United States Government Accountability Office

Report to the Honorable Ron Wyden, U.S. Senate

November 2014

HANFORD CLEANUP

Condition of Tanks May Further Limit DOE's Ability to Respond to Leaks and Intrusions

GAO-15-40

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GAO Highlights

Highlights of GAO-15-40, a report to the Honorable Ron Wyden, U.S. Senate

Why GAO Did This Study

DOE recently reported that nuclear waste is leaking from two of its underground storage tanks (T-111 and AY-102) at Hanford and that water was intruding into AY-102 and other tanks. Also, DOE has been experiencing delays in the construction of the WTP, a collection of facilities that are to treat the tank waste for disposal. These recently reported leaks and intrusions, combined with construction delays, have raised questions among regulators, the public, and Congress about the risks posed by continuing to store waste in the aging tanks.

GAO was asked to report on the tank waste cleanup program. This report examines: (1) the condition of the tanks, (2) actions DOE has taken or planned to respond to the recent tank leaks and water intrusions, and (3) the extent to which DOE's tank management plans consider the condition of the tanks and the delays in completing construction of the WTP. GAO obtained and reviewed relevant reports concerning the leaks, the status of the tanks, and the volumes of waste and available space in the tanks. GAO toured the site and interviewed DOE officials and responsible contractors.

What GAO Recommends

GAO recommends that DOE assess the extent to which other DSTs have corrosion factors similar to AY-102, update its schedule for removing waste from the tanks, and assess the alternatives for creating additional DST space. DOE agreed with this report and its recommendations.

View GAO-15-40. For more information, contact David C. Trimble at (202) 512-3841 or trimbled@gao.gov.

What GAO Found

From 2012 to 2014, the Department of Energy (DOE) assessed the physical condition of the 177 storage tanks at its Hanford, Washington, site in which it stores about 56 million gallons of nuclear waste and found them to be in worse condition than it assumed in 2011 when developing its schedule for emptying the tanks. For the 149 single-shell tanks (SST), DOE previously pumped nearly all of the liquid waste out of the SSTs into the 28 newer double-shell tanks (DST) to reduce the likelihood of leaks. However, after detecting water intruding into several SSTs, DOE reexamined them all and found that water was intruding into at least 14 SSTs and that 1 of them (T-111) had been actively leaking into the ground since about 2010 at a rate of about 640 gallons annually. Regarding the DSTs, in 2012, DOE discovered a leak from the primary shell in tank AY-102. DOE determined that the leak was likely caused by construction flaws and corrosion in the bottom of the tank. DOE found that 12 DSTs have similar construction flaws but has not determined the extent to which the other 27 DSTs are subject to the same corrosion that likely contributed to the leak in AY-102.

In response to the waste leaks and water intrusion, DOE has taken or planned several actions. For SSTs, DOE conducted additional tank inspections and temporarily increased the frequency of monitoring the tank waste levels from annually or quarterly to monthly. In addition, after finding flaws in its methods to monitor for leaks and intrusions, DOE modified its methods, which it believes may lead to more effective monitoring. For DSTs, DOE increased the frequency (from every 5 to 7 years to every 3 years) and scope of its tank inspections and convened a panel of experts to evaluate existing tank monitoring and inspection procedures. DOE also plans an independent assessment of the integrity of the DSTs (scheduled to be completed no later than 2016).

DOE's current schedule for managing the tank waste does not consider the worsening conditions of the tanks or the delays in the construction of the Waste Treatment and Immobilization Plant (WTP), a facility being constructed to treat the waste and prepare it for final, long-term disposal. First, the leak in AY-102 combined with planned waste transfers from SSTs has reduced the available DST tank storage capacity. Future leaks and intrusions, which become more likely as the tanks' condition worsens, would place additional demands on the already limited DST storage space, and it is unclear how DOE would respond. According to DOE, recent efforts to evaporate some of the water from the waste have already freed up 750,000 gallons of DST space. Second, in March 2014, DOE announced further delays in the construction of the WTP and that these delays will affect the schedule for removing waste from the tanks. However, DOE has not estimated the impact of the WTP delays on its schedule to remove the waste from the tanks. As a result, DOE cannot estimate how long the waste will remain in the aging tanks. Also, DOE officials and members of a 2014 expert panel convened to examine the integrity of the DSTs have said that corrosion is a threat to DST integrity, and, according to the panel, that there are deficiencies in DOE's understanding of corrosion in all of the DSTs. DOE lacks information about the extent to which the other 27 DSTs may also be susceptible to corrosion similar to AY-102. Without determining the extent to which the factors that contributed to the leak in AY-102 were similar to the other 27 DSTs, DOE cannot be sure how long its DSTs can safely store waste.

Contents

Abbreviations

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	Department of Energy
DST	double-shell tank
EIS	environmental impact statement
RCRA	Resource Conservation and Recovery Act
SST	single-shell tank
TPA	Tri-Party Agreement
WTP	Waste Treatment and Immobilization Plant

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
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November 25, 2014

The Honorable Ron Wyden
United States Senate

Dear Senator Wyden:

The Department of Energy (DOE) is responsible for one of the world's largest environmental cleanup projects: the treatment and disposal of millions of gallons of radioactive and hazardous waste at its 586-square mile Hanford site in southeastern Washington State. A total of nine nuclear reactors—including the world's first operating large-scale reactor, developed as part of the Manhattan Project during World War II—were built at Hanford and operated until the late 1980s. The primary mission of these reactors was to produce plutonium and other special nuclear materials for DOE's nuclear weapons program. Some of the most dangerous hazardous and radioactive waste that resulted from nuclear materials production was stored in 177 large underground storage tanks. The underground tanks currently hold more than 56 million gallons of this waste—enough to fill an area the size of a football field to a depth of over 150 feet.

In October 2012, DOE announced that nuclear waste had leaked into the space between the inner and outer shell of one of its underground storage tanks (tank AY-102) at the Hanford site. The announcement—the first to identify that one of DOE's 28 double-shell tanks (DST) at the site had leaked—raised concerns among DOE, its regulators, the public, and Congress about the viability of the other DSTs at Hanford and the risks posed by continuing to store waste in those tanks. Four months later, in February 2013, following a review of the 149 single-shell tanks (SST) at the Hanford site, DOE announced that waste was leaking into the environment from at least one SST (tank T-111). More recently, in its May 2014 update on the status of the tanks, DOE reported that it had detected water intruding into at least 14 SSTs.

DOE spends over $1 billion each year—through its Office of River Protection in Richland, WA—on its tank waste retrieval and treatment program at Hanford. Nearly half of this amount is spent managing the underground waste storage tanks, including, among other activities, monitoring them for leaks and assessing their integrity. The remaining funding is spent on the design and construction of a Waste Treatment and Immobilization Plant (WTP), a collection of facilities that will treat the

waste in the tanks for disposal, since the tanks were never intended to be a final storage solution for the waste.[1] The WTP is a key element of DOE's tank waste cleanup plan which includes retrieving the waste from the tanks, treating it in the WTP, and disposing of the waste. As we have long found, most recently in a December 2012 report, as the cleanup effort has unfolded, multiple technical challenges in the design and construction of the WTP have caused delays and resulted in mounting costs.[2] These delays could affect DOE's ability to manage the waste in the tanks.

GAO was asked to examine (1) the condition of the tanks, (2) actions DOE has taken or planned to respond to the recent tank leaks and water intrusions, and (3) the extent to which DOE's tank management plans consider the condition of the tanks and the delays in completing construction of the WTP.[3]

To conduct our work, we reviewed relevant tank waste management requirements, including applicable federal and state laws and regulations, DOE tank waste management procedural documents, and agency reports; toured the Hanford site, including DOE's tank monitoring operations and control center; and interviewed DOE officials and their contractors, officials from the Washington State Department of Ecology (Ecology) responsible for overseeing tank waste issues, and officials from the Defense Nuclear Facility Safety Board (Safety Board)—an independent oversight agency created by Congress to assess safety conditions and operations at defense nuclear facilities at DOE's sites. To assess the current condition of the tanks, we obtained and reviewed relevant DOE reports concerning the recent leaks and reports assessing the previously known condition of the tanks and spoke with Ecology

[1] The WTP, as currently configured, is to consist of a pretreatment facility that separates waste into high-level and low-activity radioactivity waste streams; two facilities to treat these separated streams using a process called vitrification, where waste is mixed with melted glass and poured into steel canisters where it cools and hardens in preparation for its final disposal; an analytical laboratory; and a variety of supporting facilities. A portion of the low-activity waste will be treated using a supplemental treatment technology and facility yet to be selected by DOE.

[2] GAO, *Hanford Waste Treatment Plant: DOE Needs to Take Action to Resolve Technical and Management Challenges*, GAO-13-38 (Washington, D.C.: Dec. 19, 2012)

[3] This request was originally made by the Chairman of the Senate Committee on Energy and Natural Resources, Senator Ron Wyden, who is now a member of the Senate.

officials and DOE officials and their contractors responsible for managing the tanks. To determine the amount and type of waste in the tanks, we used DOE's monthly tank waste summary reports. We found that, while exact amounts and types of waste in the underground tanks are difficult to calculate, the data in DOE's monthly reports was sufficiently reliable for the purposes of this report. To determine the actions DOE has taken or planned to respond to the recent tank leaks, we reviewed recent reports by DOE and by an expert panel convened by DOE to review the status of the tanks, and interviewed Ecology officials and DOE officials and their contractors. Finally, to examine the extent to which DOE's tank management plans account for the current condition of the tanks and the delays in completing construction of the WTP, we reviewed information on the available space in the DSTs, the volumes of the waste stored in the SSTs and DSTs, the volumes of waste that DOE is planning on transferring from SSTs and DSTs to other DSTs, and the potential volumes of waste DOE may need to transfer from SSTs and DSTs in the future. We also reviewed DOE's and Ecology's March 2014 proposals to amend a 2010 consent decree between DOE and Ecology, and discussed these proposals with DOE and Ecology officials.[4] We also reviewed DOE's 2011 Office of River Protection System Plan and 2012 Environmental Impact Statement (EIS).

We conducted this performance audit from June 2013 to November 2014, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

From 1944 through 1988, the production of plutonium at Hanford generated about 525 million gallons of radioactive and hazardous waste. Some of the waste was dumped directly into the soil, some was encased in drums or other containers and buried, and some was stored on-site, underground in 149 SSTs and 28 DSTs. This section describes the

[4] In October 2010, the U.S. District Court in Spokane approved and entered a judicial consent decree that imposes a schedule for constructing and beginning operation of the WTP to treat waste from Hanford's underground tanks.

history of the Hanford tanks, the contents of the tanks, and tank regulations and oversight.

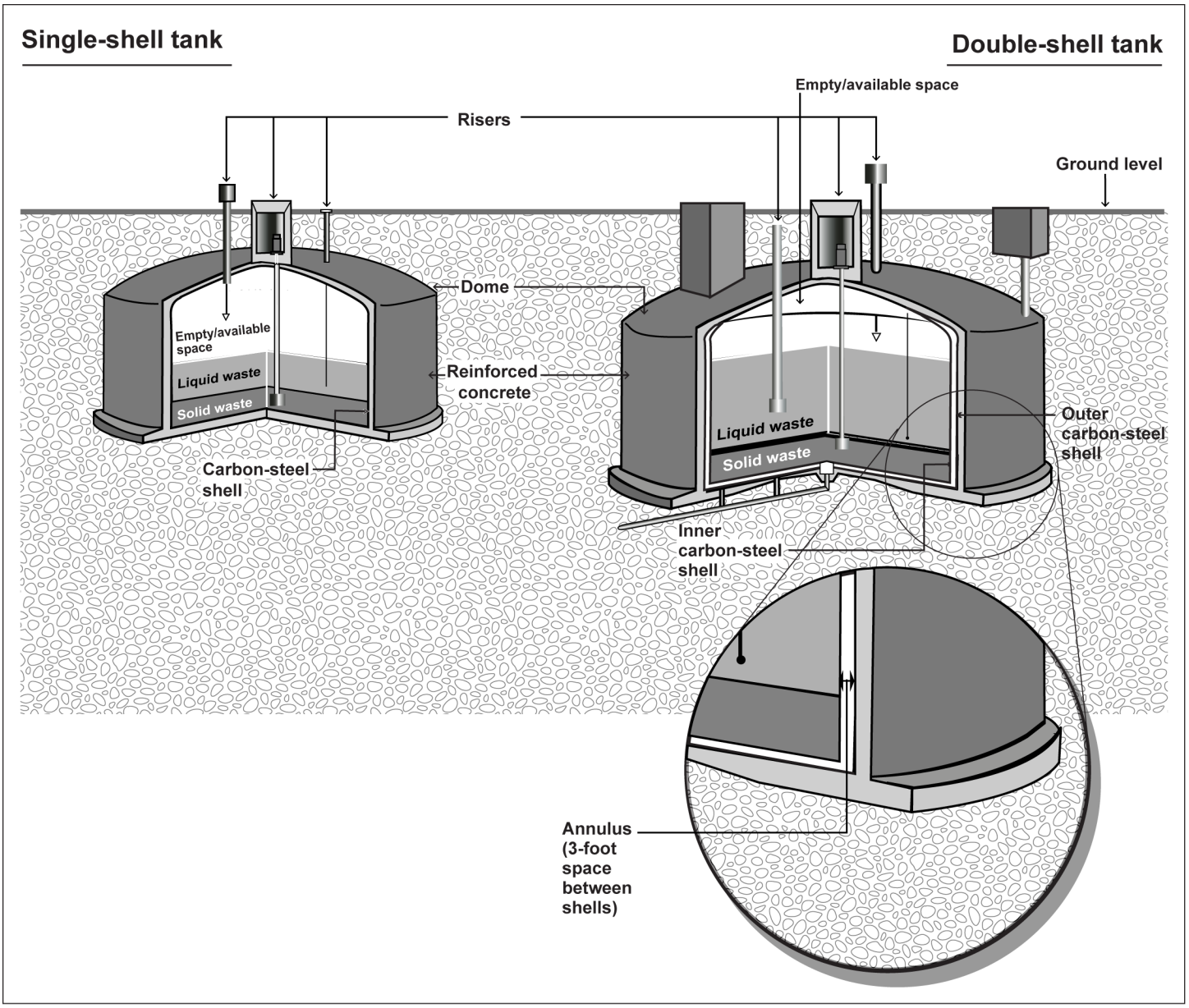
History of Hanford Tanks

The first underground storage tanks at Hanford were SSTs and were built from the 1940s through the mid-1960s. The SSTs consist of an outer concrete wall lined with one layer of carbon steel and were built with a design life of approximately 25 years. While a tank's design life is not a firm deadline beyond which a tank is no longer viable, site engineers at the time considered design life a reasonable estimate of how long a tank could be expected to effectively contain radioactive and hazardous waste. In the 1940s and 1950s, site contractors did not regard the tanks as a permanent solution to the waste produced at Hanford and viewed tank failures as inevitable. It was assumed that as the tanks failed, new tanks would be constructed to store the waste until a more permanent disposal solution could be developed.[5]

Beginning in the 1960s, DOE began reporting that some of the SSTs were leaking waste, and DOE estimates that as many as 61 SSTs may have leaked a total of over 1 million gallons of waste into the ground. After DOE discovered leaks in some of the SSTs, a new tank design using two carbon-steel shells (referred to as DSTs) was adopted. From 1968 through 1986, DOE built 28 DSTs, each with a storage capacity of 1 million gallons or more and each with a design life ranging from 20 to 50 years. (See apps. I - III for design life data for each tank.) The primary design difference between Hanford's single- and double-shell underground waste storage tanks—a second carbon-steel lining, or shell, within the outer concrete housing to provide secondary containment of the waste—improved DOE's ability to monitor and assess the tanks' integrity and contents. As shown in figure 1, the two shells in the DSTs are separated by about 3 feet of space, or annulus, which enables workers to use remote leak detection sensors and remotely operated cameras to see between the inner and outer shells, thereby making it possible to find signs of corrosion or leaks before waste breaches the outer shell and leaches outside the tank structure.

[5] Roy E. Gephart, *Hanford: A Conversation about Nuclear Waste and Cleanup* (Columbus, Ohio: Battelle Press, 2003).

Figure 1: Hanford Waste Storage Tanks



Sources: GAO and DOE. | GAO-15-40

Beginning in the 1970s, to minimize the risks of leaking tanks, DOE began transferring much of the liquid waste from the SSTs to the DSTs. This process consisted of removing (1) the liquid (more mobile) waste first

and then (2) the rest of the waste from the SSTs, thereby effectively emptying the SSTs. The first part of this process—removing liquid waste from the SSTs and transferring it to DSTs—is referred to as interim stabilization and was largely completed by 2005.[6] The interim stabilization for each tank was considered complete, and DOE could stop pumping liquid waste, when DOE and Ecology agreed that the following criteria were met[7]:

- less than 5,000 gallons of free standing liquid waste remained,
- less than 50,000 gallons of drainable liquid waste (liquid waste interspersed within the solid waste) remained, and
- pumping was no longer effective.

The second part of the process—removing the remaining waste from the SSTs and transferring it to DSTs—began in 2003 and is still under way. This work is governed by two main compliance agreements: (1) the 1989 Hanford Federal Facility Agreement and Consent Order, or Tri-Party Agreement (TPA),[8] an agreement between DOE, Ecology, and the Environmental Protection Agency and (2) a 2010 consent decree. Under the consent decree, DOE is required to retrieve waste from 19 tanks (transferring the waste to DSTs) and begin operating the WTP and treating waste by 2022. The TPA requires DOE to retrieve the waste from all of the SSTs by no later than 2040 and to have all waste retrieved from all DSTs and treated by 2047. As of July 2014, DOE had completed the retrieval and transfer of waste from 12 of the SSTs into DSTs.

[6] According to DOE documents, one SST (tank S-102) presented unique pumping challenges and did not fully meet the interim stabilization criteria until 2010. Ecology sued DOE to compel the completion of interim stabilization in 1999, leading to a consent decree, which resulted in completion of the interim stabilization program under the consent decree and the ultimate termination of that decree in 2011.

[7] According to Ecology officials, there were a number of tanks that either experienced equipment failure or were not reasonably assessable and therefore have liquids remaining in the tanks that exceeded these numerical criteria.

[8] The TPA lays out a series of legally enforceable milestones for completing major activities in Hanford's waste treatment and cleanup process. The purpose of the TPA is to ensure that Hanford cleanup activities comply with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Resource Conservation and Recovery Act (RCRA), and Washington's Hazardous Waste Management Act. DOE entered into the TPA pursuant to CERCLA, Executive Order 12580, and the Atomic Energy Act of 1954.

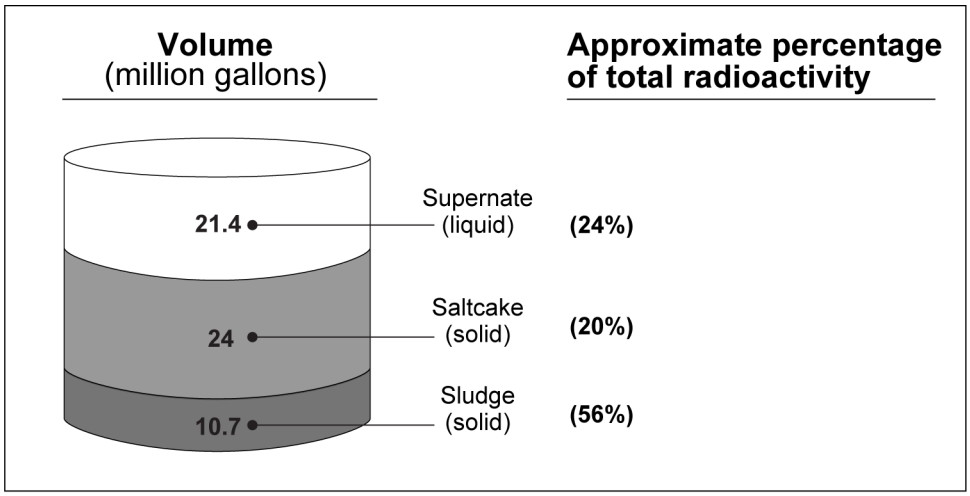
In addition to concerns about tank leaks, DOE is also monitoring tanks for water intrusion from rain and melting snow that can enter the underground tanks through the piping connected to them. Water intrusions can increase the consequences of waste leaks and also mask tank leaks, as waste levels in the tanks could remain the same even as waste was leaking into the ground. According to DOE documented reviews of the tanks, DOE has been aware of water intrusions in some SSTs since the 1980s and has detected intrusions into the annulus of some DSTs since the 1990s.

Contents of the Tanks

The waste stored in the tanks at Hanford generally sits in layers and comes in a variety of forms, depending on its physical and chemical properties. The waste in the tanks takes the following three main forms, which are illustrated in figure 2:

- **Supernate.** Above or between the denser layers may be liquids composed of water and dissolved salts that are called supernate. Supernate comprises 21.4 million gallons of the waste in the Hanford tanks and about 24 percent of the radioactivity.
- **Saltcake.** Above the sludge may be water-soluble components, such as sodium salts, that crystallize or solidify out of the waste solution to form a moist sandlike material called saltcake. Saltcake comprises 24 million gallons of the waste in the Hanford tanks and about 20 percent of the radioactivity.
- **Sludge.** The denser, water-insoluble components of the waste generally settle to the bottom of the tank to form a thick layer known as sludge, which has the consistency of peanut butter. Although sludge makes up the smallest portion of waste in the Hanford tanks (10.7 million gallons), it comprises over half (56 percent) of the total radioactivity in the tank waste.

Figure 2: Composition of Waste in Hanford Tanks, as of May 2014



Source: DOE. | GAO-15-40

Note: 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, and 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.

The tanks contain a complex mix of radioactive and hazardous waste in both liquid and solid form. About 46 different radioactive elements—by-products of chemically separating plutonium from uranium for use in nuclear weapons—represent the majority of the radioactivity currently in the tanks. Some of these elements lose most of their radioactivity in a relatively short time, while others will remain radioactive for millions of years. The rate of radioactive decay is measured in half-lives, that is, the time required for half the unstable atoms in a radioactive substance to disintegrate, or decay, and release their radiation. The half-lives of radioactive tank constituents differ widely. The vast majority (98 percent) of the radioactivity of the tank waste comes from two elements, strontium-90 and cesium-137, which have half-lives of about 29 and 30 years, respectively. The remaining radioactive elements, which account for about 2 percent of the waste's total radioactivity, have much longer half-lives. For example, the half-life of technetium-99 is 213,000 years, and that of iodine-129 is 15.7 million years.

The hazardous wastes in the tanks include various metal hydroxides, oxides, and carbonates. Some of the chemicals—including acids, caustic sodas, solvents, and toxic heavy metals, such as chromium—came from

chemically reprocessing spent nuclear fuel to extract weapons-grade plutonium. Altogether, about 240,000 tons of chemicals were added to the tanks from the 1940s to the mid-1980s.[9] A majority of the chemicals were added to neutralize acids in the waste. Other chemicals, such as solvents and several organic compounds, were added during various waste extraction operations to help recover selected radioactive elements (uranium, cesium, and strontium) for reuse. These hazardous chemicals are dangerous to human health, and they can remain dangerous for thousands of years.

Tank Regulations and Oversight

DOE's storage of waste at Hanford is governed by federal and Washington State laws and regulations. DOE's tank waste cleanup program at Hanford is governed by, among other things, the Resource Conservation and Recovery Act of 1976, as amended (RCRA), as implemented by Washington under its Hazardous Waste Management Act, and the Atomic Energy Act of 1954. RCRA governs the treatment, storage, and disposal of hazardous waste and the non-radioactive hazardous waste component of mixed waste. The tank waste at Hanford is considered mixed waste because it contains both chemically hazardous and certain radioactive materials.[10] For the chemically hazardous waste in the tanks, as shown in figure 3, RCRA establishes the following three key requirements (subject to certain limited exceptions):

- **Tank integrity.** Under RCRA, tanks must have secondary containment—that is, a second shell—and an integrity assessment must be conducted by a qualified professional engineer to assess whether the tanks are fit for use.[11]
- **Leak detection.** RCRA requires a leak detection system to be in place for each tank that will detect the failure of either the primary and secondary containment structure or any release of hazardous waste

[9] See GAO, *NUCLEAR WASTE: DOE Lacks Critical Information Needed to Assess Its Tank Management Strategy at Hanford*, GAO-08-793 (Washington, D.C.: June 30, 2008).

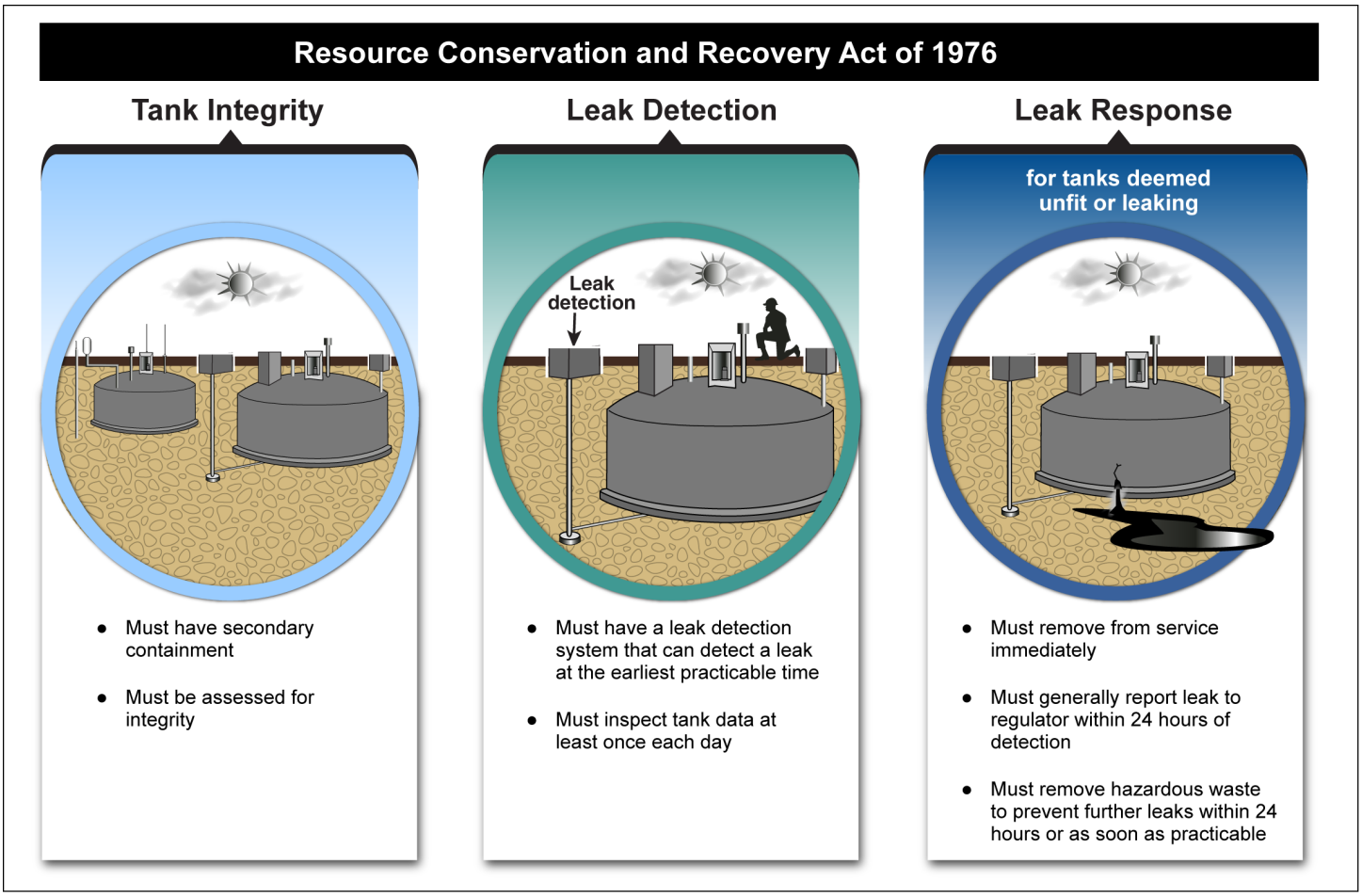
[10] RCRA defines "mixed waste" to mean waste that contains both hazardous waste and source, special nuclear, or by-product material subject to the Atomic Energy Act of 1954. 42 U.S.C. § 6903(41). The term "solid waste" does not include source, special nuclear or by-product material. 42 U.S.C. § 6903(27).

[11] Under the applicable state regulations, the assessment must be conducted by an independent, qualified registered professional engineer.

in the secondary containment system within 24 hours, or at the earliest practicable time. Data gathered from monitoring and leak detection equipment must be inspected at least once each operating day to ensure that the tank system is being operated according to its design.

- **Leak response.** Within 24 hours after detection of a leak or, if the owner or operator demonstrates that that is not possible, at the earliest practicable time, RCRA requires the tank owner, among other things, to remove as much of the hazardous waste or accumulated liquid as is necessary to prevent further release of hazardous waste to the environment and allow inspection and repair or closure of the tank system to be performed. If the release was to a secondary containment system, all released materials must be removed within 24 hours or in as timely a manner as is possible to prevent harm to human health and the environment.

Figure 3: Resource Conservation and Recovery Act of 1976 Requirements for Underground Tanks



Sources: GAO and RCRA. | GAO-15-40

Note: Secondary containment refers to, for example, a second carbon-steel lining, or shell, within the outer concrete housing of a tank to provide secondary containment of the waste.

To address these RCRA requirements, DOE conducts a variety of assessments and monitoring activities. Regarding tank integrity, DOE conducted integrity assessments for the SSTs in 2002 and the DSTs in 2006. To address the leak detection monitoring requirement, for the DSTs, DOE has one waste level monitor installed inside the primary tank space and three waste level monitors in the annulus. These monitors collect waste level data on a daily basis. For the SSTs, because they were built decades before the enactment of RCRA, they do not have secondary containment. As such, DOE has determined that the SSTs

cannot readily be made compliant with current regulations and these tanks were determined to be "unfit for use." Under RCRA, unfit for use tanks are no longer allowed to store waste and must generally be closed. DOE plans to ultimately close the tank farms in accordance with tank farm closure permits to be issued by Ecology. In the meantime, DOE monitors the SSTs under modified operating procedures, including modified leak detection and monitoring requirements as agreed with Ecology.[12] Under these modified procedures and additional DOE operating specifications, the majority of the SSTs are required to be monitored weekly, quarterly, or annually for leaks and intrusions depending on DOE's knowledge of the condition of the tanks and the type and amount of waste inside them. In 2009, DOE developed an emergency pumping guide outlining procedures for responding to leaks in DSTs, to implement the RCRA requirement that the tank system owner/operator must within 24 hours after detection of the leak or, at the earliest practicable time, remove as much waste as necessary to prevent further releases.

Condition of Tanks Is Worse than Assumed under DOE's Current Schedule for Retrieving Tank Waste

DOE's recent assessments of the SSTs and DSTs determined that they are in worse condition than DOE had assumed when developing its 2011 System Plan schedule for emptying the tanks.[13] For SSTs, following a series of assessments in 2013 and 2014, DOE concluded that water is intruding into at least 14 SSTs and that at least 1, T-111, is actively leaking. For DSTs, DOE concluded in 2012 that waste was leaking from the primary shell in tank AY-102 and subsequently found that 12 other DSTs have construction flaws similar to those that contributed to the leak in AY-102. According to recent DOE reviews of the tank, water has intruded into the space between the inner and outer shells of tank AY-102 and another tank nearby.

[12] These modified procedures are found in RPP-9937 Rev. 3E *Single Shell Tank System Leak Detection and Monitoring Functions and Requirements Document, 2014.*

[13] Initially issued in 2002, the System Plan is a long-term cleanup strategy document that DOE is required under the TPA to update every 3 years. According to DOE officials, DOE is planning to issue an update to the System Plan in October 2014.

Condition of SSTs Is Worse Than Previously Assumed, with 1 Leaking and Water Infiltrating at Least 14

In 2013 and 2014, DOE completed assessments of the SSTs and found that they are in worse condition than had been previously believed. As of 2005, DOE and Ecology agreed that the interim stabilization process had reduced the risk of leaks in SSTs, which led DOE, with concurrence from Ecology, to reduce the required frequency of monitoring from daily to quarterly or annually depending on the condition of the tank and the amount of liquid waste inside. However, concerns about historical water intrusions led DOE to reexamine all 149 SSTs in 2011 to determine the extent of the intrusions. This reexamination, which concluded in 2014, confirmed that water was intruding into at least 14 tanks and that the intrusions were adding from less than 10 to more than 2,000 gallons of water annually to each tank. According to a DOE report on intrusions, water intrusion creates additional liquid waste in the tanks as the new water becomes contaminated by the waste in the tanks. Furthermore, water intrusions can affect the level of tank waste, making it difficult to ensure that a tank is not leaking. Officials on an expert panel, convened by DOE in 2009 to assess the condition of the SSTs, concluded in August 2014 that significant amounts of drainable liquid still remain in the SSTs and removing that liquid and preventing future water intrusions should be a high priority.

In addition to increasing waste levels in several tanks, DOE found in 2013 that waste levels appeared to be decreasing in several tanks and subsequently confirmed that at least one SST, tank T-111, was actively leaking waste into the ground.[14] DOE's report on the tank leak indicates that the leak likely began in 2010. According to DOE officials, waste is leaking at a rate of approximately 640 gallons annually, and DOE continues to monitor the leak in tank T-111. DOE has also confirmed that T-111 is one of the SSTs experiencing intrusions. Though the tank is leaking, according to DOE officials, DOE is not required by regulation to remove the liquid waste from T-111 because the amount of liquid waste in the tank does not exceed the interim stabilization criteria and because

[14] This tank was initially assumed to be leaking in 1979 and, based on continued observations of decreasing levels of liquid in the tank, DOE confirmed this assessment in 1994. In 1995, DOE completed the interim stabilization process for T-111.

there are no current requirements to reestablish compliance with interim stabilization criteria if conditions in a tank change.[15]

Condition of DSTs Is Worse Than Previously Assumed, with 12 Tanks Having Flaws Similar to the Leaking Tank and Water Infiltrating at Least 2 Tanks

Regarding DSTs, prior to the discovery of the leak in AY-102 in 2012, DOE had assumed that all DSTs were sound for storing waste. In 2006, all 28 DSTs were examined by a qualified professional engineer, as required under RCRA, and deemed fit for use. In a 2010 report on the integrity of the DSTs, DOE reaffirmed their fitness for continuing to store waste. However, after the 2012 leak was discovered, in March 2014, DOE reported the discovery of a second accumulation of waste in a different location in the annulus of tank AY-102. As of August 2014, DOE reported that more than 35 gallons of waste had leaked from the primary shell of AY-102 into the annulus at a rate of about 3 gallons per month. To date, no waste has been detected outside of the secondary tank shell, according to DOE officials.

DOE is still investigating the factors that caused the AY-102 leak and the extent to which other DSTs may be susceptible to the same factors. DOE reported in October 2012 that tank construction flaws and corrosion in the bottom of the tank stemming from the type of waste and the sequence in which it was loaded into the tank AY-102 were the likely causes for the leak in AY-102.[16] According to a 2014 expert panel reviewing the leak, corrosion was among the likely causes of the leak. The panelists concluded that the corrosion likely occurred as a result of water collecting under the tank before it was fully enclosed and during a 6-year outage of the ventilation system in the annulus from 1991-1997, rather than as a result of the waste loading sequence. Beginning in 2013, DOE examined the other 27 DSTs to determine the extent to which they had construction flaws similar to AY-102. In a series of reports issued between July 2013 and February 2014, DOE reported that at least 12 of the other 27 DSTs have similar construction flaws. However, DOE has not yet assessed the extent to which the factors that led to corrosion that may have caused the leak in AY-102 are also present in the remaining 27 DSTs.

[15] DOE and Ecology are currently negotiating revisions to the SST management requirements as part of the process under way to revise Hanford's sitewide RCRA hazardous waste management permit. RCRA prohibits the treatment, storage, or disposal of hazardous waste without a permit.

[16] RPP-ASMT-53793, *Tank 241-AY-102 Leak Assessment Report* (October 2012).

DOE also determined in 2012 that water was likely intruding into the annulus of at least 2 DSTs, including the leaking tank AY-102. This is not the first time DOE has detected intrusions in the DSTs. In 1991, DOE first reported unexplained moisture in DSTs AY-101 and AY-102, the oldest DSTs on the site. Since then, DOE has periodically monitored and reviewed the status of this moisture, concluding in 2001 that water intrusions through corroded tank equipment were the likely cause. After removing some of the suspected connections and further inspecting the two tanks with video cameras, DOE concluded in 2009 that the water intrusions had stopped. However, routine inspections of the tanks in 2012 revealed that water may still be seeping into the annulus of both tanks. According to DOE officials, an investigation into this issue is ongoing. In the 2011 System Plan, DOE stated that the DSTs play an integral role in the tank waste cleanup effort.

DOE Has Taken and Planned Several Actions to Respond to Recent Leaks and Intrusions, Including Modifying Its Tank Monitoring and Inspection Procedures

Following the discovery of the leaks in tanks T-111 and AY-102, and water intrusions in some SSTs, DOE has undertaken or planned several actions. For the SSTs, DOE has, among other things, performed additional inspections and temporarily increased the frequency of monitoring the tank waste levels from annually or quarterly to monthly. For the DSTs, DOE has conducted additional inspections, modified its inspection procedures, convened an expert panel to examine its DST leak detection process, and developed a pumping plan for AY-102.

For SSTs, DOE Has Conducted Additional Inspections and Modified Its Tank Monitoring Procedures

In response to the leak in tank T-111 and intrusions in other SSTs, DOE has taken several actions, including the following:

- **Increased monitoring and conducted additional inspections.** In 2012, when the leak was initially discovered in T-111, DOE increased the leak detection monitoring for the tank from annually to weekly. In addition, for 19 other SSTs that were under review for decreasing liquid levels, DOE increased the leak monitoring frequency from annually or quarterly (depending on the tank) to monthly. DOE maintained weekly leak detection monitoring for T-111, but in April 2014 went to monthly monitoring. According to a DOE official, the monthly monitoring was deemed sufficient to understand the

relationship between the intrusion and the leak and the monitors are always in place and data are collected more frequently than the monthly requirement. Additionally, monitoring procedures for the other SSTs have since returned to their normal frequency of annual monitoring for intrusions only. For the 14 SSTs with confirmed intrusions and the 5 that do not meet interim stabilization criteria, DOE has placed them on a quarterly monitoring regime. DOE also performed additional inspections of the tanks with decreasing liquid levels but, after further analysis, concluded that none of those tanks were likely leaking.[17]

- **Modified waste analysis procedures.** As noted above, as part of its reexamination of SST waste levels, DOE discovered flaws in its methods for reviewing data on SST tank waste levels that it uses to monitor the tanks for leaks and intrusions. DOE officials determined that their method for reviewing tank waste data was flawed and masked increases and decreases in the waste levels in the SSTs that may have been due to water intrusions and leaks. In response, DOE modified its waste level monitoring methodology and procedures for analyzing waste data. For example, in 2013, DOE established a systems engineering group responsible for monitoring waste levels in all tanks. DOE is also developing training based on the modified waste level monitoring methodology, including guidance on tank waste data interpretation, trend analysis, documentation requirements, and review and approval procedures for changes in waste levels.

For DSTs, DOE Has Conducted Additional Inspections, Convened an Expert Panel, and Developed a Pumping Plan for AY-102

Following the discovery of the leak in AY-102, DOE has taken or planned several actions including the following:

- **Conducted additional inspections and modified inspection procedures.** Following the discovery of the leak in AY-102, DOE performed video inspections of the annulus of 6 of the 12 DSTs with construction histories similar to AY-102. The video inspections, which according to a DOE official in the past only examined a portion of the annulus, examined between 95 and 100 percent of the annulus in

[17] According to DOE officials, factors other than a leak, such as evaporation of liquids in the waste, can cause waste levels to decrease slightly.

each of the tanks.[18] According to DOE officials, DOE plans to continue these full video inspections for the remaining 21 DSTs over the next several years. In addition, in April 2014, DOE formally modified its inspection procedures by shortening the time between inspections from every 5 to 7 years to every 3 years. In addition, in June 2014, DOE began soliciting proposals to award a contract for another independent assessment of the integrity of the DSTs to be completed in 2016.

- **Convened expert panel.** DOE convened an expert panel to review its DST leak detection procedures and make recommendations for improvement. This panel met three times and developed preliminary findings and suggested program improvements. One of the preliminary findings was that additional DST leaks cannot be ruled out given current DST integrity program limitations and the extended schedule for the construction and operation of the WTP. During the panel's most recent meeting in August 2014, members of the panel said that more analysis needs to be done to understand the factors that led to the leak in AY-102 and the extent to which the other DSTs are susceptible to similar factors.
- **Developed AY-102 pumping plan.** If a leak is detected, RCRA requirements call for the hazardous waste or accumulated liquid to be retrieved from the tank to the extent necessary to prevent further releases within 24 hours or as soon as practicable and to allow inspection and repair. In addition, DOE's emergency pumping guide outlines steps to "immediately" remove waste from a leaking DST. DOE officials stated that this guide did not anticipate a leak from the bottom of the primary shell of a tank such as the one occurring in AY-102. Instead, DOE proposed that the waste not be retrieved until at least 2016, maintaining that that was as soon as it could practicably retrieve the waste due to concerns that doing so would cause the temperature of the tank to rise to dangerous levels without liquid waste to act as a cooling agent. In addition, DOE noted in its plan that it needed to procure and install additional equipment in order to pump waste out of the tank. In response to DOE's submitted plan, Ecology issued an administrative order to compel DOE to begin pumping

[18] A DOE official said that the previous inspection methodology did not attempt to inspect the entire annulus space. Prior inspections looked for changes in the general conditions, and areas of interest from previous inspections were tracked. Prior inspections viewed as much as possible through one riser in each of the four quadrants of a DST, which typically covered about 40 percent of the annulus.

waste out of AY-102 by September 1, 2014, and retrieve enough waste to allow for an inspection to determine the cause of the leaks no later than December 1, 2016. The two sides reached a settlement agreement in September 2014, under which DOE is to begin pumping the waste out of AY-102 no later than March 2016 and to have the waste removed by March 2017—over 5 years after the leak was first discovered.[19]

DOE's Current Waste Retrieval Schedule Does Not Account for the Worsening Condition of the Tanks or WTP Delays

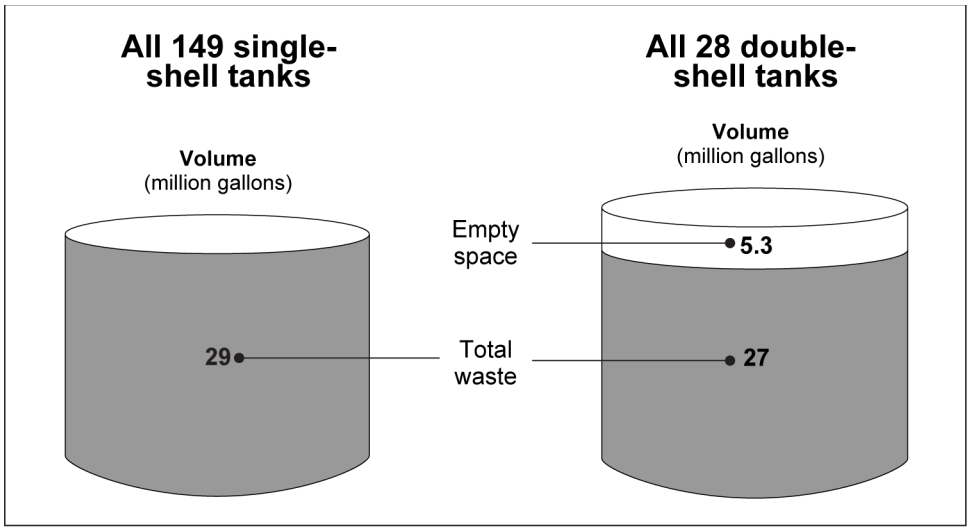
DOE's current schedule for retrieving the waste from the tanks (developed in 2011), which includes transferring waste from SSTs to DSTs and treating the waste in the DSTs, does not take into account the worsening conditions of the tanks or the delays in the construction of the WTP. The leak in AY-102 combined with planned waste transfers has reduced the available DST space, and DOE's plans to create additional space remain uncertain. Future leaks and intrusions, which become more likely as the tanks' conditions worsen, would place additional demands on the limited available DST space, and it is unclear how DOE would respond. According to DOE, recent efforts to evaporate some of the water from the waste have already freed up 750,000 gallons of DST space. In addition, in March 2014, DOE announced that it plans to indefinitely delay construction of the key WTP facilities needed to retrieve and treat tank waste for disposal until technical issues are resolved. As a result, it is unclear how long waste will remain in the tanks. However, without an analysis of the extent to which the factors which may have led to the leak in AY-102 are present in the other DSTs, DOE cannot be sure how long its DSTs will be able to safely store the waste.

[19] The agreement also requires, among other things, that DOE submit a revised monitoring plan for annulus inspection, waste temperature monitoring, and annulus ventilation monitoring, and establishes monetary penalties for DOE's failure to meet the agreement's deadlines.

DOE's Retrieval Schedule Does Not Account for the Worsening Condition of Tanks and Growing Demand on the Limited DST Space

The free space available in the DSTs is currently limited, and operational requirements and planned transfers from the SSTs constrain DOE's ability to respond to future emergencies, such as leaks. As shown in figure 4, SSTs hold a total of about 29 million gallons of waste and, as noted above, have been deemed "unfit for use" under RCRA and therefore cannot be used for storing additional waste.[20] The DSTs currently hold a total of about 27 million gallons of waste, leaving about 5.3 million gallons of available space for waste to be transferred from other tanks.

Figure 4: Approximate Configuration of Space Usage in Hanford's 177 Tanks, as of May 2014



Source: DOE. | GAO-15-40

Note: Single-shell tanks (SST) have been declared unfit for use and cannot readily be made compliant with current regulations.

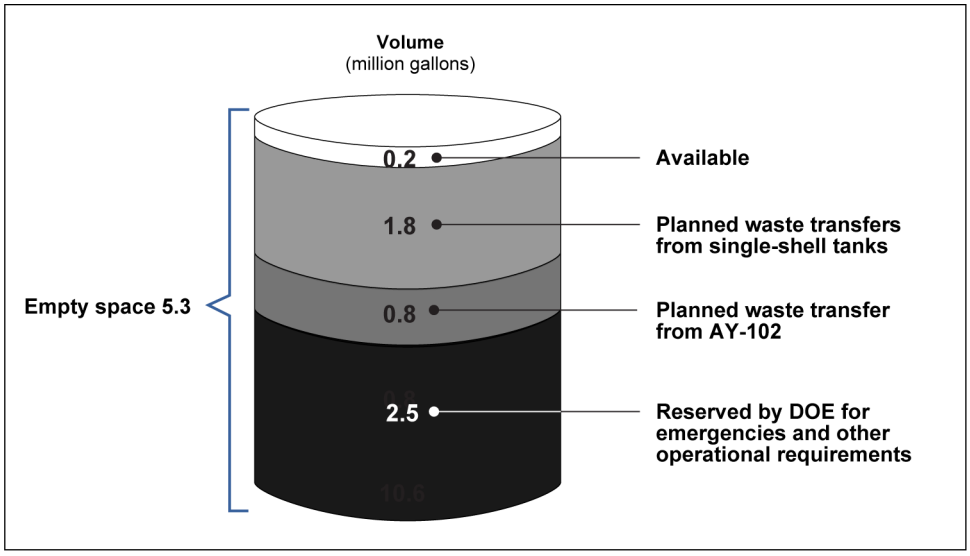
However, DOE policy and planned waste transfers further reduce the amount of space available. As shown in figure 5, about 2.5 million gallons

[20] Under RCRA, the SSTs may not be used indefinitely for waste storage. In its 2012 tank waste management environmental impact statement, DOE stated that it did not consider in detail the option of using the SSTs to temporarily store waste, in part because the SSTs have been declared unfit for use and cannot readily be made compliant with current regulations. The EIS noted that Ecology has established several conditions for considering SSTs for staging, including SST system upgrades and agreement on selection criteria for the tanks to be used. DOE noted that these criteria had not been developed.

of the 5.3 million gallons of empty space is reserved by DOE for safety purposes, for emergency space if necessary, and to enable DOE to more easily transfer waste among tanks. In addition, planned waste transfers from SSTs (about 1.8 million gallons) and AY-102 (about 800,000 gallons) will further reduce available DST space (see fig. 5). Specifically, DOE plans to first empty an additional 15 SSTs, containing a total of approximately 1.8 million gallons of waste, into DSTs by 2022. Second, DOE plans to pump all of the approximately 800,000 gallons of waste in AY-102 into other DSTs no early than 2016. As a result of these planned transfers and operational requirements, about 200,000 gallons of storage space is actually available in the DSTs. DOE officials said that they plan to restart an evaporator facility at Hanford that could reduce the overall amount of waste in the tanks and result in 3 million gallons of additional DST space. This facility, which began operating in 1973 and was designed to operate for 25 years, has not operated since 2010 and was only recently restarted by DOE.[21] According to DOE officials, since restarting the evaporator in September 2014, DOE has reduced the waste volume by over 750,000 gallons.

[21] Prior to restarting the evaporator, in June 2014, officials from the Safety Board raised concerns about the safety of restarting this facility. DOE responded to these concerns in August 2014 to the satisfaction of the Safety Board.

Figure 5: Current and Planned Usage of Empty Double-shell Tank Space at Hanford, as of May 2014



Source: DOE. | GAO-15-40

In addition to these scheduled waste transfers, future leaks and intrusions, which become more likely as the tanks' condition worsens, would require DOE to pump more waste and place additional demands on the limited remaining DST space. Both DOE and Ecology have reported that leaving waste in the tanks past their design life increases the risk of leaks over time. Similarly, the panel of experts that DOE convened to review the AY-102 leak concluded in May 2014 that, given the extended time frames for the cleanup mission and the growing concerns about the integrity of the tanks, additional leaks cannot be ruled out. Such leaks and intrusions could place further demands on the available space in the DSTs because when leaks occur, DOE is required by RCRA and associated tank monitoring and pumping requirements, as described below, to pump hazardous waste from these tanks into the already limited space available in the nonleaking DSTs. For example, if a leak is detected in a SST that exceeds interim stabilization criteria (i.e., it has more than 5,000 gallons of freestanding liquid or 50,000 gallons of drainable liquid waste), DOE is then required by modified leak detection and monitoring requirements as agreed with Ecology to install emergency

pumping equipment and begin pumping the liquid waste out of the tank as soon as practicable.[22] At least five SSTs currently fall into this category because they have exceeded the amount of liquid waste allowed under interim stabilization (likely as a result of water intrusion, according to DOE officials). Similarly, if another DST begins to leak, DOE is required by RCRA to remove the hazardous waste or accumulated liquid from the tank to the extent necessary to prevent further releases within 24 hours or as soon as practicable. The only RCRA compliant alternative currently available for storing this retrieved waste is into the limited space available in the nonleaking DSTs. According to the DOE official responsible for managing Hanford's tank operations, given the current constraints on available DST space, if another DST was to fail before additional DST space is available, DOE would have nowhere to move the waste. However, according to DOE officials, DOE currently has no plans to build new tanks and estimates that it would take about 8 years before the new tanks would be available to receive waste.

DOE's Retrieval Schedule Does Not Account for Recently Acknowledged WTP Delays, and the Extent to Which the Tanks Can Continue to Safely Store Waste Is Unknown

In March 2014, DOE reported that unresolved technical issues could prevent the WTP from operating safely as currently designed. Under the existing TPA and consent decree, DOE is required to begin operating the WTP and treating waste in 2022, to have retrieved all waste from the SSTs by 2040, and to have all waste retrieved from all DSTs and treated by 2047. DOE reported in March 2014 that, until the technical uncertainties are resolved, it is not possible to predict when the WTP will be completed. In addition, DOE has proposed building at least two new waste processing facilities to allow waste treatment to begin while it is resolving the WTP's technical uncertainties. One of the two facilities would, if constructed, treat some of the low-activity waste in the tanks. According to DOE officials, this facility would be operational no later than December 2022 and would make available about 1.3 million gallons of DST space after the first 3 years of operation.[23]

DOE has not estimated the impact of the WTP delay on its tank management plans, but delays in the schedule to retrieve waste from the SSTs are already occurring. Before its decision to delay the WTP, in a

[22] Conversely, however, under the modified requirements SSTs that meet the interim stabilization criteria do not require leak response.

[23] We currently have an ongoing review of DOE's proposal to build these new treatment facilities.

series of letters to Ecology from November 2011 to September 2014, DOE stated that it would likely miss the scheduled milestones in the consent decree, including milestones for completing the WTP and emptying waste from the SSTs.[24] DOE further reported in March 2014 that delays in the WTP will affect the schedule for retrieving waste from the tanks but that, until the technology it is developing to treat the tank waste in the WTP can be demonstrated to work as intended, it is impossible to estimate what the impact will be on the retrieval of waste from the tanks. DOE cannot reliably update its scheduled deadlines for retrieving waste from tanks without considering the impact of the WTP delay.

The technical challenges at WTP and the continued uncertainty about the schedule for retrieving and treating the waste mean that the overall cleanup mission will continue to depend on the integrity of the DSTs. However, the extent to which the DSTs can continue to safely store waste is unknown. In the 2011 System Plan, DOE stated that the DSTs play an integral role in the tank waste cleanup effort.[25] Both a DOE report and members of DOE's 2014 expert panel, convened to examine the integrity of the DSTs, have stated that corrosion is a threat to DST integrity, and the expert panel also highlighted deficiencies in DOE's understanding of corrosion in all of the DSTs. The panel officials concluded in August 2014 that more work needs to be done to better understand the factors that led to the corrosion in AY-102. However, as noted previously, DOE has not examined the other DSTs for the same corrosion factors that may have lead to corrosion in AY-102 and therefore lacks information about the extent to which the other 27 DSTs may also be susceptible to similar corrosion. As a result, DOE lacks assurance that these tanks will be available for use through the end of the cleanup mission, as DOE's 2011 System Plan contemplates, and cannot reliably update its schedule for emptying the SSTs.

[24] The 2010 consent decree called for 10 SSTs in the C Farm to be emptied by September 30, 2014. As of the writing of this report, only 5 of those 10 SSTs had been emptied. In response to this and other missed milestones in the 2010 consent decree, Ecology petitioned the court to amend the consent decree with DOE in October 2014.

[25] In 2001, DOE established a DST Integrity Program to implement controls and inspections to ensure that the DSTs will be available for use through the end of the cleanup mission.

All of the SSTs and DSTs will be well beyond their design life before they are emptied. Of the 137 SSTs that are still storing waste, all are currently decades beyond their design life, and all but 13 of them would be at least 40 years beyond their design life before being emptied under DOE's existing schedule for emptying the tanks. While the design life of the DSTs varies, 4 of the 28 DSTs are already past their design life, and under the current TPA milestones, all DSTs are expected to be well beyond their design life by the time they are scheduled to be emptied. (See app. I and III for design life data for each SST and app. II for design life data for each DST. Figure 6, an interactive figure in appendix I, shows a timeline of all Hanford SSTs. Appendix III, table 1, is the noninteractive, printable version of figure 6.)

DOE does not have plans to construct additional storage to address its long-term storage needs and the risks presented by the aging tanks. DOE has looked at options for building new tanks to address the constraints on DST space if the cleanup mission were to take significantly longer than currently planned. DOE has developed a rough estimate of the time and cost that would be required to build additional tanks. Specifically, in 2011, Ecology asked DOE to include the option of building new tanks in an update to its System Plan. In response, DOE developed a rough estimate for how much it would cost to build 8 additional storage tanks, if necessary. DOE estimated that doing so would cost about $800 million and would take about 8 years to complete. According to the System Plan, this was a rough order of magnitude estimate and a more detailed estimate would be required before a decision to build new tanks could be considered. In 2012, DOE issued its final EIS for Hanford, which included discussion of several tank waste cleanup alternatives that would have involved building additional DSTs as part of the response to delayed cleanup schedules.[26]

Conclusions

DOE has recently taken and has plans for taking additional steps to improve its tank monitoring and inspection procedures at Hanford and is in the process of reassessing the integrity of the DSTs at the site.

[26] An EIS must, among other things, (1) describe the environment that will be affected, (2) identify alternatives to the proposed action and identify the agency's preferred alternative, (3) present the environmental impacts of the proposed action and alternatives, and (4) identify any adverse environmental impacts that cannot be avoided should the proposed action be implemented.

However, these steps do not address the longer-term concerns about leaving waste in the aging tanks indefinitely. Specifically, DOE lacks specific information about the condition of the DSTs, including whether the factors that may have led to corrosion contributed to the leak in AY-102 may affect other tanks which are already many years beyond their design life. Given the current condition of the tanks, it is unclear how long they can safely store the waste. Moreover, following the leak in AY-102, available DST space—which is essential to DOE's tank management plans—is increasingly limited, constraining DOE's ability to respond to potential future leaks and protect human health and the environment. It is unclear, however, whether DOE has enough DST space available to address current and future waste transfers. As we mentioned earlier, DOE officials responsible for managing Hanford's tank operations said that given the current constraints on available DST space, if another DST was to fail, DOE may have nowhere to move the waste. Additional space, either from treating waste or building new tanks, is still at least 8 years away assuming DOE's schedule estimates for these projects are accurate, although DOE has begun recently to free up some DST space by restarting its evaporator facility. Notably, responding to tank leaks can take many years even when there is available DST space, as the leak in AY-102 illustrates. By developing a more a detailed and up-to-date schedule estimate for emptying the tanks, DOE will be in a better position to consider its waste storage needs and need for new tanks. As the tanks age, there will be a continued and increasing risk of tank failure that can only be permanently addressed by emptying the existing SSTs and DSTs. Given the long-standing technical problems facing the WTP, it is highly uncertain when waste treatment operations could begin to create significant available space in the DSTs. However, creating capacity to move some of this waste to RCRA-compliant tanks would allow DOE to respond to future leaks and ensure it has sufficient space for treatment operations once WTP is completed.

Recommendations for Executive Action

To ensure that DOE's long-term plans for storing waste in the existing SSTs and DSTs at Hanford consider the condition of the tanks and the WTP construction delay, we recommend that the Secretary of Energy take the following three actions:

- Assess the extent to which the factors that may have led to corrosion in AY-102 are present in any of the other 27 DSTs.
- Update the schedule for retrieving waste from the tanks, taking into consideration
    - the impact of the delays in the WTP,

- the risks associated with continuing to store waste in aging tanks, and
- an analysis of available DST space.

- Assess the alternatives for creating new RCRA-compliant tank space for the waste from the SSTs, including building new DSTs.

Agency Comments and Our Evaluation

We provided DOE with a draft of this report for its review and comment. In its written comments, reproduced in appendix IV, DOE agreed with the report and its recommendations. DOE also provided technical comments that were incorporated, as appropriate.

As agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies of this report to the appropriate congressional committees; the Secretary of Energy; the Director, Office of Management and Budget; and other interested parties. In addition, this report will be available at no charge on the GAO website at http://www.gao.gov.

If you or your staff members have any questions about this report, please contact me at (202) 512-3841 or 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 major contributions to this report are listed in appendix V.

Sincerely yours,

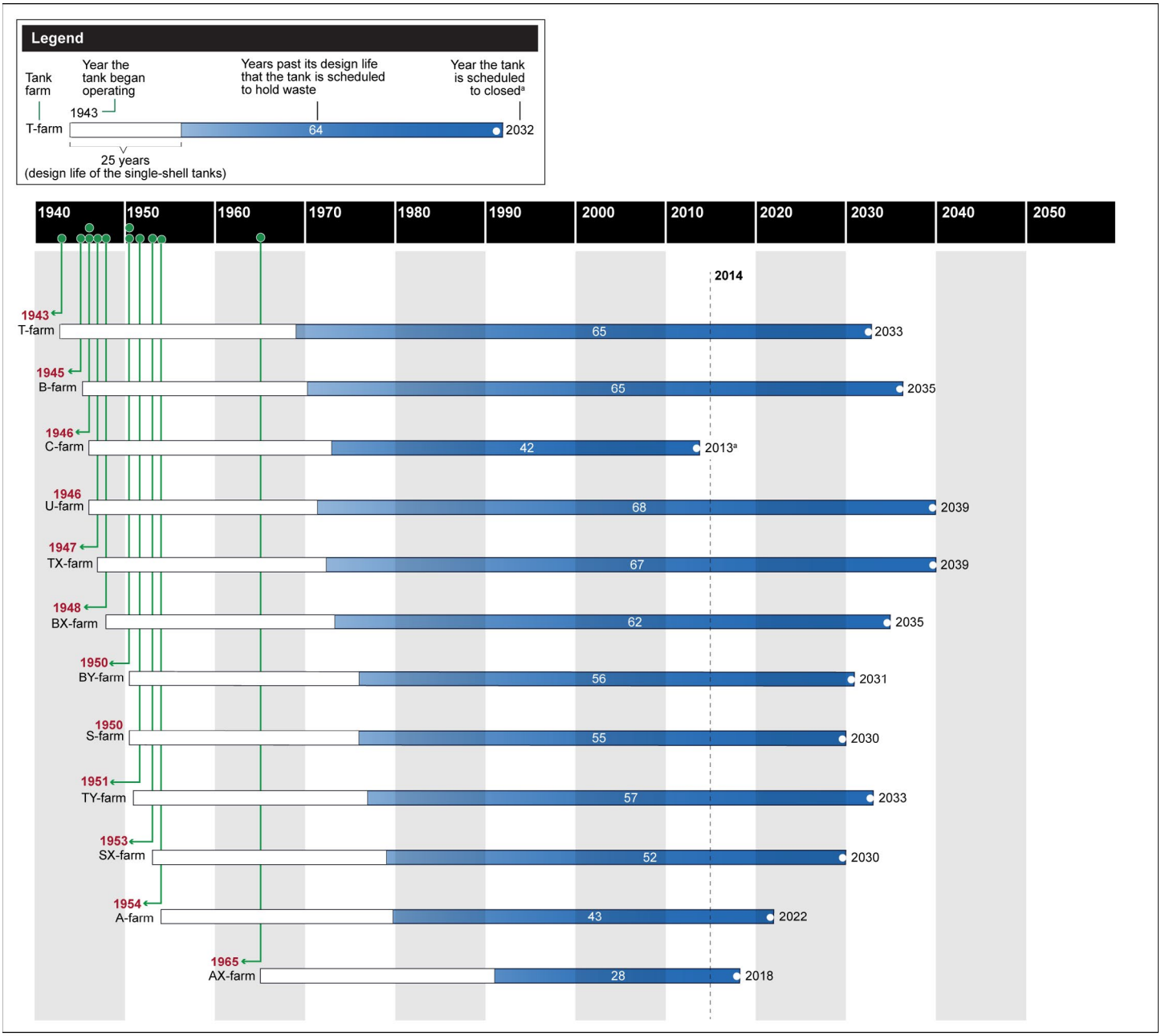
David C. Trimble
Director, Natural Resources and Environment

Appendix I: Timeline of Hanford Single-shell Tanks

Interactive Graphic

Figure 6: Timeline of Hanford Single-shell Tanks

Instructions: **Online, roll your mouse over each year in the figure for additional information.**
For a printable version, see appendix III, page 30.



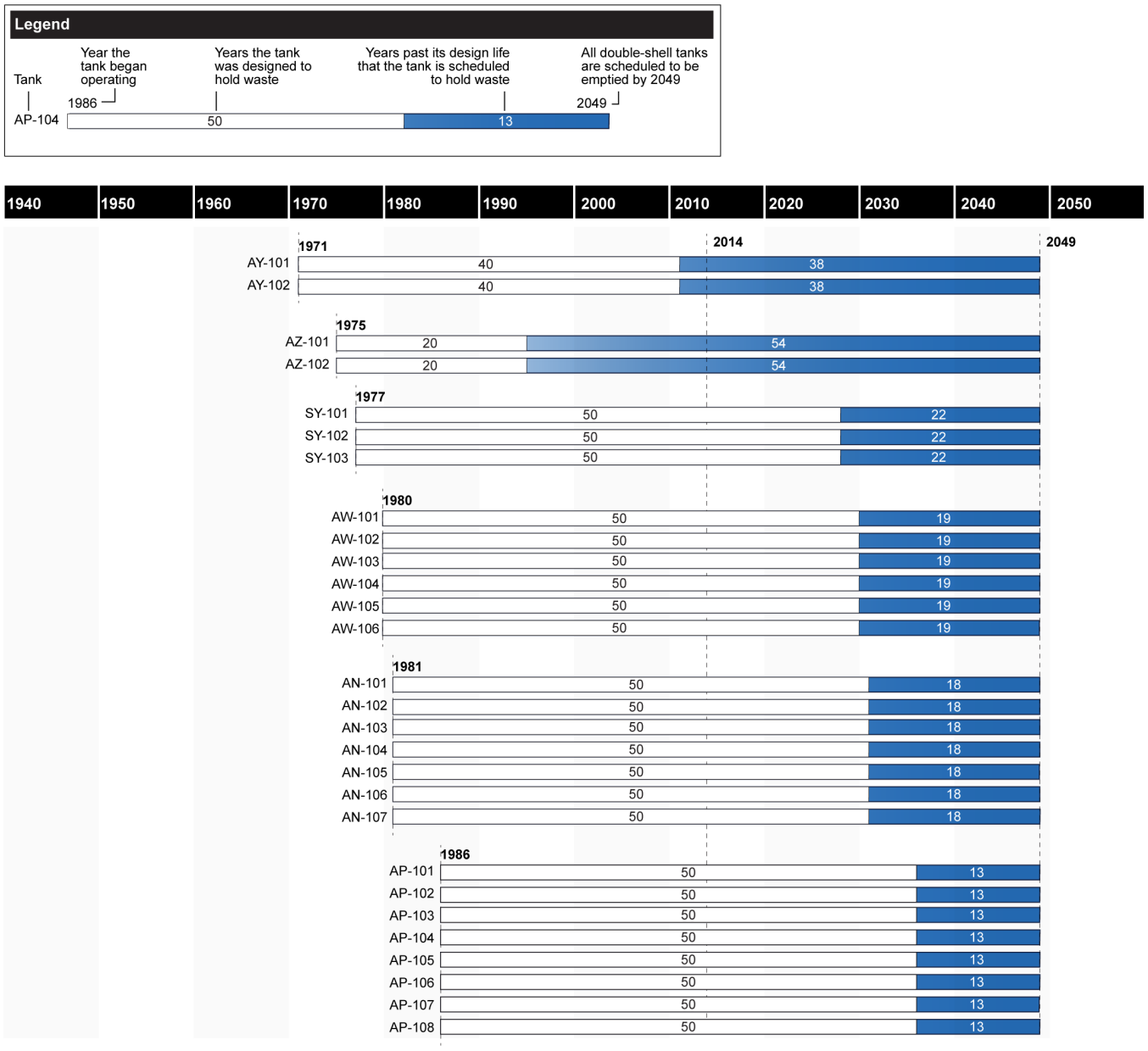
Source: GAO analysis of DOE data. | GAO-15-40

[a] These dates for retrieving the waste from the tanks are based on the Department of Energy's (DOE) 2011 Office of River Protection System Plan. Although DOE had planned to have completed the retrieval of waste from all tanks in the C Farm by 2013, that work is still ongoing with five tanks yet to be retrieved. An update to this plan is scheduled to be released by DOE in the beginning of fiscal year 2015.

Appendix II: Timeline of Hanford Double-Shell Tanks

Figure 7 shows design life data for double-shell tanks.

Figure 7: Timeline of Hanford Double-shell Tanks



Source: GAO analysis of DOE data. | GAO-15-40

Appendix III: Age and Retrieval Schedule for Hanford Single-Shell Tanks (Corresponds to Fig. 6)

Table 1 lists information contained in interactive figure 6.

Table 1: Age and Retrieval Schedule for Single-Shell Tanks

Tank	Year the tank was placed in service	Planned or actual retrieval of waste (as of 2011)	Years past its design life that the tank is scheduled to hold waste	Year the tank was designated as a leaking tank
T-101	1943	2032	64	1992
T-102	1943	2030	62	
T-103	1943	2031	63	1974
T-104	1943	2023	55	
T-105	1943	2030	62	
T-106	1943	2032	64	1973
T-107	1943	2033	65	1984
T-108	1943	2032	64	1974
T-109	1943	2031	63	1974
T-110	1943	2022	54	
T-111	1943	2022	54	1979
T-112	1943	2030	62	
T-201	1943	2020	52	
T-202	1943	2020	52	
T-203	1943	2021	53	
T-204	1943	2021	53	
B-101	1945	2033	63	1974
B-102	1945	2032	62	
B-103	1945	2034	64	1978
B-104	1945	2032	62	
B-105	1945	2034	64	1978
B-106	1945	2033	63	
B-107	1945	2033	63	1980
B-108	1945	2032	62	
B-109	1945	2034	64	
B-110	1945	2033	63	1981
B-111	1945	2035	65	1978
B-112	1945	2034	64	1978
B-201	1945	2018	48	1980
B-202	1945	2018	48	
B-203	1945	2019	49	1983

Tank	Year the tank was placed in service	Planned or actual retrieval of waste (as of 2011)	Years past its design life that the tank is scheduled to hold waste	Year the tank was designated as a leaking tank
B-204	1945	2019	49	1984
C-101	1946	2012	41	1980
C-102	1946	2013[a]	42	
C-103	1946	2006	35	
C-104	1946	2011	40	
C-105	1946	2013[a]	42	2013
C-106	1946	2003	32	
C-107	1946	2011[a]	40	
C-108	1946	2012	41	
C-109	1946	2012	41	
C-110	1946	2012	41	
C-111	1946	2013[a]	42	
C-112	1946	2012[a]	41	
C-201	1946	2006	35	1988
C-202	1946	2005	34	1988
C-203	1946	2005	34	1984
C-204	1946	2006	35	1988
U-101	1946	2038	67	1959
U-102	1946	2035	64	
U-103	1946	2033	62	
U-104	1946	2039	68	1961
U-105	1946	2037	66	
U-106	1946	2033	62	
U-107	1946	2034	63	
U-108	1946	2036	65	
U-109	1946	2034	63	
U-110	1946	2037	66	1975
U-111	1946	2034	63	
U-112	1946	2038	67	1980
U-201	1946	2035	64	
U-202	1946	2036	65	
U-203	1946	2037	66	
U-204	1946	2036	65	
TX-101	1947	2035	63	

Tank	Year the tank was placed in service	Planned or actual retrieval of waste (as of 2011)	Years past its design life that the tank is scheduled to hold waste	Year the tank was designated as a leaking tank
TX-102	1947	2035	63	
TX-103	1947	2034	62	
TX-104	1947	2037	65	
TX-105	1947	2036	64	1977
TX-106	1947	2033	61	
TX-107	1947	2037	65	1984
TX-108	1947	2035	63	
TX-109	1947	2035	63	
TX-110	1947	2038	66	1977
TX-111	1947	2036	64	
TX-112	1947	2035	63	
TX-113	1947	2036	64	1974
TX-114	1947	2038	66	1974
TX-115	1947	2039	67	1977
TX-116	1947	2035	63	1977
TX-117	1947	2034	62	1977
TX-118	1947	2033	61	
BX-101	1948	2030	57	1972
BX-102	1948	2035	62	1971
BX-103	1948	2024	51	
BX-104	1948	2024	51	
BX-105	1948	2028	55	
BX-106	1948	2026	53	
BX-107	1948	2031	58	
BX-108	1948	2032	59	1974
BX-109	1948	2028	55	
BX-110	1948	2033	60	1976
BX-111	1948	2032	59	1984
BX-112	1948	2028	55	
BY-101	1950	2028	53	
BY-102	1950	2026	51	
BY-103	1950	2028	53	1973
BY-104	1950	2026	51	
BY-105	1950	2031	56	1984

Tank	Year the tank was placed in service	Planned or actual retrieval of waste (as of 2011)	Years past its design life that the tank is scheduled to hold waste	Year the tank was designated as a leaking tank
BY-106	1950	2030	55	1984
BY-107	1950	2029	54	1984
BY-108	1950	2031	56	1972
BY-109	1950	2029	54	
BY-110	1950	2026	51	
BY-111	1950	2028	53	
BY-112	1950	2031	56	
S-101	1950	2027	52	
S-102	1950	2023	48	
S-103	1950	2026	51	
S-104	1950	2030	55	1968
S-105	1950	2023	48	
S-106	1950	2027	52	
S-107	1950	2026	51	
S-108	1950	2027	52	
S-109	1950	2026	51	
S-110	1950	2029	54	
S-111	1950	2028	53	
S-112	1950	2007	32	
TY-101	1951	2033	57	1973
TY-102	1951	2031	55	
TY-103	1951	2032	56	1973
TY-104	1951	2032	56	1981
TY-105	1951	2032	56	1960
TY-106	1951	2031	55	1959
SX-101	1953	2024	46	
SX-102	1953	2027	49	
SX-103	1953	2028	50	
SX-104	1953	2030	52	
SX-105	1953	2027	49	
SX-106	1953	2026	48	
SX-107	1953	2027	49	1964
SX-108	1953	2030	52	1962
SX-109	1953	2029	51	1965

Tank	Year the tank was placed in service	Planned or actual retrieval of waste (as of 2011)	Years past its design life that the tank is scheduled to hold waste	Year the tank was designated as a leaking tank
SX-110	1953	2030	52	
SX-111	1953	2028	50	1974
SX-112	1953	2027	49	1969
SX-113	1953	2028	50	1962
SX-114	1953	2026	48	1972
SX-115	1953	2027	49	1965
A-101	1954	2020	41	
A-102	1954	2017	38	
A-103	1954	2022	43	
A-104	1954	2020	41	1975
A-105	1954	2020	41	1963
A-106	1954	2017	38	
AX-101	1965	2018	28	
AX-102	1965	2017	27	
AX-103	1965	2016	26	
AX-104	1965	2016	26	

Source: DOE | GAO-15-40

[a] Although the Department of Energy (DOE) had planned, in its 2011 Office of River Protection System Plan (the source of the data), to retrieve the waste from these tanks by the dates indicated, the waste retrieval from these tanks is not yet completed. An update to this plan is scheduled to be released by DOE in the beginning of fiscal year 2015.

Appendix IV: Comments from the Department of Energy

Department of Energy
Washington, DC 20585

November 7, 2014

Mr. David Trimble
Director
Natural Resources and Environment
U.S. Government Accountability Office
441 G Street, N.W.
Washington, DC 20548

Dear Mr. Trimble:

The Department of Energy (DOE) appreciates the opportunity to provide comments, including those related to the factual accuracy on the Government Accountability Office's (GAO) draft report, GAO-15-40, *HANFORD CLEANUP: Condition of Tanks May Further Limit DOE's Ability to Respond to Leaks and Intrusions*. The Department believes that the comments contained in the enclosed table clarify inaccuracies in the draft report and importantly contribute to its overall quality. The recommendations provided in the draft report are well aligned with DOE's ongoing initiatives for management of the double-shell tanks (DSTs) and single-shell tanks (SSTs) at Hanford, and we accept the recommendations.

DOE has an active DST/SST integrity program, and systematically assesses the condition of the DSTs and SSTs. This program includes the use of robotic ultrasonic devices, corrosion monitoring probes, and remote video cameras for the DSTs. In 2012, these programs identified a leak in DST AY-102. To the extent that the cause of the leak can be determined when DOE completes removal of the waste from this tank, that information will inform the assessments and maintenance of other DSTs. In the near term, the Office of River Protection (ORP) has further enhanced the DST inspection program that identified this leak and has convened an expert independent panel to further recommend additional improvements.

DOE is also actively evaluating methods to create and is creating additional DST space. For example, since the last operation of the 242-A Evaporator in 2010, substantial upgrades were made to increase its operational reliability. The 242-A Evaporator restarted in September, and has created over 750,000 gallons of space to date. This facility is planned to reduce waste volume in the DST system at an estimated rate of 1M gallons per year for the next 3 years.

At the same time, DOE has also increased the operational limits in the DSTs (i.e., the levels at which waste can be safely stored). The operating capacity in four DSTs has already been increased, creating approximately 400,000 gallons of additional usable space. The waste level capacity in two tanks will be increased in fiscal year 2015 by a total of 200,000 gallons. In addition to evaluating operational capacity with the DSTs,

ORP will examine the extent to which future planned facilities will provide additional storage capacity.

DOE is also systematically initiating actions to reduce the volume of the remaining waste in the SSTs through retrievals and the removal of surface liquids to further minimize the potential of leaks to the environment and the volume of waste that will be transferred to the DSTs. For example, DOE plans to use an exhauster to further reduce surface liquids in the SSTs. The exhauster is in place at SST T-111 and will begin reducing the remaining surface liquid in this tank in calendar year 2015. Once exhauster operations at this tank are complete, the exhauster will be used at other SSTs.

DOE has made progress in the management of the tanks at Hanford. The mitigation of risks associated with managing this waste continues to be one of DOE's highest priorities for Hanford and the mission of the Office of Environmental Management. DOE appreciates GAO's recognition of its comprehensive management practices and addressing the enclosed comments in GAO's final report.

If you have any questions, please contact me or Mr. Kenneth G. Picha, Jr., Deputy Assistant Secretary for Tank Waste and Nuclear Material, at (202)586-2003.

Sincerely,

Mark Whitney
Acting Assistant Secretary
for Environmental Management

Enclosure

Appendix V: GAO Contact and Staff Acknowledgments

GAO Contact

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

Staff Acknowledgments

In addition to the individual named above, Dan Feehan, Assistant Director; Mark Braza; John Delicath; Scott Fletcher; Rich Johnson; Jeff Larson; Armetha Liles; and Kyle Stetler made key contributions to this report.