Office's (GAO) recommendation.

Contaminated environmental media (e.g. soil and groundwater) are managed in accordance with the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). The ongoing negotiations are also intended to enhance the integration of CERCLA and RCRA into remediation of soil surrounding the tanks in the Hanford tank farms.

EPA, not NRC, is the lead federal agency and is responsible for proposing remedies for contaminated environmental media (e.g. soil and groundwater) and addressing conflicts that may exist between CERCLA and RCRA.

**Estimated Completion Date:** Complete/ongoing

**Recommendation 2:** The Secretary of Energy should direct the Assistant Secretary of the Office of Environmental Management to develop a long-term plan for DOE's waste retrieval and tank closure mission at the Hanford site.

**Management Response:** Concur

DOE already has engaged in long-term planning for waste retrieval and tank closure, and such planning activities will continue. Therefore, DOE believes it is implementing, and will continue to implement, GAO's recommendation. Long-term planning for tank waste retrieval and closure is memorialized in the Hanford Federal Facility Agreement and Consent Order (HFFACO), or Tri-Party Agreement (TPA), and the Amended Consent Decree, along with the closure plans that have already been submitted to Washington Department of Ecology. These documents, along with, among others, the Tank Closure and Waste Management Environmental Impact Statement Record of Decision, and TPA-045-00 milestone series, form a basis for establishing the plans for

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

tank waste retrieval and tank closure. Therefore, DOE believes it is implementing, and will continue to implement, GAO's recommendation.

The TPA includes a framework to develop, and regularly update, a System Plan that identifies the approach(es) to be taken for sequencing tank retrievals and closures. The TPA also specifies the required closure plans. The first TPA Tier 1 closure plan was submitted to the State of Washington in 2002. It was later updated in 2004 to address State of Washington comments. The most recent TPA Tier 1 closure plan was submitted on September 30, 2015. The Tier 2/3 closure plans were submitted on May 17, 2018.

**Estimated Completion Date:** Complete/ongoing

**Recommendation 3:** The Secretary of Energy should direct the Assistant Secretary of the Office of Environmental Management to assess DOE's efforts to involve stakeholders in the Hanford tank closure process to ensure that DOE engages them in the decision-making process, communicates with them throughout the process in a way that addresses their concerns regarding technical challenges, and provides them with transparent information about the science and rationale behind decisions.

**Management Response:** Concur

Because DOE recognizes the importance of stakeholder engagement in critical decision-making, stakeholders are included in the decision-making process in a transparent way, using existing, well-established processes. Therefore, DOE believes it is implementing, and will continue to implement, GAO's recommendation.

As described in the *HFFACO Hanford Public Involvement Plan*, the public plays a vital role in Hanford cleanup decision-making. The three agencies that are parties to the TPA understand that for decisions to have overall acceptance or understanding from stakeholders, other organizations and the public, it is important that these groups be provided the opportunity to voice their values and concerns early in the process. In addition, stakeholder engagement opportunities are a part of the RCRA and CERCLA processes. Stakeholder sessions are provided by DOE to inform and receive input from stakeholders. Also, there is a formal public input process associated with, for example, the *Draft Waste Incidental to Reprocessing Evaluation for Closure of Waste Management Area C at the Hanford Site* ("Draft WIR Evaluation"), and consultation with the NRC on the Draft WIR Evaluation. The process is transparent and open, with public comment periods, public meetings to explain both DOE and NRC technical information, and DOE-NRC clarification teleconferences that are open to the public. Furthermore, documents are publicly available in the Hanford Administrative Record/Public Information Repository. DOE continues to provide avenues for public information and feedback as part of the cleanup decision-making processes. DOE will also continue to enhance opportunities for stakeholder participation to ensure that decisions are informed by an understanding of the perspectives of the Hanford Advisory Board and other Hanford stakeholders.

**Estimated Completion Date:** Complete/ongoing

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## Text of Appendix IV: Comments from the Department of Energy

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Page 1

Mr. David Trimble Director

Natural Resources and Environment

U.S. Government Accountability Office Washington, DC 20548

Dear Mr. Trimble:

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Sincerely,

William I. White

Senior Advisor for Environmental Management to the Under Secretary for Science

Enclosures

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Page 2

Management Response

Government Accountability Office Draft Report, "HANFORD CLEANUP DOE's Efforts to Close Tank Farms Would Benefit from Clearer Legal Authorities and Communication"

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**Management Response: Concur**

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Estimated Completion Date: Complete/ongoing

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Page 3

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The most recent TPA Tier 1 closure plan was submitted on September 30, 2015. The Tier 2/3 closure plans were submitted on May 17, 2018.

Estimated Completion Date: Complete/ongoing

**Recommendation 3: The Secretary of Energy should direct the Assistant Secretary of the Office of Environmental Management to assess DOE's efforts to involve stakeholders in the Hanford tank closure process to ensure that DOE engages them in the decision-making process, communicates with them**

**throughout the process in a way that addresses their concerns regarding technical challenges, and provides them with transparent information about the science and rationale behind decisions.**

**Management Response: Concur**

Because DOE recognizes the importance of stakeholder engagement in critical decision-making, stakeholders are included in the decision-making process in a transparent way, using existing, well-established processes. Therefore, DOE believes it is implementing, and will continue to implement, GAO's recommendation.

As described in the HFFACO Hanford Public Involvement Plan, the public plays a vital role in Hanford cleanup decision-making. The three agencies that are parties to the TPA understand that for decisions to have overall acceptance or understanding from stakeholders, other organizations and the public, it is important that these groups be provided the opportunity to voice their values and concerns early in the process. In addition, stakeholder engagement opportunities are a part of the RCRA and CERCLA processes. Stakeholder sessions are provided by DOE to inform and receive input from stakeholders. Also, there is a formal public input process associated with, for example, the Draft Waste Incidental to Reprocessing Evaluation for Closure of Waste Management Area C at the Hanford Site ("Draft WIR Evaluation"), and consultation with the NRC on the Draft WIR Evaluation. The process is transparent and open, with public comment periods, public meetings to explain both DOE and NRC technical information, and DOE-NRC clarification teleconferences that are open to the public. Furthermore, documents are publicly available in the Hanford Administrative Record/Public Information Repository. DOE continues to provide avenues for public information and feedback as part of the cleanup decision-making processes. DOE will also continue to enhance opportunities for stakeholder participation to ensure that decisions are informed by an understanding of the perspectives of the Hanford Advisory Board and other Hanford stakeholders.

Estimated Completion Date: Complete/ongoing

## Appendix V: Comments from the Nuclear Regulatory Commission



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

December 3, 2020

Ms. Amanda Kolling, Assistant Director  
Natural Resources and Environment  
U.S. Government Accountability Office  
441 G Street, NW  
Washington, DC 20548

Dear Ms. Kolling:

Thank you for providing the U.S. Nuclear Regulatory Commission (NRC) with the opportunity to review and comment on the U.S. Government Accountability Office's draft report GAO-21-73, "Hanford Cleanup: DOE's [U.S. Department of Energy] Efforts to Close Tank Farms Would Benefit from Clearer Legal Authorities and Communication." The NRC has reviewed the draft report and has no comments.

If you have any questions regarding this response, please contact John Jolicoeur. Mr. Jolicoeur can be reached by telephone at (301) 415-1642 or e-mail at [John.Jolicoeur@nrc.gov](mailto:John.Jolicoeur@nrc.gov).

Sincerely,

*Margaret M. Doane* Signed by Doane, Margaret  
on 12/03/20

Margaret M. Doane  
Executive Director  
for Operations

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## Text of Appendix V: Comments from the Nuclear Regulatory Commission

December 3, 2020

Ms. Amanda Kolling, Assistant Director Natural Resources and Environment

U.S. Government Accountability Office

441 G Street, NW

Washington, DC 20548

Dear Ms. Kolling:

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Sincerely,

Margaret M. Doane Executive Director for Operations

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## Appendix VI: GAO Contact and Staff Acknowledgments

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### GAO Contact

David C. Trimble, (202) 512-3841 or [trimbled@gao.gov](mailto:trimbled@gao.gov).

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### Staff Acknowledgments

In addition to the contact named above, Amanda Kolling (Assistant Director); Cristian Ion (Analyst in Charge); Chad Clady; Richard P. Johnson; Cynthia Norris; Elaina Stephenson; and Brianna Taylor made key contributions to this report. Also contributing to this report were Antoinette Capaccio, Cindy Gilbert, April Gillens, Suzanne Kaasa, Donna Morgan, Katrina Pekar-Carpenter, and Sara Sullivan.

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Washington, DC 20548

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U.S. Government Accountability Office, 441 G Street NW, Room 7149  
Washington, DC 20548

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Stephen J. Sanford, Acting Managing Director, [spel@gao.gov](mailto:spel@gao.gov), (202) 512-4707  
U.S. Government Accountability Office, 441 G Street NW, Room 7814,  
Washington, DC 20548



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