United States Government Accountability Office

Report to Congressional Requesters

HANFORD CLEANUP

DOE Should Take Actions to Improve Inspections and Oversight of Contaminated Excess Facilities

Accessible Version

January 2020

GAO-20-161

January 2020

HANFORD CLEANUP

DOE Should Take Actions to Improve Inspections and Oversight of Contaminated Excess Facilities

GAO Highlights

Highlights of GAO-20-161, a report to congressional requesters

Why GAO Did This Study

DOE's Hanford site in Washington State contains thousands of contaminated excess facilities and waste sites that remain to be cleaned up. In May 2017, a partial roof collapse at a waste storage tunnel facility for one of the former plutonium nuclear processing plants raised questions about the S&M of Hanford's excess facilities and how RL prioritizes cleanup of these facilities.

GAO was asked to review DOE's cleanup of Hanford's contaminated excess facilities, including how DOE ensures that the Hanford Site contractor inspects and maintains facilities. This report examines, among other things, (1) DOE's actions to evaluate the causes of the PUREX tunnel collapse, and (2) the extent to which DOE ensures that S&M of Hanford's contaminate excess facilities meet DOE requirements.

GAO reviewed DOE documents, administered a questionnaire to collect S&M information about 18 selected facilities representing the majority of the Hanford facilities cleanup effort, conducted in-depth reviews of selected Hanford facilities, and interviewed DOE and Hanford cleanup contractor officials.

What GAO Recommends

GAO recommends that DOE (1) analyze the programmatic root causes of the tunnel collapse, (2) routinely conduct comprehensive inspections of contaminated excess facilities and take timely action as warranted, and (3) assess RL oversight of S&M of Hanford excess facilities. DOE agreed with GAO's recommendations and stated that it is taking steps to implement all of them by December 2020.

View GAO-20-161. For more information, contact David Trimble at (202) 512-3841 or trimbled@gao.gov.

What GAO Found

The Department of Energy (DOE) has taken some actions to evaluate the physical causes that contributed to the May 2017 partial collapse of the Plutonium Uranium Extraction (PUREX) Tunnel 1, but has not determined the programmatic causes that led to the collapse, such as by completing an accident investigation or a root cause analysis, among other things. For example, although an engineering evaluation of the tunnels was completed at the request of the State of Washington, Richland Operations Office (RL) officials told GAO an accident investigation was not initiated because the event did not meet threshold requirements in a DOE order that includes, among other things, damages or costs exceeding $2.5 million. However, GAO's analysis shows that the costs of responding to the event and stabilizing the tunnel were about $10 million. At the contractor's request, RL also waived performance of a root cause analysis, which DOE guidance states is typically required for such a significant event, and agreed to a less rigorous analysis of the potential physical causes of the event. By conducting a root cause analysis to determine any programmatic weaknesses that contributed to the collapse of PUREX Tunnel 1, and taking action to address any identified weaknesses, DOE will have greater assurance that another, similar event will not take place. According to a DOE report and GAO's review, although the Hanford contractor is generally conducting routine surveillance inspections of contaminated excess facilities, these inspections have weaknesses and GAO found that DOE has not ensured requirements are fully met. Specifically, DOE orders require that processes be in place to ensure that inspections are conducted to detect deterioration and determine whether the structural integrity of facilities is threatened. A December 2017 DOE report and GAO's review found that the surveillance and maintenance (S&M) inspections at several facilities were not comprehensive and that there are areas of some facilities that personnel infrequently or never enter—physically or by remote means—to conduct inspections. For example, parts of the Reduction-Oxidation Facility have not been entered in more than 50 years and structural conditions are unknown. Without conducting comprehensive inspections, RL cannot ensure that it is meeting all of DOE's S&M requirements, such as addressing aging degradation and obsolescence of some facilities, and preventing other potential events similar to the PUREX tunnel collapse.

In addition, GAO's review of oversight reports since 2013 by DOE headquarters offices responsible for evaluating field office operations found that none of these assessments focused on RL's management and oversight of the contractor's S&M activities. DOE's Oversight Policy requires DOE to conduct independent oversight to the extent necessary to evaluate the effectiveness of DOE field office oversight of contractor activities. Without conducting periodic assessments or audits focused on RL's management and oversight of the contractor's S&M activities for contaminated excess facilities, DOE does not have assurance that RL is overseeing S&M activity in a way that ensures these facilities are inspected and maintained in a safe and compliant condition pending final cleanup.

Contents

Figures

Abbreviations

DOE	Department of Energy
EM	Office of Environmental Management
PUREX	Plutonium Uranium Extraction Plant
REDOX	Reduction-Oxidation Plant
RL	Richland Operations Office
S&M	Surveillance and maintenance
TPA	Tri-Party Agreement

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
441 G St. N.W.
Washington, DC 20548

January 21, 2020

Congressional Requesters

The legacy of more than 40 years of nuclear weapons production at the Hanford Site in Washington State includes enormous quantities of spent (used) nuclear fuel, leftover plutonium in various forms, buried waste, contaminated soil and groundwater, and contaminated excess facilities that must undergo cleanup.[1] The federal government is responsible for the cleanup of the Hanford Site, which is estimated to cost more than $320 billion and take more than 50 years to complete.[2] Of the laboratories and sites that require cleanup in the Department of Energy's (DOE) portfolio, Hanford is the most complex and expensive, comprising nearly half of DOE's environmental liability.[3] From 1944 through 1989, more than 20 million uranium fuel elements were irradiated in nine nuclear reactors along the Columbia River. Five massive plutonium plants (referred to as "canyons"), including the Plutonium Uranium Extraction (PUREX) Plant, operated in the center of the site and processed 110,000 tons of fuel from the reactors, discharging an estimated 450 billion gallons of liquids in planned and uncontained releases to soil disposal sites and 53 million gallons of radioactive waste to 177 large underground tanks.[4] In addition to larger facilities, thousands of supporting excess facilities and waste sites also require cleanup creating the need to identify the greatest

[1]Cleanup of contaminated excess facilities includes four elements: deactivation, decommissioning, decontamination, and demolition. DOE considers a facility "excess" when DOE has determined that the facility is not required to support its missions and by DOE as excess to the agency's needs.

[2]Department of Energy, *Hanford 2019 Lifecycle Scope, Schedule, and Cost Report,* DOE/RL-2018-45 (Washington, D.C.: Jan. 31, 2019).

[3]DOE is responsible for cleaning up radioactive and hazardous waste left over from nuclear weapons production and energy research at DOE sites and facilities across the country. In January 2019, we reported that DOE faces an environmental liability of $494 billion, according to DOE's fiscal year 2018 financial statement, and that the estimated cost to complete cleanup was likely to increase. See GAO, *Department of Energy: A Program-Wide Strategy and Better Reporting Needed to Address Growing Environmental Cleanup Liability*, GAO-19-28 (Washington, D.C.: Jan. 29, 2019).

[4]During the Cold War, DOE recovered nuclear materials—primarily highly enriched uranium and plutonium—for the U.S. nuclear weapons programs by dissolving highly radioactive spent nuclear fuel from the site's nuclear reactors in large, heavily shielded chemical separation facilities known as "canyons."

cleanup risks and prioritize work. Given the urgency to protect the Columbia River, DOE has focused its cleanup effort on contaminated excess facilities located closest to the river.

In May 2017, Hanford workers discovered a partial collapse of the timber roof structure in one of the PUREX Plant's two storage tunnels.[5] While the PUREX event did not result in any injuries to workers or measurable release of radioactive or toxic materials into the surrounding environment, it raised questions about the adequacy of surveillance and maintenance (S&M) activities for contaminated excess facilities, such as PUREX, that are not scheduled for final cleanup in the near future.[6] In addition, this event caused concerns about how DOE prioritizes and schedules cleanup of contaminated excess facilities at Hanford.

Cleanup of the Hanford Site is governed primarily by the 1989 Hanford Federal Facility Agreement and Consent Order, or Tri-Party Agreement (TPA),[7] an agreement among DOE, the Washington State Department of Ecology, and the Environmental Protection Agency.[8] The TPA established hundreds of legally enforceable milestones and established a procedural framework and schedule for developing, prioritizing, and implementing various waste treatment and cleanup actions and monitoring appropriate response actions at the Hanford Site. It also provides the framework for ensuring that cleanup of the Hanford Site complies with applicable federal

[5]Two rail car tunnels were built adjacent to the PUREX facility to accommodate failed equipment and other contaminated materials.

[6]For the purpose of this report, we use "surveillance and maintenance activities" to indicate activities conducted to assure that a site or facility remains in a physically safe and environmentally secure condition, and includes periodic inspections and monitoring of the property, appropriate contamination control actions, and required maintenance of barriers controlling access.

[7]Hanford Federal Facility Agreement and Consent Order, Environmental Protection Agency Document No. 1089-03-04-120, Washington State Department of Ecology Docket No. 89-54, as amended through February 25, 2019. One purpose of the agreement is to ensure that DOE's Hanford cleanup activities comply with federal and state environmental hazardous waste laws. The agreement has been amended numerous times for various reasons, including adding milestones and extending previously agreed-upon completion dates. The agreement as available at: http://www.hanford.gov/page.cfm/TriParty/TheAgreement.

[8]Cleanup is also governed by a 2010 consent decree in Washington v. Chu, Civ. No. 08-05085 (E.D. Wash), entered October 25, 2010, amended in March and April 2016 and October 2018. The consent decree established new milestones related to tank waste cleanup and construction of the Waste Treatment Plant, with a revised deadline of achieving initial plant operations by 2036.

and state environmental hazardous waste laws, primarily (1) the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended; and (2) the Resource Conservation and Recovery Act of 1976, as amended. DOE's Office of Environmental Management (EM) manages the Hanford cleanup work through the Richland Operations Office (RL) and the Office of River Protection, headquartered in Richland, Washington. RL is responsible for managing and overseeing work performed by the Hanford Site cleanup contractors. The Office of River Protection is responsible for the retrieval, treatment, and disposal of Hanford tank waste. In addition, RL is responsible for overseeing the cleanup contractor's S&M activities, which are intended to ensure that contaminated excess facilities are maintained in a safe and environmentally sound manner until final cleanup is completed. DOE policy requires that nuclear facilities be maintained to prevent degradation and that the contractor's S&M activities include inspections to determine whether the structural integrity of contaminated excess facilities is threatened.[9]

Since signing the TPA, DOE has made progress at Hanford by starting cleanup of contaminated excess facilities. However, much work remains, and DOE faces the task of cleaning up large excess facilities and hundreds of associated support facilities that are contaminated with hazardous industrial, chemical, nuclear, or radiological materials. These excess facilities include contaminated excess facilities identified in the TPA as presenting sufficient potential environmental concerns that coordination of DOE's decommissioning process with regulatory cleanup requirements is necessary.[10] In addition, there are hundreds of associated buildings and structures, which may be above or below ground, that were used for material handling and processing, storage, maintenance, administrative, or support activities that also need to be cleaned up.

For years, we have reported on issues with DOE's management of nuclear waste cleanup, including cost increases and changes in scope for major construction projects, technical and management challenges, and

[9]Department of Energy, *Maintenance Management Program for DOE Nuclear Facilities*, DOE Order 433.1B (Washington, D.C.: Apr. 4, 2010); and *Real Property Asset Management,* DOE Order 430.1C (Washington, D.C.: Aug. 19, 2016). The inspections are to evaluate aging-related degradation and technical obsolescence.

[10]In Section 8 of the TPA Action Plan, DOE and its regulators refer to these facilities as "key facilities." In this report, we refer to them as "contaminated excess facilities." A more detailed discussion of our scope is presented in appendix I.

delays in completing cleanup work at Hanford.[11] In 2017, we added the federal government's environmental liability, of which DOE is responsible for the majority, to our High-Risk List. In our 2019 update to the High-Risk List, we reported that DOE's environmental liability grew by $110 billion in fiscal year 2018, primarily due to the estimated cost of cleanup at Hanford.[12] Most recently, we reported in February 2019 that DOE was not accurately tracking or reporting whether milestones were met at cleanup sites, including Hanford.[13]

You asked us to review issues related to the cleanup of Hanford's contaminated excess facilities, including how DOE prioritizes and schedules cleanup and ensures that the Hanford Site contractor inspects and maintains facilities. This report (1) examines actions DOE has taken to evaluate the causes of the PUREX tunnel collapse, 2) examines the extent to which DOE ensures that the contractor's surveillance and maintenance of Hanford's contaminated excess facilities meet DOE requirements, and (3) describes how DOE determines the priority ranking and schedule for cleanup of Hanford's excess facilities.

To examine actions DOE has taken to address the PUREX tunnel collapse and the extent to which DOE ensures that the contractor's S&M of Hanford's contaminated excess facilities meets DOE requirements, we reviewed DOE orders, policies, RL procedures, and documents that describe DOE's S&M requirements. We also obtained and reviewed DOE evaluation reports and assessments of S&M activities and operations at Hanford facilities; these include an EM 2017 Extent of Condition Review for Excess Facilities report and historic S&M assessment reports on PUREX tunnel structural stability.[14] In addition, we examined DOE headquarters oversight assessments conducted by EM's Office of

[11]See, for example, GAO, *Hanford Waste Treatment Plant: DOE Needs to Take Further Actions to Address Weaknesses in Its Quality Assurance Program,* GAO-18-241 (Washington, DC: Apr. 24, 2018); and *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).

[12]GAO, *High-Risk Series: Substantial Efforts Needed to Achieve Greater Progress on High-Risk Areas*, GAO-19-157SP (Washington, D.C.: Mar. 6, 2019).

[13]GAO, *Nuclear Waste: DOE Should Take Actions to Improve Oversight of Cleanup Milestones*, GAO-19-207 (Washington, D.C.: Feb. 14, 2019).

[14]Department of Energy, Office of Environmental Management, *Extent of Condition Review for Office of Environmental Management Hazard Category I, II, and III Excess Facilities, Final Report* (December 2017).

Standards and Quality Assurance and DOE's Office of Enterprise Assessment, which reviewed RL oversight of the Hanford cleanup contractor between June 2013 and June 2018. Due to the high number of Hanford contaminated excess facilities requiring cleanup (approximately 800), we focused our review on 13 of the 15 key excess contaminated facilities identified in the TPA, as well as five other contaminated excess facilities.[15] We identified and selected the five other facilities based on our review of assessments by DOE regarding the risks posed by the facilities, including questions about their structural integrity. We developed and administered a questionnaire to RL to collect specific S&M information about the 18 selected contaminated excess facilities. In addition, we conducted in-depth reviews regarding S&M of selected Hanford facilities. For these reviews, we selected four contaminated excess facilities for in-depth review; specifically, we selected two contaminated excess facilities cited as key facilities in the TPA—the PUREX and the Reduction-Oxidation Facility (REDOX)—and two other contaminated excess facilities—the 224B Concentration Facility and the 216–Z-9 Crib.[16] For these contaminated excess facilities, we reviewed DOE's inspection records from the start of fiscal year 2008 through the end of fiscal year 2018 to determine if inspections were occurring.

To describe how DOE determines the priority ranking and schedule for cleanup at Hanford, we focused on contaminated excess facilities. We reviewed federal environmental regulations, legal agreements, planning documents from DOE and the Hanford cleanup contractor, DOE directives and guidance, and reports by the Consortium for Risk Evaluation with Stakeholder Participation on ways to consider risk in making cleanup decisions.[17] These documents include, but are not limited to: the Tri-Party Agreement and associated Action Plan; EM's Fiscal Year 2020 budget request; RL's 2015 Vision and 2020 Vision (planning documents), which include high-level cleanup priorities and goals; the

[15]As of September 30, 2019, the TPA identified 15 key contaminated excess facilities at the Hanford Site. We excluded two of the 15 key contaminated excess facilities from our scope because S&M is no longer taking place at these facilities given that they are either undergoing cleanup or have already been cleaned up.

[16]A crib is an underground structure designed to allow liquid wastes to percolate to the soil. The 216-Z-9 Crib is a 20-foot-deep excavation trench with a concrete cover that is supported by concrete columns.

[17]The Consortium for Risk Evaluation with Stakeholder Participation is an independent multidisciplinary consortium of universities led by Vanderbilt University.

Hanford cleanup contractor's Project Evaluation Matrix and its associated guideline; and RL's Integrated Priority List.[18]

For all objectives, we also interviewed DOE officials with RL, the DOE Office of Inspector General at Hanford, and DOE headquarters, including Environmental Management's Office of Standards and Quality Assurance and the Office of Enterprise Assessments. In addition, we interviewed Hanford cleanup contractors, officials from the Washington State Department of Ecology, and officials from the Defense Nuclear Facilities Safety Board. A more detailed discussion of our objectives, scope, and methodology is presented in appendix I.

We conducted this performance audit from March 2018 to January 2020, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

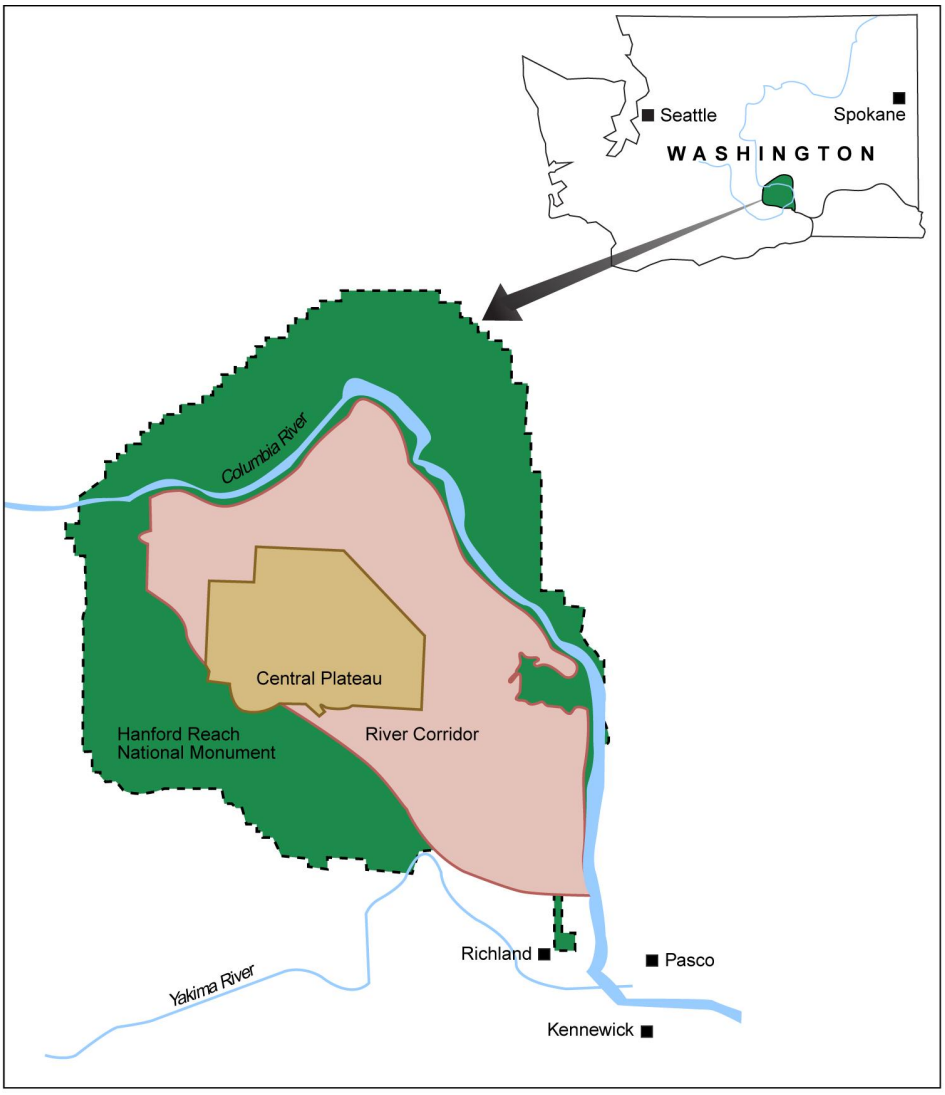
This section provides an overview of the Hanford Site, including DOE's progress cleaning up the site, and DOE's requirements and organizational structure for managing and overseeing cleanup and S&M activities at the site.

Overview of Hanford Site and Cleanup Progress

Located in southeastern Washington State, the Hanford Site is one of the most contaminated nuclear waste sites in North America. The site covers 586 square miles upriver from the cities of Richland, Pasco, and Kennewick. The Columbia River flows through about 50 miles of the site. The River Corridor and Central Plateau represent the two main geographic areas for cleanup work. See Figure 1 for a map of the Hanford Site.

[18]These documents are used to assist decision-makers when prioritizing long- and short-term cleanup goals and milestones.

Figure 1: Hanford Site Map with Principal Areas Designated for Cleanup



Source: Based on a map provided by Department of Energy. | GAO-20-161

DOE's primary goal for cleaning up Hanford is to protect the Columbia River from contamination now and in the future and to restore groundwater.[19] Since cleanup began in 1989, DOE has made progress towards these goals, including remediating 1,342 of 2,032 waste sites, demolishing 889 of 1,715 excess facilities, removing 18.5 million tons of contaminated soil and debris from areas along the Columbia River, and treating 20 billion gallons of contaminated groundwater. DOE's most recent schedule estimate for completing cleanup of the Hanford Site is 2078, although final decisions for many cleanup actions have not yet been made. RL's current overarching set of near-term cleanup goals and priorities—outlined in its 2020 Vision—include initiating the transfer of radioactive sludge from the K basin, cleaning up highly contaminated soils underneath the 324 building, and completing demolition of the Plutonium Finishing Plant, which is among Hanford's most contaminated nuclear facilities.[20]

Hanford Contaminated Excess Facilities Selected for Our Review

Table 1 includes a list and summary descriptions for each of the contaminated excess facilities we selected for our review. A more detailed discussion of the scope for our review is presented in appendix I.

[19]Specifically, RL's overarching goals for Hanford cleanup include: (1) protect the Columbia River; (2) restore groundwater; (3) clean up River Corridor waste sites and facilities; (4) clean up Central Plateau waste sites and facilities; (5) safely mitigate and remove the threat of Hanford's tank waste; (6) safely manage and transfer legacy materials, such as spent nuclear fuel and transuranic waste, scheduled for off-site disposition; (7) consolidate waste treatment, storage, and disposal operations on the Central Plateau; and (8) develop and implement institutional controls and long-term stewardship activities. Department of Energy, Richland Operations Office, *Hanford Site Cleanup Completion Framework,* DOE/RL-2009-10, Rev. 1 (Richland, WA: January 2013).

[20]According to RL documents, the 2020 Vision provides a roadmap of key accomplishments that RL hoped to complete in calendar years 2017 through 2019, assuming the site received annual funding of approximately $900 million.

Table 1: Hanford Contaminated Excess Facilities Selected by GAO for Review

Facility name and hazard category	Description	Active operation dates
Plutonium Uranium Extraction Plant (PUREX) (HC-2)	This facility includes the main 202-A building along with 59 supporting buildings and structures, including two underground storage tunnels. The facility processed about 75 percent of the plutonium produced at Hanford. Following deactivation in 1998, the remaining radioactive material inventory consists of contaminated equipment and surfaces, dust and debris, and about 29,000 curies of plutonium and oxide dust stabilized in gloveboxes.	1956-1972; 1983-1988
B Plant (HC-2)	This facility includes the main 221-B building along with 44 ancillary buildings and their associated equipment. One of Hanford's earliest plutonium processing plants, it was modified and restarted in 1968 to recover cesium and strontium from the tank waste generated during the fuel processing operations.	1945-1957; 1968-1985
U Plant (<HC-3)	This facility includes the main 221-U building and numerous ancillary buildings and associated equipment. The plant originally was designed to remove plutonium for irradiated fuel rods before conversion to extracting uranium from the waste generated from the plutonium extraction process. The plant was then used to receive, decontaminate, and maintain contaminated equipment from other processing facilities. The quantity, form, and distribution of hazardous material is uncertain because there is no written record of its deactivation.	1944-1964
Reduction-Oxidation Plant (REDOX) (HC-2)	This facility includes the main 202-S building along with 13 ancillary buildings and associated equipment. The facility processed approximately 24,000 tons of irradiated uranium fuel rods and remains highly contaminated.	1952-1967
105-B (B Reactor) (<HC-3)	This was the world's first full-scale plutonium production reactor. It was named a National Historic Landmark in 2008 and is now managed for preservation and safe public access.	1944-1946; 1948-1968
105-C (<HC-3)	This was the sixth of eight reactors at the site. It was the first reactor to be cocooned in 1998.[a]	1952-1969
105-D (<HC-3)	This was the second full-scale reactor constructed and one of the longest serving facilities. It was cocooned in 2004.	1944-1967
105-DR (<HC-3)	This was the fifth reactor constructed at the site. It was built due to concerns that the D reactor would fail and was active for the shortest period. It was cocooned in 2002.	1950-1964
105-F (<HC-3)	This was the third reactor constructed at the site and is closest to Richland, Washington. At peak operation, it used almost 70,000 gallons of water per minute to cool the nuclear reactor. It was cocooned in 2003.	1945-1965
105-H (<HC-3)	This was the fourth nuclear reactor constructed at the site. It was the fifth reactor to be cocooned in 2005.	1949-1965
105-K East/ 105-K West (HC-2)	These "sister reactors" were the seventh and eight reactors constructed at the site and built side-by-side. K-East is in surveillance and maintenance mode. Active operations are ongoing in the K-West basin to remove contaminated sludge, debris, and water. The reactor blocks each contain approximately 18,000 curies of radionuclides, primarily tritium, carbon-14, nickel-63, and cobalt-60.	1955-1971
105-N/109-N (<HC-3)	This was the last of the nine plutonium production reactors built at Hanford. It served as a dual purpose reactor that produced plutonium for the weapons defense program as well as for electricity. It was cocooned in 2012.	1963-1987

Facility name and hazard category	Description	Active operation dates
Fast Flux Test Facility (HC-3)	This is a non-defense-funded facility that includes numerous support buildings and structures. It was a 400-megawatt liquid-metal cooled nuclear research and test reactor that served a variety of missions. Deactivation of the facility, including removal of all nuclear material and draining approximately 243,000 gallons of sodium, was completed in 2009. The remaining radionuclide inventory consists primarily of 700,000 curies of cobalt and 200,000 curies of nickel.	1982-1992
324 Waste Technology Engineering (HC-2)	This facility is one of the last remaining to be demolished in the River Corridor Area, located 1,000 feet from the Columbia River. It was the center of Hanford's radiological research and nuclear fabrication efforts. It is currently undergoing cleanup activities to remove highly contaminated waste under the facility prior to demolition of the building.	1966-1996
242B Radioactive Particle Research Laboratory (HC-3)	This facility is a reinforced concrete structure located to the north of B Plant. It served three missions during its operations, including waste evaporation, fuel corrosion testing, and conducting accident simulation research on airborne releases of radioactive material using uranium particles.	1951-1985
224B Concentration Facility (HC-3)	This facility consists of a single, small, concrete reinforced canyon-type building located next to the B-Plant. It was used to purify and concentrate diluted plutonium nitrate in conjunction with B Plant separation activities.	1944-1952
216-Z-9 Crib (HC-2)	This crib is a 20-foot-deep excavation trench with a concrete roof that is supported by concrete columns. It was used for the disposal of waste from the plutonium recovery operations at the Plutonium Finishing Plant. The facility is highly contaminated and is estimated to contain 48 kilograms of plutonium.	1955-1962
Plutonium Finishing Plant 241-Z-361 Settling Tank (HC-2)	This tank is an underground rectangular reinforced concrete structure that served as a settling tank for liquid waste from Plutonium Finishing Plant operations. It holds approximately 75 cubic meters of radioactive sludge containing an estimated 29 to 70 kilograms of plutonium.	1949-1973

Source: GAO summary of Department of Energy documents. | GAO-20-161.

Notes: Hazard Category

HC1 – Hazard Category 1 (a nuclear facility with the potential for significant off-site consequences)
HC2 – Hazard Category 2 (a nuclear facility with the potential for significant on-site consequences)
HC3 – Hazard Category 3 (a nuclear facility with the potential for only significant localized consequences). Below category 3 facilities are those where only consequences less than those that provide a basis for categorization as a hazard category 1, 2, or 3 nuclear facility.

[a]Cocooned reactors have been put in an interim safe storage state where the existing structure is supplemented with a new containment "cocoon" structure for containment of highly radioactive portions of the reactor over a minimum 50- to 100-year life with minimum monitoring. Surveillance and maintenance activities for these reactors include annual external inspections to evaluate the structural integrity of each enclosure and ensure confinement of remaining hazardous materials and internal surveillances that are performed every 5 years.

DOE Requirements for Surveillance and Maintenance of Hanford's Contaminated Excess Facilities

The objectives for conducting S&M of contaminated excess facilities are to ensure adequate containment of any contaminants left in place; provide physical safety and access controls; and maintain the facility in a

manner that will minimize risk to human health and the environment.[21] S&M requirements are derived primarily from nuclear facility safety regulations and DOE orders concerning occupational safety, environmental protection, security, and emergency response planning.[22] DOE orders also require that nuclear facility maintenance plans address aging degradation and obsolescence and that surveillance inspections be conducted to detect malfunction and deterioration and determine whether the structural integrity of contaminated excess facilities is threatened.[23] Under the TPA Action Plan, DOE has established an S&M plan for each of the key excess facilities. The S&M plan identifies the facility and associated structures covered by the plan and the specific inspection activities and frequencies to be conducted. For the other excess facilities, S&M requirements are established through provisions of the cleanup contract which require that the contractor perform the S&M activities necessary to maintain them in a safe and compliant condition.

Due to the wide variation in types of contaminated excess facilities and associated hazards and risks, RL uses a graded approach that allows for differences from facility to facility regarding the frequency and extent of inspections and associated structural integrity engineering evaluations.[24]

[21]S&M activities are conducted throughout the facility life cycle, including those times when a facility is not operating and is not expected to operate again. S&M activities are adjusted during the facility life cycle as transition, deactivation, and decommissioning activities are completed. S&M activities may include, for example, periodic inspections of structures, as well as preventive, predictive, and corrective maintenance. These activities may also include the maintenance of selected systems and equipment essential for transition and disposition activities, such as maintaining ventilation systems, to ensure, at a minimum, that any contamination is adequately contained and that the potential hazards to workers, the public, and the environment are eliminated or mitigated and controlled.

[22]These authorities include 10 CFR part 830, Nuclear Safety Management, Subpart A, Quality Assurance Requirements and Subpart B, Safety Basis Requirements; DOE Orders such as DOE O 430.1C, *Real Property Asset Management*; DOE O 433.1B, *Maintenance Management Programs for DOE Nuclear Facilities*; DOE O 414.1D, *Quality Assurance*, which is intended to ensure that DOE work meets requirements and expectations, and that quality improvement is effected through rigorous assessments and effective corrective actions.

[23]DOE Order 433.1B and DOE Order 430.1C.

[24]See, for example, 10 C.F.R §§ 830.3, 830.7; DOE O 414.1D, *Quality Assurance*. In the graded approach, the level of analysis, documentation, and actions needed to effectively provide oversight of a safety program is commensurate with, among other things, the relative magnitude of the hazards associated with the facilities. Hazard controls means measures taken to eliminate, limit, or mitigate hazards to workers, the public, or the environment, including but not limited to physical, design, structural, and engineering features.

Structural integrity engineering evaluations are conducted to determine the adequacy, structural integrity, and soundness of structures and their components. Inspections are conducted using a procedural checklist comprising a list of functional areas from the facility's inspection plans or procedures, which personnel performing inspections are to evaluate. Inspection checklists can include, among other things, structural integrity (an integral part of excess facility inspections), animal and water intrusion, electrical hazards, and ground subsidence. The S&M plans for contaminated excess facilities require interior walk-through inspections generally on an annual basis but that can vary depending on the facility. Typically, these inspections follow a designated path intended to represent conditions that might be present in areas of the facility that are not visually inspected. In addition, a qualified structural engineer conducts an inspection of the roof integrity—recognized as the most likely risk of failure for the contaminated excess facilities—and other associated structures at those facilities. The frequency, extent of future inspections, and recommendations resulting from these periodic inspections are to be documented by the structural engineer.

DOE Framework for Oversight of Hanford Cleanup and S&M of Contaminated Excess Facilities

The program offices at DOE headquarters, RL, and Hanford contractors have overlapping roles and responsibilities for managing and overseeing the cleanup and S&M of Hanford excess facilities. These include:

- **Office of Environmental Management:** DOE established EM in 1989 to address the environmental legacy of 50 years of nuclear weapons production and government-sponsored nuclear energy research across the country. EM is responsible for the cleanup of large amounts of radioactive wastes, spent nuclear fuel and nuclear material, contaminated soil and groundwater, and the decommissioning and demolition of contaminated excess facilities at various sites. EM offices involved with oversight of contaminated excess facilities cleanup and S&M activities include:
    - **Field Operations Oversight/Chief of Nuclear Safety Office.** This office has responsibility for strengthening federal oversight of EM's cleanup mission, including maintaining operational awareness of field office sites' operations oversight and implementation of nuclear safety requirements, including requirements for S&M.

- **The Standards and Quality Assurance Office.** This office assists with headquarters review of deactivation and decommissioning project planning documents, configuration management and controls, and S&M programs.

- **Office of Enterprise Assessments.** This independent office, which reports directly to the Office of the Secretary, is responsible for implementing DOE's Independent Oversight Program for safety and security in accordance with various DOE policies and orders.[25] Through this program, the office conducts appraisals of the adequacy of DOE policy and requirements and the effectiveness of DOE and contractor line management performance in safety and security.
  - **The Office of Environment, Safety, and Health Assessments.** This office is responsible for conducting assessments to provide information on programs and performance in protecting DOE workers, the public, and environment from hazards present at DOE sites and operations. It also conducts special reviews and studies of safety and emergency management topics and activities where warranted based on circumstances or performance or as directed by DOE management.

- **Hanford Site.** RL is responsible for managing and overseeing non-tank waste cleanup activities at Hanford—including S&M of excess facilities—in the Central Plateau area and for completion of some remaining cleanup work in the River Corridor. RL management and oversight includes verification that work is performed in a safe, secure, and quality manner that protects the public, the worker, and the environment and complies with contractual requirements.
  - **Project and Facilities Division.** This division is responsible for managing and overseeing the cleanup and S&M of Hanford's excess facilities.
  - **Operations Oversight Division.** This division has primary responsibility for day-to-day oversight to ensure cleanup

[25]This responsibility includes assessing the performance of DOE programs and operations in the areas of nuclear and industrial safety; cyber, information, and physical security; and other critical functions as directed by the Secretary.

work is performed in compliance with requirements for safety, quality assurance, and quality control. This includes ensuring that S&M activities follow approved plans and procedures and that the contractor corrects any deficiencies identified during facility inspections.

- **Site Stewardship Division.** This division manages the Long Term Stewardship Program that includes overseeing S&M of the six cocooned reactors.

- **Cleanup Contractor.** Private firms under contract to DOE perform the cleanup and S&M work at Hanford.
  - **Central Plateau Cleanup.** Since 2008, cleanup and S&M of most of the contaminated excess facilities discussed in this report have been performed under the Plateau Remediation Contract by C2HM HILL Plateau Remediation Company. The S&M activities for excess facilities, including how often and what parts of the facility are inspected, are determined by the contractor as necessary to meet contract requirements.
  - **Mission Support.** Mission Support Alliance is the contractor for the Long Term Stewardship Program and is responsible for ongoing S&M activities for the six cocooned reactors; these activities are expected to last for at least 75 years.

DOE Did Not Assess the Programmatic Causes or Fully Implement Key Recommendations Following the PUREX Tunnel Collapse

DOE has taken some actions to evaluate the causes of the PUREX tunnel 1 collapse, but has not determined the programmatic causes that contributed to the tunnel collapse, such as by completing an accident investigation or a root cause analysis. In addition, DOE headquarters' recommendations to improve S&M of contaminated excess facilities and the availability of information on the condition of at-risk areas within these facilities have not been fully implemented.

DOE Did Not Conduct a Root Cause Analysis of the Tunnel Collapse

RL has taken some actions to evaluate the physical causes that contributed to the PUREX Tunnel 1 collapse, but has not determined the programmatic causes that led to the collapse, such as by completing an accident investigation or a root cause analysis, among other things. Specifically, after the collapse, RL took several actions to comply with a 2017 Washington State Department of Ecology Administrative Order.[26] In this order, the Washington State Department of Ecology determined that RL and the Hanford cleanup contractor were not operating and maintaining the PUREX Tunnel 1 to achieve compliance with the site's hazardous waste permit and failed, among other things, to keep the operation of the tunnel undisturbed until closure of the facility. The Administrative Order required RL to take several corrective actions to address violations outlined in the Administrative Order, including determining the cause of the PUREX Tunnel 1 collapse. To fulfill the 2017 Administrative Order corrective action, the cleanup contractor performed an engineering evaluation to determine the structural conditions that led to the collapse of PUREX Tunnel 1.[27] However, the contractor noted in the evaluation that due to the risks of exposure to high radiation levels and urgency to seal the collapsed area, there was insufficient information available to determine the causes of the collapse. Instead, the evaluation identified three potential causes of the collapse, with the most likely cause being deterioration and decay of the tunnel's timber structure. The state accepted these findings from the engineering evaluation as satisfying the requirements in the Administrative Order corrective action that RL identify the causes of the collapse.

Notably, the 2017 structural engineering evaluation of Tunnel 1 conducted after the tunnel collapse did not include a root cause analysis to determine the underlying programmatic causes that contributed to DOE not performing previously recommended structural assessments or detecting through regular S&M activity the imminent collapse of PUREX Tunnel 1 collapse. DOE had been aware of concerns with the structural integrity of Tunnel 1 since the 1970s. These concerns lead to the

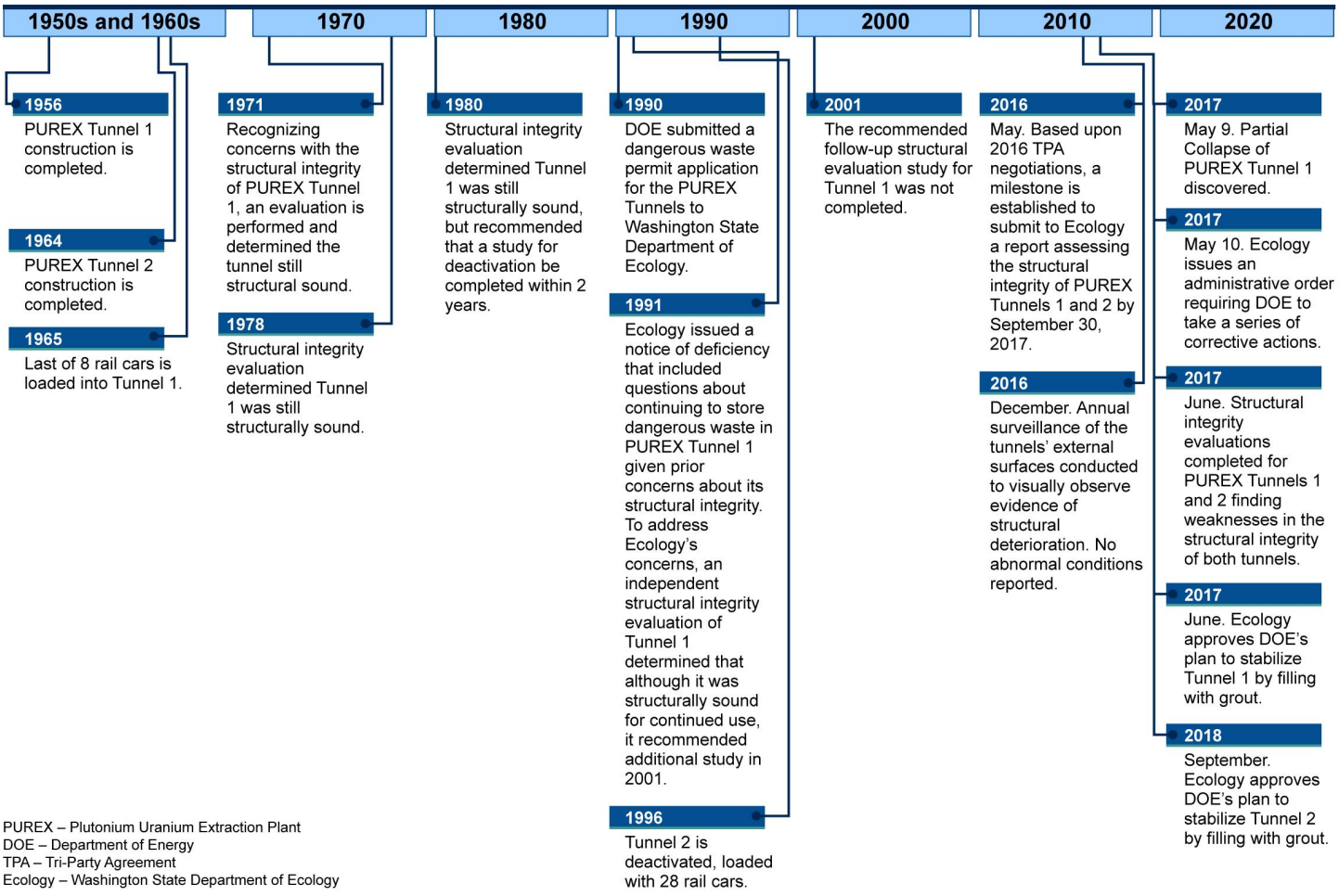
[26]Washington State Department of Ecology, Amended Administrative Order Docket # 15419, May 10, 2017, as amended September 14, 2017.

[27]The order also required DOE to conduct an engineering evaluation to assess the structural integrity of Tunnel 2.

completion of structural assessments in the late 1970s, early 1980's, and in 1991, when it was recommended that the tunnel be reassessed again in 10 years. Due to elevated risk of contamination and radiation exposure to inspectors, subsequent structural integrity assessments were completed using existing information from prior evaluations, including testing of tunnel structural material, instead of collecting updated information through physical inspections to determine if the PUREX tunnels were structurally sound for continued use, according to RL officials. Figure 2 illustrates the timeline of events related to the tunnels, showing that while the structural integrity of Tunnel 1 was raised several times over the last 40 years and it was recommended in 1991 to assess the tunnel again by 2001, an assessment did not occur until after the May 2017 PUREX Tunnel 1 collapse as part of the corrective actions required by the state.[28]

[28]Prior to 2017, despite known concerns about potential degradation and risk of collapse, stabilization of the PUREX tunnels was not among RL cleanup priorities, according to RL officials. RL officials that we spoke with acknowledged that despite what had been known about the potential degradation of the tunnels and potential risks of collapse since the early 1970s, RL prioritized completing other work ahead of taking steps to stabilize or cleaning up the tunnels. Evaluating the structural integrity of the tunnels was not part of the annual routine S&M inspections conducted for the PUREX facility, according to the PUREX S&M plan. Furthermore, although a 1991 engineering evaluation report recommended that RL complete another evaluation by 2001 to determine if the tunnel 1 was still structurally sound for continued use, RL did not conduct such an evaluation. As a result, neither RL management nor the contractor had gathered updated data necessary to make an informed decision on the status of risks posed by the tunnels relative to other facilities being stabilized or prioritized for cleanup. RL officials explained that, given the exposure and safety risks posed to workers conducting such inspections and the perceived low consequences of potential effects of a tunnel collapse, limited resources were better utilized elsewhere.

Figure 2: Timeline of Events Related to the May 2017 PUREX Tunnel 1 Collapse



PUREX – Plutonium Uranium Extraction Plant
DOE – Department of Energy
TPA – Tri-Party Agreement
Ecology – Washington State Department of Ecology

Source: GAO analysis of Department of Energy data. | GAO-20-161

DOE's order on accident investigations contains requirements to initiate an investigation into both the individual and organizational (programmatic) root and contributing causes of events resulting in, but not limited to, a fatality of an employee or member of the public or serious injury requiring hospitalization; loss of control of radioactive material or environmental release of hazardous material; or at least $2.5 million in damage to property or in costs for cleaning, decontaminating, renovating, replacing

or rehabilitating.[29] According to RL officials, RL did not initiate such an investigation into programmatic causes because management concluded that the PUREX Tunnel 1 collapse did not reach these threshold requirements. However, according to RL officials' written responses to our questions about incident, the costs of responding to the PUREX Tunnel 1 collapse and stabilizing the tunnel exceeded $10 million.[30]

DOE Order 232.2A, *Occurrence Reporting and Processing of Operations Information*, also requires the investigation, categorization, and analysis of reportable occurrences by facility representatives and contractors using a graded approach in accordance with locally approved procedures for implementing the requirements of this order.[31] For an occurrence such as the May 2017 PUREX tunnel collapse, which constituted noncompliance with regulatory requirements that created the potential for actual harm, DOE's order and related guidance indicates that a causal analysis should have been performed to identify the root causes, including the programmatic causal factor or factors that, if corrected, would prevent similar future occurrences.[32]

According to the cleanup contractor's condition report on the PUREX tunnel collapse, the contractor initially classified the incident as a significant event because it was categorized as an operational emergency

[29]Department of Energy, *Accident Investigations for Radiological Release, Safety Concerns, or Cost of Accident Mitigation,* DOE Order 225.1B (Washington, D.C.: Mar. 4, 2011). The order defines an accident as an unplanned event that has resulted in or suggests the failure of a DOE safety management system, barriers, or loss of controls that rises to the threshold criteria.

[30]RL officials estimated that the costs of responding to the collapse were approximately $850,000 with a cost of about $9.5 million to stabilize Tunnel 1. In addition, officials told us the interim stabilization of both PUREX tunnels would cost approximately $50 million.

[31]Department of Energy, *Occurrence Reporting and Processing of Operations Information,* DOE Order 232.2A, (Washington, D.C.: Jan. 17, 2017). DOE Order 232.2A defines occurrences broadly to include events or conditions that adversely affect, or may adversely affect, DOE (including the National Nuclear Security Administration) or contractor personnel, the public, property, the environment, or the DOE mission. An occurrence report is a documented evaluation of a reportable occurrence that is prepared in sufficient detail to enable the reader to assess its significance, consequences, or implications and to evaluate the actions being proposed or employed to correct the condition or to avoid recurrence.

[32]Department of Energy, *DOE Standard, Occurrence Reporting Causal Analysis,* DOE-STD-1197-2011 (Washington, D.C.: September 2011).

and significant by default.[33] According to this report, under the contractor's reporting procedures, such a classification requires the performance of a root cause analysis to determine the causes and corrective actions with the intent of preventing recurrence.[34] The contractor's condition report related to the incident notes that RL waived the performance of a root cause analysis in favor of a less rigorous apparent cause analysis to determine the structural factors that led to the collapse of PUREX Tunnel 1.[35] According to a written explanation provided to us by RL management, while the tunnel collapse was due to structural degradation, RL's first priority was stabilizing the tunnel to mitigate the potential for further collapse, and a programmatic root cause analysis to determine the cause was not warranted. In this written response, RL did not provide any explanation for why a programmatic root cause analysis was not warranted. In an email, RL's Operations and Oversight Division facility representative granted the cleanup contractor's request for a waiver from conducting a root cause analysis and concurred with their assertion that an apparent cause analysis was more

[33]CHPRC Condition Report Form, *PUREX Tunnel Breach,* CR Number: CR-2017-8044, (May 9, 2017). A condition report is used to process and track the identification, evaluation and resolution of events, conditions, and opportunities for improvement and the process to document preventive and remedial actions as part of the improvement element of the contractor's quality assurance program. We requested a copy of the occurrence report prepared for the tunnel collapse, but instead of providing the requested occurrence report, RL provided a copy of a condition report.

[34]CH2M Hill, *Administrative Procedures,* PRC-PRO-QA-052, *Issues Management,* Revision 7, Change 3, October 10. 2018 and PRC-PRO-EM-060*, Reporting Occurrences and Processing Information,* Revision 5, Change 4, May 12, 2016.

[35]DOE's occurrence reporting standard defines an apparent cause(s) as the most probable cause(s) that explains why the event happened, that can be reasonably be identified, that local or facility management has the control to fix, and for which effective recommendations for corrective action(s) to remedy the problem can be generated. Root cause(s) are the factor(s) that, if corrected, would prevent the recurrence of the occurrence. It is the most basic cause that explains why the event happened, that can reasonably be identified, that senior management has the control to fix, and for which effective recommendations for corrective actions to the remedy the problem, prevent specific recurrence of the problem, and preclude the occurrence of similar problems can be generated, if necessary. This is typically one level further in the analysis beyond the apparent cause.

appropriate.[36] Based on this direction, a root cause analysis was not performed.

A root cause analysis, performed by either DOE headquarters or RL in accordance with the requirements of DOE's orders on accident investigations and occurrence reporting, would have included an assessment of the underlying programmatic factors that contributed to the collapse of PUREX Tunnel 1. For example, a root cause analysis would determine why PUREX facility inspections that only include visual observations of the surface areas around the tunnels were insufficient in identifying the likelihood of the imminent collapse of PUREX Tunnel 1; why a recommendation made in 1991 for an engineering evaluation to be completed by 2001 to determine if the tunnel was still structurally sound for continued use was not completed; or why RL did not make stabilization or cleanup of the tunnel a higher priority. By conducting a root cause analysis to determine any programmatic weaknesses that contributed to the collapse of PUREX Tunnel 1, and taking action to address any identified weaknesses, DOE would have greater assurance that another, similar event will not take place at Hanford.

DOE Has Not Fully Implemented 2017 Extent of Condition Review Recommendations

In June 2017, shortly after the PUREX Tunnel 1 collapse, EM initiated an Extent of Condition Review to investigate program weaknesses and risks in regard to contaminated excess facilities at three DOE sites, including

[36]The condition report notes that the significance level was lowered from significant to adverse based on the waiver and therefore an apparent cause analysis would be performed. In our review of the contractor's reporting procedures in PRC-PRO-QA-052, while it allows for the waiver of a root cause analysis and rescreening of certain high level events to a lower significance level, it does not discuss waiving a root cause analysis for an event classified as an operational emergency under PRC-PRO-EM-060. Moreover, the procedures require that there is to be a justification or rationale provided to justify rescreening the initial significance level in a significant condition report. In the email correspondence and condition report, the contractor did not provide any justification in support of its request for a waiver, nor did the RL facility representative cite any criteria or rationale for agreeing to the request.

Hanford.[37] Although EM's 2017 Extent of Condition Review concluded that, overall, the S&M processes for excess facilities were adequate in mitigating risks, EM's review identified some weaknesses and made four recommendations to improve the S&M of contaminated excess facilities and availability of information on these facilities' condition.[38] Specifically, two of these four recommendations addressed weaknesses in inspections of facilities and improving information about the condition of excess facilities:

- A comprehensive review should be conducted to identify high-risk areas within excess facilities where inspections have not been conducted for over 5 years. The results of the review should be used to inform the risk management process used to prioritize actions and projects.
- For excess facilities for which limited areas may be used for ongoing operations or storage of nuclear materials, the S&M of the unused areas should be reviewed to assure long-term integrity and stability that is comparable to facilities that are excess.

RL has not fully implemented these two recommendations. RL has taken some actions, including commissioning an engineering team to evaluate the structural integrity of some facilities similar to the PUREX tunnels that may pose a future threat of collapse. However, this evaluation of the structural integrity of Hanford's contaminated excess facilities was not comprehensive and did not include an evaluation of the structural integrity of all excess facilities of concern that may be at risk of structural failure. For instance, the scope of the evaluation was focused on 27 underground waste storage structures in the Central Plateau, such as cribs, tanks and trenches, which were constructed prior to PUREX Tunnel 1. In addition,

[37]Office of Environmental Management, *2017 Extent of Condition Review for Excess Facilities*. In June 2017, EM management issued a directive for an Integrated Project Team to conduct an EM wide Extent of Condition Review for deferred maintenance risk at HAZ CAT I and II excess facilities. The purpose was to investigate program weaknesses and find opportunities for improvement. The Extent of Condition Review Integrated Project Team visited three EM Sites – Hanford, Oak Ridge and the Savannah River Site to review the safety and risk management of contaminated excess facilities. The review team included personnel from EM headquarters offices, EM's Consolidated Business Center, and a representative from each of the three sites.

[38]In addition to the two recommendations noted above, the other two S&M recommendations called for DOE to develop more detailed guidance to ensure that facilities' safety and accident analyses adequately address situations like those with the PUREX tunnel and address the difficulty of physical access for surveillance inspections.

this evaluation was largely based on old data and did not include any physical or non-physical inspection and testing to verify if a facility or part of a facility needed to be stabilized or prioritized for cleanup, according to RL officials. In addition, although recommended in EM's 2017 Extent of Condition Review, to date, RL has not taken action to direct the cleanup contractor to carry out comprehensive inspections at all contaminated excess facilities, and there are areas of some facilities that still have not been entered, either physically or by remote means, to conduct internal inspections. RL officials told us that they generally agree that inspections of aging facilities should include evaluations of their structural integrity. According to these officials, there have been ongoing discussions about such inspections, including how often and in what areas to conduct them. Officials said these decisions would need to be determined on a case-by-case basis depending on the safety consequences of potential incidents. They also stated that RL has prioritized removing hazards to reduce potential threats to human health and the environment to reduce future surveillance and maintenance costs and preparing the canyon areas and other facilities for final cleanup.

According to EM headquarters officials, the 2017 Extent of Condition Review recommendations were intended to be considered as opportunities for improvement which site management could incorporate as deemed appropriate. EM officials explained that there is no requirement for sites to take action to implement the review recommendations or track their progress. However, by not taking actions to implement the Extent of Condition Review recommendations, RL will continue to lack information about the condition of high-risk areas within contaminated excess facilities where inspections have not been conducted for several years and will miss opportunities to identify and address any deteriorating conditions that could lead to the collapse of another contaminated excess facility.

Most Contaminated Excess Facilities Are Inspected as Required, but Some Inspections Are Not Comprehensive

The Hanford contractor is generally conducting surveillance inspections of most contaminated excess facilities as required. However, EM's 2017 Extent of Condition Review and our review found that the cleanup contractor did not conduct comprehensive inspections at all contaminated excess facilities and that there are areas of some facilities that personnel

infrequently or never enter, physically or by remote means, to conduct interior inspections. In addition, although EM's 2017 Extent of Condition Review team noted that they observed examples where appropriate S&M activities were taking place at contaminated excess facilities, the team also acknowledged that such activities do not assure the EM sites' S&M programs are adequate to prevent mishaps, as evidenced by the collapse of PUREX tunnel. Further, DOE headquarters offices responsible for the evaluation of DOE site activities have not conducted any specific assessments or audits focusing on management and oversight of Hanford S&M activities since 2013.

DOE Conducts Inspections of Most Contaminated Excess Facilities, but Some Facilities Are Not Comprehensively or Regularly Inspected

According to EM's 2017 Extent of Condition Review and our review of inspection reports at selected facilities, routine surveillance inspections of Hanford's contaminated excess facilities are being conducted and the EM review concluded that Hanford's surveillance inspections were generally adequate. However, this same EM review, as well as our review, identified weaknesses in Hanford's inspection program.

DOE orders require sites to clearly address aging degradation and obsolescence and to conduct surveillance inspections at contaminated excess facilities to detect malfunction and deterioration and determine whether the structural integrity of contaminated excess facilities is threatened.[39] Once DOE determines that a facility is excess to mission needs, the disposition phase of a contaminated excess facility's life cycle usually includes deactivation, decommissioning, and S&M activities, followed by decontamination and demolition.[40] According to RL officials, a

[39]See DOE Order 430.1C; Order 433.1B; and Order 414.1. Contractor requirements for S&M of excess facilities are set for in the Plateau Remediation Contract, Contract No. DE-AC06-08RL14788, Modification 664, Section C Statement of Work.

[40]Following operational shutdown and transition, the first disposition activity is usually to deactivate the facility. The purpose of deactivation is to place a facility in a safe shutdown condition that is economical to monitor and maintain for an extended period, until the eventual decommissioning, decontamination, and demolition of the facility. Deactivation of contaminated, excess facilities should occur as soon as reasonable possible and is typically followed by a period in which the facility is in a S&M mode until final disposition is started. The final facility disposition activity is typically decommissioning, during which the facility is taken to its ultimate end-state through decontamination and demolition.

graded approach—taking into account the risks posed at each contaminated excess facility— can be used to tailor S&M activities, including the frequency of facility inspections. In addition, S&M plans and procedures are prepared by DOE and implemented by the contractor, who determines the frequencies and areas of contaminated excess facilities included in surveillance inspections.

EM's 2017 Extent of Condition Review found that at three EM sites, including Hanford, contaminated excess facilities surveillance inspections were adequate and overall ensured that the S&M programs were mitigating risks. Additionally, the review found that the sites were giving appropriate attention to roof integrity through the S&M process. Roof structural integrity is a key concern at contaminated excess facilities, as the roof serves as protection against spread of contamination and represents the most likely failure risk and safety risk for workers.[41] Further, in our review of selected contaminated excess facilities, we found that the Hanford cleanup contractor has conducted annual surveillance inspections of most of these facilities and has taken action to ensure the structural integrity of some contaminated excess facilities. For example, RL's responses to our questionnaire indicated that for 16 of the 18 contaminated excess facilities we selected for our review, the contractor conducts interior inspections of structural integrity on a periodic basis. In addition, we found that between 2008 and 2018, the contractor annually inspected three of the four contaminated excess facilities we selected for our in-depth reviews.[42]

However, RL responses to our questionnaire revealed concerns with completeness of structural integrity evaluations and the structural integrity of some facilities. For five of 18 facilities, RL officials identified structural integrity or degradation which could lead to the potential release of hazardous or nuclear materials, such as the May 2017 partial collapse of

[41]For example, based on inspection results, RL directed the cleanup contractor to replace the degrading roof of the REDOX canyon facility, which the contractor completed in 2017, according to RL officials.

[42]According to our review of DOE documentation, DOE has cocooned six of nine shutdown plutonium production reactors and has transitioned them into interim safe storage pending their final disposition. These reactors are now considered to be in a minimum safe condition and are undergoing periodic surveillance inspections and maintenance that may be required for the next 75 years to allow radionuclides to decay before cleanup. Following this 75-year period, the reactor blocks will be removed from their current locations and transported to the Central Plateau for disposal.

PUREX Tunnel 1, as a concern.[43] RL responses also indicated that engineering analyses to evaluate structural integrity had been conducted for 13 of the 18 facilities; however, at 10 of these facilities some areas were not included in the evaluation due to concerns about worker safety from radiological or other hazards. Further, EM's 2017 Extent of Condition Review, other recent DOE reports, and our review of inspection reports for selected contaminated excess facilities found several instances in which the cleanup contractor did not conduct comprehensive surveillance inspections at all excess contaminated facilities, including infrequently or never entering portions of some facilities, either physically or by remote means, to conduct interior structural integrity evaluations.

For example:

- **REDOX.** According to the 2015 Canyon Risk Mitigation Plan, the REDOX canyon is not accessed during routine S&M activities. This report also notes that the canyon deck area is expected to be highly contaminated, is not inspected, has not been entered in more than 50 years, and structural conditions are unknown.[44] The canyon deck is located in the central portion of the canyon building and is isolated from other areas of the facility by thick reinforced concrete walls and floors. It is located above the facility process cells that were used to extract plutonium. According to RL officials, these process cells and other parts of the main canyon building are not accessed during routine walkthrough inspections due to high levels of radioactive contamination. Furthermore, in the contractor's 2016 annual inspection of the REDOX facility complex, the contractor did not evaluate three annexes of the canyon facility for structural integrity, according to RL's response to our questionnaire.[45] According to RL officials, the contractor did not carry out these evaluations of the annexes because RL plans

[43]These facilities include PUREX, REDOX, B Plant, 216-Z-9 crib, and the Plutonium 241-Z-361 Settling Tank.

[44]CH2M Hill Plateau Remediation Company, *Canyon Risk Mitigation Plan*, CP-59374, Revision 0, a report prepared for the U.S. Department of Energy, Assistant Secretary for Environmental Management, (Richland, WA: October 2015).

[45]The REDOX facility, including these annexes, are classified as TPA Tier 1 facilities. Tier 1 facilities are generally large heavily shielded metal and concrete structures containing tanks, heavily shielded gloveboxes or hot cells, underground vaults, piping, etc., that are integral to the facility structure which pose a threat of release of hazardous substances to the environment during disposition.

to complete their final cleanup in the near term. However, according to a 2016 DOE planning document, the schedule for conducting the cleanup of the annexes is unknown, and RL officials told us it may be several more years before cleanup begins.

Because these annexes are not inspected for structural integrity, RL and the cleanup contractor may not have sufficient information regarding their condition for planning purposes, such as assessing if immediate maintenance is required to stabilize a structure or prioritizing an annex for immediate cleanup. In addition, according to a 2012 DOE report, because the canyon was not deactivated after shutdown in the 1960s, information is very limited and there is a significant level of uncertainty about the conditions inside the building.[46] According to the EM's 2017 Extent of Condition Review, despite ongoing S&M activities, if facility deterioration continues and is left unaddressed, the condition of the facility could present a threat to human health and the environment, as well as increase the costs of S&M in the near term.[47]

- **PUREX.** According to EM's 2017 Extent of Condition Review, parts of the main PUREX facility are not physically inspected, including the canyon deck. The canyon deck is in the central portion of the main canyon building and is isolated from the surrounding areas of the facility by thick, reinforced concrete walls and floors and has not been entered in more than 10 years, according to the Hanford cleanup contractor's 2015 Canyon Risk Mitigation Plan report.[48] According to this report, conditions within this space are unknown, and high contamination levels are expected. Due to lack of information and concerns about this area, the 2015 Canyon Risk Mitigation Plan recommended—for data-gathering and planning purposes—inspecting this area either physically or remotely, if physical entry is not possible due to high levels of radiation. This report also stated that future cleanup work

[46]CH2M Hill Plateau Remediation Company, *Central Plateau Remediation Optimization Study*, DOE/RL-2012-33, Revision 0, a report prepared for the U.S. Department of Energy, Assistant Secretary for Environmental Management (June 2012).

[47]In September 2019, RL officials told us that DOE management had approved RL's interim plans to proceed with targeted cleanup, stabilization, and demolition actions for selected structures within the REDOX complex.

[48]*2015 Canyon Risk Mitigation Plan.*

could not be initiated in this area without sufficient information related to the condition of the canyon deck. In addition, a 2019 engineering evaluation of the facility determined that degradation may not be fully addressed by S&M activities and the risk of release of hazardous substances will increase as degradation continues or goes undetected.[49] Figure 3 shows the main PUREX plant and auxiliary facilities.

Figure 3: Main PUREX Plant and Auxiliary Facilities

Source: Department of Energy. | GAO-20-161

- **216-Z-9 Crib.** According to the EM's 2017 Extent of Condition Review, due to the highly contaminated nature of 216-Z-9 Crib, inspections of this facility are limited to external surveillance of the roof and looking down the facility stairwell to the trench area of the crib. However, a 2006 inspection of the interior of the crib utilized a remote controlled device to inspect and determine that the structural integrity of the facility's roof was suspect. This inspection recommended that the roof be inspected for structural integrity every 5 years; however RL did not direct the contractor to

[49]Department of Energy, Richland Operations Office, *Engineering Evaluation/Cost Analysis for the PUREX Complex,* DOE/RL-2016-15 Revision 0 (Richland, WA: June 2019).

inspect the facility until 2016. Furthermore, according to RL officials, when the facility was inspected in 2016 and then again in 2018, the inspections did not include an engineering evaluation or use of non-physical engineering or robotic tools to inspect the structural integrity of the roof, as was done in 2006, to determine if the facility was safe for continued use. Despite the lack of an engineering evaluation or interior inspection of the roof, the 2016 and 2018 inspection reports gave the facility a passing grade for structural integrity—raising questions about both the basis and reliability of this assessment. RL officials told us they did not instruct the contractor to conduct such an evaluation because recent visual surveillance inspections of the outside of the crib roof did not indicate that structural failure was imminent. However, in its January 2019 structural integrity assessment of contaminated excess facilities at risk of collapse, the contractor reported that this facility was among 11 facilities needing further evaluation.[50]

- **Plutonium Finishing Plant 241-Z-361 Settling Tank.** According to RL's response to our January 2019 questionnaire, the interior of the Plutonium Finishing Plant 241-Z-361 Settling Tank is not inspected. RL's response noted that although there are concerns regarding the structural integrity of the facility, the facility is safe for continued use. However, RL's response is not consistent with prior studies on the condition of the tank. To support the questionnaire response, RL referred to the 2018 Documented Safety Analysis and a 1997 Structural Integrity Assessment for Plutonium Finishing Plant 241-Z-361 Settling Tank. The 2018 Documented Safety Analysis concludes that the tank is in a structurally degraded condition but is not considered at risk of imminent failure.

However, the 1997 Structural Integrity Assessment that DOE used to support the conclusion in its Documented Safety Analysis determined it was not possible to accurately assess the condition of concrete in the facility and there were uncertainties associated with the strength of its structural steel. The 1997 report also concluded that deteriorating conditions of the facility could lead to the leakage of radioactive waste material, further accelerating the degradation through corrosion and conditions that could result in the collapse of the tank. Notably, a subsequent 1999 video inspection revealed

[50]TerraGraphics Environmental Engineering, Inc. and LPI, Inc., *RL-40 Aging Structures Risk Assessment*, Report No. 6759-RPT-001, a report prepared at the request of CH2M Hill Plateau Remediation Company (January 2019).

cracking in the interior roof, dissolving of the interior steel liner, and deterioration of the concrete sidewall of the tank.[51]

Despite these documented concerns about the structural integrity of the facility, RL officials that we spoke with could not provide a specific reason for why the interior of this facility has not been inspected. Most recently, a structural integrity initial assessment performed for the contractor in January 2019 identified the Plutonium Finishing Plant 241-Z-361 Settling Tank as the top priority among 11 contaminated excess facilities needing further evaluation to determine if the facility is structurally sound for continued use. This report stated that the facility is currently in a structurally degraded condition, with severe deterioration of the construction materials supporting the structure.

- **224B Concentration Facility.** This facility is contaminated from past operations and parts of the facility are not physically inspected, according to the 2015 Canyon Risk Mitigation report.[52] In addition, according to a 2015 RL briefing report, the facility's roof is aging and will likely require replacement within 5 years. According to RL officials, the roof of this facility has not been replaced, and according to RL's response to our questionnaire, no significant maintenance or structural work has been conducted since 2008 and none is needed or planned based upon the current condition of the facility. However, RL's response to our questionnaire indicates that RL has not conducted a structural integrity engineering evaluation of the facility to support this conclusion. According to RL officials, they are currently in the process of developing a plan to complete decommissioning and decontamination of the facility. Under the TPA, the plan is to be submitted by the end of September 2020. However, RL officials told us that even with regulatory approval of the plan, DOE likely will use additional funding to pursue other near-term cleanup priorities rather than clean up the 224B Concentration Facility.

According to EM's 2017 Extent of Condition Review, other recent DOE reports, and our review of inspection reports for selected contaminated excess facilities, gaps in S&M activities are, in some cases, due to access challenges at the facilities. According to the EM 2017 Extent of Condition

[51]A video camera was used to inspect the inside of the tank for this review.

[52]The building is divided along its length into a process cell side and an office and gallery side.

Review, not all facility areas are inspected regularly due to difficulty of access or elevated risk of contamination or exposure, or because those areas are in such a degraded condition they are not safe to enter. However, the contractor has demonstrated the capability to use engineering or robotic evaluations to inspect or determine the structural integrity of the facility, or parts of the facility, and verify whether it needs to be stabilized or prioritized for cleanup. For example, such analyses were done at the PUREX tunnels and at the 216-Z-9 Crib, as noted above. Despite this capability, RL management has not directed the cleanup contractor to perform such inspections for some of Hanford's contaminated excess facilities or parts of facilities. According to RL officials, decisions on regularity and types of inspections and structural evaluations will depend on the known risks associated with the facility. Without directing the contractor to routinely conduct comprehensive inspections to gather crucial information on the condition of contaminated excess facilities, RL cannot ensure that it is meeting all of DOE's S&M requirements—such as addressing aging degradation and obsolescence of facilities—and preventing other potential events similar to the PUREX tunnel collapse.

DOE Headquarters Has Conducted Some Assessments of RL Cleanup Work but Has Not Conducted Oversight Reviews of S&M Activities at Hanford

DOE headquarters offices have conducted some assessments of RL cleanup work but have not conducted any assessments or audits focused on RL's oversight of the cleanup contractor's S&M activities since 2013.[53] EM's Field Operations Oversight/Chief of Nuclear Safety Office and DOE's Office of Enterprise Assessments are required to conduct independent oversight to the extent necessary to evaluate the effectiveness of DOE field office oversight of contractor activities, including activities needed to maintain contaminated excess facilities in a safe and compliant condition pending their final cleanup.[54] We reviewed

[53]These offices have conducted some recent assessments of other aspects of RL's cleanup work, such as concerns about worker safety in the ongoing demolition of the Plutonium Finishing Plant.

[54]Officials with EM's Field Operations Oversight/Chief of Nuclear Safety Office indicated the office's oversight function is to be implemented in accordance with DOE's Oversight Policy in DOE Order 226.1B. Under DOE Order 227.1A, the Office of Enterprise Assessments is responsible for implementing the requirements of DOE's Independent Oversight Program.

21 DOE HQ oversight reports on RL activity from the past 5 years and determined that none of these assessments or audits focused on RL's management and oversight of the contractor's S&M activities for contaminated excess facilities.[55]

We spoke with DOE officials from two headquarters offices responsible for independent oversight of DOE field offices—the EM Field Operations Oversight/Chief of Nuclear Safety Office and the Office of Enterprise Assessments. Officials with both headquarters offices confirmed that neither office has conducted a specific assessment or audit focusing on RL's management and oversight of S&M activities for contaminated excess facilities in the last 5 years. Officials with the Office of Enterprise Assessments told us that, given the limited resources available to conduct oversight, they have to prioritize and be selective about the reviews they plan to conduct in a given year, and conducting an in-depth assessment of RL's oversight of Hanford S&M activity has not been a priority with that office. In December 2018, the office considered whether to conduct a formal assessment of RL oversight of Hanford S&M activity, but decided that such an assessment was not needed.

However, the projected overall time in S&M mode underscores the importance that S&M be adequate to maintain facility safety during the final stages of cleanup operations through a seamless transition to the final disposition of the facility to protect human health and the environment. We found that S&M requirements for selected contaminated excess facilities will continue for decades. Specifically, our review of 18 contaminated facilities at Hanford found that many of these facilities were determined to be excess between the 1960s and the late 1980s and transitioned into S&M status at that time.[56] Notably, our review of these

[55]For example, DOE's Office of Enterprise Assessments conducted an assessment of RL oversight processes in June 2018. This assessment was part of the oversight effort headquarters performed in response to the December 2017 radiological contamination event at the Hanford Plutonium Finishing Plant. However, this assessment did not include an examination of RL's oversight of Hanford S&M activity. DOE, Office of Enterprise Assessments, *Assessment of the Richland Operations Office Federal Oversight*, June 4-7, 2018.

[56]As noted earlier, due to the high number of Hanford contaminated excess facilities requiring cleanup, we focused our review on 13 of the 15 key excess contaminated facilities identified in the TPA, as well as five other contaminated excess facilities. We identified and selected the five other contaminated excess facilities based on our review of assessments by DOE regarding the risks posed by the facilities, including questions about their structural integrity.

facilities shows that several of them do not have planned cleanup completion dates and for those with cleanup completion dates, cleanup is scheduled to be completed between 1 and 6 decades in the future. Table 2 shows the dates for when the 18 contaminated excess facilities transitioned into S&M mode and how long RL will need to continue S&M activities until cleanup is completed.

Table 2: Projected Duration of Time Spent in Surveillance and Maintenance (S&M) Mode for 18 Selected Hanford Contaminated Excess Facilities Pending Final Disposition, as of October 2019

Excess facility	Transitioned to S&M mode date	Planned cleanup completion date[a]	Projected overall time in S&M mode (in years)
Plutonium Uranium Extraction Plant (PUREX)	1998	2047	49
B Plant	1998	2041	43
U Plant	1965	2027	62
Reduction-Oxidation Plant (REDOX)	1969	2076	107
105-B (B Reactor)	1968	n/a[b]	—
105-C	1969	TBD	75[c]
105-D	1967	TBD	75
105-DR	1964	TBD	75
105-F	1965	TBD	75
105-H	1965	TBD	75
105-K East/105-K West	1971	TBD	75
105-N/109-N	1998	TBD	75
Fast Flux Test Facility	2009	2042	33
324 Waste Technology Engineering	1998	2022	24
242B Radioactive Particle Research Laboratory	1985	2020	35
224B Concentration Facility	1976	2039	63
216-Z-9 Crib	1977	2034	57
Plutonium Finishing Plant 241-Z-361 Settling Tank	1980	2028	48
Average Years Projected to be Spent in S&M Mode			**61.5 years**

Source: GAO summary of Department of Energy (DOE) documents. | GAO-20-161.

[a]This column is based on responses to our questionnaire that asked DOE's anticipated date for completing cleanup of the facility.

[b]This reactor is preserved as a national historic landmark and managed by the National Park Service as part of the Manhattan Project National Historical Park. The park's purpose is to preserve and interpret the nationally significant historic sites, stories, and legacies associated with the top-secret race to develop an atomic weapon during World War II, and provides access to these sites consistent with the mission of the Department of Energy.

[c]To date, six of the reactors have been cocooned and placed in Interim Safe Storage status, with the two K reactors to be placed in this status once decommissioning actions are completed. Reactor cocooning was designed to keep the reactors in a safe configuration for up to 75 years to allow the radiation levels to decay to a point where the reactor could be dismantled and disposed.

As S&M of Hanford's contaminated excess facilities is expected to continue for many decades, conducting an effective S&M program is essential to minimize the risks of potential releases of contamination that could harm the environment or human health before cleanup is completed. Notably, RL has not established final cleanup dates for several of the 18 contaminated excess facilities included in our review. DOE, however, has not conducted independent reviews of S&M oversight activity necessary to determine whether weaknesses exist in RL's management and oversight of the Hanford Site contractor's S&M activities for these facilities. Without prioritizing and conducting periodic assessments or audits focused on RL's management and oversight of the Hanford Site contractor's S&M activities for contaminated excess facilities, DOE does not have assurance that RL is overseeing S&M activity in a way that ensures contaminated excess facilities are being inspected and maintained in a safe and compliant condition pending final cleanup.

DOE Seeks to Balance Risks with Other Factors to Establish Hanford Site Cleanup Priorities

RL seeks to balance risks with other factors, such as legally enforceable milestones, available budget, and stakeholder interests, to prioritize cleanup activities that support achieving its overarching Hanford Site cleanup goals, according to RL officials and planning documents. While EM has overall responsibility for managing DOE's cleanup program, including deactivation and demolition of excess facilities, it has delegated prioritization of cleanup activities to the sites through the annual budget process. As part of the process, EM requests sites develop and submit a site-specific Integrated Priority List to EM management. The Integrated Priority List is based on a number of site-specific factors, including regulatory commitments, agreements with EPA and states, and risks to worker safety and the environment. According to RL officials, EM does not provide specific written guidance for the sites to follow in developing

their priority lists, other than a list of seven general factors.[57] RL officials told us that more specific guidance is not necessary because site management needs the flexibility in setting and adjusting cleanup priorities to reflect changes in site conditions and other evolving circumstances as they arise.

Since 2017, RL and the Hanford cleanup contractor have been using a new site-wide risk-informed tool, known as the Project Evaluation Matrix, to help inform decisions on which cleanup priorities to include in the Integrated Priority List. The matrix is used to produce a prioritized listing of the stabilization, waste removal, and other activities that need to be completed as part of the deactivation and decommissioning of the contaminated excess facilities and their associated buildings, structures, and waste sites. RL and cleanup contractor officials described the matrix as a broad, overarching tool to aid in establishing a qualitative basis by which they can determine and agree on cleanup priorities that are planned to be executed within the next 1 to 5 years. Neither the Washington State Department of Ecology nor the Environmental Protection Agency is directly involved in the development of the rankings in the matrix.

The contractor's guidance document explains that the risk evaluation process used to develop the matrix rankings involves a number of steps. It starts with the data collection phase, during which RL and the contractor collect information on site conditions from a variety of sources, such as historical records, safety assessments, subject matter experts, and S&M activities. This information is then used to develop relative ranking scores for the various cleanup and S&M activities using weighted scores for three criteria: (1) risk reduction; (2) mortgage reduction/cost avoidance; and (3) TPA milestones/regulatory drivers. The initial scores also take into consideration other factors such as potential consequences of failure and overall project lifecycle costs. After developing an initial risk ranking of cleanup projects and activities, the contractor works with RL management to evaluate the initial results and make adjustments as necessary to reflect comments, changes in conditions, or new work

[57]According to EM budget documents, after taking many variables into account, it has generally prioritized and funded its cleanup activities as follows: (1) activities to maintain a safe, secure, and compliant posture in the EM complex; (2) radioactive tank waste stabilization, treatment, and disposal; (3) spent (used) nuclear fuel storage, receipt, and disposition; (4) nuclear material consolidation, stabilization, and disposition; (5) transuranic and mixed/low-level waste disposition; (6) soil and groundwater remediation; and (7) excess facilities deactivation and decommissioning.

scope. The risk rankings are then updated and used by RL to inform decisions on which projects to prioritize in its Integrated Priority List budget submission to EM. As funding decisions are made and cleanup work proceeds, risks are reassessed and the process starts again.

RL officials explained that planned cleanup priorities established in the Integrated Priority List can be adjusted as necessary to reflect information learned through S&M activities and changes in site conditions. For example, routine annual S&M inspections at one facility identified concerns with the integrity of the roof. Based on these concerns, a structural analysis was performed by the cleanup contractor, and RL adjusted its priorities for fiscal year 2016 to include replacing the facility's roof. Similarly, RL may also modify its planned cleanup priorities to reflect changes in site conditions, such as completing cleanup of a facility or taking actions to stabilize a facility pending its final disposition. For example, based on structural evaluations completed after the partial collapse of Tunnel 1 in May 2017, RL elevated interim stabilization of both PUREX tunnels as among its top priorities in fiscal years 2018-2019.

The ability of RL management to establish and adjust cleanup priorities depends on the availability of quality information on site conditions that is reliable, complete, and current. One source of information for this process is annual and routine S&M activities for Hanford's contaminated excess facilities. These activities, such as facility inspections, structural integrity evaluations, and radiological monitoring, help provide management with updated information on potential changes in site conditions that may lead to an adjustment in previously planned priorities. As discussed above, however, both EM's 2017 Extent of Condition Review and our review found that parts of certain contaminated excess facilities that may be at risk for structural deterioration—such as the REDOX annexes—are not included in the routine surveillance inspections and have not been inspected within the past 5 years, or longer. We also identified instances where structural integrity evaluations for some facilities, such as for the 216-Z-9 crib and the Plutonium Finishing Plant 241-Z-361 Settling Tank, appear to have relied on outdated information and reached determinations seemingly inconsistent with the contractor's more recent analyses and conclusions. By conducting comprehensive surveillance inspections of Hanford's contaminated excess facilities, DOE would have greater assurance that RL and the contractor's process for identifying cleanup priorities reflects the current status of the potential human health and environmental risks present at such facilities.

Conclusions

At Hanford, RL has made progress in cleaning up approximately 800 excess facilities, and six major plutonium production reactors are now cocooned and waiting final dispositioning. Despite efforts to mitigate risks and cleanup excess facilities, significant vulnerabilities remain at Hanford due to, among other things, the degrading state of hundreds of contaminated excess facilities still requiring cleanup. Given the pivotal role of the S&M program in ensuring that aging and degrading contaminated excess facilities do not collapse or fail to contain radioactive or hazardous material, it is important that this program is functioning effectively and that any weaknesses are addressed in a timely manner.

The partial collapse of PUREX Tunnel 1 was a clear signal that there are flaws in the S&M program at Hanford. By conducting a root cause analysis to determine any programmatic weaknesses that contributed to the causes of the PUREX Tunnel 1 collapse, and taking action to address any identified weaknesses, DOE will have greater assurance that another, similar event will not occur at Hanford. Additionally, the PUREX Tunnel 1 event demonstrates that RL and the cleanup contractor need complete and updated information regarding the condition of aging contaminated excess facilities to determine if facilities should be stabilized to prevent structural failure or prioritized for cleanup. This information can only be acquired by routinely completing comprehensive surveillance inspections, to include, if necessary, engineering evaluations including the use of remote controlled probes. Without directing the contractor to conduct routine and comprehensive inspections to gather crucial information on the condition of contaminated excess facilities, RL cannot ensure that it is meeting all of DOE's S&M requirements—such as addressing aging degradation and obsolescence of facilities—and preventing other potential events similar to the PUREX tunnel collapse. Furthermore, because DOE headquarters offices have not prioritized and conducted any assessments or audits focused on RL's oversight of the cleanup contractor's S&M activities within the past 5 years or since the PUREX Tunnel 1 collapse, they are missing an opportunity to identify and address any Hanford S&M program weaknesses that may have led to the collapse.

Recommendations for Executive Action

We are making the following three recommendations to DOE:

The Assistant Secretary of DOE's Office of Environmental Management should direct RL to conduct a root cause analysis to identify any programmatic causes that may have led to the collapse of PUREX Tunnel 1. (Recommendation 1)

The Assistant Secretary of DOE's Office of Environmental Management, while ensuring the protection of DOE workers, the public, and the environment, should ensure that RL directs the Hanford Site cleanup contractor to explore using robotic or other means to routinely complete comprehensive surveillance inspections of contaminated excess facilities to identify aging degradation and obsolescence of facilities and take timely action as warranted. (Recommendation 2)

The Secretary of Energy should ensure DOE headquarters offices responsible for the oversight of EM sites' field offices conduct an assessment of RL's management and oversight of the Hanford Site contractor's surveillance and maintenance activity for contaminated excess facilities. Based on the results of this assessment, DOE headquarters offices should consider whether such assessments should be conducted on a periodic basis. (Recommendation 3)

Agency Comments

We provided a draft of this report to the Secretary of the Department of Energy. In its written comments, reproduced in appendix III, DOE agreed with the report's findings and concurred with our recommendations. In addition, DOE described ongoing and planned actions to address our recommendations by December 31, 2020.

As agreed with your offices, 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 to the appropriate congressional committees; the Secretary of Energy; the Director, Office of Management and Budget; and other interested parties. In addition, the report will be available at no charge on the GAO website at 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 IV.

David C. Trimble
Director, Natural Resources and Environment

List of Requesters

The Honorable Frank Pallone, Jr.
Chairman
The Honorable Greg Walden
Republican Leader
Committee on Energy and Commerce
House of Representatives

The Honorable Maria Cantwell
United States Senate

The Honorable Patty Murray
United States Senate

The Honorable Ron Wyden
United States Senate

The Honorable Cathy McMorris Rodgers
House of Representatives

The Honorable Dan Newhouse
House of Representatives

Appendix I: Objectives, Scope, and Methodology

This report reviews issues related to the cleanup, inspection and maintenance of Hanford's contaminated excess facilities, such as the Plutonium Uranium Extraction Plant (PUREX), and how the Department of Energy (DOE) and the Richland Operations Office (RL) prioritizes and schedules cleanup and ensures that the Hanford Site contractor inspects and maintains these facilities. The objectives of our review were to (1) examine actions DOE has taken to evaluate the causes of the PUREX Tunnel Collapse, 2) examine the extent to which DOE ensures that the contractor's surveillance and maintenance of Hanford's contaminated excess facilities meet DOE requirements, and (3) describe how DOE determines the priority ranking and schedule for cleanup of Hanford's excess facilities.

To examine actions DOE has taken to address the PUREX Tunnel Collapse and the extent to which DOE ensures that the contractor's surveillance and maintenance (S&M) of Hanford's contaminated excess facilities meets DOE requirements, we reviewed DOE orders, policies, RL procedures, and documents that describe DOE's S&M requirements.[1] We also obtained and reviewed DOE evaluation reports and assessments of S&M activities and operations at Hanford facilities; these include the Office of Environmental Management's (EM) 2017 Extent of Condition Review for Excess Facilities and historic S&M assessment reports on PUREX tunnel structural stability.[2]

To describe how DOE determines the priority ranking and schedule for Hanford cleanup work of Hanford's contaminated excess facilities, we reviewed federal environmental regulations, legal agreements, planning

[1]For the purpose of this report, we use "surveillance and maintenance activities" to indicate activities conducted to assure that a site or facility remains in a physically safe and environmentally secure condition, and includes periodic inspections and monitoring of the property, appropriate contamination control actions, and required maintenance of barriers controlling access.

[2]Department of Energy, Office of Environmental Management, *Extent of Condition Review for Office of Environmental Management Hazard Category I, II, and III Excess Facilities,* Final Report (Washington, D.C.: December 2017).

documents from DOE and the Hanford cleanup contractor, DOE directives and guidance, and reports by the Consortium for Risk Evaluation with Stakeholder Participation and others on ways to consider risk in making cleanup decisions.[3] These include, but are not limited to, the Tri-Party Agreement (TPA) and associated Action Plan; EM's Fiscal Year 2020 budget request; RL's 2015 Vision and 2020Vision, which include high-level cleanup priorities and goals; the Hanford cleanup contractor's Project Evaluation Matrix and its associated guideline; and RL's Integrated Priority List.[4]

For all objectives, we also interviewed DOE officials with RL, the DOE Office of Inspector General at Hanford, and DOE headquarters offices, including the Office of Enterprise Assessments and EM's Office of Safety, Security, and Quality Assurance. In addition, we interviewed Hanford cleanup contractors, officials from the Washington State Department of Ecology, and officials from the Defense Nuclear Facilities Safety Board.

Due to the large number of Hanford contaminated excess facilities requiring cleanup (approximately 800), we focused our review on 18 contaminated excess facilities. These contaminated excess facilities represent the majority of the excess facilities cleanup effort and include some of the most challenging of the non-tank waste cleanup efforts remaining at Hanford, according to DOE officials.[5] We chose key excess contaminated facilities as identified in the TPA because, among other things, DOE and its regulators identify these facilities in Section 8 of the agreement as presenting sufficient potential environmental concern that coordination of the decommissioning process with cleanup activities under the agreement was deemed necessary. We also selected the five other contaminated excess facilities because DOE identified them as having 1) high risks to the environment, workers, and public safety, 2) high annual S&M costs, and 3) high disposition costs. See Table 1 in the report for summary descriptions of each facility we selected.

[3]The Consortium for Risk Evaluation with Stakeholder Participation is an independent multidisciplinary consortium of universities led by Vanderbilt University.

[4]These documents are used to assist decision-makers when prioritizing long- and short-term cleanup goals and milestones.

[5]As of September 30, 2019, the parties had identified 15 key contaminated excess facilities at the Hanford Site. We excluded two of the 15 key contaminated excess facilities from our scope because S&M is no longer taking place at these facilities given that they are either undergoing cleanup or have already been cleaned up.

To gather information about RL's planning on S&M activities at Hanford and estimated costs for fiscal year 2019,[6] we administered a questionnaire to RL facility representatives responsible for overseeing the cleanup contractor's implementation of S&M for contaminated excess facilities. For each facility, the representatives were asked whether there was an S&M plan for the facility, when it was developed, and when it was most recently updated. We also asked about the type and frequencies of facility inspections, whether the facility included areas where structural integrity was a concern, if any structural integrity evaluations had been conducted, and whether any significance corrective or preventative maintenance had been performed. We also asked them to explain the facility representative's role in overseeing that the contractor was conducting S&M activities in accordance with the applicable plan and DOE requirements. A copy of the complete questionnaire is included in appendix II.

We conducted two pretests of the questionnaire with RL officials in November and December 2018, and we revised it in response to their comments. During this process, we sought to ensure that (1) the questionnaire questions were clear and unambiguous, (2) terminology was used correctly, (3) the questionnaire did not place an undue burden on respondents, and (4) respondents had sufficient information to answer the questions.

For the questionnaire we identified an initial set of 21 contaminated excess facilities based on the following criteria: (1) whether they were a key facility identified by DOE and its regulators in Section 8 of the Tri-Party Agreement Action Plan and (2) whether we considered them to be a contaminated excess facility that poses high risks to the environment, workers, and public safety; (3) whether it has potentially high annual surveillance and maintenance costs; and (4) whether it has high final disposition costs based on information we gathered from DOE. After further correspondence with RL officials, we agreed that three of the contaminated excess facilities on our list could be deleted because they were not in S&M mode, as cleanup was completed for one facility, one

[6]The questionnaire defined "surveillance" to include any activity at a facility that involves the scheduled, periodic inspection of a facility, equipment, or structure as required by federal and state environmental, safety, and health laws and regulations, and by DOE Orders. The questionnaire defined "maintenance" to include any activity required to sustain property in a condition suitable for the property to be used for its designated purpose; maintenance includes preventative, predictive, and corrective maintenance.

was undergoing active cleanup, and the other was in operational status.[7] We sent the questionnaire by email in a password-protected Word document to which respondents could return electronically after marking checkboxes or entering responses into open-answer boxes. We sent the questionnaire with a cover letter to DOE officials on January 10, 2019, with a request to complete and return it by January 31, 2019. By February 25, 2019, we received completed questionnaires for each of the 18 selected contaminated excess facilities.

In addition, to provide further context for all objectives, we conducted in-depth reviews regarding S&M of selected Hanford facilities. For these reviews, we selected four high-risk facilities: PUREX, REDOX, the 224B Concentration Facility, and the 216–Z-9 Crib. We used a judgmental (non-probability) sample to select four contaminated excess facilities for in-depth review. These facilities have been identified by DOE, the DOE Office of Inspector General, or the Consortium for Risk Evaluation with Stakeholder Participation as contaminated excess facilities with concerns regarding high risks to the environment, workers, and public safety and risk of potential release of radioactive material and other hazardous materials due to aging degradation and weakening structural integrity. In addition, these contaminated excess facilities are moderate- to high-risk priority facilities for cleanup, according to the contractor's June 2018 Project Evaluation Matrix, but not scheduled to start cleanup for at least 5 years. For these reviews, we examined DOE documents, including inspection records dating back to the start of fiscal year 2008 through the end of fiscal year 2018 to determine if inspections were occurring, and interviewed RL officials.

We conducted this performance audit from March 2018 to January 2020 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

[7]According to RL officials, demolition of the Uranium Oxide Facility was completed in 2010; the Plutonium Finishing Plant is in the process of being demolished; and the Waste Encapsulation Restoration Facility was still in operation for dry storage of 1,900 cesium and strontium capsules pending transfer for final disposal.

Appendix II: Questionnaire

GAO U.S. GOVERNMENT ACCOUNTABILITY OFFICE

Introduction

The United States Government Accountability Office (GAO), an independent, legislative branch agency, has been requested to review Department of Energy's (DOE) progress in cleaning up legacy facilities at the Hanford Site near Richland, WA. As part of this review, we are requesting the facility representative and/or project manager(s) responsible for the 15 key facilities that are listed in Section 8 of the Hanford Federal Facility Agreement and Consent Order (commonly referred to as the Tri-Party Agreement), along with other notable facilities and sites we have identified, to complete this questionnaire. The questionnaire is designed to gather information about DOE's planning on surveillance and maintenance activities for these facilities and estimated costs for fiscal year 2019.

To answer some of the questions, you may need to coordinate your responses with other staff familiar with surveillance and maintenance activities for the facility or site.

Instructions

The questionnaire can be completed using MS Word and returned via e-mail to meleadym@gao.gov. To do this, first save this MS Word file containing the questionnaire to your computer. You may then enter your responses directly into that file.
To complete the questionnaire, follow these steps:

- Please use your mouse to navigate by clicking on the field or check box ☐ you wish to answer.
- To select a check box or button, simply click on the center of the box.
- To change or deselect a check box response, simply click on the check box and the 'X' will disappear.
- To answer a question that requires you to write a comment, click on the answer box _____ and begin typing. The box will expand to accommodate your answer.
- When returning the questionnaire, please also attach any relevant supporting documentation in your e-mail response.
- Please return the completed questionnaire and related attachments to meleadym@gao.gov by **January 31, 2019.**

If you have any questions about the scope of our review, what types of activities to include in your responses, or experience difficulty gathering the requested information, please contact Michael Meleady at 206-287-4831 or meleadym@gao.gov.

Definitions

In responding to our questions, please consider the following definitions for relevant terms and phrases:

- **Facilities**: The buildings and structures used for material handling and processing, storage, maintenance, administrative, or support activities. Facilities may be above or below grade and may be contaminated or uncontaminated.
- **Key Facilities**: Facilities identified in Section 8 of the Tri-Party Agreement, and defined as to include the associated buildings and structures used for material handling and processing, storage, maintenance, administrative, or support activities, which may be above or below grade and may be contaminated or uncontaminated..
- **Other Notable Facilities:** Facilities that GAO identified as posing high risks to the environment, workers, and public safety; have potentially high annual surveillance and maintenance costs; and having high final disposition costs based on information presented by DOE, Washington Department of Ecology, and the Consortium for Risk Evaluation with Stakeholder Participation (CRESP).
- **Structural Integrity:** Damage or deterioration, such as structural faults, openings or holes in buildings, walls, ceilings, that would allow intrusion, unsafe or abnormal condition, or compromise the integrity of the facility, building, or other associated structure resulting in the potential release of hazardous or nuclear materials.
- **Structural Integrity Evaluation:** A review of the structural design, age, and anticipated amount of deterioration or degradation of a facility, building, or other structure, that includes an evaluation of the potential likelihood and consequences of failure.
- **Surveillance and Maintenance (S&M):** Activities conducted to assure that a site or facility remains in a physically safe and environmentally secure condition, and includes periodic inspections and monitoring of the property, appropriate contamination control actions, and required maintenance of barriers controlling access.
    - **Surveillance** includes any activity at a facility that involves the scheduled, periodic inspection of a facility, equipment, or structure as required by Federal and State environmental, safety, and health laws and regulations, and by DOE Orders.
    - **Maintenance** includes any activity required to sustain property in a condition suitable for the property to be used for its designated purpose; maintenance includes preventative, predictive, and corrective maintenance.

Page 2

Section I: Development of Surveillance and Maintenance Plans for Hanford's Key Facilities and Other Notable Facilities at Hanford

Facility/Site Name:

Background/General Information Questions

1. Is there a Surveillance and Maintenance (S&M) plan for the facility? *Please check one.*

   ☐ Yes ➔ *Continue to question 2*
   ☐ No If no, explain why not. _____ ➔ *Skip to question 7*
   ☐ Don't know No If don't know, please explain. _____ ➔ *Skip to question 7*

2. Who developed the plan?_____

3. When was the plan initially adopted? _____ *Insert date in mm/dd/yyyy*

4. Has the plan been updated since it was originally developed?

   ☐ Yes ➔ If yes, what is the date of the most recent update? _____ *Insert date in mm/dd/yyyy*
   ☐ No If no, please explain why not. _____➔ *Skip to question 7*

5. How often is the plan required to be updated?

Frequency	Yes or No
a. **Annually**	○ Yes ○ No
b. **Bi-Annually**	○ Yes ○ No
c. **Every 5 years**	○ Yes ○ No
d. **Other** *(please specify)*:_____	○ Yes ○ No

6. What is the process for updating the plan?_____

Page 3

S&M Requirements and Implementation:

7. What facilities, buildings, and other associated structures are included in the S&M requirements for the facility?

   _____

8. Has structural integrity or degradation that could lead to the potential release of hazardous or nuclear materials, such as the May 2017 partial collapse of PUREX Tunnel 1, been identified as a concern for any of the facilities, buildings, or other associates structures listed in response to question 7?

   ☐ Yes ➔ Please list. _____.
   ☐ No ➔Please explain why not. _____
   ☐ Don't know ➔ Please explain. _____

If you would like to explain your responses to this question, please use the space provided below._____

9. Has DOE conducted an engineering analysis to evaluate the structural integrity of the facility or any of the other associated buildings and structures?
   ☐ Yes ➔ Please attach a copy with your response. *Continue to question 10*
   ☐ No ➔Please explain why not. _____ *Skip to question 12*
   ☐ Don't know ➔ Please explain. _____ *Skip to question 12*

If you would like to explain your responses to this question, please use the space provided below. _____

10. When was the evaluation conducted?
    a. _____ (*insert date in mm/dd/yyyy*)
    b. What were the findings?_____
    c. What actions, if any, were taken in response to the evaluation?_____

11. Were any parts of the facility **not** included in the structural integrity evaluation due to radiological or other hazards?

    ☐ Yes ➔If Yes, which parts of the facility or associated building and structures were not evaluated and why were they not included in the evaluation? _____.

    ☐ No

Page 4

12. Which of the following types of **surveillance** activities are conducted to inspect the structural integrity of the facilities, buildings, and other associated structures?

Type of Surveillance Activity	Yes or No	Frequency *Check all that apply in each row*	Description
a. **Interior Inspection**	☐ Yes → ☐ No	Weekly ☐ Monthly ☐ Quarterly ☐ Annually ☐ Other _____	_____
b. **External Inspection**	☐ Yes → ☐ No	Weekly ☐ Monthly ☐ Quarterly ☐ Annually ☐ Other _____	_____
c. **Other Inspection(s)** *(please specify)*:_____	→	Weekly ☐ Monthly ☐ Quarterly ☐ Annually ☐ Other _____	_____
d. **Other Inspection(s)** *(please specify)*:_____	→	Weekly ☐ Monthly ☐ Quarterly ☐ Annually ☐ Other _____	_____
e. **Other Inspection(s)** *(please specify)*:_____	→	Weekly ☐ Monthly ☐ Quarterly ☐ Annually ☐ Other _____	_____

If you would like to explain your responses to this question, please use the space provided below._____

13. What are the requirements for documenting results of surveillance activities conducted at the facility?

_____

14. Please describe the plan's requirements for maintaining the structural integrity of buildings, facilities, and other associated structures?

_____

Page 5

15. Has any significant preventative or corrective maintenance for the purpose of stabilizing the structural integrity of facilities, buildings, and other associated structures been conducted at the facility since the beginning of FY2008?

☐ Yes ➔ Please describe the action(s) taken. _____
☐ No ➔ Please explain why not. _____

Oversight Questions

16. As the assigned Facility Representative, please describe your role and responsibilities in providing oversight of the contractor's surveillance and maintenance activities.

_____

17. Since the start of FY 2014, for about how many inspections do you or other DOE Richland Operations Office staff accompany the contractor on surveillance inspections of the interior of the facility, buildings, and other associated structures?

a. All inspections ☐
b. Most inspections ☐
c. Half of the inspections ☐
d. Less than half of inspections ☐
e. None of the inspections ☐
f. Don't know ☐

If you would like to explain your response to this question, please use the space provided below.

_____

Page 6

Section II: DOE's Estimated Costs for Surveillance and Maintenance Activities at the Facility in Fiscal Year 2019

18. For fiscal year 2019, what are DOE's total estimated costs for surveillance and maintenance activities related to this facility?

Please enter the dollar amount in the cell in the table below. If there were no S&M costs estimated for Fiscal Year 2019, enter '0'. If you are unsure or don't know, enter 'DK'.

	Total Estimated S&M Costs (in thousands)
Fiscal Year 2019	$

a. If you entered 'DK' as a response provided in the table above, please provide an explanation for this response.

_____

b. Please describe the general process your agency followed, including source(s) of information used, to determine the estimated costs provided in the table above.

_____

19. What is the anticipated year for DOE to complete final disposition (cleanup) of the facility? _____

20. What is the total estimated lifecycle cost for S&M at the facility pending final disposition? *If you are unsure or don't know, enter 'DK'.*
    a. Enter amount. $_____
    b. If unable to estimate, explain why. _____

Page 7

Section III: Data Reliability Questions

21. Do the total estimated costs provided in response to question 18 include administrative costs?

☐ Yes ➔ *If "yes", please describe what costs were included.* _____.

☐ No ➔

22. Do the total estimated costs provided in response to question 18 include implementation of efforts for purposes that were **not related** to surveillance and maintenance of the facility?

☐ Yes ➔ *If "yes", please describe what costs were included.* _____.

☐ No ➔ *Skip to question 24.*

23. What process did your agency use to determine the total estimated costs for **surveillance and maintenance activities** at the facility as opposed to the amount expended for other purposes?

_____

24. In compiling the estimated costs you've provided in this questionnaire, did you encounter any challenges that would affect your confidence in the completeness or accuracy of these estimates?

☐ Yes ➔ If yes, please describe these challenges: _____

☐ No

25. Were the total estimated costs provided in response to question 18 prepared or reviewed by staff from the Budget Office or Chief Financial Officer to assess the quality and accuracy of the amounts?

☐ Yes ➔ If yes, please explain the process and results of the review: _____

☐ No

Page 8

26. Is there any additional information about the way the estimated costs were developed that would help inform our understanding of the amounts provided?

☐ Yes ➔ If yes, please explain this response: _____

☐ No

27. Are there any surveillance and maintenance activities which **are not reflected** in the estimated costs provided in question 18?

☐ Yes ➔ If yes, please explain this response: _____

☐ No

If yes, please provide a description, including specific examples, and explain why it was not possible to include estimated expenditures for these activities:

_____

28. Apart from the details you provided above, are there any caveats or limitations that would affect the reliability of the estimated expenditures amounts you provided?

☐ Yes ➔ If yes, please explain this response: _____

☐ No

29. Please list in the space below any supporting documents you are emailing us in addition to your completed questionnaire.

_____

30. Please identify a point of contact for any follow-up questions we may have about this program/initiative:

Name: _____

Agency/Division: _____

Title: _____

E-mail: _____

Phone #: _____

Thank you for completing these questions. We appreciate your assistance.

(Please make sure to save the completed file on your computer before sending it back to GAO at meleadym@gao.gov)

Page 9

Appendix III: Comments from the Department of Energy

Department of Energy
Washington, DC 20585
December 13, 2019

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

Dear Mr. Trimble:

The Department of Energy (DOE) appreciates the opportunity to provide a response to the Government Accountability Office's (GAO) draft report titled, *Hanford Cleanup: DOE Should Take Actions to Improve Inspections and Oversight of Contaminated Excess Facilities (GAO-20-161).* The Department has reviewed the draft report and concurs with the recommendations. The Department's response and detailed actions are enclosed.

The Office of Environmental Management's (EM) current and planned actions, such as the Extent of Condition review and resulting improvements, align with the report recommendations. EM agrees that improvements in inspections and oversight of contaminated excess facilities will support the cleanup at Hanford and continued focus on the protection of DOE workers, the public, and the environment.

If you have any questions, please contact me or Jeff C. Griffin, Ph.D., Associate Principal Deputy Assistant Secretary for Field Operations, at (202) 287-5502.

Sincerely,

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

Enclosure

Management Response

GAO Draft Report, *Hanford Cleanup: DOE Should Take Actions to Improve Inspections and Oversight of Contaminated Excess Facilities*, GAO 20-161

Recommendation 1: The Assistant Secretary of DOE's Office of Environmental Management should direct RL to conduct a root cause analysis to identify any programmatic causes that may have led to the collapse of PUREX Tunnel 1.

Management Response: Concur

The Office of Environmental Management (EM) agrees to conduct a programmatic root cause analysis. The programmatic root cause analysis will build upon already completed analyses and assessments following the PUREX Tunnel 1 collapse. These completed analyses and assessments include a detailed engineering analysis to determine the cause of the partial tunnel roof collapse; an assessment of immediate risk of further failures for Tunnel 1 and failure for Tunnel 2; and an analysis by an Expert Panel chartered to evaluate Tunnel 2. Further, EM completed a complex-wide Extent-of-Condition Review of the conditions of former category I and II excess facilities with a focus on the impacts of deferred maintenance. The cause identified will be utilized as lessons learned for analysis of other potential high risk excess facilities.

Estimated Completion Date: December 31, 2020

Recommendation 2: The Assistant Secretary of the DOE's Office of Environmental Management, while ensuring the protection of DOE workers, the public, and the environment, should ensure that RL directs the Hanford Site cleanup contractor to explore using robotic or other means to routinely complete comprehensive surveillance inspections of contaminated excess facilities to identify aging degradation and obsolescence and take timely action as warranted.

Management Response: Concur

EM will direct the Hanford Site cleanup contractor to continue to explore and use robotic or other means, as appropriate, to routinely complete comprehensive surveillance inspections of contaminated excess facilities. EM has made sizable investments in robotics across the complex to expedite the cleanup mission. At the Hanford Site, the cleanup contractor has already procured an autonomous instrumented vehicle to explore opportunities to reduce the need for worker entry to the tank farms, primarily for collecting data, industrial hygiene monitoring, and performing visual inspections. Robotic technologies for performing tank and pipeline non-destructive examinations and leak detection are also being investigated.

Estimated Completion Date: March 31, 2020

Recommendation 3: The Secretary of Energy should ensure DOE headquarters offices responsible for the oversight of EM sites' field offices to conduct an assessment of the Richland Operations Office's management and oversight of the Hanford Site contractor's surveillance and maintenance activity for contaminated excess facilities. Based on the results of this assessment, DOE headquarters offices should consider whether such assessments should be conducted on a periodic basis.

Management Response: Concur

EM will conduct an assessment, in coordination with headquarters oversight offices, of Richland Operations Office's management and oversight of the Hanford Site contractor's surveillance and maintenance activity for contaminated excess facilities. This assessment will consider whether periodic assessments are necessary.

Estimated Completion Date: December 31, 2020

Appendix IV: 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, Ned Woodward, Assistant Director; Tara Congdon; Justin Fisher; Richard Johnson; Michael Meleady; Peter Ruedel; Sara Sullivan; and Roxanne Sun made key contributions to this report.

Appendix V: Accessible Data

Data Table

Accessible Data for Figure 2: Timeline of Events Related to the May 2017 PUREX Tunnel 1 Collapse

PUREX Tunnels Timeline

- 1956 – PUREX Tunnel 1 construction is completed.
- 1964 – PUREX Tunnel 2 construction is completed.
- 1965 – Last of 8 rail cars is loaded into Tunnel 1.
- 1996 – Last of 28 rail cars is loaded into Tunnel 2.
- 1971 – Recognizing concerns with the structural integrity of PUREX Tunnel 1, an evaluation is performed and determined the tunnel still structural sound.
- 1978 – Structural integrity evaluation determined Tunnel 1 was still structurally sound.
- 1980 – Structural integrity evaluation determined Tunnel 1 was still structurally sound, but recommended that a study for deactivation be completed within 2 years.
- 1990 – DOE submitted a dangerous waste permit application for the PUREX Tunnels to Washington State Department of Ecology.
- 1991 – Ecology issued a notice of deficiency that included questions about continuing to store dangerous waste in PUREX Tunnel 1 given prior concerns about its structural integrity. To address Ecology’s concerns, an independent structural integrity evaluation of Tunnel 1 determined that although it was structurally sound for continued use, it recommended additional study in 2001.
- 1996 - Tunnel 2 is deactivated, loaded with 28 rail cars.

- 2001 - The recommended follow-up structural evaluation study for Tunnel 1 was not completed.
- 2016 – May. Based upon 2016 TPA negotiations, a milestone is established to submit to the Washington State Department of Ecology a report assessing the structural integrity of PUREX Tunnels 1 and 2 by September 30, 2017.
- 2016 – December. Annual surveillance of the tunnels' external surfaces conducted to visually observe evidence of structural deterioration. No abnormal conditions reported.
- 2017 – May 9. Partial Collapse of PUREX Tunnel 1 discovered
- 2017 - May 10. Ecology issues an administrative order requiring DOE to take a series of corrective actions.
- 2017 – June. Structural integrity evaluations completed for PUREX Tunnels 1 and 2 finding weaknesses in the structural integrity of both tunnels.
- 2017 – June. Ecology approves DOE's plan to stabilize Tunnel 1 by filling with grout.
- 2018 – September. Ecology approves DOE's plan to stabilize Tunnel 2 by filling with grout.

PUREX -- Plutonium Uranium Extraction Plant

DOE -- Department of Energy

TPA – Tri-Party Agreement

Ecology -- Washington State Department of Ecology

Agency Comment Letter

Accessible Text for Appendix III: Comments from the Department of Energy

Page 1

December 13, 2019

Mr. David Trimble

Director

Natural Resources and Environment

U.S. Government Accountability Office

441 G Street, N.W.

Washington, D.C. 20548

Dear Mr. Trimble:

The Department of Energy (DOE) appreciates the opportunity to provide a response to the Government Accountability Office's (GAO) draft report titled, Hanford Cleanup: DOE Should Take Actions to Improve Inspections and Oversight of Contaminated Excess Facilities (GAO-20-161). The Department has reviewed the draft report and concurs with the recommendations. The Department's response and detailed actions are enclosed.

The Office of Environmental Management's (EM) current and planned actions, such as the Extent of Condition review and resulting improvements, align with the report recommendations. EM agrees that improvements in inspections and oversight of contaminated excess facilities will support the cleanup at Hanford and continued focus on the protection of DOE workers, the public, and the environment.

If you have any questions, please contact me or Jeff C. Griffin, Ph.D., Associate Principal Deputy Assistant Secretary for Field Operations, at (202) 287-5502.

Sincerely,

William I. White

Senior Advisor for Environmental Management to the Under Secretary for Science

Enclosure

Page 2

Management Response

GAO Draft Report, Hanford Cleanup: DOE Should Take Actions to Improve Inspections and Oversight of Contaminated Excess Facilities, GAO 20-161

Recommendation 1: The Assistant Secretary of DOE's Office of Environmental Management should direct RL to conduct a root cause analysis to identify any programmatic causes that may have led to the collapse of PUREX Tunnel 1.

Management Response: Concur

The Office of Environmental Management (EM) agrees to conduct a programmatic root cause analysis. The programmatic root cause analysis will build upon already completed analyses and assessments following the PUREX Tunnel 1 collapse. These completed analyses and assessments include a detailed engineering analysis to determine the cause of the partial tunnel roof collapse; an assessment of immediate risk of further failures for Tunnel 1 and failure for Tunnel 2; and an analysis by an Expert Panel chartered to evaluate Tunnel 2. Further, EM completed a complex-wide Extent-of-Condition Review of the conditions of former category I and II excess facilities with a focus on the impacts of deferred maintenance. The cause identified will be utilized as lessons learned for analysis of other potential high risk excess facilities.

Estimated Completion Date: December 31, 2020

Recommendation 2: The Assistant Secretary of the DOE's Office of Environmental Management, while ensuring the protection of DOE workers, the public, and the environment, should ensure that RL directs the Hanford Site cleanup contractor to explore using robotic or other

means to routinely complete comprehensive surveillance inspections of contaminated excess facilities to identify aging degradation and obsolescence and take timely action as warranted.

Management Response: Concur

EM will direct the Hanford Site cleanup contractor to continue to explore and use robotic or other means, as appropriate, to routinely complete comprehensive surveillance inspections of contaminated excess facilities. EM has made sizable investments in robotics across the complex to expedite the cleanup mission. At the Hanford Site, the cleanup contractor has already procured an autonomous instrumented vehicle to explore opportunities to reduce the need for worker entry to the tank farms, primarily for collecting data, industrial hygiene monitoring, and performing visual inspections. Robotic technologies for performing tank and pipeline non-destructive examinations and leak detection are also being investigated.

Estimated Completion Date: March 31, 2020

Page 3

Recommendation 3: The Secretary of Energy should ensure DOE headquarters offices responsible for the oversight of EM sites' field offices to conduct an assessment of the Richland Operations Office's management and oversight of the Hanford Site contractor's surveillance and maintenance activity for contaminated excess facilities. Based on the results of this assessment, DOE headquarters offices should consider whether such assessments should be conducted on a periodic basis.

Management Response: Concur

EM will conduct an assessment, in coordination with headquarters oversight offices, of Richland Operations Office's management and oversight of the Hanford Site contractor's surveillance and maintenance activity for contaminated excess facilities. This assessment will consider whether periodic assessments are necessary.

Estimated Completion Date: December 31, 2020

GAO's Mission

The Government Accountability Office, the audit, evaluation, and investigative arm of Congress, exists to support Congress in meeting its constitutional responsibilities and to help improve the performance and accountability of the federal government for the American people. GAO examines the use of public funds; evaluates federal programs and policies; and provides analyses, recommendations, and other assistance to help Congress make informed oversight, policy, and funding decisions. GAO's commitment to good government is reflected in its core values of accountability, integrity, and reliability.

Obtaining Copies of GAO Reports and Testimony

The fastest and easiest way to obtain copies of GAO documents at no cost is through our website. Each weekday afternoon, GAO posts on its website newly released reports, testimony, and correspondence. You can also subscribe to GAO's email updates to receive notification of newly posted products.

Order by Phone

The price of each GAO publication reflects GAO's actual cost of production and distribution and depends on the number of pages in the publication and whether the publication is printed in color or black and white. Pricing and ordering information is posted on GAO's website, https://www.gao.gov/ordering.htm.

Place orders by calling (202) 512-6000, toll free (866) 801-7077, or TDD (202) 512-2537.

Orders may be paid for using American Express, Discover Card, MasterCard, Visa, check, or money order. Call for additional information.

Connect with GAO

Connect with GAO on Facebook, Flickr, Twitter, and YouTube.
Subscribe to our RSS Feeds or Email Updates. Listen to our Podcasts.
Visit GAO on the web at https://www.gao.gov.

To Report Fraud, Waste, and Abuse in Federal Programs

Contact FraudNet:

Website: https://www.gao.gov/fraudnet/fraudnet.htm

Automated answering system: (800) 424-5454 or (202) 512-7700

Congressional Relations

Orice Williams Brown, Managing Director, WilliamsO@gao.gov, (202) 512-4400,
U.S. Government Accountability Office, 441 G Street NW, Room 7125,
Washington, DC 20548

Public Affairs

Chuck Young, Managing Director, youngc1@gao.gov, (202) 512-4800
U.S. Government Accountability Office, 441 G Street NW, Room 7149
Washington, DC 20548

Strategic Planning and External Liaison

James-Christian Blockwood, Managing Director, spel@gao.gov, (202) 512-4707
U.S. Government Accountability Office, 441 G Street NW, Room 7814,
Washington, DC 20548