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Report to Congressional Addressees

November 2018

AGENT ORANGE

Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations

Accessible Version

GAO-19-24

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GAO Highlights

Highlights of GAO-19-24, a report to congressional addressees

Why GAO Did This Study

The tactical herbicide Agent Orange was first produced in 1964, and some 12 million gallons were shipped from U.S. ports to Southeast Asia from 1965 to 1970. DOD suspended its use in 1970 and incinerated remaining stockpiles at sea in 1977. Congress has expressed long-standing interest in the effects of Agent Orange exposure.

The House report accompanying a bill for the National Defense Authorization Act for Fiscal Year 2018 included a provision that GAO review the government's handling of Agent Orange on Guam. This report examines (1) information the federal government has about the procurement, distribution, use, and disposition of Agent Orange; (2) DOD and VA efforts to make information about where Agent Orange and its components were tested and stored available; and (3) challenges associated with Agent Orange testing. GAO reviewed agency policies, documents, and available archival records that GAO identified; interviewed DOD, VA, and other agency officials; and met with a non-generalizable sample of 38 veterans and a veterans service organization.

What GAO Recommends

GAO is making six recommendations, including that DOD develop a process for updating its list of Agent Orange testing and storage locations, and that DOD and VA develop a process for coordinating the communication of information on where Agent Orange was known to have been present. DOD concurred with four recommendations. VA concurred with one recommendation and non-concurred with one recommendation.

View GAO-19-24. For more information, contact Brian Lepore at (202) 512-4523 or leporeb@gao.gov

What GAO Found

Available shipment documentation indicates that nearly all of the Agent Orange procured was either used in U.S. military operations in Southeast Asia, used for testing, damaged, or destroyed. However, some records are incomplete, such as shipment documentation and logbooks that identify ports where vessels stopped on the way to Southeast Asia. GAO obtained and reviewed shipment documentation for over 12.1 million of the 13.9 million gallons of Agent Orange procured by the Department of Defense (DOD). GAO reviewed logbooks for 96 percent (152 of 158) of those shipments and identified that vessels stopped at various ports on the way to Southeast Asia, including at least one vessel carrying Agent Orange that stopped at Guam. While the logbooks GAO reviewed identify when vessels left various ports as they traveled to and from Vietnam, they do not show whether and how much cargo was loaded or unloaded at those ports.

DOD's official list of herbicide testing and storage locations outside of Vietnam that is posted on the Department of Veterans Affairs' (VA) website is inaccurate and incomplete. For example, the list lacks clarity in descriptive information and omits both testing and storage locations and additional time periods covered by testing events. Also, the list has not been updated in over a decade, though DOD and VA have obtained reports on its shortcomings since 2006. Both DOD and VA communicate with veterans in response to inquiries about Agent Orange, but some veterans GAO met with expressed confusion regarding how to obtain information on potential exposure. DOD officials acknowledged this confusion and stated that veterans are contacting multiple agencies to obtain such information. However, DOD and VA have not established a formal process for coordinating on how best to communicate information to veterans and the public regarding the presence of Agent Orange outside of Vietnam. Without a reliable list with complete and accurate information and a formal process for DOD and VA to coordinate on communicating this information, veterans and the public do not have quality information about the full extent of locations where Agent Orange was present and where exposure could potentially have occurred.

Challenges exist with testing for Agent Orange today due to degradation of the herbicide's two chemical components and a potential for sources of contamination other than the herbicide. According to scientific research, the half-life (average time for components to decrease by half of the original amount) of Agent Orange's two chemical components—n-butyl 2,4-D and n-butyl 2,4,5-T—in soil can range from several days to many months, depending on conditions. The suggested half-life of the dioxin 2,3,7,8-TCDD—a by-product of the 2,4,5-T manufacturing process—is much longer, but there are multiple sources of dioxins, including the burning of wood and waste. DOD and the U.S. and Guam Environmental Protection Agencies are testing for the acid form of the components of Agent Orange at Andersen Air Force Base on Guam. While acknowledging the low probability of conclusively identifying the components of Agent Orange on Guam, DOD has made a decision to move forward with testing to address veterans' and the public's concerns, and it expects to complete the updates for the sampling and analysis plan, field sampling, analysis, and reporting in early 2019.

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Abbreviations

2,3,7,8-TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
2,4-D	2,4-dichlorophenoxyacetic acid
2,4,5-T	2,4,5-trichlorophenoxyacetic acid
DOD	Department of Defense
EPA	Environmental Protection Agency
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
VA	Department of Veterans Affairs

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
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Congressional Addressees

From the 1940s to the 1970s, the U.S. government developed and tested tactical herbicides in the United States and abroad. These tactical herbicides were known as "rainbow herbicides" and included Orange, Purple, Pink, Green, Blue, and White.[1] Tactical herbicides were intended for use by the U.S. military in the conflicts in Korea and Vietnam, but were not intended for use on U.S. military installations. During the mid-1960s, U.S. chemical companies manufactured and shipped large quantities of tactical herbicides to Vietnam for use by the U.S. military to eliminate enemy cover and destroy the enemy's crops. The tactical herbicide designated "Orange"—later known as Agent Orange—was first produced in 1964, and approximately 12.1 million gallons were shipped to Southeast Asia from several U.S. ports between 1965 and 1970.[2] The Department of Defense (DOD) suspended the use of Agent Orange in Vietnam in 1970 and incinerated remaining stockpiles at sea in 1977.

In 1984, the U.S. Environmental Protection Agency (U.S. EPA) determined that a form of dioxin that is a by-product of the manufacturing process of one of the two components of Agent Orange had been associated with a number of health effects, including cancer, in exposed animals and in humans, including children.[3] The Agent Orange Act of 1991, as amended, established a presumption of service connection for certain diseases manifesting in veterans by way of exposure to herbicide agents while deployed in the Republic of Vietnam at any time beginning

[1]Consistent with House Report 115-200 including a provision for us to conduct this review, this report focuses primarily on the tactical herbicide Agent Orange and its components. Tactical herbicides were developed specifically by DOD to be used in combat operations.

[2]In this report, we use the term "Agent Orange" following the language in our prior reports. However, DOD officials use the term "Herbicide Orange" in referring to the same agent.

[3]Environmental Protection Agency, *Health Effects Assessment for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin*, EPA-540/1-86-044, September 1984. As we describe later in this report, there are many sources of dioxin contamination in addition to the dioxin that was formed as the by-product of the manufacturing process for one of the components of Agent Orange.

January 9, 1962, and ending on May 7, 1975.[4] The act also required that whenever the Secretary of Veterans Affairs determined that a positive association existed between humans' exposure to an herbicide agent and the occurrence of a disease in humans, the Secretary shall prescribe regulations providing that a presumption of service connection was warranted for that disease.[5] The Department of Veterans Affairs (VA) has developed procedures to assess veterans' claims for disability compensation for exposure to Agent Orange and provides on its website a list of locations where tactical herbicides were thought to be tested, stored, or destroyed. Both DOD and U.S. EPA have conducted some remediation of dioxin-contaminated sites where these herbicides were known to be present in the United States.[6]

There has been long-standing congressional interest in and concern about the effects of exposure to herbicides such as Agent Orange. Although DOD policy restricted the domestic use of tactical herbicides, the House Armed Services Committee has expressed concern that additional exposures to Agent Orange may have occurred on Guam.[7] House Report 115–200 accompanying a bill for the National Defense Authorization Act for Fiscal Year 2018 included a provision that we review the government's handling of Agent Orange on Guam. In response to both this provision and a separate request letter, this report examines (1) the extent to which the federal government has information about the procurement, distribution, use, and disposition of Agent Orange or its components at locations in the United States and its territories, including Guam; (2) the extent to which DOD and VA have complete and accurate information about where Agent Orange and its components were tested and stored and communicated this information to veterans and the public; and (3) challenges associated with testing for Agent Orange.

We scoped this review to include locations where Agent Orange or its components were tested, distributed, and stored in the United States and

[4]Pub. L. No. 102-4, § 2 (1991) (codified as amended at 38 U.S.C. § 1116). Service connection is a factor the Department of Veterans Affairs considers in determining whether to grant disability compensation to a veteran.

[5]The requirement to prescribe regulations when the Secretary determines such an association exists ceased to be in effect on September 30, 2015. 38 U.S.C. § 1116(e).

[6]Over the past decade, Congress has also appropriated funds for the remediation of dioxin-contaminated sites in Vietnam.

[7]H.R. Rep. No. 115-200, at 113-114 (2017).

its territories.[8] For each objective, we reviewed agency documents and policies; interviewed officials from DOD, VA, and U.S. EPA, as well as from the government of Guam; and met with some veterans and a veterans service organization.

For objective one, we obtained through archival research available shipping and agency records, including U.S. military correspondence and logistics reports, and we reviewed these documents to trace the federal government's procurement, distribution, use, and disposition of Agent Orange and its components. We analyzed this documentation, hereinafter referred to as shipment documentation, to prepare summary information on the quantities of Agent Orange and the vessels that carried the shipments.[9] We used this information to obtain official Navy and merchant vessel logbooks—hereinafter referred to as logbooks—to the extent that they were available, to identify the routes the vessels took from U.S. ports to Vietnam and back, and to identify any port calls made en route.[10]

For objective two, we obtained documentation from DOD and analyzed archives search reports and other environmental studies for several U.S. installations to identify additional locations where Agent Orange or its components were tested and stored in the United States and its territories. We compared the results with information DOD has provided to VA for public dissemination on testing and storage locations of tactical herbicides in the United States and its territories. We also compared the results with DOD policies for conducting records research and responding to inquiries related to past environmental exposures. We reviewed the process by which DOD and VA communicate with veterans, to include providing information about where Agent Orange was tested and stored. We compared the communication process with DOD's policy on assessing long-term health risks and with VA's process for determining

[8]For this review we are including only veterans; we are excluding DOD civilians or the civilian populations at those locations where potential herbicide exposure could have occurred.

[9]We used the best available records to identify the amounts of Agent Orange we refer to in this report, but these figures should be seen as estimates.

[10]For those voyages for which we were not able to locate logbooks, we obtained copies of the vessels' shipping articles. Shipping articles are the articles of agreement between the captain of a ship and the seamen with respect to wages, length of time for which they are shipped, and related matters. They provide the dates and locations for different personnel actions but do not necessarily identify every port of sailing for a voyage, and thus do not provide complete documentation of the route taken by a vessel.

benefits based on veterans' claims, and we assessed the extent to which DOD and VA had responded to reports related to the information on locations that were posted on VA's website.

For objectives one and two, we held six discussion sessions with a non-generalizable sample of veterans—four sessions in person in Hawaii and Guam, and two sessions that were moderated via telephone from Washington, D.C.—to discuss veterans' experiences specific to Agent Orange. A total of 38 individuals attended the sessions, which ranged from 1 to 10 participants per session. During the sessions, we discussed information that individuals received from DOD, VA, and other federal agencies about any links between exposure to herbicides and negative health effects, or the potential that they could have been exposed to Agent Orange or its components at locations where Agent Orange was manufactured, transported, stored, used, or destroyed.[11] We also asked the veterans whether they believed they had been exposed to Agent Orange in Vietnam, Guam, or another location, and, if so, to describe the circumstances of the exposure. At the discussion sessions in Hawaii and Guam, we also requested participants to complete a short questionnaire about their military service and their recollections about experiences with herbicides during their military service.

For objective three, we reviewed scientific literature and agency documents regarding the degradation and sources of the components of Agent Orange and an associated dioxin contaminant. This review included documents from the Agency for Toxic Substances and Disease Registry and reports and protocols from U.S. EPA, the World Health Organization, and the Centers for Disease Control and Prevention. We also reviewed the draft and final plan for testing for the presence of the components of Agent Orange at three sites at Andersen Air Force Base on Guam. We compared the information outlined in the testing plan with scientific literature on the environmental fate of the components of Agent Orange and other Agent Orange testing methodologies. We conducted a site visit to Guam and visited the three sites where testing was subsequently done. We also spoke with cognizant officials at DOD, U.S.

[11]DOD, VA, and Guam EPA officials worked to schedule three discussion sessions for participants to attend on Guam, but only two of those sessions had attendees present. Thus, for the purposes of this report, we are using only the two Guam-located discussion sessions in which attendees were present. In addition to veterans, a few civilians, including spouses accompanying some veterans, were present at some discussion sessions. We handled any comments these individuals provided separately from those provided by veterans.

EPA, and Guam EPA about testing for the components of Agent Orange. Further details on our scope and methodology can be found in appendix I.

We conducted this performance audit from May 2017 through November 2018 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

Composition of Agent Orange

Agent Orange is composed of two different chemical components—the n-butyl ester forms of 2,4-dichlorophenoxyacetic acid (hereinafter referred to as n-butyl 2,4-D) and 2,4,5-trichlorophenoxyacetic acid (hereinafter referred to as n-butyl 2,4,5-T)—that are manufactured separately and then combined to form the tactical herbicide.[12] The U.S. EPA has determined that there was not adequate data either to support or to refute that the acid or ester forms of 2,4-D can cause cancer in humans.[13] In 2015 the International Agency for Research on Cancer classified 2,4-D as possibly causing cancer to humans, since there was inadequate evidence in humans and limited evidence in experimental animals.[14] According to an Institute of Medicine report, information on the toxic effects of 2,4,5-T alone is sparse.[15] However, in the 2,4,5-T manufacturing process, the dioxin 2,3,7,8-tetrachlorodibenzo-p-dioxin (hereinafter referred to as

[12]Agent Orange is composed of 50 percent 2,4-D in its n-butyl ester form and 50 percent 2,4,5-T in its n-butyl ester form. The ester form of the chemicals breaks down into 2,4-D and 2,4,5-T when it undergoes a reaction with water. The specifications for Agent Orange were revised later in the 1960s to include specifications for Orange II (50 percent n-butyl 2,4-D and 50 percent isooctyl ester 2,4,5-T) and Orange III (66.6 percent n-butyl 2,4-D and 33.3 percent n-butyl 2,4,5-T).

[13]Environmental Protection Agency, reregistration eligibility decision for 2,4-D, June 2005.

[14]International Agency for Research on Cancer, *DDT*, *Lindane, and 2,4-D, IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*, vol.113 (Lyon, France: June 2-9, 2015).

[15]The National Academies of Sciences, Engineering, and Medicine, *Veterans and Agent Orange: Update 2014* (Washington, D.C.: 2016) [hereinafter NASEM, 2016].

2,3,7,8-TCDD) is formed, particularly when the reaction temperature is excessive.[16]

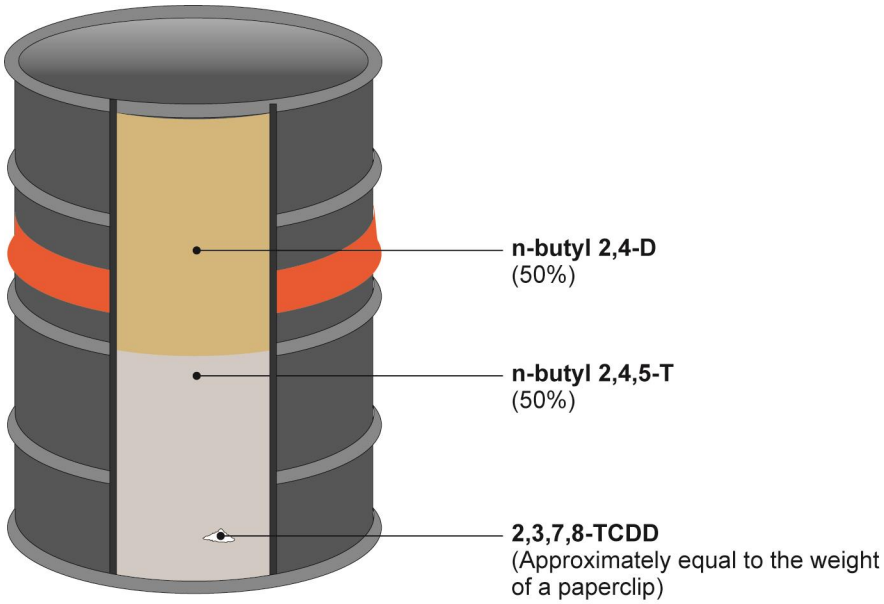
The World Health Organization has determined that dioxins are highly toxic and can cause a variety of illnesses, including reproductive and developmental problems and damage to the immune system. The World Health Organization reports that 2,3,7,8-TCDD, a human carcinogen, is the most toxic dioxin-related compound.[17] Moreover, according to the National Academies of Sciences, Engineering, and Medicine report, 2,3,7,8-TCDD has been shown by researchers to be very toxic in animals.[18] Figure 1 depicts the proportion of the components of Agent Orange and the amount of 2,3,7,8-TCDD contamination that would be present in an average 55-gallon drum.

[16]According to the World Health Organization, dioxins are a group of chemically related compounds that are persistent environmental pollutants. Dioxins can be released into the environment through a variety of means, to include the burning of materials such as wood and waste, the combustion of fossil fuels, and certain industrial activities. According to the U.S. EPA, in the 2,4,5-T manufacturing process, a dioxin compound (2,3,7,8-TCDD) is formed, particularly when the reaction temperature is excessive, most commonly at temperatures above 160º Celsius.

[17]World Health Organization, *Exposure to Dioxins and Dioxin-Like Substances: A Major Public Health Concern* (Geneva, Switzerland: 2010); National Toxicology Program, *14th Report on Carcinogens*, U.S. Department of Health and Human Services, 2016.

[18]NASEM, 2016.

Figure 1: Composition of Agent Orange



Source: GAO analysis of government documents. | GAO-19-24

Note: Agent Orange is composed of a mixture of 50 percent 2,4-dichlorophenoxyacetic acid (2,4-D) in its n-butyl ester form and 50 percent 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) in its n-butyl ester form, plus a contaminant, 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). This figure shows 50 percent of each chemical as if separated, but in actuality the chemicals would be mixed together and packaged in 55-gallon drums. According to archival sources, a drum of Agent Orange weighed approximately 600 pounds.

Agent Orange Origins and Life Cycle

The Crops Division of the U.S. Army Chemical Corps was established at Camp Detrick (now Fort Detrick), Maryland, in 1943 to conduct anti-crop research, development, and engineering. In 1944 the Crops Division was given the mission of developing chemical compounds to destroy or reduce the value of crops. These chemical compounds were intended to rapidly clear vegetation in military operations in order to eliminate concealed enemy positions, improve air and ground observations, and destroy or reduce the value of crops. Initial field trials at Camp Detrick were small-scale efforts involving test plots typically 6 by 18 feet in size, and the herbicides being tested were usually applied using a hand sprayer. Over the following three decades, DOD collaborated with the U.S. Department of Agriculture, universities, and private companies to conduct testing activities ranging from laboratory experiments to spray

tests of larger-scale aerial dissemination of a variety of chemical compounds throughout the United States, U.S. territories, and abroad.[19]

The tactical herbicides used by the U.S. military in Vietnam were formulations based on tests of thousands of different chemical compositions at Camp Detrick in an effort to determine chemical agents and chemical compounds that would meet specific requirements. The U.S. military developed and tested six tactical "rainbow" herbicides that it used during the Vietnam War era—Pink, Purple, Green, Blue, White, and Orange. The chemical component n-butyl 2,4,5-T, which is known to have been contaminated with 2,3,7,8-TCDD, was present in four of these six tactical herbicides—specifically, Agents Pink, Purple, Green, and Orange.[20] In late 1961, DOD began color-coding the herbicide formulations that it was testing in aerial spray trials in Vietnam and elsewhere in Southeast Asia. The tactical herbicides, which were used for a variety of different purposes, to include defoliation and crop destruction, were identified by colored bands placed around the drums, as shown in figure 2. Beginning in 1962, the U.S. Air Force received shipments of Agents Pink, Purple, and Green to supply the first spray missions for Operation Ranch Hand, the program for defoliation and crop destruction missions during the Vietnam War.[21] Agent Purple was similar to the herbicide formulation that was later designated "Orange," but it was more costly to purchase.[22] Agents Blue and White were used in Vietnam extensively along with Agent Orange after 1964, but they were of a different chemical composition and did not contain any form of 2,4,5-T, the component that produced 2,3,7,8-TCDD as a by-product of the manufacturing process.

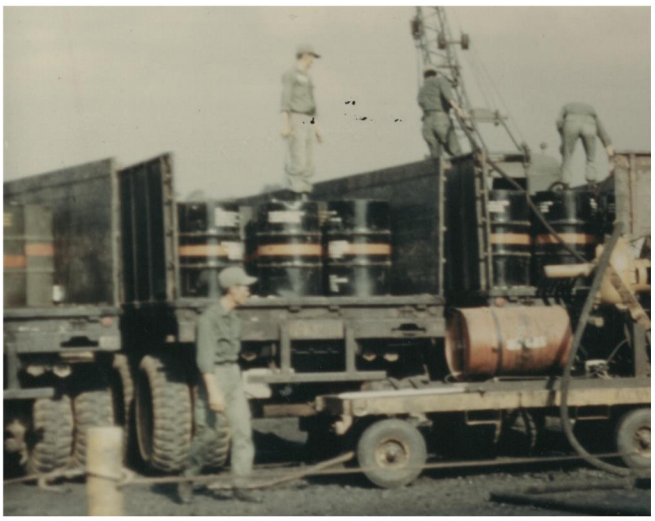
[19]We discuss DOD's list of locations and dates where these testing activities were conducted in more detail later in this report.

[20]Agents Blue and White did not contain any form of 2,4,5-T and thus did not contain the associated contaminant, 2,3,7,8-TCDD. Rather, Agent Blue contained cacodylic acid, an arsenic compound. The components of Agent White, which was commercially available as Tordon 101, were n-butyl 2,4-D and picloram.

[21]In 1961 President Kennedy authorized DOD to begin aerial spraying of tactical herbicides to defoliate the jungle canopy and to destroy food sources in Vietnam. Under the project name "Ranch Hand," U.S. military personnel conducted these operations primarily from C-123 aircraft and from helicopters from January 1962 to January 1971.

[22]According to archival sources, Agent Purple was replaced by Agent Orange for use in Vietnam in late 1964. Agent Purple contained the two components of Agent Orange but in different proportions. It also contained another form of one of those two components.

Figure 2: 55-Gallon Drums of Agent Orange in Vietnam Showing Orange Bands



Source: National Archives and Records Administration. | GAO-19-24

Note: Photo by Kelly Air Force Base.

Of the tactical herbicides, Agent Orange was used the most extensively in Vietnam. In 1964 DOD began to procure large quantities from U.S. manufacturers for military use in Vietnam. The first shipment of Agent Orange arrived in Saigon in February 1965 by merchant vessel. Together, nine manufacturers produced a total of approximately 13.9 million gallons of Agent Orange,[23] and DOD is estimated to have used approximately 12.1 million gallons between 1965 and 1970 in operations in Vietnam, and much smaller quantities in Korea and Thailand.[24]

Evidence from animal and epidemiologic studies of adverse effects from Agent Orange exposure led the U.S. government to restrict the use of 2,4,5-T in April of 1970 and led DOD to temporarily suspend the use of Agent Orange. In 1972 the U.S. Air Force consolidated the approximately 1.36 million gallons of the herbicide that had remained unused in Vietnam

[23]The manufacturers of Agent Orange were Dow, Monsanto, Hercules, Thompson-Hayward, Diamond-Alkali/Shamrock, Uniroyal, Thompson, Agrisect, and Hoffman-Taft.

[24]Available records indicate that approximately 19,250 gallons of Agent Orange were shipped to Korea in March 1968. We were unable to determine precise quantities shipped to or used in Thailand due to a lack of records. As we note later in this report, the estimated amounts used varied over the decades, and we are using the figure of approximately 12.1 million gallons based on the latest update from the National Academy of Sciences' Institute of Medicine.

and shipped them for storage on Johnston Island in the Pacific.[25] DOD held its remaining stocks of Agent Orange—approximately 860,000 gallons—within the continental United States, at the Naval Construction Battalion Center Gulfport, Mississippi, until those stocks were also shipped toward Johnston Island in June 1977. All of these remaining stocks of Agent Orange were incinerated at sea aboard the M/T *Vulcanus* by September 1977.[26]

Comparison between Tactical and Commercial Herbicides

In addition to the tactical herbicides used during the Vietnam War era, the U.S. military also used commercial herbicides to manage vegetation on its installations. The U.S. military managed tactical herbicides differently from commercial herbicides. According to DOD officials and archived military specifications, tactical herbicides were not authorized for use on lands owned by, or otherwise managed as military installations and were not to be diverted for domestic use.[27] DOD developed military specifications for the tactical herbicides that provided detailed information on product requirements, quality assurance, packaging, and precautionary statements that prohibited domestic use.[28] The tactical herbicides were centrally managed, first by the Army Chemical Corps and later by the U.S. Air Force Logistics Command. Agent Orange used in Vietnam was formulated for aerial spraying by aircraft and helicopter and applied at full strength without additional solvents at a rate of 3 gallons per acre. Agent Orange is soluble in diesel fuel and organic solvents, but

[25]Johnston Island is located in the North Pacific Ocean, 717 nautical miles from Hawaii.

[26]Available records show that some of the stocks of Agent Orange from Vietnam had been mixed with other herbicides when they were redrummed for shipment to Johnston Island. According to an Office of Air Force History monograph, the U.S. EPA research permit, which was used for incineration of the stocks of Agent Orange from the continental United States, did not authorize the incineration of any material other than Agent Orange. As a result, the mixed herbicide drums were segregated from the other drums until the U.S. EPA approved their destruction in August 1977 under a special permit for the incineration of the stocks on Johnston Island. The records did not identify the quantities of these other herbicides, but they reported that a total of approximately 2.3 million gallons of Agent Orange were destroyed.

[27]We obtained and reviewed copies of the military specifications for Agent Orange from December 1965, September 1967, and October 1969.

[28]Department of the Army, MIL-D-51239 (MU), *Military Specification, Defoliant LNX (U)* (Dec. 30, 1965). These military specifications were subsequently updated in September 1967 and again in October 1969.

it is insoluble in water, so equipment was cleaned using diesel fuel rather than water.

Commercial herbicides, conversely, were widely available worldwide for use in vegetation management at military installations, to include controlling vegetation adjacent to flightlines or along perimeter fencing. Federal agencies developed federal specifications for these products to ensure that they met specific requirements, and these specifications were approved by the Commissioner, Federal Supply Service, in the General Services Administration for use by all federal agencies. According to DOD officials, during the Vietnam era there was no requirement for DOD to retain records concerning the use of commercial herbicides on military bases beyond 5 years. DOD officials also stated that DOD catalogued these herbicides available for use on military installations in the federal supply schedule under federal supply classification group 68, which contains chemicals and chemical products.

In reviewing supply catalogues from that time period, DOD officials identified more than 35 different commercial herbicides that were listed in the federal supply system for use on DOD installations between 1960 and 1973. Some of these commercial herbicides contained 2,4-D; 2,4,5-T; or both, although they were not in the n-butyl form used in Agent Orange. These included at least 4 commercial herbicides that contained some form of 2,4,5-T, the component that contained the contaminant 2,3,7,8-TCDD.[29] In addition, numerous commercial herbicides that were not in the federal supply system but were being widely used elsewhere for agriculture purposes contained the form of n-butyl 2,4,5-T found in Agent Orange and thus its associated contaminant, 2,3,7,8-TCDD. According to DOD officials, the commercial herbicides used on installations were mixed with diesel or water and sprayed by hand or truck. Tactical herbicides, however, were formulated for aerial spraying by fixed-wing aircraft or helicopter without being diluted.[30]

[29]According to DOD, herbicides often did not have a commercial name in the 1960s and 1970s, but rather were referred to by their active ingredients, such as 2,4-D, and were listed in the federal supply schedule this way. DOD also provided information from U.S. EPA's Pesticide Product and Label System that identified various commercial herbicides that contained the n-butyl form of 2,4,5-T.

[30]The dioxin in the commercial form of the herbicide is the same as the dioxin in the tactical form of Agent Orange. However, the toxicity of the dioxin is dependent on multiple factors, including the route of exposure (for example, spraying by hand or aerial spraying) and the dose being administered.

When the U.S. military was employing these tactical and commercial herbicides during the Vietnam War era, U.S. EPA had not yet been established, and the U.S. Department of Agriculture had oversight of commercial herbicides. The Federal Insecticide, Fungicide, and Rodenticide Act of 1947, then administered by the U.S. Department of Agriculture, governed the marketing and use of these commercial herbicides.[31] Until amended in 1972, the Federal Insecticide, Fungicide, and Rodenticide Act review process was designed as a consumer protection measure that focused primarily on a product's effectiveness, rather than on concerns about health or the environment.[32]

Agent Orange Legislative and Regulatory History

The Agent Orange Act of 1991, as amended, requires a review of the available scientific evidence regarding the associations between certain diseases and exposure to tactical herbicides.[33] The act specifically requires the VA to enter into an agreement with the National Academy of Sciences (the Academy), or with an alternative scientific organization, to review and evaluate the scientific evidence concerning the association between exposure to an herbicide agent and each disease suspected to be associated with such exposure.[34] The Academy is required to submit

[31]Federal officers acting pursuant to their authority under the Federal Insecticide, Fungicide, and Rodenticide Act, 7 U.S.C. §§ 135-135k ('FIFRA'), directed defendants [chemical manufacturers working under government contracts] to supply Agent Orange without the warnings and directions which would have been used for any of defendants' commercial herbicides for civilian use. Federal officers did not register Agent Orange under FIFRA and did not comply with FIFRA requirements for warnings, relying on a statutory exception for 'public officials while engaged in the performance of their official duties.' 7 U.S.C. § 135e(a)(3). This exception extended to defendants as 'person[s] acting for' such public officials pursuant to 7 U.S.C. § 135f(d)." Isaacson v. Dow Chemical Co. (In re "Agent Orange" Prod. Liab. Litig.), 304 F. Supp. 2d 404, 430 (E.D.N.Y. 2004).

[32]See Angelo, *Embracing Uncertainty, Complexity, and Change: An Eco-Pragmatic Reinvention of a First-Generation Environmental Law*, 33 ECOLOGY L.Q. 105, 159 (2006).

[33]38 U.S.C. § 1116 note (Agreement with National Academy of Sciences). This provision applies to an herbicide used in support of the United States and allied military operations in the Republic of Vietnam during the Vietnam era, which we refer to as tactical herbicides.

[34]Reports were prepared by the Institute of Medicine Committee to Review the Health Effects in Vietnam Veterans of Exposure to Herbicides. The Institute of Medicine, now the National Academy of Medicine, was chartered in 1970 by the National Academy of Sciences to enlist distinguished members of the appropriate professions to advise the nation on medical and health issues.

periodic reports at least once every 2 years. The most recent report—the 2014 report—was issued in March 2016. The next report, which Academy officials told us would focus on inter-generational and trans-generational effects of exposure to herbicides, was at the time of our report scheduled to be issued in late 2018.[35]

In its biannual reports, the Academy identifies different levels of association between exposure to 2,3,7,8-TCDD or other chemical compounds in herbicides used in Vietnam and a wide range of health effects. These levels include the following:

- sufficient evidence of an association;
- limited or suggestive evidence of an association;
- inadequate or insufficient evidence to determine an association; and
- limited or suggestive evidence of no association.

The Academy has identified that there is either sufficient evidence of an association with exposure to a tactical herbicide or limited or suggestive evidence of an association leading to certain diseases.[36] For example, the Academy has identified both chloracne and non-Hodgkin's lymphoma as having sufficient evidence of an association with exposure to a tactical herbicide, and both Parkinson's disease and diabetes mellitus (type 2) as having limited or suggestive evidence of an association. Examples of diseases for which the Academy has found inadequate or insufficient evidence to determine an association include kidney disease and pancreatic cancer.

In making determinations regarding the association between certain diseases and exposure to herbicide agents, the Secretary of Veterans Affairs is required to take into account the Academy's reports. Once the Secretary finds that such an association existed, the Secretary is then required to prescribe regulations, providing that a presumption of service

[35]According to VA officials, the upcoming report will be released before the end of 2018 and will review the literature on all potential health outcomes. VA further stated that this report will not be focused on inter-generational health outcomes, which will be covered in a separate report in the Gulf War and Health series. However, one of the four topics that VA requested the Agent Orange committee look at in its report is paternal transmission of possible inter-generational effects.

[36]In its most recent Institute of Medicine report, the committee reviewed the U.S. Agricultural Health Study, which found that individuals exposed to commercial herbicides could also suffer from adverse health effects, such as prostate cancer. NASEM, 2016.

connection is warranted for that disease.[37] The Agent Orange Act of 1991, as amended, also establishes a presumption of service connection, by reason of exposure to an herbicide agent, for diseases listed in the statute, to include Hodgkin's disease and diabetes mellitus (type 2).[38] This presumption applies to veterans who, during active military, naval, or air service, served in the Republic of Vietnam during the period beginning on January 9, 1962, and ending on May 7, 1975.[39] Veterans who served in Vietnam and other specific locations and time frames and who have been diagnosed with those diseases are presumed to have incurred those diseases as a result of their service and are thus eligible for presumptive service connection for disability compensation.[40] Figure 3 illustrates the diseases for which the Academy has found either sufficient, or limited or suggestive, evidence of an association. In addition, appendix II provides information on the 14 presumptive diseases that the VA currently identifies as being associated with exposure to Agent Orange or other tactical herbicides during military service for which veterans and their survivors may be able to receive disability compensation benefits.

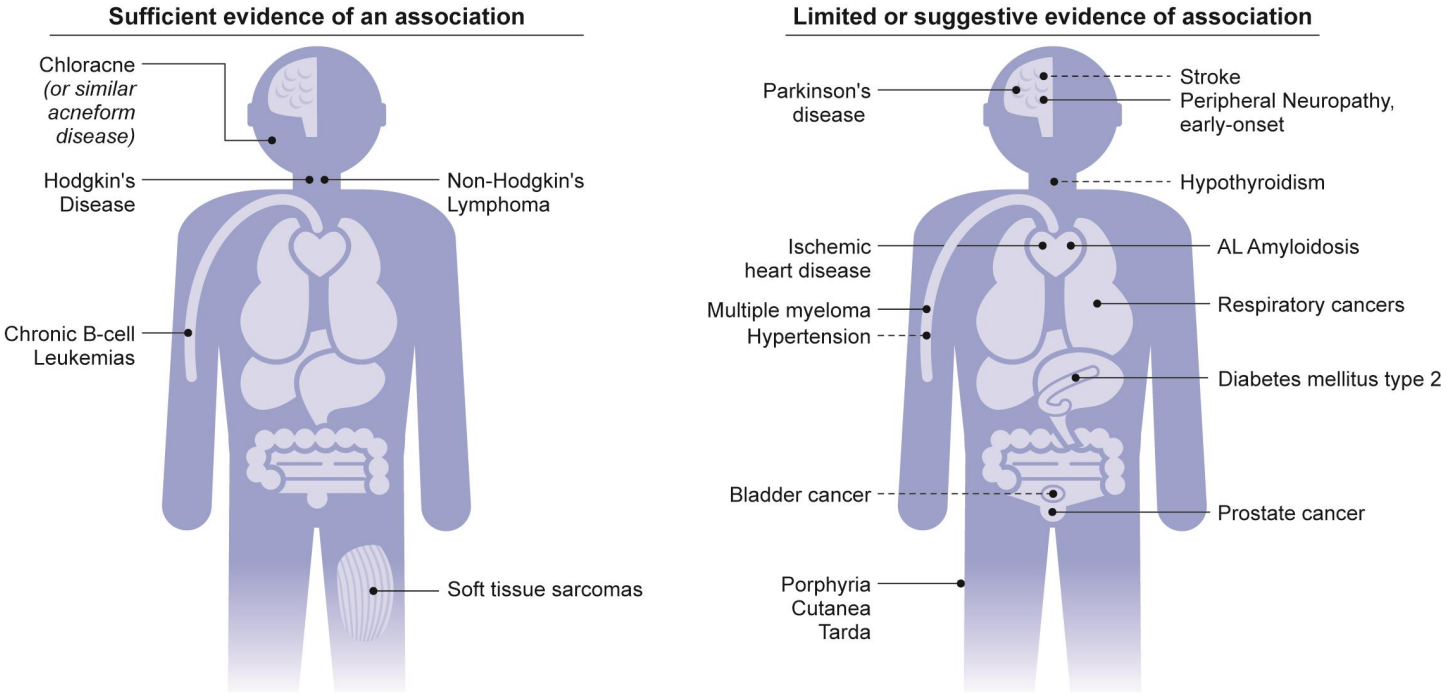
[37]38 U.S.C. § 1116.

[38]*Id.* "Herbicide agent" includes the following components: 2,4-D; 2,4,5-T and its contaminant 2,3,7,8-TCDD; cacodylic acid; and picloram. 38 C.F.R. § 3.307(a)(6) (2018).

[39]"Service in the Republic of Vietnam" includes service in the waters offshore and service in other locations if the conditions of service involved duty or visitation in the Republic of Vietnam. 38 C.F.R. § 3.307(a)(6)(iii) (2018).

[40]Title 38, section 3.307 of the Code of Federal Regulations also affords a presumption of exposure to an herbicide agent for veterans who served in active military, naval, or air service between April 1, 1968, and August 31, 1971, in a unit that operated in or near the Korean demilitarized zone in an area in which herbicides are known to have been applied during that period; and for individuals who performed service in the Air Force or Air Force Reserve under circumstances in which the individual concerned regularly and repeatedly operated, maintained, or served onboard C-123 aircraft known to have been used to spray an herbicide agent during the Vietnam era. The VA's *Adjudication Procedures Manual* also addresses exposure to herbicide agents for veterans who served in certain locations and positions in Thailand. In addition, the VA affords a presumption of herbicide exposure to veterans who served in the inland waterways of Vietnam or the waters offshore, if the conditions of service involved duty or visitation in Vietnam between January 9, 1962, and May 7, 1975. The Manual refers to service in the inland waterways and waters offshore as brown- and blue-water Navy service, respectively. We are not making a judgment about the reasons behind providing compensation for veterans who have been diagnosed with these associated diseases. As we have previously reported, it is often difficult to establish causation between an exposure and an adverse health condition, because scientific research has not always established a clear link between the contaminant and an adverse health effect. GAO, *Defense Infrastructure: DOD Can Improve Its Response to Environmental Exposures on Military Installations*, GAO-12-412 (Washington, D.C.: May 1, 2012).

Figure 3: Diseases Recognized by the National Academy of Sciences as Having Sufficient or Limited or Suggestive Association with Agent Orange Exposure



Source: GAO analysis of National Academies of Sciences information and Department of Veterans Affairs Regulations. | GAO-19-24

Veterans' Benefits

Under 38 U.S.C. § 1110, the United States will pay benefits to any veteran disabled for a disability resulting from personal injury suffered or disease contracted in line of duty, or for aggravation of a preexisting injury suffered or disease contracted in line of duty, in the active military, naval, or air service, during a period of war.[41] The VA offers health registry exams, health care, disability compensation, and other benefits to eligible veterans who were exposed to herbicides during military service. According to the VA's *Claims Adjudication Procedures Manual*, the claims evaluation process begins with the VA requesting any information missing

[41]In determining compensation, if the veteran was discharged or released from service, the discharge or release must have been under conditions other than dishonorable. *See* 38 C.F.R. § 3.4 (2018).

from the veteran's claim, such as the approximate dates and location(s) of service, claimed disability, and, for certain locations, the nature of the alleged exposure to herbicides. Generally, the veteran then has 30 days to submit the requested information. During the claims process, VA will check military records to confirm exposure to Agent Orange or other herbicides and qualifying military service. Certain diseases have already been presumed to be associated with herbicide exposure, and no further evidence of an association is needed. However, if the claimed disability is not a presumed condition, then VA will request that the veteran present scientific or medical evidence showing that the claimed condition is medically associated with herbicide exposure. If the veteran is not able to provide this information, the case is referred to DOD for verification of exposure to herbicides. Veterans' claims can either be approved or denied based on the evidence submitted by the veteran, and, if needed, by DOD.[42]

The VA tracks its claims data for Agent Orange exposure according to whether the exposure occurred inside or outside of Vietnam, which includes the Korean demilitarized zone and certain locations in Thailand. According to VA officials, as of June 30, 2018, 557,653 living veterans and 199,451 deceased veterans have been granted benefits for diseases associated with Agent Orange exposure *inside* Vietnam, with 44,925 claims pending for veterans who served in Vietnam and believe they were exposed to Agent Orange. For diseases associated with Agent Orange exposure *outside* of Vietnam, VA had granted service connection decisions to more than 10,758 veterans and denied service connection decisions to more than 58,250 veterans, as of June 30, 2018. According to VA, there are an additional 23,400 claims pending for veterans who did not serve in Vietnam but believe they were exposed to Agent Orange.

Environmental Cleanup

In 1980 Congress passed the Comprehensive Environmental Response, Compensation, and Liability Act, which established the Superfund program—the federal government's principal program to clean up hazardous waste sites.[43] The U.S. EPA is responsible for administering

[42]VA Claims Adjudication Procedures Manual, M21-1, part IV, subpart ii, ch. 1, sec. H, *Developing Claims for Service Connection (SC) Based on Herbicide Exposure* (change date Mar. 27, 2018).

[43]Pub. L. No. 96-510, 94 Stat. 2767 (1980) (codified as amended at 42 U.S.C. §§ 9601-9675).

the Superfund program, which places some of the most seriously contaminated sites on the National Priorities List, and has oversight for federal and non-federal sites on that list. Additionally, amendments to the act in 1986 require the Secretary of Defense to carry out the Defense Environmental Restoration Program, which was specific to DOD environmental cleanup activities at active installations, formerly used defense sites, and base realignment and closure locations in the United States.[44] The cleanup process under the Environmental Response, Compensation, and Liability Act process generally includes the following phases and activities: preliminary assessment, site inspection, remedial investigation and feasibility study, remedial design and remedial action, and long-term monitoring.[45]

Through this process, DOD and U.S. EPA cleaned up some U.S. sites where Agent Orange was known to have been present after the sites were tested and confirmed to have been contaminated with 2,3,7,8-TCDD.[46] For example, U.S. EPA identified a site in Jacksonville, Arkansas, where 2,4,5-T had been manufactured, that was contaminated with 2,3,7,8-TCDD. In addition, under the Defense Environmental Restoration Program, DOD cleaned up the Naval Construction Battalion Center Gulfport, Mississippi, where Agent Orange had been stored while awaiting shipment for use in Southeast Asia. The site had also been used to store Agent Orange drums that were awaiting shipment to Johnston Island for disposal. According to a DOD report, approximately 860,000 gallons of the herbicide were stored at the site. An Agency for Toxic Substances and Disease Registry report further states that spills that occurred during storage caused 2,3,7,8-TCDD contamination around several water areas. According to a 5-year review completed by DOD in

[44]Pub. L. No. 99-499, § 211 (1986) (codified as amended at 10 U.S.C. § 2700 et seq.).

[45]*See* 40 C.F.R. part 300, subpart E.

[46]For some of the sites it assessed, DOD determined that the levels of contamination and associated risks did not warrant cleanup actions. For example, DOD assessed risks to human health as a result of dioxin contamination at Eglin Air Force Base in Florida, which was a testing site for aerial sprayers, to evaluate the capabilities of the equipment systems used to spray Agent Orange. Environmental assessments identified herbicides and dioxins in soils, sediments, and surface water and groundwater in a one-square mile test grid where massive quantities of herbicides were tested via repeated application, over a period of 8 years. DOD did not perform cleanup activities at the test grid, however, because the final risk assessment in 2001 concluded that the risks to human health were acceptable. However, DOD did implement remedies to control the use of the land near the herbicide testing sites to prevent future residential development. These land use controls will remain in effect indefinitely, and the site will continue to be monitored every 5 years.

2017, capping of the contaminated soil at the site where herbicides were stored has been completed, and long-term monitoring of the soil and groundwater began in 2012 and continues today.

DOD also cleaned up the Johnston Island site where Agent Orange was ultimately disposed of. Once drums of Agent Orange were stored at Johnston Island, environmental sea conditions caused them to corrode and leak. Initial cleanup activities assessed and monitored the area to track the chemical components remaining as a result of Agent Orange contamination. Site remediation and environmental monitoring continued throughout the 1970s until February 1989, when the Air Force, in accordance with the Defense Environmental Restoration Program, completed a final site cleanup at Johnston Island by destroying all remaining 2,3,7,8-TCDD-contaminated soil. Figure 4 shows drums of Agent Orange stored at Johnston Island.

Figure 4: May 1975 Photo of Drums of Agent Orange Stored on Johnston Island

Source: Alvin L. Young, *Agent Orange: A History of Its Use, Disposition, and Environmental Fate* (June 30, 2008). | GAO-19-24

Note: Many of the drums were no longer marked with an orange band around their center as a result of redrumming that took place from 1972 through mid-1977. According to archival sources, efforts were made to continue labeling new drums as “Herbicide Butyl Esters.”

In addition, U.S. EPA listed on its National Priorities List two former Agent Orange manufacturing sites—the Kanawha River site in West Virginia previously owned by the Monsanto Company and a site in Newark, New Jersey, owned by the Diamond Alkali Company—due to high levels of contamination from various sources and threats to human health. In 2017,

U.S. EPA entered into an agreement with the Monsanto Company on a cleanup plan to address 2,3,7,8-TCDD contamination at the Kanawha River Superfund Site in Putnam and Kanawha counties, West Virginia. The cleanup effort will focus on a 14-mile stretch within the Kanawha River. Cleanup work will include constructing a cap over more than 9 acres of contaminated river sediments. Similarly, the Diamond Alkali site in New Jersey contained 2,3,7,8-TCDD contamination at both the manufacturing site and the nearby Lower Passaic River. The site was found to contain high levels of 2,3,7,8-TCDD and was placed on the National Priorities List in 1984. As late as 2014, the site was still undergoing cleanup actions to prevent exposure to the contaminated soil and prevent further releases to the river.

It is difficult to isolate the specific costs of cleaning up Agent Orange contamination under the Comprehensive Environmental Response, Compensation, and Liability Act, according to DOD and U.S. EPA officials.[47] Moreover, cleanup plans address multiple contaminants, making it difficult to isolate the costs for cleaning up a specific contaminant, according to DOD and U.S. EPA officials. For example, the Diamond Alkali site had multiple contaminants from a number of companies that owned or operated facilities from which hazardous substances, including 2,3,7,8-TCDD and pesticides, were potentially discharged into the river and found in the soil and groundwater. Various cleanup actions were taken to address not only 2,3,7,8-TCDD contamination but the other contaminants as well. These actions included a groundwater collection and treatment system and capping to prevent exposure to contaminated soil (including contaminated soil that originated at the facility and soil that was brought to the facility from neighboring lots) and prevent further releases to the river.

The Federal Government Has Some Information on the Procurement, Use, and

[47]The national goal of the Comprehensive Environmental Response, Compensation, and Liability Act remedy selection process is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste. 40 C.F.R. § 300.430(a)(1)(i) (2018). Cleanup alternatives providing effectiveness similar to that of another alternative but at greater cost, may be eliminated from further consideration. 40 C.F.R. § 300.430(e)(7) (2018). According to DOD officials, cost is not a primary driver for cleanup actions; such decisions are instead based on human health concerns.

Destruction of Agent Orange, and Available Documentation Indicates at Least One Vessel Carrying Agent Orange Transited through Guam to Vietnam, but Information Is Not Complete

The federal government maintains information on Agent Orange, and available records indicate that DOD procured approximately 13.9 million gallons of the tactical herbicide, which was either used in U.S. military operations in Southeast Asia, used for testing, or destroyed. Our analysis of the available logbooks for 152 of the 158 shipments (approximately 96 percent) of Agent Orange to Southeast Asia that we identified indicates that the vessels carrying tactical herbicides generally stopped at foreign ports and sometimes at U.S. ports en route to Southeast Asia. Available primary source materials, such as shipment documentation, are incomplete because they were likely not maintained during and after the Vietnam era.[48] However, based on the available information, we identified at least one ship carrying Agent Orange that stopped at Port Apra (now Apra Harbor) on Guam on its way to Vietnam, although we could not locate any evidence showing that any cargo was offloaded. Further, while DOD documents identify the use of commercial herbicides on Guam, they do not identify the use of tactical herbicides there.

Available Records Indicate That All of the Agent Orange Procured Was Either Used in U.S. Military Operations, Used for Testing, Damaged, or Destroyed

Available records that the federal government maintains indicate that DOD procured approximately 13.9 million gallons of Agent Orange between 1963 and 1968, of which it used an estimated 12.1 million gallons in Southeast Asia from 1965 to 1970; used a small amount for

[48]As noted earlier, shipment documentation includes shipping and agency records, including U.S. military correspondence and logistics reports.

testing; and incinerated another 2.3 million gallons in 1977.[49] Thus, the total quantity of Agent Orange that DOD procured was approximately equal to the total quantity that records indicate was tested in the United States and its territories, damaged during storage and shipment, and used during the Vietnam War, combined with the total quantity that records indicate was disposed of afterwards.[50]

Procurement and Use. Based on available records we reviewed, DOD procured approximately 13.9 million gallons of Agent Orange from nine chemical manufacturers between 1963 and 1968.[51] In 1963 DOD used small amounts of Agent Orange for testing. DOD procurement officers then advised the Military Assistance Command, Vietnam, in late 1964 that they could fulfill the supply requirements for tactical herbicides with Agent

[49]We used the best available records to identify the amounts of Agent Orange we refer to in this report, but these figures should be seen as estimates. The "amount used" is based on an estimate by the National Academy of Sciences of the amount of Agent Orange used in Vietnam during Operation Ranch Hand. This total includes quantities used in Korea and Thailand as well as quantities used for testing or lost during storage, according to DOD records. The estimated amounts used varied over the decades, but we are using the estimate of approximately 12.1 million gallons identified in the Institute of Medicine's 2014 update. See NASEM, 2016.

[50]The amounts of Agent Orange used in support of military operations plus that incinerated do not equal the amount of Agent Orange that DOD procured because we do not have complete documentation regarding the amounts used for testing or the amounts that were lost or damaged. Specifically, we were not able to obtain source documents for the procurement of Agent Orange for testing, nor were we able to determine the accuracy or completeness of records for the quantities of Agent Orange used in military operations in Vietnam. The quantities estimated to have been disposed of that include the incineration of stocks of Agent Orange in 1977 also vary, and we were not able to estimate quantities lost during storage or transit, or in redrumming operations. Therefore, we are relying on published estimates for these figures.

[51]Domestic chemical manufacturers produced 78.1 million pounds of n-butyl 2,4,5-T, one of the two components of Agent Orange, for military use beginning in 1961 and ending in 1969. DOD managed its Agent Orange procurement through 45 contracts. In 1968 DOD decided to terminate 7 of the final Agent Orange contracts due to an oversupply of Agent Orange, because fewer herbicide missions were being flown in Vietnam than had been projected.

Orange.[52] Available records further indicate that of the approximately 13.9 million gallons of Agent Orange procured, DOD used an estimated 12.1 million gallons in operations in Vietnam from 1965 to 1970.[53] In addition to the quantity used in Vietnam, Agent Orange usage also included quantities that were tested in the United States and its territories; used or tested in countries outside of Vietnam; lost during shipment and storage; or removed from the inventory and used to test different disposal options after its use was suspended.[54] With the exception of the disposal testing amounts, no archival resources we could locate and obtain provided definitive usage figures. The last known shipment of Agent Orange to Vietnam was aboard the SS *Frederick Lykes* and arrived in May 1970.

Restrictions on Use. In 1969 the National Environmental Health Service of the Department of Health, Education, and Welfare conducted testing of n-butyl 2,4,5-T—the component of Agent Orange whose manufacturing process produced 2,3,7,8-TCDD as a by-product—on mice, which raised concerns about health effects of the herbicide for women of child-bearing age. These concerns led to several U.S. government decisions that ended the use of tactical herbicides. Specifically, in 1969 DOD restricted the use of Agent Orange in Vietnam to keep it away from population

[52]Military Assistance Command, Vietnam, was the command in charge of U.S. military operations in Vietnam as of February 8, 1962. It succeeded the Military Assistance Advisory Group, Vietnam. DOD procured other tactical herbicides that contained forms of n-butyl 2,4,5-T, to include thousands of gallons of Agents Green, Pink, and Purple that were disseminated in Vietnam from January 1962 through December 1964. DOD discontinued the use of Agents Green and Pink by 1965, and Agent Purple was also replaced by Agent Orange in 1964. Although Agents White and Blue were used in spraying operations in Vietnam alongside Agent Orange, neither of them contained the chemical n-butyl 2,4,5-T. DOD discontinued the use of Agent Orange in 1970 and all use of the tactical herbicides in 1971.

[53]The U.S. Air Force Logistics Command was responsible for fulfilling Air Force supply requirements for Operation Ranch Hand during the Vietnam era. According to a San Antonio Air Materiel Area historical monograph, the Middletown Air Materiel Area, located at the former Olmsted Air Force Base in Pennsylvania, initially had this responsibility, but responsibility was transferred to the San Antonio Air Materiel Area Directorate of Air Force Aerospace Fuels located at the former Kelly Air Force Base in Texas in 1966. Although herbicide management responsibility was transferred to the San Antonio Air Materiel Area, the Defense General Supply Center based in Richmond, Virginia, maintained procurement responsibility.

[54]For example, according to archival sources, about 10 out of every 10,000 drums (one-tenth of 1 percent) received at ports were damaged or defective. About 50 percent of the damaged drums leaked as a result of punctures or split seams caused by improper loading and defective drums. These sources also indicated that forklifts operated by stevedores also caused punctures of the drums.

centers. In April 1970 the federal government began restricting the use of 2,4,5-T in the United States.[55] Exceptions were made for the control of weeds and brush on range, pasture, and forests, or on rights of way and other nonagricultural land. On April 15, 1970, DOD temporarily suspended the use of Agent Orange, including new procurement, acceptance of product on terminated contracts, transfer of stocks at Gulfport, and ocean shipping operations.

Consolidation and Incineration of Remaining Stocks. After the U.S. government restricted the use of n-butyl 2,4,5-T—a component of Agent Orange—in 1970, DOD decided to consolidate the remaining 2.3 million gallons of Agent Orange stored in Vietnam and Gulfport, Mississippi, as well as any remaining amounts of n-butyl 2,4,5-T. According to an Office of Air Force History monograph, on January 16, 1971, DOD ordered the termination of all crop destruction missions by U.S. forces in Vietnam, and on September 27 of that year, the Chairman of the Joint Chiefs of Staff directed the Air Force to return all remaining stocks of Agent Orange to the United States and to dispose of them. Specifically,

- Agent Orange stocks in Vietnam were temporarily stored at U.S. Air Force bases at Da Nang, Phu Cat, and Bien Hoa until they were moved to Johnston Island in 1972. In 1972 the U.S. military moved approximately 1.36 million gallons of Agent Orange onto Johnston Island for storage. The cargo vessel SS *Transpacific* picked up this quantity at three Vietnamese ports from March 15 to April 1, traveled to Johnston Island, arrived on April 18, and completed offloading on April 28 before returning to the United States. This consolidated quantity of Agent Orange from Vietnam remained at Johnston Island until 1977.
- The Naval Construction Battalion Center Gulfport, Mississippi, was the final storage location in the continental United States for Agent Orange until the U.S. Air Force began the incineration of Agent Orange in 1977. There were approximately 860,000 gallons of Agent Orange at this location in 1977, which takes into account amounts lost in Hurricane Camille in 1969 or shipped away for testing, as described

[55]Specifically, on April 15, 1970, the Departments of Agriculture, Interior, and Health, Education and Welfare announced the suspension of the registrations of liquid formulations of 2,4,5-T for uses around the home and on lakes, ponds, and ditch banks. The agencies also announced the intent to cancel registered uses of non-liquid formulations of 2,4,5-T around the home and on all food crops intended for human consumption. USDA Press Release 1176-70 (April 15, 1970). See also USDA Pesticide Registration Notice 70-11.

previously. The 1977 figure also takes into account 14,025 gallons transferred to the Naval Construction Battalion Center Gulfport, from Eglin Air Force Base, Florida, where the Air Force had tested formulations of Agent Orange for aerial spraying. In addition, available records show that quantities of the two components of Agent Orange were stored at the former Kelly Air Force Base, Texas, until 1972 before they were transferred to the U.S. Department of Agriculture for brush control projects. These reported amounts included 106,260 gallons of n-butyl 2,4-D and 38,940 gallons of n-butyl 2,4,5-T. These records also show that 173,910 gallons of Agent Blue were stored at the installation; see figure 5.

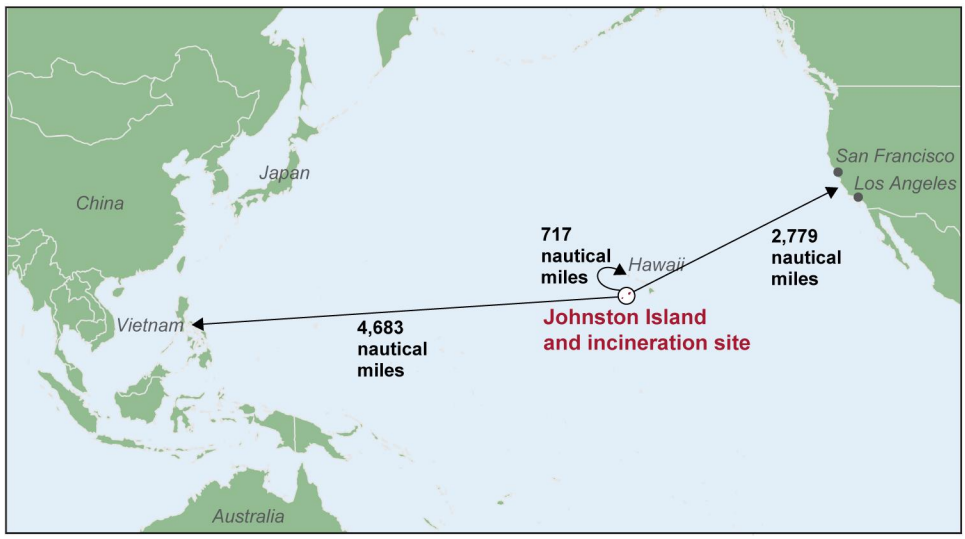
Figure 5: Photo of Drums of Agent Orange Components (n-butyl 2,4-D and n-butyl 2,4,5-T) and Agent Blue Located at San Antonio Air Materiel Area, Kelly Air Force Base, Texas

Source: National Archives and Records Administration. | GAO-19-24

Note: Photo by San Antonio Air Materiel Area, Kelly Air Force Base, Texas (October 12, 1971).

DOD chartered the incinerator ship M/T *Vulcanus* and loaded the 860,000 gallons stored at Naval Construction Battalion Center Gulfport, Mississippi, beginning in May 1977. The vessel left Gulfport, Mississippi, in June 1977, and began incinerating the Agent Orange on board in July 1977 in a research burn to test the incineration process at sea near Johnston Island. In August 1977, the M/T *Vulcanus* loaded the remaining 1.36 million gallons stored at Johnston Island and conducted two more incineration operations just southwest of Johnston Island, as shown in figure 6. By September 3, 1977, all stocks of Agent Orange had been incinerated.

Figure 6: Map of Johnston Island and M/T *Vulcanus* Burn Site



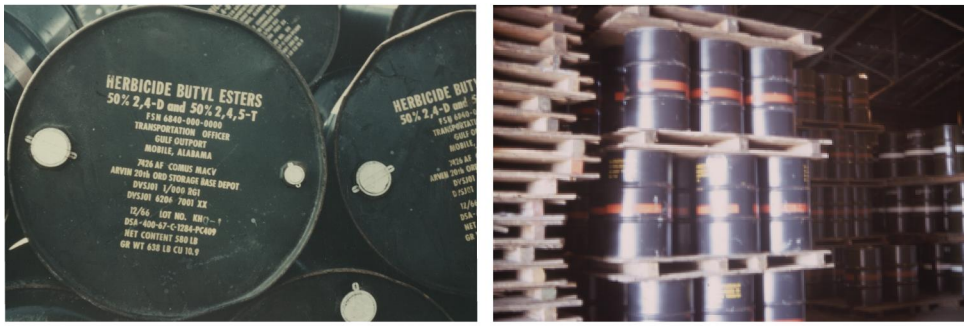
Source: GAO analysis of Department of Defense data; Map Resources (map). | GAO-19-24

Available Records Indicate That Vessels Transporting Agent Orange Stopped at Various Ports en Route to Southeast Asia, but Shipment Information Is Not Complete

Our review of documentation for the shipment of almost 12.1 million gallons of the approximately 13.9 million gallons (approximately 87 percent) of Agent Orange procured by DOD found, based on available shipment documentation, that vessels transporting Agent Orange made stops at various ports on the way to Southeast Asia. However, shipment documentation is incomplete. Manufacturers of Agent Orange blended the two components of the herbicide—the n-butyl forms of 2,4-D and 2,4,5-T—and marked 55-gallon drums for shipment to Southeast Asia. Available records indicate that manufacturers produced Agent Orange according to military specifications and marked all drums for shipment directly to the receiving U.S. military unit in Vietnam. These specifications indicated the precise herbicide formulation of Agent Orange (n-butyl esters, 50 percent 2,4-D and 50 percent 2,4,5-T) and general instructions for marking the 55-gallon drums for shipment. For example, according to a historical monograph by the San Antonio Air Materiel Area, DOD specified that each drum was to be marked with a colored band or bands

around the center as well as with transportation and contract data. Figure 7 shows an example of these drum markings.

Figure 7: Drum Markings for Agent Orange with Destination and Orange Band



Source: National Archives and Records Administration. | GAO-19-24

Note: Photos of Agent Orange drums taken by San Antonio Air Materiel Area, Kelly Air Force Base, Texas. The photo on the right indicates how Agent Orange was palletized on the vessels. Precise dates of photos are unknown.

DOD then arranged for the transport of these drums, as well as drums of other tactical herbicides, by train from the manufacturers to several U.S. ports.[56] DOD transportation officials accepted the product by signing a Material Inspection and Receiving Report that indicated the destination of the rail shipment and the final destination in Vietnam. DOD primarily chartered merchant marine vessels to ship the drums to Southeast Asia, but we identified one official Navy vessel, the USNS *Lt. George W.G. Boyce*, that carried Agent Orange to Southeast Asia.[57] The first known shipment of Agent Orange left the port of New Orleans, Louisiana, on the SS *Adabelle Lykes* and arrived in Vietnam in February 1965. The last known shipment left the port of Gulfport, Mississippi, on the SS *Frederick Lykes* and arrived in Vietnam in May 1970.[58] By that time, DOD had suspended all further shipments of Agent Orange. The photos in figure 8

[56]Based on available Air Force records, the known ports of embarkation for Agent Orange were Bayonne, New Jersey; Baltimore, Maryland; Gulfport, Mississippi; New Orleans, Louisiana; Mobile, Alabama; Seattle, Washington; and Oakland, California.

[57]There are limited shipment records available for herbicides shipped before 1965—Agents Pink, Green, and Purple. There are records available for Agents Blue and White for the period 1965 to 1970, but those herbicides do not contain n-butyl 2,4,5-T.

[58]Available records indicate that DOD chartered cargo ships operated by various shipping companies. Examples include the SS *American Charger* (U.S. Lines), the SS *Flower Hill* (Ocean Freighting & Brokerage Corp.), and the SS *Sir John Franklin* (American Export-Isbrandtsen Line).

provide examples of drums of Agent Orange being shipped by rail and tactical herbicides being loaded onto a cargo ship.

Figure 8: Photos Showing Transportation of Agents Orange and White

Drums with an orange band on a rail car in Gulfport, Mississippi.

Drums marked with a white band being loaded onto a cargo ship.

Source: National Archives and Records Administration. | GAO-19-24

Note: Photos by San Antonio Air Materiel Area, Kelly Air Force Base, Texas (March 1969).

The bulk of materiel used to support U.S. military forces in Vietnam, including tactical herbicides, was transported from the continental United States to Vietnam via ship. The vessels carrying the tactical herbicides generally stopped at foreign ports and sometimes at U.S. ports on the way to Southeast Asia. Our analyses of available shipment documentation indicate that at least 114 unique cargo vessels carried Agent Orange to Southeast Asia on at least 158 different voyages from 1965 through 1970. For each of these voyages, merchant vessel captains submitted logbooks to the U.S. port authorities at the end of each voyage.[59] We were able to locate and obtain logbooks for 152 of the 158 shipments (approximately 96 percent) we identified. For 3 of the 6 voyages for which we were not able to locate logbooks, we obtained copies of the vessels' shipping articles.[60] We were not able to obtain

[59]Logbooks contain information such as the ship's location, crew, and key events. However, they generally do not identify specific cargo that was loaded on or offloaded from a ship. Logbooks from the Vietnam era are generally held at National Archives and Records Administration facilities closest to the arrival ports where the voyages ended.

[60]Shipping articles are the articles of agreement between the captain of a ship and the seamen with respect to wages, length of time for which they are shipped, and related matters. They provide the dates and locations for different personnel actions but do not necessarily identify every port of sailing for a voyage, and thus do not provide complete documentation of the route a vessel took.

shipping articles for the 3 foreign-flagged vessels because documents for such vessels were not turned in at U.S. ports.

Our review of the logbooks and shipping articles for vessels carrying Agent Orange and other tactical herbicides showed that these vessels made stops at several U.S. and foreign ports, both in going to and in returning from Vietnam. For example, we identified vessels that stopped at several West Coast ports to load cargo before traveling to Vietnam, and others that made port calls to refuel in Hawaii. We also identified vessels that stopped at foreign ports such as Okinawa, Thailand, and Taiwan, as well as locations near the major U.S. Naval Supply Depots in Yokosuka, Japan, or Subic Bay, Philippines. These supply depots were major logistics hubs for U.S. military operations in East Asia, and they provided supplies to commercial ships that were chartered by DOD's Military Sea Transportation Service through contracts with shipping companies. These companies would reserve cargo space for military cargo and include Saigon, Vietnam, as a destination, but the voyages were otherwise made for normal commercial activities. From those locations, the cargo vessels traveled to one or more ports in Vietnam. However, while the logbooks we reviewed identify when vessels left the various ports as they traveled to and from Vietnam, logbooks do not provide information on whether and how much cargo was loaded and unloaded at those ports of call, nor do they indicate whether tactical herbicides were offloaded at any ports before the vessels reached Vietnam.

Lykes Company Ships

The Military Sea Transportation Service directly chartered merchant vessels to carry tactical herbicides during the Vietnam War. At least 28 vessels owned by the New Orleans, Louisiana-based Lykes Brothers Steamship Company transported Agent Orange between 1965 and 1970 from Gulf Coast ports to Southeast Asia. Lykes Brothers vessels were designed to handle cargo with cables that could place the cargo in a series of holds—numerous compartmented internal storage spaces. Tactical herbicides were stored vertically on pallets in these holds. The first large shipments of Agent Orange took place on the SS *Adabelle Lykes*, SS *Elizabeth Lykes*, and SS *Mayo Lykes*, traveling from the port of New Orleans, Louisiana, through the Panama Canal, and refueling in the Philippines before offloading a total of 1,782 55-gallon drums (approximately 97,000 gallons) in Saigon, Vietnam, in February and March of 1965.

Source: Photo from National Archives and Records Administration of a Lykes Line ship docked in Gulfport, Mississippi. Photo by San Antonio Air Materiel Area, Kelly Air Force Base, Texas (March 1969). | GAO-19-24

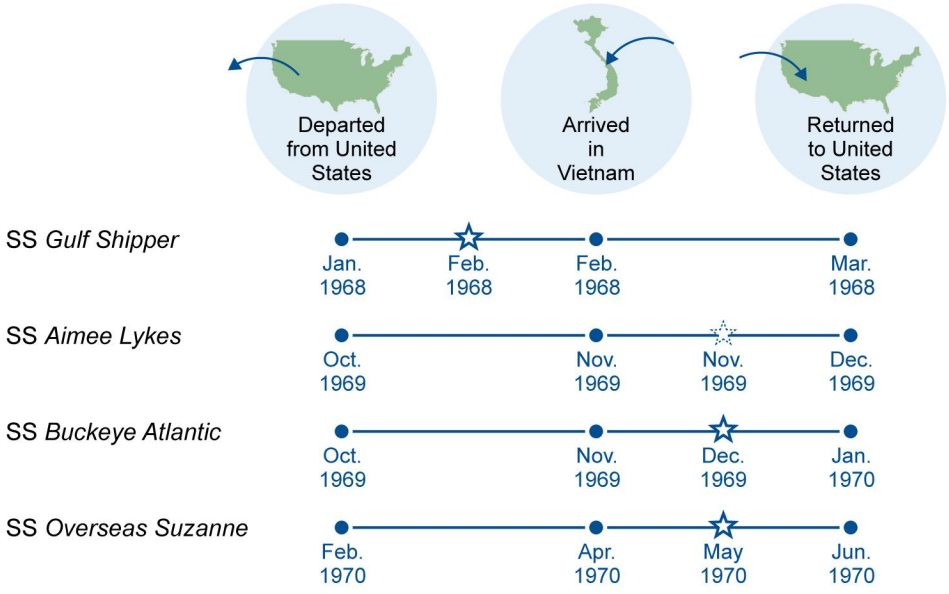
Available Shipment Documentation Indicates at Least One Vessel Carrying Agent Orange Went Through Guam en Route to Vietnam, but Archival Information Lacks Details or Is Not Complete

Based on our review of available logbooks, we identified at least one vessel carrying Agent Orange that stopped at Guam en route to Vietnam and at least three vessels that stopped at Guam on the return from Vietnam.[61] However, in our review of available shipment documentation,

[61]As we discuss later, the logbook for one of the vessels does not identify a port stop on Guam, but it does include an entry indicating that the vessel pulled into Apra Harbor and offloaded an injured mariner onto a small motorboat to transport the individual for medical treatment on Guam. Therefore, we cannot confirm whether the vessel actually docked at Port Apra, Guam.

we found no evidence indicating that Agent Orange or any other tactical herbicides[62] were offloaded from those vessels or used in the U.S. territories of Guam or the Northern Mariana Islands. Figure 9 indicates the timelines of the four vessels known to have carried Agent Orange that stopped at Guam either on their way to or returning from Vietnam, each of which is discussed in detail below.

Figure 9: Timelines of Vessels Carrying Agent Orange That Stopped at Guam on the Way to or from Vietnam



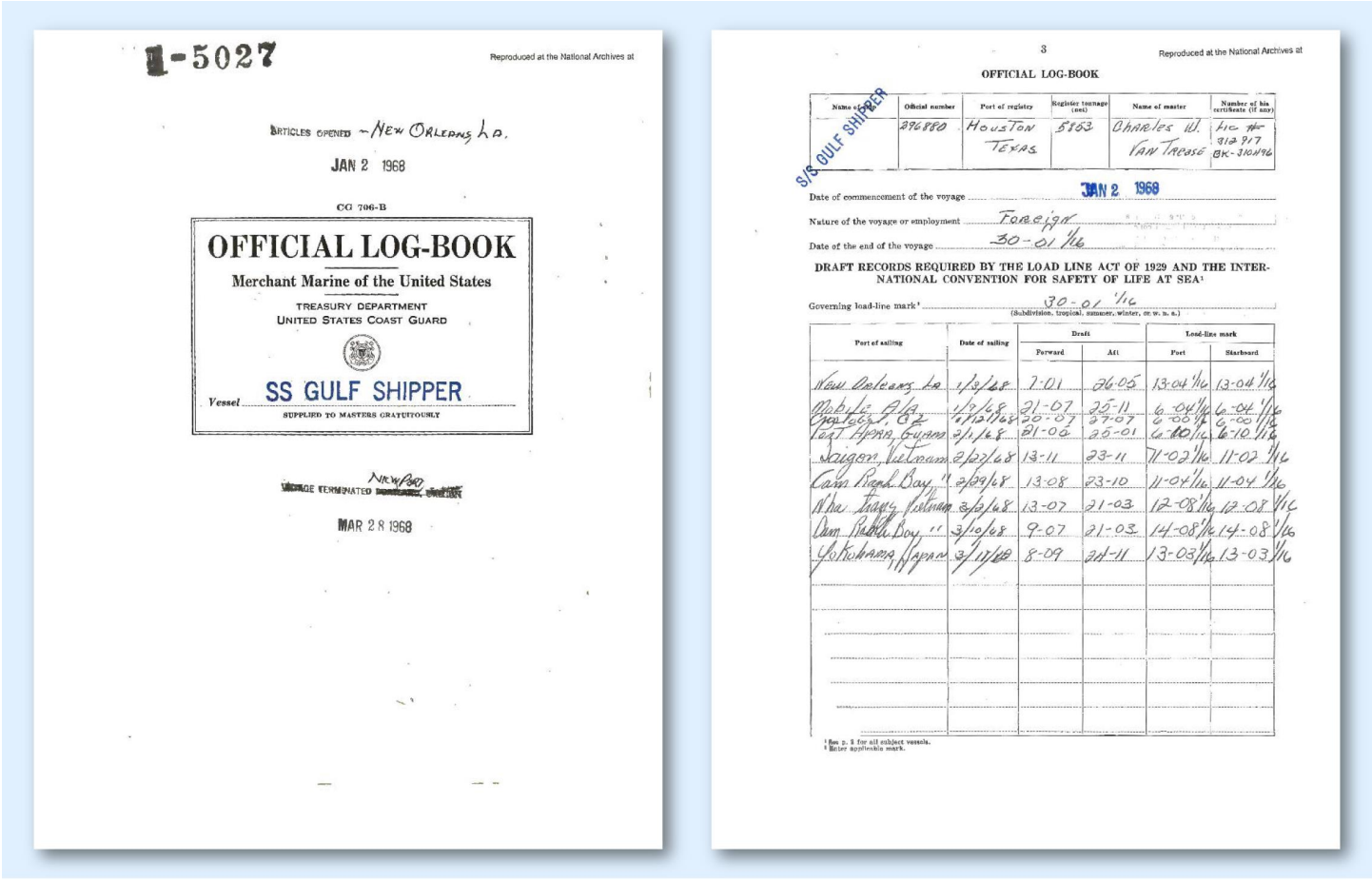
Source: GAO analysis of archived logbooks and shipping articles. | GAO-19-24

Note: While the ports of call listed in the SS *Aimee Lykes* logbook do not indicate a port of call on Guam, it does include an entry that describes pulling into Apra Harbor and offloading an injured mariner into a small motorboat so that the individual could be hospitalized on Guam. Therefore, we cannot confirm whether the vessel docked at Port Apra or stayed in the harbor.

[62]Available records include limited information on Agent Purple, which was alleged to have been shipped to Guam at some time. While Agent Purple was outside of the scope of this review, earlier research that was conducted on the possible presence of Agent Purple on Guam found no records in the National Archives and Records Administration to indicate that Agent Purple was ever shipped to or stored on the Island of Guam. See Alvin Young and Kristian Young, *The Agents Orange and Purple Controversy on the Island of Guam* (Cheyenne, WY: September 2017).

Available shipment documentation indicates that hundreds of vessels delivered supplies to the Naval Supply Depot, including supplies bound for Andersen Air Force Base, on Guam during the Vietnam War due to both installations' strategic location in supporting the war effort. While the logbooks we were able to locate and review for vessels that transported Agent Orange to Southeast Asia between 1965 and 1970 do not show that these vessels typically stopped at Guam or the Northern Mariana Islands at any time during their voyages, we identified one ship carrying Agents Orange, Blue, and White that did stop at Guam on its way to Vietnam. Specifically, available records indicate that sometime around February 1, 1968, the SS *Gulf Shipper* stopped at Port Apra (now Apra Harbor) on Guam en route to Vietnam. Figure 10 shows a photo of the logbook from the SS *Gulf Shipper* indicating the ship's ports of call en route to Vietnam.

Figure 10: Excerpts from March 1968 SS *Gulf Shipper* Logbook



Source: National Archives and Records Administration. | GAO-19-24

The logbooks do not provide details about whether cargo was moved on or off the vessels during these port calls, or whether tactical herbicides were offloaded at these ports before the vessels reached Vietnam. However, the SS *Gulf Shipper's* logbook indicates that the stop at Guam could have been related at least in part to the repatriation of an injured crew member to the United States, and not to matters related to the loading or unloading of cargo. Further efforts to locate information on cargo movements for the SS *Gulf Shipper*, such as customs records, manifests, or bills of lading, were unsuccessful, because those records were not routinely retained. As such, we were not able to verify why the

SS *Gulf Shipper* stopped at Guam, what its crew did while there, or whether any cargo was loaded or unloaded.[63]

We also identified at least three vessels that stopped on Guam on their return from Vietnam, based on our review of available logbooks. Specifically, around November 30, 1969, the SS *Aimee Lykes* stopped at Port Apra on Guam and offloaded an injured crew member into a small motorboat so that he could be hospitalized on Guam. In addition, around December 23, 1969, the SS *Buckeye Atlantic* stopped at Guam and offloaded two injured crew members. Lastly, around May 5, 1970, the SS *Overseas Suzanne* stopped at Guam and offloaded an injured crew member. Based on a review of the vessels' logbooks, it is not clear whether the stops at Guam were for reasons other than offloading injured crew members—for example, reasons related to the loading or unloading of any cargo.[64] Appendix III describes information that we were able to obtain regarding the quantities of herbicides known to have been shipped to Southeast Asia on the four vessels that we identified as having stopped at Guam (either on the way to or from Vietnam) between February 1968 and May 1970.

As noted earlier, based on our review of available shipment documentation, we were able to identify approximately 87 percent of the shipments of Agent Orange to Southeast Asia, and to obtain logbooks for about 96 percent of the vessels known to have transported Agent Orange from U.S. ports to Vietnam. Because we were unable to obtain logbooks for every shipment of Agent Orange, we cannot conclude with certainty whether any ships other than the SS *Gulf Shipper* that were transporting the tactical herbicide to Vietnam, or the three ships returning to the United States from Vietnam—the SS *Aimee Lykes*, the SS *Buckeye Atlantic*, and the SS *Overseas Suzanne*—made port calls either at Guam or the Northern Mariana Islands. Additionally, we found and U.S Air Force officials agreed that it is unlikely that Agent Orange was shipped by air to or from Guam. The U.S. Air Force transported small quantities of tactical herbicides by air to Vietnam in 1961. However, we did not identify any documentation showing the transport of tactical herbicides by air to

[63]See appendix I for more information on the steps GAO took to attempt to locate information on the cargo movements for this SS *Gulf Shipper* voyage.

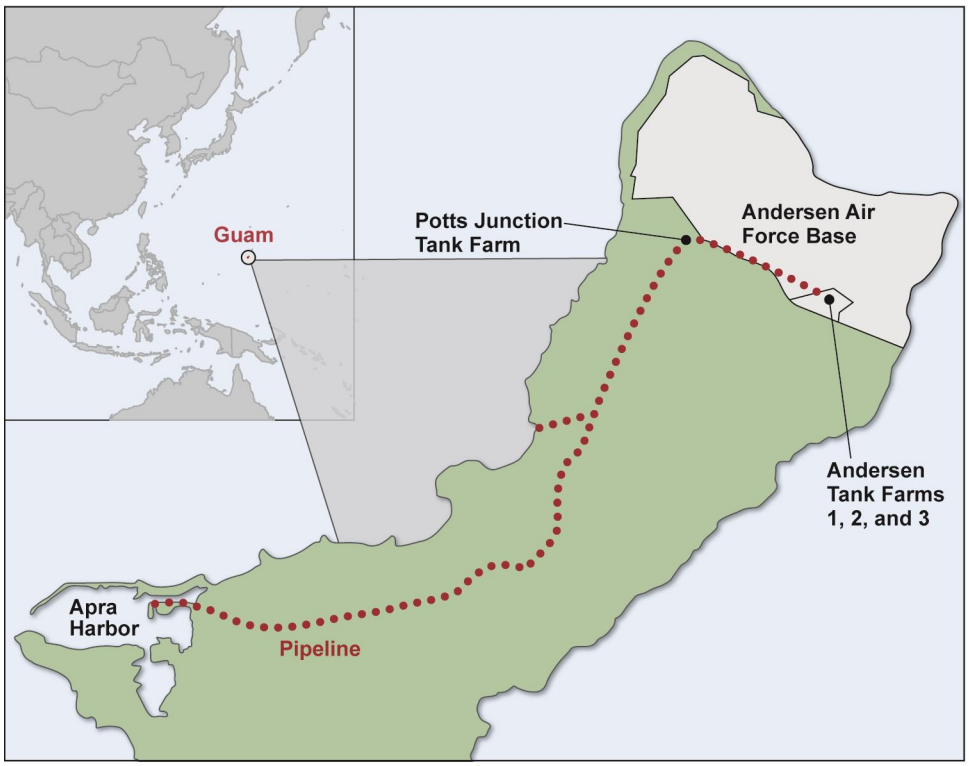
[64]Archival sources we reviewed did not provide information on the cargo that was loaded on these vessels after they arrived in Southeast Asia and began their return voyages to domestic U.S. ports. Additionally, logbooks do not provide information about whether cargo was moved onto or off of vessels at any port calls during these voyages.

Vietnam after 1961. During our visit, officials at Andersen Air Force Base stated that it would have been possible to fly 55-gallon drums from Guam to supply operations in Vietnam, but that such an action would have been an inefficient method of transporting large quantities of herbicides. Agent Orange weighed approximately 600 pounds per drum, or about 11 pounds per gallon, a weight that, according to a 1966 memorandum from the Military Assistance Command, Vietnam, would have precluded large-scale transport of the herbicide by aircraft.

DOD Documents Identify the Use of Commercial but Not Tactical Herbicides on Guam

Available records show that DOD stored and used commercial herbicides on Guam, possibly including those containing n-butyl 2,4,5-T, during the 1960s and 1970s, but documents do not indicate the use of tactical herbicides on Guam. Commercial herbicides were available through the federal supply system for use on U.S. military installations worldwide. For example, the fuel supply for Andersen Air Force Base was delivered by ship to the port at Naval Base Guam and was then delivered to the Air Force base by a cross-island fuel pipeline—see figure 11. A detailed 1968 report by the Naval Supply Depot states that the Public Works Center sprayed herbicides semi-annually to control the vegetation along fuel pipelines between the depot and Andersen Air Force Base.

Figure 11: Fuel Pipeline from Naval Base Guam to Andersen Air Force Base in 1968



Source: GAO analysis of Department of Defense data; Map Resources (map). | GAO-19-24

Note: Document entitled, “Condition of Naval Supply Depot” (June 1968).

Additionally, draft environmental assessments written in 1999 and 2009 by Naval Facilities Engineering Command, Pacific, indicate that commercial herbicides containing 2,4-D were present on Guam, and that commercial herbicides containing 2,4,5-T, which included the contaminant 2,3,7,8-TCDD, had been used for weed control along power lines and substations through 1980. Further, a 1969 master storage plan for the Naval Supply Depot includes sketches of storage facilities that specify the location of weed killers. Commercial herbicides approved for DOD procurement for use on installations were issued in 55-gallon drums and 5-gallon containers during the Vietnam War era, as were a range of other products, such as fuel oil and diesel. According to DOD officials, records for such purchases were not typically retained due to short record retention policies related to such routine supply transactions.

During the course of our review, we received photographs and written statements from veterans alleging the presence of Agent Orange on Guam. However, based on our discussion sessions with veterans and

civilians and our review of this documentation, we could not substantiate the presence or use of Agent Orange or other tactical herbicides on Guam. We asked veterans in our six discussion sessions about their potential for exposure to Agent Orange and where, if, and how they believe they were exposed. In their responses, some veterans in each of the six discussion sessions stated that they believe they were exposed to Agent Orange while deployed in Vietnam or other areas where a presumption of service for benefits has already been granted, while some veterans in three of the six discussion sessions stated that they believe they were exposed to Agent Orange while stationed on Guam. Specifically, some veterans in our discussion sessions described using herbicides or witnessing the spraying of herbicides at locations on Andersen Air Force Base and along the pipeline, as well as the burning of contaminated fuel as part of firefighting training on the installation. As we previously stated, according to DOD officials and archived military specifications, tactical herbicides were not authorized or available for use on lands owned by, or otherwise managed as military installations. However, commercial herbicides were widely available worldwide for use in vegetation management at military installations, to include controlling vegetation adjacent to flightlines or along perimeter fencing.

Selected Comments by Veterans at Discussion Sessions Moderated by GAO Regarding Where They Believe They Were Exposed to Agent Orange or Its Components

- I feel like I was exposed on Guam. I was [on] temporary duty there during the conflict and my duties were as a squadron controller that worked the schedules for the B-52 Bombers on Guam. I did venture into the loading area because I was with the aircrew on the Navy field at Andersen Air Force Base.
- I thought I was in contact with Agent Orange in Guam loading bombs in sites. We would move from one site to another and they would spray those areas before we got there. I never saw spraying but could smell it. One time I was near that and I broke out in boils and blisters on my face and arms.
- I was a fuel specialist [and] I witnessed spraying going on at the barracks at Marbo Annex, 2 to 3 miles off the main Air Force base. It was sprayed all around the barracks. As my job, I worked at POL [fuels]—where they stored all of the 55-gallon drums—fuels, pesticides, herbicides—in bulk storage. Those were constantly sprayed around—for maintenance and fire safety. Also, I would work on the flightline and at the pump houses—these were about 20 yards from the security fence. As I was working there, I witnessed spraying.

Source: Comments from veterans during GAO's facilitated discussions at moderated discussion sessions. | GAO-19-24.

Note: We documented, as closely as possible, the actual comments made by veterans and civilians at the six moderated discussion sessions held from December 2017 to March 2018. We did not edit their comments to further clarify the information provided. The views of these veterans are not generalizable to all veterans, but they provide illustrative examples of comments that we heard. The veterans' comments also do not necessarily reflect GAO conclusions contained in this report.

DOD's List of Herbicide Testing and Storage Locations Is Incomplete, and Veterans Have Expressed Confusion about How to Obtain Information on Potential Exposure

DOD's official compilation of herbicide testing and storage locations outside of Vietnam, which is posted on the VA's website, is inaccurate and incomplete, and DOD does not have a process for managing the list. Further, while DOD and VA each have methods for communicating information to veterans and the public about Agent Orange, they do not have a formal process for communicating the most accurate available information to veterans about potential locations where they could have been exposed to Agent Orange or other tactical herbicides.

DOD's List of Locations Where Herbicides Were Tested and Stored Is Inaccurate and Incomplete

DOD developed a list that identifies locations and dates where herbicides, including Agent Orange, are thought to have been tested and stored outside of Vietnam, which VA has made publicly available on its website, but this list is neither accurate nor complete. DOD's list includes information on testing and storage locations, applicable dates, the herbicide or herbicide components tested, a description of the project, and DOD's involvement. See appendix IV for the list that was posted on the VA website as of September 2018. When we began this review, DOD and VA officials were unable to identify the origin of the DOD list that is posted on the VA website, which does not have a date. A DOD official subsequently informed us that the list was initially created in 2003 by an individual in the Office of the Secretary of Defense in response to a congressional inquiry about the use of Vietnam-era herbicides at specific locations in the United States and overseas. DOD subsequently provided this list to VA, which in turn posted the information on its website. *VA's Claims Adjudication Procedures Manual* related to Agent Orange directs VA officials to review the DOD list to determine whether herbicides were used as claimed as part of verifying potential herbicide exposure when a veteran alleges exposure at locations other than the Republic of Vietnam,

the Korean demilitarized zone, or Thailand.[65] However, in our review of several sources provided by DOD and VA officials,[66] we identified multiple examples of inaccurate and incomplete information in DOD's list, to include the following:[67]

- **Omission of specific testing and storage locations:** We identified additional testing and storage locations in the United States and its territories that were not included on DOD's list.[68] For instance, we identified additional testing locations at Belle Glade, Florida, and Stuttgart, Arkansas, where researchers reported small-plot field tests of the components of Agent Orange on rice. In addition, we found examples of shipments of herbicides to Kelly Air Force Base, Texas, where Agent Orange components were stored following the cancellation of tactical herbicide contracts. None of these locations are included on DOD's list.
- **Lack of clarity in descriptive information:** DOD's list lacks clarity in descriptive information, making it difficult to identify which specific herbicides or components were tested and stored, as well as when and where. For example, the size and scope of some testing activities are unclear from the descriptions provided in DOD's list, making it difficult to differentiate between small-scale and large-scale testing. Some testing events on DOD's list are described in detail, including the amount of herbicide or components tested, while descriptions of other testing activities contain little information about what took place. Furthermore, we could not identify the chemical components of some of the agents on DOD's list. We asked DOD and VA officials to

[65]VA Claims Adjudication Procedures Manual, M21-1, part IV, subpart ii, ch. 1, sec. H, *Developing Claims for Service Connection (SC) Based on Herbicide Exposure* (change date Mar. 27, 2018).

[66]We reviewed, for example, the proceedings of three defoliation conferences; archives search reports and other environmental studies for several Army, Air Force, and Navy installations; contractor studies; and other historical documents related to the development and testing of tactical herbicides, including Agent Orange.

[67]We did not attempt to recreate the DOD list or perform a comprehensive update of its contents; therefore, there may be other locations and testing events that are not reflected above.

[68]While we did not work to identify every location, in our research we found at least 30 testing and storage locations that were not included. Of these locations, 20 were identified in a report prepared for DOD in 2006, and we identified an additional 9 locations that were neither in the 2006 report nor on the list on VA's website. Our research also indicated that this list did not include, among the storage locations, the manufacturing sites, nor did it include all of the ports from which Agent Orange was shipped to Southeast Asia.

identify those specific agents for us, and they were unable to do so. Specifically, neither DOD nor VA officials could identify the chemical composition of 26 different agents on the DOD list, making it difficult to determine whether these agents should be included on the list.[69]

- **Omission of additional time periods for identified locations:** We identified additional testing events of Agent Orange or its components at locations that are on the DOD list but that cover additional time periods not reflected on the list. For instance, the DOD list identified testing that took place at Aberdeen Proving Grounds, Maryland, in July 1969. However, our review uncovered additional testing events that took place at Aberdeen Proving Grounds in 1963, 1965, and 1966.[70]

In addition to the lack of clarity and omissions that we identified, reports commissioned by DOD and VA since 2003 have also identified omissions in the list. For example, a report prepared for DOD in 2006 identified 40 different locations where Agent Orange was tested or stored outside of Vietnam.[71] However, during our review, we found several examples of locations in the United States and its territories that were included in that 2006 report but are not included on the DOD list that is currently posted on the VA website. These include locations in Arkansas, California, New Jersey, New York, Maryland, Ohio, Oregon, Puerto Rico, Texas, and

[69]The DOD list also included a biological agent called stem rust of wheat that is not an herbicide. Amiendo and V-C 3-173 are two examples of agents on the list that neither DOD nor VA officials could identify.

[70]We did not work to identify every instance where there were additional testing events at every location on DOD's list. We refer to the testing at Aberdeen Proving Grounds as an illustration of incomplete information in DOD's list. In addition to the testing events at Aberdeen Proving Grounds, archival sources show that there was application of 2,4,5-T; 2,4-D; and other commercial herbicides continuing into the 1970s as part of the installation's vegetation management.

[71]Alvin Young, *The History of the US Department of Defense Programs for the Testing, Evaluation, and Storage of Tactical Herbicides* (Cheyenne, WY: December 2006). This report was prepared for DOD and, according to a DOD official, has not been publicly released. We did not perform an independent assessment of the information on site locations and dates in this report, using archival sources, nor did we evaluate the potential that a veteran could have been exposed at those locations.

Utah.[72] Similarly, a report prepared for VA in May 2013 described locations where Agent Orange exposure to Vietnam-era veterans has been alleged.[73] This report summarized additional sites where veterans alleged Agent Orange was used, stored, or destroyed. It also included an assessment of the DOD information posted on the VA's website—and indicated, notably, that information had not changed since the 2006 report to DOD. In the assessment, the report identified that the list contained many errors of dates, chemicals, locations, and the governmental agencies or institutions responsible for conducting the tests or military operations. The report suggested specific criteria for validating the presence of a tactical herbicide at a site, including evidence that a veteran actually came into contact with a tactical herbicide at that site.[74]

Even though they have received reports dating back more than a decade that identified issues with the accuracy and completeness of the list, neither DOD nor VA has taken steps to validate or correct the list, or to develop the criteria they would use to determine which locations and dates to include on the list. As previously stated, this list is posted on the VA's Agent Orange website as a primary source for veterans seeking information on Agent Orange. Despite its inconsistencies, the list can be accessed from multiple places on the VA website, and we found that some veterans service organizations and other groups also post this incomplete and inaccurate list of testing and storage sites on their websites, as well as communicate this information to their members. *Standards for Internal Control in the Federal Government* state that

[72]Locations that were included in the 2006 report but are not included on the list on the VA website include: Dugway, Utah; Middleport, New York; Preston, Maryland; Llano, Texas; Refugio, Texas; Victoria, Texas; Carlos, Texas; Livingston, Texas; Maricao, Puerto Rico; Guajataca, Puerto Rico; Toro Negro, Puerto Rico; El Verde, Puerto Rico; Jimenez, Puerto Rico; Garden City, Kansas; Corvallis, Oregon; Pullman, Washington; Bound-Brook, New Jersey; Painesville, Ohio; Jacksonville, Arkansas; and Van Nuys, California. Note that the list in the 2006 report contained additional time periods for some locations that also were not included on DOD's list on the VA website.

[73]Alvin Young, *Investigations into Sites Where Agent Orange Exposure to Vietnam-Era Veterans Has Been Alleged* (Cheyenne, WY: May 2013). This report was prepared for VA and, according to VA officials, has not been publicly released.

[74]We did not perform an independent assessment of the information on site locations and dates in this report, using archival sources, nor did we evaluate the criteria that the report proposes DOD and VA use in determining the presence of Agent Orange, or the potential that a veteran could have been exposed at those locations. We mention the 2006 and 2013 reports to illustrate that both DOD and VA were aware that the list on the VA website was inaccurate and incomplete, but have not taken steps to update the list.

agencies should use quality information to achieve their objectives.[75] We found and DOD officials agreed that DOD's list was not as accurate or complete as available records would allow because (1) there are not clearly identified responsibilities for validating the information on this list, (2) there is no process for updating the list as needed, and (3) criteria have not been developed and used to determine which locations and dates to include on the list.

Until recently, neither DOD nor VA has taken responsibility for ensuring the accuracy and completeness of the list, which is being provided to veterans and the public on the VA website. Federal internal control standards state that management should establish an organizational structure, assign responsibility, and delegate authority to achieve the entity's objectives.[76] As noted earlier, DOD and VA officials were initially unable to identify the source or date of this list, and neither agency took action to respond to reports about the problems with it. During the course of our review, DOD took some initial steps to begin validating the accuracy and completeness of information on its list by reviewing primary source records for additional locations and events of herbicide testing and storage. However, thus far in its efforts, DOD has not identified responsibilities for completing the validation of the information included on the list, nor has it established a process for updating the list as any new information becomes available.

Moreover, it remains unclear whether DOD's review will cover all locations, including non-DOD sites, where testing and storage of Agent Orange or its components were thought to have occurred, or if it will focus only on U.S. military installations. Private companies, academic institutions, and other federal agencies were involved in the testing of herbicides at some of the non-DOD sites on the list, and, in some of those cases, Army personnel were involved in the testing at the non-DOD locations. For instance, testing was performed by DOD personnel at non-DOD locations in Georgia and Tennessee in the 1960s. Some non-DOD storage locations included various U.S. commercial ports, such as Mobile, Alabama, where Agent Orange was transferred by rail from the manufacturers to be stored until it was loaded onto vessels for shipment to Vietnam. According to a DOD official, DOD's priority in its review of

[75]GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: September 2014).

[76]GAO-14-704G.

testing and storage locations is to focus on DOD installations. Although this official told us that the department expects to eventually identify non-DOD locations where the department was involved in herbicide testing and/ or storage through collaboration or funding, the official was not able to provide information on the time frames for conducting this review. Finally, DOD has not established a process for how this list will be updated once it has been validated and revised, when and if new information about Agent Orange testing and storage locations is identified.

In our analysis of the DOD list, we were also unable to determine the criteria that DOD initially used to select which locations and time periods to include—particularly given that the testing varied in intensity and duration, and that the likelihood that personnel at a particular location could have been exposed to the herbicides or components was unclear. For example, some tests on the list included small laboratory experiments on a couple of plants using a very small amount of chemical agents, as in bench tests of various compounds at Forts Detrick and Ritchie, Maryland, in the 1950s, while other tests included gallons of Agent Orange or other chemical agent components that were used in field testing trials or to test aerial spraying, as in a defoliation effort in which 13 drums were sprayed by helicopter over an area covering 4 square miles. Similarly, the duration of testing events could have been over a total of 3 days, as with spray testing in Marathon, Florida, or over several months or even years, as with spray testing of several tactical herbicides at Eglin Air Force Base, Florida. Because of the variance in the size and duration of testing events; the specific areas where the testing events took place at the locations; and the number of personnel who actually came into contact with the chemical agents during the testing, the presence of a location on this list does not clearly indicate the likelihood or extent of potential exposure that individuals not involved would have had if they were simply present at the locations on the list at the times indicated.

In May 2018, during the course of our review, a DOD official noted that DOD and VA formed a joint Herbicide Orange Working Group to address the issues with the DOD list and identify criteria for including information on this list. This group held its first meeting on May 31, 2018. As of July 2018, a DOD official noted that the group was working to identify appropriate steps to take, but that it was too soon to report specific actions that were being implemented, and that no documentation on the group’s efforts was available.

Without assigned responsibility for ensuring an accurate and complete list of locations where Agent Orange or its components were tested and stored; a process for updating the list as needed; and clearly defined and transparent criteria for what to include on this list, DOD will not have reasonable assurance that it has identified the most complete information possible for VA to use when informing veterans and the public of the full extent of locations where Agent Orange exposure could potentially have occurred. As a result, veterans may not have complete information about the risk that they could have been exposed to Agent Orange during their military service, and VA may not have quality information when making important decisions on claims for veterans who may not be eligible for benefits.

DOD and VA Have Communicated with Veterans and Others about Potential Exposure to Agent Orange, but Veterans Have Expressed Confusion Regarding How to Obtain Needed Information

Both DOD and VA have communicated with veterans in response to inquiries about Agent Orange, but veterans have expressed confusion regarding how to obtain information to determine their potential exposure to Agent Orange. Further adding to this confusion are inconsistencies in the list of testing and storage locations, as discussed above. As the agency responsible for reviewing and validating veterans' disability compensation claims for possible Agent Orange exposure, VA communicates with veterans largely through the agency's website, which contains information on Agent Orange regarding related diseases, benefits, exposure locations, and resources. The VA also communicates through other means, including an annual newsletter and forums with veterans service organizations. DOD also receives inquiries from veterans about the potential that they could have been exposed to Agent Orange at DOD installations outside of Vietnam. In addition, DOD receives Freedom of Information Act inquiries and congressional requests for information on where Agent Orange was present. A DOD official stated that while they will respond to veterans' inquiries, they typically direct veterans with Agent Orange inquiries to VA.

In responding to these inquiries, both DOD and VA officials stated that they rely on the expertise of staff at the Armed Forces Pest Management Board to provide details to answer questions related to locations where exposure might have occurred. According to a DOD official, the board received 109 inquiries in 2017 alone. In addition, DOD's Joint Services

Records Research Center provides information to VA regional liaisons electronically in response to their questions about where and when specific units were stationed or on temporary duty. The center extracts operational records from various record repositories and, if the information is available, corroborates the descriptions of incidents described by veterans in their claims. According to DOD officials, unless an herbicide-related incident was documented in some sort of unit record, the center would not have information on where Agent Orange was present.

Despite these various approaches for communicating information to veterans and the public, veterans we spoke with expressed confusion as to where to obtain information on their potential exposure to Agent Orange. Specifically, we asked veterans in our six discussion sessions about what they had heard from DOD, VA, or other federal agencies about the potential that they could have been exposed to Agent Orange or its components at locations where Agent Orange was manufactured, transported, stored, used, or destroyed. Veterans in each of the six sessions stated that, generally, the federal government has not reached out to them regarding Agent Orange, but that they instead have relied on their own research to learn more about their potential for having been exposed, adding to the confusion about where to obtain information on Agent Orange exposure. Other veterans, however, stated that they have received information from VA regarding potential exposure. DOD officials acknowledged that there is confusion among veterans about a variety of issues related to their potential for exposure to Agent Orange, including where to go for information. U.S. EPA and DOD officials stated that veterans are contacting multiple agencies to get information on herbicide exposure.

Selected Comments by Veterans at Discussion Sessions Moderated by GAO Regarding What They Had Heard from the Federal Government about Negative Health Effects Associated with Exposure to Herbicides, Including Agent Orange or Its Components

- I've heard things from multiple sources—media, newspaper, television, people themselves. It has mainly been from my own research, not from a federal agency.
- Just based on the fact that I have heart disease and going through the VA process means I receive updates from VA on just about everything going on, including Agent Orange and all of the research they have done. I do know the Secretary is authorized by law from Congress late last year to add additional presumptive diseases associated with Agent Orange and how one would contract that.
- I had to do the research myself. It seems to be a secret with information coming out in spurts. When you have things happen to your body, they [the Department of Veterans Affairs] say it is not service connected. Sometimes when the government tries to explain something, they don't give the whole thing and they give it piecemeal. It does not carry any essence of importance.
- I am not hearing anything from the federal government. Most of the information I get is from a USveterans.com website and I subscribe to a daily newsletter from the Vietnam Veterans of America and the Veterans of Foreign Wars.
- There is information on the VA website about conditions attributed to Agent Orange In that context, I went to the VA website and found that there are 21 states where Agent Orange was used, including on Hawaii in Kauai. It is because of this list that I became aware that people in Hawaii may have been exposed to Agent Orange. I learned that such exposure might increase the likelihood of having diabetes or cancer. I believe the list is still on the VA website and that there is also a list of units that were possibly exposed to Agent Orange.
- I have not been contacted by any government agency with regard to Agent Orange exposure or ill health. I first heard about Agent Orange and dioxin and cancer related issues/illnesses in late 1980s or early 1990s and later on after doing own research.

Source: Comments from veterans during GAO's facilitated discussions at moderated discussion sessions. | GAO-19-24.

Note: We documented, as closely as possible, the actual comments made by veterans and civilians at the six moderated discussion sessions held from December 2017 to March 2018. We did not edit their comments to further clarify the information provided. The views of these veterans are not generalizable to all veterans, but they provide illustrative examples of comments that we heard. The veterans' comments also do not necessarily reflect GAO conclusions contained in this report.

Standards for Internal Control in the Federal Government state that management should internally and externally communicate the necessary quality information to achieve an entity's objectives. The standard further states that management should evaluate the entity's methods of communication so that the organization has the appropriate tools to communicate quality information throughout the entity on a timely basis.[77] Additionally, DOD issued guidance in June 2017 establishing procedures for DOD components to implement when there is a scientifically plausible likelihood of a significant long-term health risk from a past environmental exposure to military personnel or civilians resulting from living or working

[77]GAO-14-704G.

on military installations.[78] Even though the testing and storage of Agent Orange and its components occurred several decades ago, this instruction states that DOD components should provide targeted and effective health risk communication early and continuously, as new and credible information becomes available.

However, DOD and VA officials stated that they have not developed a formal process for coordinating on how best to communicate information to veterans and the public regarding the presence of Agent Orange at locations outside of Vietnam. Officials stated that the DOD-VA Deployment Health Working Group—an existing forum for exchanging information—meets monthly to discuss health issues, including those related to Agent Orange. However, the working group is not focused on ensuring the availability and distribution of information on Agent Orange testing and storage locations. DOD's and VA's joint Herbicide Orange Working Group has the potential for being an effective forum for communicating this information; however, a DOD official noted that this is an ad hoc group, and as we discussed earlier, it has not yet determined the direction it will be taking for communicating with veterans regarding exposure to Agent Orange. By coordinating on how best to communicate this information, VA would be better positioned to provide veterans with information regarding their potential exposure to Agent Orange at locations where Agent Orange was known to have been present outside of Vietnam.

[78]DOD Instruction 6055.20, *Assessment of Significant Long-Term Health Risks from Past Environmental Exposures on Military Installations* (June 6, 2017). This instruction does not apply to occupational exposure, which DOD defines as contact with a chemical, biological, or physical hazard occurring in the workplace as covered by DOD Instructions 6055.05 and 6490.03. Rather, DOD Instruction 6055.20 focuses on past environmental exposure, which DOD defines as contact with a chemical, biological, or physical hazard in the ambient environment that existed in, or occurred during, a time before the present. According to DOD officials, occupational exposure could have occurred if an individual were testing or applying a tactical herbicide, whereas environmental exposure could have occurred if an individual walked through a field after it had been sprayed.

Challenges Exist with Testing for Agent Orange Today Due to Degradation and Multiple Sources of Potential Contamination

Testing to determine whether Agent Orange was present in a particular location is challenging because, for example, derivatives of Agent Orange—including the two components of Agent Orange (n-butyl 2,4-D and n-butyl 2,4,5-T) and the contaminant from the 2,4,5-T manufacturing process (2,3,7,8-TCDD)—degrade over time, and because derivatives of 2,4-D and 2,4,5-T can come from multiple sources. Regardless of these challenges, in response to a request by the Government of Guam, DOD developed a testing plan that was reviewed and accepted by U.S. EPA and Guam EPA to conduct a limited investigation into alleged Agent Orange use at three sites on Guam.

Testing for Agent Orange Presents Challenges Due to Degradation and Multiple Sources of Potential Contamination

Challenges Due to Degradation

Testing to identify locations where Agent Orange may have been present is challenging because the components of Agent Orange degrade over time. It has been nearly 50 years since Agent Orange was last transported and used in support of military operations in Vietnam. According to scientific research, it is difficult to find traces of the two components of Agent Orange—n-butyl 2,4-D and n-butyl 2,4,5-T—because, under normal environmental conditions, the n-butyl forms break down rapidly into the acid forms.[79] Scientific research indicates that the half-lives of the acid forms of the chemical components 2,4-D and 2,4,5-T in soil can range from several days to many months, depending on

[79]U.S. Department of Agriculture, Forest Service, *2,4-D Human Health and Ecological Risk Assessment Final Report*, (Arlington, Va., Sept. 30, 2006); National Library of Medicine Toxicology Data Network, *2,4,5-T, N-Butyl Ester*, accessed November 1, 2018, https://toxnet.nlm.nih.gov/cgi-bin/sis/search/a?dbs+hsdb:@term+@DOCNO+4494. The EPA method used for testing samples includes a step that converts herbicide esters into the acid forms of 2,4-D and 2,4,5-T prior to analysis.

conditions.[80] The World Health Organization has stated that the half-life of 2,4-D in soil is reported to range from 4 to 7 days in most soil types. According to the Centers for Disease Control and Prevention, the half-life of 2,4,5-T in soil varies with conditions, ranging from several weeks to many months.[81] In addition, when Agent Orange is sprayed for defoliation, there are several things that can happen to it. For example, it can be washed out by rain, degrade in the presence of sunlight (photodegradation), or slowly turn into a vapor (volatize) from surfaces such as foliage. These factors reduce the chances of finding traces of Agent Orange components after 50 years.

The amount of time it takes for the contaminant 2,3,7,8-TCDD to degrade is longer than that for the components of Agent Orange, although estimates vary. For example, according to the research cited by the Agency for Toxic Substances and Disease Registry, the half-life of 2,3,7,8-TCDD is approximately 9 to 15 years in surface soil and 25 to 100 years in subsurface soil.[82] Further, 2,3,7,8-TCDD breaks down quickly when exposed to sunlight, providing one explanation for the shorter half-life in surface soil.[83] Any 2,3,7,8-TCDD contamination from herbicide spraying—as opposed to being spilled onto the soil—would generally be expected to be found in surface soil, where it would be exposed to degradation due to sunlight. This reduces the likelihood of detecting this compound 50 years later. However, as discussed below, there are multiple sources of dioxins, including 2,3,7,8-TCDD, and the specific source of dioxin contamination is difficult to identify.

[80]A half-life is the time it takes for a certain amount of an herbicide to be reduced by half, which occurs as it dissipates or breaks down in the environment.

[81]World Health Organization, *2,4-D in Drinking-water: Background document for development of WHO Guidelines for Drinking-water Quality* (Geneva, Switzerland: 2003); Centers for Disease Control and Prevention, *Biomonitoring Summary: 2,4,5-Trichlorophenoxyacetic Acid*, CAS No. 93-76-5, 2016.

[82]Agency for Toxic Substances and Disease Registry, *Toxicological Profile for Chlorinated Dibenzo-p-dioxins* (Atlanta, G.A.: December 1998), citing D.J. Paustenbach, R.J. Wenning, V. Lau, et al., 1992. Recent developments on the hazards posed by 2,3,7,8-tetrachlorodibenzo-p-dioxin in soil: Implications for setting risk-based cleanup levels at residential and industrial sites. J Toxicol Environ Health 36(2):103-150.

[83]D. G. Crosby and A. S. Wong, “Environmental Degradation of 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD),” *Science*, New Series, vol. 195, no. 4284 (Mar. 25, 1977).

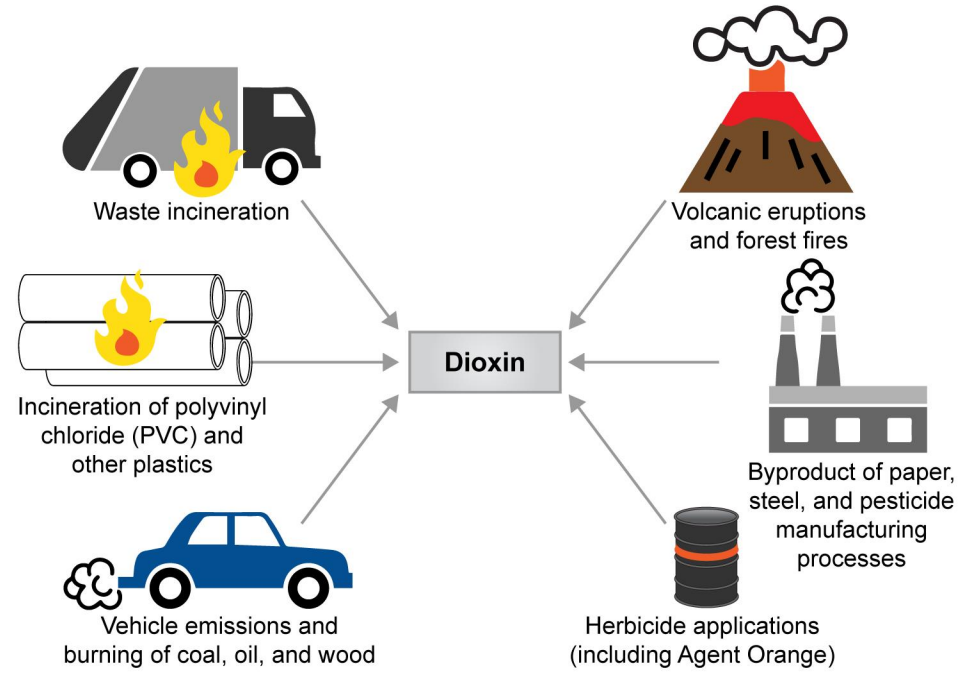
Challenges Due to Multiple Sources of Potential Contamination

Testing to identify locations where Agent Orange may have been present is challenging because there are multiple sources of 2,4-D and 2,4,5-T derivatives as well as multiple sources of the contaminant, 2,3,7,8-TCDD. Specifically, many commercial herbicides that were available at the time Agent Orange was used contained derivatives of 2,4-D; 2,4,5-T; or both. Additionally, 2,4-D derivatives are still used in commercial herbicides today. Therefore, even if testing were to show the presence of one of the two components of Agent Orange, it would be difficult to distinguish whether the chemicals were present from the use of commercial herbicides or the use of tactical herbicides. Further, because 2,4-D is still used in many commonly used herbicides sold today, the presence of this component could be due to a recent use of a commercial herbicide rather than a tactical herbicide used decades ago.

Moreover, multiple sources of the contaminant 2,3,7,8-TCDD can be found in the environment today. DOD and U.S. EPA officials told us that if 2,3,7,8-TCDD is found in soil today, the source of the dioxin contamination could be a result of other sources besides Agent Orange. For example, according to the World Health Organization, dioxins—including 2,3,7,8-TCDD—are primarily released to the environment with the burning of materials such as wood and waste (see figure 12).[84]

[84]World Health Organization, *Dioxins and Their Effects on Human Health Fact Sheet* (Updated October 2016).

Figure 12: Examples of Sources That Contribute to the Presence of Dioxins in the Environment



Source: GAO analysis of various sources. | GAO-19-24

Testing for the Components of Agent Orange on Guam Is Challenging

In 2017 the Government of Guam coordinated with DOD to test for Agent Orange and other tactical herbicides at Andersen Air Force Base due to claims from veterans that they were exposed to Agent Orange while stationed on Guam during the 1960s and 1970s. In December 2017 DOD developed a draft testing plan in collaboration with U.S. EPA and Guam EPA to test for the acid form of the components 2,4-D and 2,4,5-T at three different sites on Andersen Air Force Base. The draft testing plan did not include testing for the presence of 2,3,7,8-TCDD. According to DOD and U.S. EPA officials, they are not testing for 2,3,7,8-TCDD because the test would not be able to conclusively link any positive results to the use of tactical herbicides, given that dioxins are also produced by, among other things, burning fossil fuels. These officials noted that, over time, large quantities of fuel have been burned at Andersen Air Force Base, and they stated their belief that if 2,3,7,8-TCDD were found, the likely source would be from combustion. The areas

identified for testing included the fuel pipeline, a perimeter fenceline, and an area near some fuel storage tanks. See figure 13 for a photograph of the fenceline testing site near the fuel storage tanks on Andersen Air Force Base.

Figure 13: Fenceline Testing Site Near the Fuel Storage Tanks at Andersen Air Force Base, Guam

Source: GAO. | GAO-19-24

Based on our initial review of the draft testing plan and a review of the scientific literature, we identified and discussed with DOD and U.S. EPA officials some challenges the two agencies would face in detecting the presence of Agent Orange on Guam due to two factors: (1) the short amount of time that it takes for 2,4-D and 2,4,5-T to degrade; and (2) the inability of testing to determine whether the presence of 2,4-D and 2,4,5-T is attributable to the use of Agent Orange or to some other source.

- Degradation of 2,4-D and 2,4,5-T: DOD officials and the jointly developed draft testing plan acknowledged that the planned testing would not be able to confirm the presence of Agent Orange, given that the components degrade over time. The draft testing plan indicates that the maximum half-lives of 2,4-D and 2,4,5-T are 14 days and 24 days, respectively, in soil and groundwater. Even given the possible variation in half-lives discussed above, it is likely that no detectable concentrations remain in soil today, given that the alleged period of use on Guam was in the 1960s and 1970s.
- Inability to distinguish whether the presence of 2,4-D and 2,4,5-T is attributable to the use of Agent Orange or some other source: Even if

the results were to confirm the presence of either 2,4-D or 2,4,5-T in any form, it would be difficult to distinguish the source of the chemical, and whether its presence was attributable to the use of Agent Orange or some other source. For example, 2,4-D is still in use today, and 2,4,5-T was used in both tactical and commercial herbicides during the 1960s. In addition, if the components were found, the interpretation of those results could be complicated by, for example, natural variability in the potential half-lives and the possibility of more recent use of banned products. Further, the testing protocol will convert all forms of 2,4-D and 2,4,5-T, including the ester forms, to the acid forms, further complicating any attempt to identify the source of the compounds.[85]

We discussed with cognizant officials the challenges that we identified in the draft testing plan to determine how the information from the testing would be used to inform U.S. EPA, DOD, veterans, and the public about whether Agent Orange was present on Andersen Air Force Base. DOD officials subsequently stated that the questions raised by us and internally within DOD led them to reconsider the approach for testing for Agent Orange on Guam. For example, in December 2017, DOD officials told us that they would begin testing for Agent Orange and other tactical herbicides in March 2018. In late March 2018, a DOD official noted that the department had placed the testing on hold until they were certain that the methodology to be employed would meet scientific rigor and could be replicated in future testing efforts at other locations. In April 2018, DOD officials told us that the contract execution took longer than anticipated, and that soil sample testing would commence that month.

In April 2018, DOD provided us with a copy of the final plan that was reviewed and approved by U.S. EPA and Guam EPA and was used to test for Agent Orange and other tactical herbicides at Andersen Air Force Base. When we reviewed the final testing plan and compared it with the draft previously provided, we found that some of the challenges we had initially identified in the draft testing plan, as described above, were still

[85]The original version of Agent Orange consisted of the n-butyl ester forms of 2,4-D and 2,4,5-T. As noted earlier, a later version of Agent Orange (II) consisted of the n-butyl ester form of 2,4-D and the isooctyl ester form of 2,4,5-T. The ester form of the chemicals breaks down into 2,4-D and 2,4,5-T when it undergoes a reaction with water. Herbicide esters generally have a half-life of less than one week in soil. The draft testing plan called for testing for the acid forms of 2,4-D and 2,4,5-T rather than the ester forms that were present in Agent Orange. According to DOD officials, sampling parameters and methodology address all of the tactical or non-tactical forms or mixtures and will return a single value for 2,4-D and for 2,4,5-T without regard to the form.

present. For example, based on our review of the final testing plan, with the proposed testing methodology, it would be difficult to determine if 2,4-D and 2,4,5-T came from Agent Orange or another source, and there were inconsistencies in the reported half-lives of the components of Agent Orange. At the same time, both DOD and U.S. EPA officials questioned the ability of any testing for 2,4-D or 2,4,5-T on Andersen Air Force Base to either confirm or deny the presence of Agent Orange on Guam. Specifically, the final testing plan states that more than 50 years have passed since the period of alleged use, and that a lack of detection provides no evidence that herbicides were not used historically. Moreover, U.S. EPA officials noted that the testing on Guam would not provide definitive proof of Agent Orange use on the island. Although DOD officials recognized these challenges and acknowledged the low probability of conclusively identifying the components of Agent Orange, they decided to move forward with testing to address veterans' and the public's concerns.

In April 2018, samples were collected from the three areas at Andersen Air Force Base, according to DOD officials. Each sample was divided following procedures outlined in the final testing plan, resulting in two identical sample sets. A sample set was sent to two independent laboratories for analysis. According to officials from DOD and U.S. EPA, test results and associated quality control reports from both laboratories agreed on the results from two of the area samples, but did not agree on the third area sample. The jointly developed decision rules for the sampling and analysis plan required the results from both laboratories to agree in order to draw a conclusion on the presence or absence of Agent Orange. As a result, according to the officials, the DOD, U.S. EPA, and Guam EPA project team agreed in July 2018 to resample the one area where the two labs reported differing results. The project team is updating the sampling and analysis plan to address the various possible reasons for the differing laboratory results in order to provide a conclusive final testing result. DOD officials told us they do not anticipate completing the updates for the sampling and analysis plan, field sampling, analysis, and reporting until early 2019. As such, we were not able to comment on the results of the final testing in this report. Moreover, DOD officials said that, provided the final resampling results are negative, DOD does not have plans to conduct additional testing, because the testing was conducted in areas alleged to be the likeliest locations for the application of Agent Orange. However, an official from U.S. EPA said that the challenges associated with testing on Guam are not insurmountable and that the agency would like to continue this investigation. Given that (1) DOD, working with U.S. EPA and Guam EPA, made a decision to test for Agent

Orange and other tactical herbicides; (2) DOD, U.S. EPA, and Guam EPA recognize the limitations associated with the testing; (3) the testing and analysis of results are still on-going; and (4) there is currently uncertainty regarding whether any additional testing will take place on Guam, we are not making any recommendations with respect to the testing plan or its execution.

Conclusions

DOD suspended the use of Agent Orange in Vietnam in 1970 and incinerated remaining stockpiles at sea in 1977, but concerns about the effects of exposure in U.S. locations have persisted. DOD developed a list that identifies locations and dates where herbicides, including Agent Orange, are thought to have been tested and stored outside of Vietnam, which VA has made publicly available on its website, but this list is neither accurate nor complete. Without assigning responsibilities for verifying the accuracy of the information included on the list; a process for ensuring that the list is updated, as new information is found; and clear and transparent criteria, indicating which locations should be included on the list, DOD and VA will not have assurance that they have the most complete information possible when informing veterans and the public of the full extent of locations where Agent Orange exposure could potentially have occurred. By relying on an inaccurate list, VA may not have quality information when making important decisions on claims for veterans who might or might not be eligible for benefits. Further, while DOD and VA both communicate with veterans in response to their Agent Orange inquiries, the two agencies do not have a formal process for coordinating on how best to communicate this information. Until DOD and VA develop a process for how best to coordinate to ensure that they are communicating information, veterans and the public may not have the information needed regarding their potential exposure to Agent Orange.

Recommendations for Executive Action

We are making six recommendations: four to the Secretary of Defense and two to the Secretary of Veterans Affairs.

The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment assigns responsibility for ensuring that DOD’s list of locations where Agent Orange or its

components were tested and stored is as complete and accurate as available records allow. (Recommendation 1)

The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment develops a process for updating the revised list as new information becomes available. (Recommendation 2)

The Secretary of Defense, in collaboration with the Secretary of Veterans Affairs, should develop clear and transparent criteria for what constitutes a location that should be included on the list of testing and storage locations. (Recommendation 3)

The Secretary of Veterans Affairs, in collaboration with the Secretary of Defense, should develop clear and transparent criteria for what constitutes a location that should be included on the list of testing and storage locations. (Recommendation 4)

The Secretary of Defense, in collaboration with the Secretary of Veterans Affairs, should develop a formal process for coordinating on how best to communicate information to veterans and the public regarding where Agent Orange was known to have been present outside of Vietnam. (Recommendation 5)

The Secretary of Veterans Affairs, in collaboration with the Secretary of Defense, should develop a formal process for coordinating on how best to communicate information to veterans and the public regarding where Agent Orange was known to have been present outside of Vietnam. (Recommendation 6)

Agency Comments and Our Evaluation

We provided a draft of this report for review and comment to DOD, VA, U.S. EPA, the U.S. Department of Agriculture, and the U.S. Department of Health and Human Services. In its written comments, DOD concurred with each of our four recommendations directed to the Secretary of Defense and identified actions it plans to take to implement them. In its written comments, VA concurred with one recommendation directed to the Secretary of VA and described actions it would take to implement the recommendation. VA also non-concurred with one recommendation. In its written comments, the U.S. Department of Agriculture agreed with the report's findings related to matters under the purview of agricultural

research and programs, though we did not make any recommendations to the department. Comments from DOD, VA, and the U.S. Department of Agriculture are reprinted in their entirety in appendixes V through VII. We also received technical comments from DOD, VA, U.S. EPA, and the U.S. Department of Health and Human Services, which we incorporated as appropriate.

Based on oral comments we received from DOD, we revised our recommendation regarding the development of clear and transparent criteria for what constitutes a location that should be included on the list of testing and storage locations to clarify that DOD and VA should collaborate on this effort. VA non-concurred with this recommendation, noting that DOD chairs the Herbicide Orange Working Group that will be responsible for developing the criteria (Recommendation 4). However, VA stated that as a member of the working group, it would work collaboratively with DOD as the lead. Doing so would meet the intent of our recommendation.

In its overall written comments, VA stated that it was concerned that the report conflates the terms “commercial herbicides” with “tactical herbicides,” which the department noted were distinctive from one another. While VA stated that it does not dispute that some chemicals found in the VA regulation may be included in certain commercial herbicides, VA noted that exposure to tactical herbicides intended for military operations in Vietnam is required for VA to grant disability benefits on a presumptive basis. We recognize that the presumption for service-connection applies to exposure to tactical herbicides and nothing in our report states otherwise. VA also stated in its letter that the focus on commercial herbicides is not relevant for determining the list of locations where tactical herbicides were tested or stored. We agree and as we noted in this report, the U.S. military managed tactical herbicides used during the Vietnam War era differently from commercial herbicides in the federal supply system, which were widely available worldwide for use in vegetation management at military installations. To avoid conflating tactical and commercial herbicides, the report further notes that while some of these commercial herbicides contained 2,4-D; 2,4,5-T; or both, these commercial herbicides were not in the n-butyl form used in Agent Orange. However, commercial herbicides with 2,4,5-T likely contained some level of 2,3,7,8-TCDD. Moreover, we believe it is important to reiterate that numerous commercial herbicides that were being widely used elsewhere for agriculture purposes contained the form of 2,4,5-T found in Agent Orange and thus its associated dioxin contaminant, 2,3,7,8-TCDD.

In its overall written comments, VA also recommended that GAO analyze its list to ensure that only locations where the presence of tactical herbicides has been confirmed are included on the list of locations. It is important to note that we do not maintain a list of herbicide testing and storage locations. As we noted in this report, DOD developed a list that identifies locations and dates where herbicides, including Agent Orange and its components, are thought to have been tested and stored outside of Vietnam, which VA has made publicly available on its website.

We are sending copies of this report to the appropriate congressional addressees; the Secretaries of Defense, VA, Agriculture, and Health and Human Services; and the Administrator of U.S. EPA. In addition, the report will be available at no charge on the GAO website at http://www.gao.gov.

If you or your staff have any questions about this report, please contact Brian Lepore at (202) 512-4523 or leporeb@gao.gov or J. Alfredo Gómez at (202) 512-3841 or gomezj@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 key contributions to this report are listed in appendix VIII.

Brian J. Lepore
Director, Defense Capabilities and Management

J. Alfredo Gómez
Director, Natural Resources and Environment

List of Addressees

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

The Honorable Madeleine Z. Bordallo
Ranking Member
Subcommittee on Readiness
Committee on Armed Services
House of Representatives

The Honorable Tim Walz
Ranking Member
Committee on Veterans' Affairs
House of Representatives

The Honorable Gregorio Kilili Camacho Sablan
House of Representatives

Appendix I: Objectives, Scope, and Methodology

House Report 115–200 accompanying a bill for the National Defense Authorization Act for Fiscal Year 2018 included a provision that we review the government's handling of Agent Orange on Guam. In response to both this provision and a separate request letter, this report examines (1) the extent to which the federal government has information about the procurement, distribution, use, and disposition of Agent Orange or its components at locations in the United States and its territories, including Guam; (2) the extent to which the Department of Defense (DOD) and the Department of Veterans Affairs (VA) have complete and accurate information about where Agent Orange and its components were tested and stored and communicated this information to veterans and the public; and (3) challenges associated with testing for Agent Orange.

For objective one, we collected and reviewed available agency records and shipping documents on Agent Orange from the following sources:

- the U.S. National Archives and Records Administration;
- the U.S. National Agricultural Library;
- the U.S. Air Force Historical Research Agency at Maxwell Air Force Base, Alabama;
- staff historians at the Air Force Materiel Command at Wright-Patterson Air Force Base, Ohio, and Pacific Air Forces at Joint Base Pearl Harbor–Hickam, Hawaii;
- the Armed Forces Pest Management Board in Silver Spring, Maryland;
- the Defense Logistics Agency;
- the U.S. Army Corps of Engineers; and
- the Naval History and Heritage Command.

The records we researched and collected include published and unpublished materials on the procurement, shipment, and disposition of Agent Orange, including U.S. military correspondence, logistics reports, and Navy and merchant vessel logbooks. We reviewed DOD documents related to Agent Orange contracts to determine the total quantity of Agent

Orange that was produced by the nine manufacturers. To show how much Agent Orange was used in Vietnam, we used estimates from the National Academy of Sciences analysis of Operation Ranch Hand data. Details about the estimated quantity of Agent Orange that was destroyed in 1977 are available in public reports from DOD and the U.S. Environmental Protection Agency (U.S. EPA).[1]

We used a variety of archival sources to identify the shipping routes for Agent Orange, to include a database prepared for VA that lists records held in National Archives and Records Administration Record Group 341, which contains more than 200 boxes of unclassified records relating to tactical herbicides used in Vietnam. During our review of this record group, we identified and summarized the correspondence between and reports submitted by the U.S. military commands that managed the tactical herbicides, to identify details of tactical herbicide shipments and, to the extent that the data were available, to develop a consolidated list of shipments of Agent Orange, including vessel names, ports of embarkation and debarkation, time frames, and quantities. In some cases, individual source documents did not identify which specific tactical herbicides were being shipped. To the extent we were able, we used multiple sources to identify which shipments carried Agent Orange. For the purposes of this report, we refer to these records collectively as shipment documentation.

Using this shipment documentation, we located and obtained from several regional facilities of the National Archives and Records Administration logbooks for the vessels that we had identified as having shipped Agent Orange—hereinafter referred to as logbooks—which accounted for approximately 83 percent of the shipments we found. Logbooks that were submitted to port authorities upon the vessels' returns to the United States were consolidated at National Archives and Records Administration facilities including Fort Worth, Texas; Seattle, Washington; San Francisco and Riverside, California; New York, New York; Philadelphia, Pennsylvania; Boston, Massachusetts; Chicago, Illinois; and Atlanta, Georgia, as well as at Archives I in Washington, D.C.,

[1]We used the best available records to identify the amounts of Agent Orange we refer to in this report, but these figures should be seen as estimates.

and Archives II in College Park, Maryland.[2] These logbooks recorded basic details about each ship's operation and route, which we analyzed to identify any shipments that stopped at locations in the United States or its territories before arriving in Vietnam. Because none of the logbooks we reviewed provided detail about the specific types of cargo that were loaded onto or unloaded from the vessels, we relied on available military correspondence and reports about those vessels to identify whether the ships carried Agent Orange.

We attempted to locate the remaining 17 percent of the logbooks, or 27 shipments. Of those shipments, 3 were by foreign-flagged merchant vessels, which did not submit logbooks to U.S. ports. Working with officials from the U.S. Coast Guard, the agency that oversees the retention and archiving of logbooks, we coordinated with archivists at the Federal Records Centers to determine whether there were any unprocessed boxes of logbooks that had not yet been archived. When that effort did not turn up additional logbooks, we worked with archivists at Archives I to obtain copies of shipping articles—the articles of agreement between the captain of a ship and the seamen with respect to wages, length of time for which they are shipped, and related matters—for the remaining 24 shipments. While these documents focus on employment issues, the annotations include the locations where different personnel actions took place. We reviewed these documents to identify the locations and approximate dates of the ports of call during those voyages. We were able to obtain the shipping articles for the 24 remaining voyages, as well as for the one vessel that stopped in Guam on the way to Vietnam (SS *Gulf Shipper*) and the three that stopped in Guam on the way back (SS *Aimee Lykes*, SS *Buckeye Atlantic*, and SS *Overseas Suzanne*).[3] Using the information on voyage ending dates and ports that we obtained from the shipping articles, we were able to work with the regional archives to obtain another 21 logbooks, bringing the total number of logbooks

[2]We also contacted archivists at the regional archives in Denver, Colorado, and St. Louis, Missouri, to confirm that there were no merchant vessel logbooks from the Vietnam War era archived at their locations. The regional archives facility in Kansas City, Missouri, does not maintain logbooks prior to the 1970s but does store logbooks for some other archives facilities that have run out of room at their locations.

[3]We had previously obtained logbooks for three of these vessels and voyages—SS *Aimee Lykes*, SS *Buckeye Atlantic*, and SS *Gulf Shipper*. We obtained the logbook for the SS *Overseas Suzanne* after obtaining additional information from its shipping articles.

obtained to 152, or 96 percent of the shipments we identified.[4] We relied on the shipping article information for the remaining three voyages (excluding the shipments on the three foreign-flagged vessels) to provide some information on the routes taken by those vessels. However, one limitation of relying on shipping articles for port information and dates is that locations are mentioned only if a personnel action—such as an injury, hospitalization, or desertion—took place. If no personnel action took place at a location on a vessel's route, that port would not be listed in the shipping articles.

To obtain specific information about the SS *Gulf Shipper* voyage that stopped in Guam en route to Vietnam, to include documentation on its cargo and whether or not cargo was loaded or unloaded at the ports on the way to Vietnam, we contacted officials at several agencies.

- In Guam, we contacted the Customs and Quarantine Service, the University of Guam's Micronesian Research Center, and officials at Naval Base Guam for information on vessels that stopped in Guam during the Vietnam War era, and any cargo they carried.
- We also contacted archivists at the Federal Records Center in Seattle, Washington, where the SS *Gulf Shipper* logbook is archived, and the regional archives in Fort Worth, Texas, for additional information on the vessel itself and guidance on retaining and archiving cargo information. The National Archives had some information on the SS *Gulf Shipper*, such as sales documents and company correspondence records. However, the National Archives did not have records for the manifest or bills of lading, which may have documented any cargo offloaded from the ship.
- We contacted U.S. Customs and Border Protection for information on movements of vessels engaged in foreign trade in and out of ports, which is found in customs forms that are required to be archived after 30 years. We were unsuccessful in locating the customs forms for the SS *Gulf Shipper's* voyage to Vietnam through Guam; however, an official noted that although these records provide manifest numbers and ports of sailing, the manifests themselves are not archived.
- An online search on the SS *Gulf Shipper* through the U.S. Maritime Administration's website identified the transfer of vessel ownership

[4]The ports of call in 1 of the 21 logbooks matched the dates in the shipment documentation, but the vessel did not travel to Vietnam. For this reason, we removed this particular voyage from our list of Agent Orange shipments.

over the years. We contacted the latest company that owned the vessel to see whether the company had retained any cargo manifests or other historical records as the ownership changed hands. However, we could not obtain this information because, according to a company official we contacted, the vessel's records, along with other historical documents, were stored in an off-site storage facility in New Jersey, and were subsequently destroyed in a fire in 1996.

We also looked at articles from Guam newspapers and news sources such as the Military Sea Transportation Service Vietnam Chronicles for any information about vessel comings and goings in Guam in early 1968 to see if they mentioned the SS *Gulf Shipper* or specific cargo being offloaded in Guam. None of these contacts or written sources provided information specific to any cargo that was being moved through Guam, or about this particular vessel.

We also obtained original DOD reports and command histories that provided additional operational details about the procurement, distribution, use, and disposition of Agent Orange and its components. According to an Office of History, Air Force Logistics Command, monograph, the command directly responsible for managing Agent Orange was the Directorate of Aerospace Fuels at the San Antonio Air Materiel Area at the former Kelly Air Force Base, Texas, which was a sub-component of the U.S. Air Force Logistics Command during the Vietnam War. The unclassified San Antonio Air Materiel Area command histories for the years 1966 through 1973 include chapters with extensive documentation on "herbicide management." We obtained copies of command histories from the Air Force Historical Research Agency at Maxwell Air Force Base, Alabama, and the Air Force Materiel Command at Wright-Patterson Air Force Base, Ohio.

To obtain information regarding herbicide use on Guam, we obtained command histories for Naval Base Guam and an analysis and summary of the available documentation by the historian at Andersen Air Force Base. We also spoke with Navy and Air Force officials on Hawaii and Guam to identify any relevant records pertaining to such use. In addition, we met with and obtained information from officials representing the Office of the Governor of Guam and senior members and staff from the Guam Legislature. We also met with officials representing a veterans service organization. Finally, as discussed below, we spoke directly with veterans about their recollections of herbicide use on Guam, and any documentation they might have pertaining to such use.

For objective two, we analyzed the archival search records provided by DOD to identify additional locations where Agent Orange or its components were tested and stored in the United States and its territories. We reviewed Army archives search reports of herbicide testing at Aberdeen Proving Grounds (including Edgewood Arsenal), Maryland; Dugway Proving Ground, Utah; Fort Chaffee, Arkansas; Fort Gordon, Georgia; Fort Meade, Fort Ritchie, and Fort Detrick, Maryland; and two Air Force studies related to herbicide equipment testing at Eglin Air Force Base, Florida, to determine whether there were additional sites and testing events that were not included on the DOD list found on the VA website.[5] We also reviewed the proceedings of the First, Second, and Third Defoliation Conferences, technical and special reports, and published papers provided by the Armed Forces Pest Management Board to determine whether there were additional sites and testing events that were not included on the list. We compared the information about testing locations and dates on the DOD list found on the VA website with information found in a 2006 report on locations where Agent Orange was tested and stored.[6]

To determine the locations where Agent Orange or its components were tested and stored, we attempted to identify the chemical composition of all the agents on DOD's list found on the VA website. We located information on the chemical composition of agents on the list in archives search reports for Forts Detrick, Meade, and Gordon; a glossary of pesticide chemicals from the Food and Drug Administration; journal articles; and the defoliation conference proceedings.[7] We also interviewed DOD and VA officials about the chemical composition of agents on the list, the origins of the list, how the list is used, and the role of each agency in managing the list. We compared the results with information that DOD

[5]The Army undertook the compilation of its 7 archives search reports to provide research and analysis regarding herbicide testing that occurred at these locations. In addition to studies on Eglin Air Force Base, the Air Force also provided summary information on current and former Air Force installations where Agent Orange or its components were known to be present.

[6]Alvin Young, *The History of the US Department of Defense Programs for the Testing, Evaluation, and Storage of Tactical Herbicides* (Cheyenne, WY: December 2006).

[7]U.S. Army Corps of Engineers, *Archives Search Report Findings for Field Testing of 2,4,5-T and Other Herbicides Fort Detrick* (Frederick, Maryland: Apr. 4, 2012); *Archives Search Report Herbicide Testing at Fort George G. Meade* (Fort Meade, Maryland: Mar. 17, 2015); *Archives Search Report Findings for Field Testing of 2,4,5-T and Other Herbicides Fort Gordon* (Fort Gordon, Georgia: Sept. 20, 2013); Food and Drug Administration, *Glossary of Pesticide Chemicals* (College Park, Maryland: June 2005).

and VA provided publicly on testing and storage locations of tactical herbicides in the United States and its territories, and with DOD policies for conducting record research and responding to inquiries related to past environmental exposures. We also compared the accuracy and completeness of the list with *Standards for Internal Control in the Federal Government*, which state that management should internally and externally communicate the necessary quality information to achieve the entity's objectives.[8]

We also reviewed the extent to which DOD and VA have communicated health information to DOD personnel and veterans. We compared the communication process that both DOD and VA use with DOD's guidance on assessing long-term health risks, and with VA's process for determining benefits based on veterans' claims. We also compared DOD and VA actions with *Standards for Internal Control in the Federal Government*, which state that management should internally and externally communicate the necessary quality information to achieve the entity's objectives.[9] The standard further states that management should evaluate the entity's methods of communication so that the organization has the appropriate tools to communicate quality information throughout the entity on a timely basis. We also reviewed documents from DOD and VA on communication with veterans, including the VA's website on Agent Orange. Further, we interviewed cognizant agency officials from DOD and VA, including officials from the Armed Forces Pest Management Board and DOD's Joint Services Records Research Center.

For objectives one and two, to better understand veterans' experiences with Agent Orange and other herbicides and the health effects of exposure to them, we conducted six small discussion sessions with a non-generalizable sample of veterans.[10] Four of the discussion sessions were conducted in person in the following locations: two discussion

[8]GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: September 2014).

[9]GAO-14-704G.

[10]Participants in the discussion sessions were self-selected. In addition to veterans, a few civilians, including spouses, were present at some discussion sessions. We handled any comments these individuals provided separately from the veterans' comments. Specifically, we documented whether speakers were veterans or not, and we included comments only from participants who identified themselves as Vietnam era veterans.

sessions in Guam, and two discussion sessions in Hawaii.[11] We conducted two additional discussion sessions that were moderated via telephone from Washington, D.C.: one of those had individuals participate both in person and by telephone, while the other was held solely by telephone. We selected Guam because of the provision in House Report 115–200 accompanying a bill for the National Defense Authorization Act for Fiscal Year 2018 for GAO to review the government's handling of Agent Orange on Guam. We selected Hawaii because of its strategic location during the Vietnam War and because of the VA presence in the region. A total of 38 individuals attended the sessions, which ranged from 1 to 10 participants per session and lasted approximately 1 to 2 hours.[12] These discussion sessions were consistently moderated by the same team member using a prepared script and documented by several other team members.

To select candidates for participating in our discussion sessions, we worked with the Veterans Health Administration as well as veteran clinics and veteran centers at the selected locations to identify non-combat veterans who had served during the Vietnam era. In Guam, we also worked with the Guam Environmental Protection Agency to coordinate a discussion session. Attendees included Vietnam-era veterans who self-reported that they were in active service between 1961 and 1977 in Vietnam, the United States, and its territories, including Guam. As we became aware of other veterans who might be interested in these discussion sessions, including Vietnam combat veterans, we reached out to offer them the opportunity to participate in one of our discussion sessions. Our six discussion sessions included questions to individuals regarding what, if anything, they had heard from DOD, VA, or other federal agencies about links between exposure to herbicides and negative health effects, and whether attendees believed that they had been exposed to Agent Orange or its components at locations where Agent Orange was manufactured, transported, stored, used, or destroyed. We also asked individuals if they believed they had been

[11]DOD, VA, and Guam Environmental Protection Agency officials worked to schedule three discussion sessions for participants to attend in Guam, but only two of the sessions had attendees present. Thus, for the purposes of this report, we are counting only the two discussion sessions with attendees present.

[12]Although the session with one participant was not technically a discussion session because only one person participated, for simplicity and fairness we combined that person's responses with those from the discussion sessions and describe them all as discussion sessions.

exposed to Agent Orange in Guam, Vietnam, or another location, and if so, to describe the situation.[13] At the start of the discussion sessions, the moderator told participants that their responses would be kept confidential and that we were not recording their statements. The moderator noted that we would be taking notes to make sure we accurately captured the conversations, but that we would not attribute statements directly to individuals.

For those discussion sessions held in person in Guam and Hawaii, we also administered a brief, written questionnaire about individuals' experiences during the Vietnam era (for example, duty locations, military occupation, rank), and what they had heard and experienced related to Agent Orange and other herbicides. Due to logistical obstacles, we were not able to administer the questionnaire to participants in sessions held via telephone. However, the information requested in the questionnaire was also covered in the discussion sessions themselves. Therefore, we did not analyze the information from the completed questionnaires. We also solicited from the veterans any documentation they might have that could support their allegations of the use of Agent Orange on Guam, but we did not receive documentation that corroborated the use of Agent Orange on Guam. In addition, we met with officers from the Vietnam Veterans of America to discuss how, if at all, veterans could have been exposed to Agent Orange beyond serving directly in Vietnam as part of Operation Ranch Hand, and how the organization disseminates information, especially on Agent Orange, to veterans.

For objective three, we reviewed scientific literature and agency documents regarding the degradation and sources of the components of Agent Orange and an associated dioxin contaminant, 2,3,7,8-TCDD, as well as other sources of dioxins. This review included documents from the Agency for Toxic Substances and Disease Registry and reports and protocols from U.S. EPA, the World Health Organization, the Centers for Disease Control and Prevention, and the American Industrial Hygiene Association. We also reviewed the draft and final plans for testing for the presence of the acid forms of the components of Agent Orange—2,4-D

[13]These results are not generalizable to the population of Vietnam era veterans, and we present this information from participants as a way to report the perspectives of people who believe they were or may have been in contact with or affected by Agent Orange. We used the veterans' input to provide individual examples of their experiences but not as direct support for any findings in this report. We did not obtain documentation that would enable us to verify any comments made by participants.

and 2,4,5-T—on Guam. We compared the information outlined in the testing plan with scientific literature on the environmental fate of the components of Agent Orange and other Agent Orange testing methodologies. We interviewed officials from DOD, U.S. EPA, and Guam EPA about the testing plan for Guam and the science surrounding Agent Orange testing. We also conducted a site visit to Naval Base Guam and Andersen Air Force Base on Guam and interviewed DOD and Government of Guam officials involved in the planning for the testing for Agent Orange on Andersen Air Force Base. We visited the three selected sites where the initial testing took place and took photographs of those sites.

We conducted this performance audit from May 2017 through November 2018, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: Comparison of the Department of Veterans Affairs (VA) List of Diseases Associated with Agent Orange against Those Identified by the National Academy of Sciences

The VA recognizes 14 presumptive diseases associated with exposure to Agent Orange or other herbicides during military service for which veterans and their survivors may be eligible to receive disability compensation benefits. The list of diseases provided by the VA has generally incorporated the findings of reviews performed by the National Academy of Sciences (the Academy). The list includes 5 diseases that have been identified as having sufficient evidence of association and 9 that have been identified as having limited or suggestive evidence of association. In the Academy's biannual reports, for a disease identified as having sufficient evidence of association, the evidence is sufficient to conclude that there is a positive association—that is, a positive association has been observed between herbicides and the outcome in studies for which chance, bias, and confounding could be ruled out with reasonable confidence. For a disease identified as having limited or suggestive evidence of association, the evidence is suggestive of an association between herbicides and the outcome but is limited, because chance, bias, and confounding could not be ruled out with confidence. Table 1 describes those 14 diseases and the extent of association identified by the Academy.

Table 1: Presumptive Diseases Associated with Exposure to Agent Orange and Certain Other Herbicides by the Department of Veterans Affairs (VA), by Level of Association

Disease	Description
Sufficient Evidence of Association: Chronic B-cell Leukemias	A type of cancer which affects white blood cells.
Sufficient Evidence of Association: Chloracne (or similar acneform disease)	A skin condition that occurs soon after exposure to chemicals and looks like common forms of acne seen in teenagers. Per VA's rating regulation, it must be at least 10 percent disabling within 1 year of exposure to an herbicide.

Disease	Description
Sufficient Evidence of Association: Hodgkin's Disease	A malignant lymphoma (cancer) characterized by progressive enlargement of the lymph nodes, liver, and spleen, and by progressive anemia.
Sufficient Evidence of Association: Non-Hodgkin's Lymphoma	A group of cancers that affect the lymph glands and other lymphatic tissue.
Sufficient Evidence of Association: Soft Tissue Sarcomas (other than osteosarcoma, chondrosarcoma, Kaposi's sarcoma, or mesothelioma)	A group of different types of cancers in body tissues such as muscle, fat, blood and lymph vessels, and connective tissues.
Limited or Suggestive Evidence of Association: AL Amyloidosis	A rare disease caused when an abnormal protein, amyloid, enters tissues or organs.
Limited or Suggestive Evidence of Association: Diabetes Mellitus (Type 2)	A disease characterized by high blood sugar levels resulting from the body's inability to respond properly to the hormone insulin.
Limited or Suggestive Evidence of Association: Ischemic Heart Disease[a]	A disease characterized by a reduced supply of blood to the heart that leads to chest pain.
Limited or Suggestive Evidence of Association: Multiple Myeloma	A cancer of plasma cells, a type of white blood cell in bone marrow.
Limited or Suggestive Evidence of Association: Parkinson's Disease	A progressive disorder of the nervous system that affects muscle movement.
Limited or Suggestive Evidence of Association: Peripheral Neuropathy, Early-Onset	A nervous system condition that causes numbness, tingling, and motor weakness. Per VA's rating regulation, it must be at least 10 percent disabling within 1 year of exposure to an herbicide.
Limited or Suggestive Evidence of Association: Porphyria Cutanea Tarda	A disorder characterized by liver dysfunction and by thinning and blistering of the skin in sun-exposed areas. Per VA's rating regulation, it must be at least 10 percent disabling within 1 year of exposure to an herbicide.
Limited or Suggestive Evidence of Association: Prostate Cancer	Cancer of the prostate; one of the most common cancers among men.
Limited or Suggestive Evidence of Association: Respiratory Cancers (includes lung cancer) [b]	Cancers of the lung, larynx, trachea, and bronchus.

Source: GAO analysis of VA regulations and National Academy of Sciences studies. | GAO-19-24

[a]Per VA's rating regulation, ischemic heart disease does not include hypertension or peripheral manifestations of arteriosclerosis such as peripheral vascular disease or stroke, or any other condition that does not qualify within the generally accepted definition of ischemic heart disease. 38 CFR 3.309(e) (2018).

[b]The Academy breaks the respiratory cancers into two separate categories—laryngeal cancer and cancers of the lung, trachea, and bronchus.

The 2014 Academy biannual report, issued in 2016, listed four more diseases it categorized as having limited or suggestive evidence of association, as described in table 2.[1]

Table 2: Diseases Identified by the National Academy of Sciences as Having Limited or Suggestive Evidence of Associations, but Not Included on the Department of Veterans Affairs (VA) List of Presumptive Diseases

Disease	Description
Cancer of the urinary bladder	Cancer that forms in tissues of the bladder. Most bladder cancers are transitional cell carcinomas (cancer that begins in cells that normally make up the inner lining of the bladder). Other types include squamous cell carcinoma (cancer that begins in thin, flat cells) and adenocarcinoma (cancer that begins in cells that make and release mucus and other fluids). The cells that form squamous cell carcinoma and adenocarcinoma develop in the inner lining of the bladder as a result of chronic irritation and inflammation.
Hypertension, also called high blood pressure	A blood pressure of 140/90 or higher. Hypertension usually has no symptoms. It can harm the arteries and cause an increase in the risk of stroke, heart attack, kidney failure, and blindness.
Stroke, also called cerebrovascular accident or CVA	A loss of blood flow to part of the brain, which damages brain tissue. Strokes are caused by blood clots and broken blood vessels in the brain. Symptoms include dizziness, numbness, weakness on one side of the body, and problems with talking, writing, or understanding language. The risk of stroke is increased by high blood pressure, older age, smoking, diabetes, high cholesterol, heart disease, atherosclerosis (a buildup of fatty material and plaque inside the coronary arteries), and a family history of stroke.
Hypothyroidism, also called underactive thyroid	Too little thyroid hormone. Symptoms include weight gain, constipation, dry skin, and sensitivity to the cold.

Source: GAO analysis of VA regulations and National Academy of Sciences studies. | GAO-19-24

VA officials told us that these diseases are not included on the VA's current list of presumptive diseases associated with exposure to Agent Orange or other herbicides because, as of October 25, 2018, the Secretary of Veterans Affairs had yet to make the determination based on the most recent biannual review (the 2014 report). According to the officials, the Secretary is also considering the inclusion of parkinsonism and Parkinson-like syndromes.

Finally, according to the VA website, VA has recognized that certain birth defects among veterans' children are associated with veterans' qualifying service in Vietnam or Korea. For example, spina bifida (except spina bifida occulta) is associated with veterans' exposure to Agent Orange or

[1]The 2014 report also broadened the definition for Parkinson's disease to include Parkinson-like symptoms. In this report, the Academy clarified that the finding for Parkinson's disease should be interpreted by VA to include all diseases with Parkinson-like symptoms unless those symptoms can be definitively attributed to be secondary to an external agent other than the herbicides sprayed in Vietnam.

other herbicides during qualifying service in Vietnam or Korea.[2] The affected child must have been conceived after the veteran entered Vietnam or the Korean demilitarized zone during the qualifying service period, and a child with spina bifida or covered birth defects who is a biological child of a veteran with qualifying service may be eligible for a monetary allowance, health care, and vocational training. The 2014 report moved spina bifida to the lower category of "inadequate or insufficient evidence to determine an association," as studies that have been released since the 1996 update do not support a link between the condition and exposure to herbicides. According to VA officials, VA does not currently plan to change its regulations based on this conclusion.

[2]Spina bifida is a defect in the developing fetus that results in incomplete closing of the spine.

Appendix III: Quantities of Herbicides Known to Have Been Shipped to Southeast Asia on Ships Identified as Having Stopped in Guam between February 1968 and May 1970

Based on available shipment documentation and logbooks, we identified one vessel—the SS *Gulf Shipper*—carrying Agents Orange, Blue, and White that stopped at Port Apra (now Apra Harbor) on Guam on its way to Southeast Asia. Additionally, we identified three vessels—the SS *Aimee Lykes*, the SS *Buckeye Atlantic*, and the SS *Overseas Suzanne*—that stopped in Guam on the return routes after having made various port calls in Southeast Asia.[1] For each of these voyages, we obtained shipment documentation that outlined the quantities of herbicides that records indicate had been loaded onto the vessels while at port in the United States, and to the extent available, quantities of herbicides that were discharged in Southeast Asia. We also obtained logbooks that identified the routes the vessels took from U.S. ports to Vietnam and back, and identified any port calls en route. While we are unable to confirm the reliability of the information available in shipment documentation and logbooks, details on the quantities of herbicides that were documented to

[1]Through archival research, we obtained available shipping and agency records, including U.S. military correspondence and logistics reports, and reviewed these documents to trace the federal government's procurement, distribution, use, and disposition of Agent Orange and its components. We analyzed this available documentation, referred to as shipment documentation, to prepare summary information on the quantities of Agent Orange and the vessels that carried the shipments. We used this information to obtain official Navy and merchant vessel logbooks—referred to as logbooks—to the extent they were available. While logbooks contain information such as the vessel's location, crew, and key events, they generally do not identify specific cargo that was loaded onto or offloaded from a vessel. Logbooks from the Vietnam era are generally held at National Archives and Records Administration facilities closest to the arrival ports where the voyages ended.

have been transported on these vessels during their routes are outlined below.

SS *Gulf Shipper*: According to shipment documentation and the vessel's logbook, the SS *Gulf Shipper* left the port of Mobile, Alabama, on January 9, 1968, and stopped at Port Apra (now Apra Harbor) on Guam and offloaded a mariner for repatriation to the United States on February 2, 1968.[2] We are unable to state with certainty whether there were reasons why this vessel stopped in Guam beyond what was reported in available shipment documentation and the vessel's logbook. The logbook further indicates that the SS *Gulf Shipper* then arrived in Saigon, Vietnam, approximately February 27, 1968, with subsequent stops in Cam Rahn Bay, Vietnam, approximately February 29, 1968, and Nha Trang, Vietnam, approximately March 2, 1968.[3] According to available documentation, there is some discrepancy with regard to the amount of herbicides that records indicate were loaded onto the SS *Gulf Shipper* when it left the port of Mobile, Alabama. Specifically, shipment documentation indicates that 62,570 gallons of Agent Orange, 31,735 gallons of Agent White, and 4,620 gallons of Agent Blue—a total of 98,925 gallons of herbicides—were loaded onto the SS *Gulf Shipper* before it departed for Saigon, Vietnam.[4] On the contrary, according to the available shipping documentation, the vessel's manifest indicates that the vessel was carrying 86,270 gallons of herbicides, but does not break the total down by individual herbicide. The vessel's manifest further indicates that the SS *Gulf Shipper* discharged 93,150 gallons of herbicide in Saigon, Vietnam, on March 1, 1968, which does not align with reported dates in the vessel's logbook. However, we are unable to determine discharge quantities by specific herbicide—for example, the quantities of Agents Orange, Blue, or White discharged—because available documentation states that the breakdown of the herbicides would not be determined until arrival at the depot. Moreover, we are unable to account

[2]In addition to the stop in Guam, the SS *Gulf Shipper* also stopped in Panama on the way to Vietnam.

[3]For purposes of this report, we are using the last documented port from which the vessel left the United States.

[4]Herbicide manufacturers marked 55-gallon drums for shipment to Vietnam. DOD then arranged for the transport of these drums by train from the manufacturers to several U.S. ports. From the U.S. ports, the herbicides were shipped to Southeast Asia. The quantity of Agent Orange reported to have been loaded onto the SS *Gulf Shipper* is not divisible by 55, raising questions about the reliability of some of the numbers in the records we were able to obtain.

for the difference between the number of gallons of herbicides reported to have been loaded onto the vessel and the number of gallons reported to have been discharged in Saigon, Vietnam, or potentially any other location.

SS *Aimee Lykes*: According to shipment documentation and the vessel's logbook, the SS *Aimee Lykes* left the port of Beaumont, Texas, on October 4, 1969. The vessel arrived in Saigon, Vietnam, approximately November 9, 1969.[5] The vessel made a subsequent stop at Da Nang, Vietnam, approximately November 23, 1969. Following its departure from Vietnam, the SS *Aimee Lykes* stopped in Apra Harbor on Guam approximately November 30, 1969, and offloaded an injured crew member. However, the logbook does not include Guam on its list of ports of call. Rather, there is a separate entry within the logbook that describes the vessel pulling into Apra Harbor and offloading the injured mariner into a small motorboat so that he could be hospitalized in Guam. Therefore, we cannot confirm whether the vessel docked at Port Apra during this voyage. According to available documentation, the SS *Aimee Lykes* left the port of Beaumont, Texas, with 880 gallons of Agent Orange on board—documentation does not indicate that there were any amounts of Agents White or Blue on this voyage. Based on the available documentation, we are unable to determine the quantity of Agent Orange that was discharged in Saigon, Vietnam, or potentially any other location.

SS *Buckeye Atlantic*: According to shipment documentation and the vessel's logbook, the SS *Buckeye Atlantic* left the port of New Orleans, Louisiana, on October 1, 1969. The vessel arrived in Saigon, Vietnam, approximately November 20, 1969. The vessel made a subsequent stop at Qui Nhon, Vietnam, approximately November 29, 1969.[6] Following its departure from Vietnam, the SS *Buckeye Atlantic* stopped at various ports in Japan before stopping in Guam approximately December 23, 1969, and offloading two injured crew members, one who returned to duty and another who was repatriated to the United States. While on Guam, the SS *Buckeye Atlantic* also performed a fire and boat drill on December 26, 1969, before departing. According to available documentation, the SS *Buckeye Atlantic* left the port of New Orleans, Louisiana, with 17,105 gallons of Agent Orange on board. Based on the available

[5]Prior to arriving in Vietnam, the SS *Aimee Lykes* also stopped in Panama and Taiwan.

[6]Prior to arriving in Vietnam, the SS *Buckeye Atlantic* also stopped in Panama, Hawaii, and the Philippines.

documentation, we are unable to determine the quantity of Agent Orange that was discharged in Saigon, Vietnam, or potentially any other location.

SS Overseas Suzanne: According to shipment documentation and the vessel's logbook, the SS *Overseas Suzanne* left the port of New Orleans, Louisiana, on February 28, 1970. The vessel arrived in Saigon, Vietnam, approximately April 9, 1970.[7] The vessel made a subsequent stop at Da Nang, Vietnam, approximately April 17, 1970, and at Cam Rahn Bay, Vietnam, approximately April 22, 1970. Following its departure from Vietnam, the SS *Overseas Suzanne* stopped in Taiwan and Japan before stopping in Guam approximately May 5, 1970, and offloading an injured crew member. The vessel then departed Guam on May 9, 1970. According to available documentation, the SS *Overseas Suzanne* left the port of New Orleans, Louisiana, with 80,795 gallons of Agent Orange and 48,537 gallons of Agent Blue on board. Based on the available documentation, we are unable to determine the quantity of Agent Orange that was discharged in Saigon, Vietnam, or potentially any other location.

[7]Prior to arriving in Vietnam, the SS *Overseas Suzanne* also stopped in Panama, Hawaii, and the Philippines.

Appendix IV: The Department of Defense's (DOD) List of Testing and Storage Locations Posted on the Department of Veterans Affairs (VA) Website

Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

Location	Dates	Agents	Project Description	DoD Involvement
Fort Chaffee, AR	5/16/1967-5/18/1967, 7/22/1967-7/23/1967, 8/23/1967 - 8/24/1967	basic, in-house, improved desiccants and Orange, Blue	During the period of 12/1966 - 10/1967, a comprehensive short-term evaluation was conducted by personnel from Fort Derrick's Plant Science Lab in coordination with contract research on formulations by chemical industry and field tests by USDA and U of HI.	Yes
Pinal Mountains near Globe, AZ	1965, 1966, 1968, and 1969	2,4-D isooctyl-ester, 2,4,5-t isooctyl-ester, silvex, propyleneglycolbutylether ester, 2,4,5-T butyl ester, 2,4,5-T 2-e-h e	In 1965, the USFS began a land improvement program in the Pinal Mountains. The program called for spraying an area of chaparral with herbicides to accomplish the objectives of multiple land use.	No
Brawley, CA	1950-51	2,4-D	The purpose was to determine means of accomplishing defoliation of tropical forest vegetation by application of a chemical agent.Here, irrigation water studies were done with the agent. H.F. Arle worked here.	Undetermined
Orlando, FL at Army Grove Air Force's Tactical Center	3/14/1944, 4/12/1944	ammonium thiocynate, zinc chloride, sodium nitrate, sodium arsenate, sodium fluoride	The purpose was to determine means of accomplishing defoliation of tropical forest vegetation by application of a chemical agent.	Yes
Marathon, FL	3/21/1944-3/23/1944	zinc chloride, ammonium sulphamate, ammonium thiocynate	The purpose was to determine means of accomplishing defoliation of tropical forest vegetation by application of a chemical agent. Spraying was done here.	Yes
Near Lake George, FL	Spring 1944	zinc chloride	The purpose was to determine means of accomplishing defoliation of tropical forest vegetation by application of a chemical agent. Spraying here.	Yes
Orlando, FL, Cocoa, FL	1944	ammonium thiocyanate and zinc chloride	Tests were conducted in 1944 by the Army in Orlando and Cocoa areas of Florida to determine the value of ammonium thiocyanate and chloride as marking and defoliation agents.. They were conducted initially at ground level and later from aircraft.	Yes

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Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

Bushnell Army Air Field, FL	2/1945	LN *phenoxy	Small plot experiments were commenced to test the effectiveness of LN agents. Various trials were done under contract with the USDA, aided by personnel at Camp Detrick. Here, it was aerial spray experiments on potted plants	Yes
Bushnell Army Air Field, Bushnell, FL	2/1945-4/1945	2,4-D and its ammonium salt	Trials, performed by C.W.S. personnel from Camp Detrick, MD tested the practicability of severely injuring or destroying crop plants sprayed from smoke tanks mounted on tactical aircraft.	Yes
Avon Air Force Base, FL	2/1951-4/1951	butyl 2,4 D	Trials were conducted at Avon Air Force Base, FL by Chemical Corps with personnel of the Air Force and Navy to determine the practical effectiveness of spraying pure anticrop agents from at low volume from aircraft. C-47 and Navy XBT2D-1 aircraft with various nozzles were used.	Yes
Englin Air Force Base, FL	11/1952-12/1952	2,4-D, 2,4,5-T: 143 and 974, respectively	Two trials: Chemical Corps- concerned with basic fundamental work, using 2,4-D, Air Force-concerned with evaluating prototype large capacity spray system for aircraft installation using 2,4,5-T, primarily. Used 3 atomizing nozzles: Bete Fog Nozzles, Whirljet Spray Nozzles, and Fogjet 1.5F50	Yes
Avon Park Air Force Base, FL	Spring 1954	butyl 2,4-D, butyl 2,4,5-T, Isopropyl 2,4-D	Series of tests were conducted at Avon Park AFB during the spring of 1954 to study the behavior of chemical anticrop aerial sprays when released from high-speed jet aircraft. The Navy F3D jet fighter was used with Aero 14A Airborne Spray Tanks to disperse the anticrop agents.	Yes
Jacksonville,FL	7/18/1962-7/21/1962	Purple, Fuel Oil, Mix	The HIDAL was used successfully on an H-34 helicopter to spray herbicidal materials. Therefore, it had not been calibrated previously. Spray tests were performed to do so. This was done under order by OSD/ARPA.	Yes
Eglin AFB, FL, C-52A test area	1962-70	Orange (1962-68), Purple (1962-68), White (1967-70), Blue (1968-70)	CPT John Hunter discussed vegetation changes and ecological studies of the 2 square mile test area which had been sprayed with herbicides over the period 1962-70.	Yes

Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

Apalachicola National Forest near Sophoppy, FL	5/3/1967-5/8/1967	basic desiccants and Orange/Blue	During the period of 12/1966 - 10/1967, a comprehensive short-term evaluation was conducted by personnel from Fort Detrick's Plant Science Lab in coordination with contract research on formulations by chemical industry and field tests by USDA and U of HI	Yes
Eglin AFB, FL	6/11/1968-9/12/1968	orange, Bifluid #1, Bifluid#2, Stull Bifluid	A spread factor study was performed by the Army to correlate the spherical drop sizes of both Orange and Stull Bifluid defoliants. It involved development of new techniques to determine spread factors over an extended range of drop sizes. A spinning cup drop generator was used.	Yes
2 areas in FL, 2 areas in GA, and 1 in TN	1968	bromacil, Tandex, monuron, diuron, and fenuron	In 1968, emphasis was given to soil applied herbicides for grass control. Applications were made by a jeep-mounted sprayer on small plots or by helicopter on larger plots.	Undetermined
GA and TN	1964	diquat and Tordon 101, various	In 1964, helicopter spray tests were conducted on transmission line rights-of-way by the Georgia Power Company and Tennessee Valley Authority in collaboration with Fort Detrick to evaluate effectiveness of several commercially available herbicides.	Yes
Fort Gordon, GA	7/15/1967-7/17/1967	in-house desiccants mixtures and formulations, Orange and Blue	During the period of 12/1966 - 10/1967, a comprehensive short-term evaluation was conducted by personnel from Fort Detrick's Plant Science Lab in coordination with contract research on formulations by chemical industry and field tests by USDA and U of HI	Yes
Kauai Branch Station near Kapaa, Kawai, HI	6/1967, 10/1967, 2/1968, 12/1967	Blue,diquat,paraquat, Orange, PCP, Picloram, White, HCA, 2,4,5-T, Endothall	During the period of 12/1966 - 10/1967, a comprehensive short-term evaluation was conducted by personnel from Fort Detrick's Plant Science Lab in coordination with contract research on formulations by chemical industry and field tests by USDA and U of HI	Yes
State Forest area, 3500 ft.elevation on slope of Mauna Loa, near Hilo, HI	12/2/1966, 12/4/1966, 1/12/1967	Orange, M-3140, TORDON ester, 2,4-D ester, 2,4,5-T ester	The purpose of this project was to evaluate iso-octyl ester of picloram (TORDON) in mixtures with ORANGE, as a candidate defoliant agent, using ORANGE as standard. There were personnel from Fort Detrick there.	Undetermined

Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

Hilo, HI	12/1966	Orange	Field tests of defoliants were designed to evaluate such variables as rates, volume of application, season, and vegetation. Data from aerial application tests at several CONUS and OCONUS locations are provided in tables. There were Fort Detrick personnel there.	Yes
Kauai,HI	1967	Orange	Field tests of defoliants were designed to evaluate such variables as rates, volume of application, season, and vegetation. Data from aerial application tests at several CONUS and OCONUS locations are provided in tables.	Yes
Vigo Plant CWS, Terre Haute, IN	5/1945-9/1945	LN (see attached) *phenoxy	Small plot experiments were commenced to test the effectiveness of LN agents. Various trials were done under contract with the USDA, aided by personnel at Camp Detrick. Here, it was aerial trials spraying field grown plants.	Yes
Jefferson Proving Grounds, Madison, IN	Summer 1945	LN *phenoxy	Small plot experiments were commenced to test the effectiveness of LN agents. Various trials were done under contract with the USDA, aided by personnel at Camp Detrick. Here, it was dropping trials.	Yes
Hays, KS, Langdon, ND	1960	stem rust of	Two studies on the stem rust of wheat were conducted during 1960 to obtain data on the establishment, development, and destructiveness of artificially induced stem rust epiphytotics.	Undetermined
Fort Knox, KY	1945	various	In 1945, a special project known as Sphinx was conducted jointly by CWS and the ARML to investigate the use of chemical agents for increasing the flammability of vegetation prior to flame attack.	Yes
Area B, Camp Detrick, MD	Spring/Summer 1953	3:1 mixture 2,4-D and 2,4,5-T	Personnel at Camp Detrick tested the feasibility of using an experimental spray tower for applying a mixture of chemical anticrop agents to broad-leaf crops.	Yes
Fort Ritchie, MD	1963	Tordon, 2,4-D, Orange, diquat, endothal, and combinations of each with Tordon	Various studies were done to explore the effectiveness of different herbicides. They were all field trials. These studies were done by personnel from the US Army Biological Laboratories.	Yes

Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

Fort Meade, MD	1963	cacodylic acid, Dowco 173, butyediol	Various studies were done to explore the effectiveness of different herbicides. They were all field trials. These studies were done by personnel from the US Army Biological Laboratories.	Yes
Camp Detrick, MD-Fields A,B, and C	1946-1947	2,4,5-T, 2,4,5-T triethanolamine, tributylphosphate, ethyl 2,4-D, butyl 2,4,5-Ttriet 2,4-D,	The experiments were directed mainly towards the investigation of plant inhibitors applied as sprays or to the soil in the solid form to be taken up by the roots.	Yes
Camp Detrick, MD- Fields C,D, and E	1948	2,4,5-T, isopropyl phenol carbamate, LN-2426, 2,4-D	The experiments were directed mainly towards the investigation of plant inhibitors applied as sprays or to the soil in the solid form to be taken up by the roots.	Yes
Camp Detrick, MD-Fields C,D,E	1949	triethelyne. 2,4,5-T, carbamates	The experiments were directed mainly towards the investigation of plant inhibitors applied as sprays or to the soil in the solid form to be taken up by the roots. Experiments were done by Ennis, DeRose, Newman, Williamson, DeRigo, and Thomas.	Yes
Camp Detrick, MD-Fields A,B,D,E	1950	2464, butyl 2,4-D, 974, butyl 2,4,5-T, q:q 143 and 974	The experiments were directed mainly towards the investigation of plant inhibitors applied as sprays or to the soil in the solid form to be taken up by the roots. Experiments were done by Ennis, DeRose, Acker, Newman, Williamson, and Zimmerly.	Yes
Camp Detrick, MD-Field F	1950-51	2464, carbamate, butyl 2,4-D, 143 and 974 (orange?),2,4,5-T, 2,4-D, Orange	The experiments were directed mainly towards the investigation of plant inhibitors applied as sprays or to the soil in the solid form to be taken up by the roots. Experiments were done by Acker, DeRose, McLane, Newman, Williamson, Baker, Dean, Johnson, Taylor, Walker, and Zimmerly.	Yes
Fort Detrick, MD; Fort Ritchie, MD	1956-1957	various, 577 compounds	In 1956 And 1957, defoliation and desiccation were carried out at Fort Detrick and Fort Ritchie, Maryland by the Chemical Corps and Biological Warfare Research. These were bench tests.	Yes
Poole's Island, Aberdeen Proving Ground, MD	7/14/1969-	Orange, Orange plus foam, Orange plus foam Orange, Foam	During the week of 7/14/1969, personnel from Naval Applied Science Laboratory in conjunction with personnel from Limited War Laboratory conducted a defoliation test along the shoreline.	Yes

Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

Fort Detrick, MD	8/1961-6/1963	1410 compounds	From 8/1961 to 6/1963, compounds were spray-tested in the greenhouse to evaluate them as effective defoliants, desiccants, and herbicides.	Yes
Near Wayside, Miss., Wilcox Road, Greenville, Miss.	9/19/1967	picloram, bromacil, pyriclor, and terbacil, Orange, cacodylic acid	In 1967, the Dow Chemical Company was awarded a DoD research contract. The objective was to prepare as pellets mixtures of various herbicides and to test them on varying vegetation situations for the control of a range of plant species.	Undetermined
Fulcher Ranch, Greenville, Mississippi	4/15/1968	picloram and bromicil	In 1967, the Dow Chemical Company was awarded a DoD research contract. The objective was to prepare as pellets mixtures of various herbicides and to test them on varying vegetation situations for the control of a range of plant species.	Undetermined
Gulfport, Miss.	1968-1970	Orange	While discussing the mandatory disposal of Orange, it was mentioned that 15,161 drums were being stored at Gulfport, Mississippi.	Yes
Galatin Valley near Bozeman, Montana	7/3/1953, 7/6/1953, 7/14/1953	4- fluorophenoxy-acetic acid and 2 of its esters, 3:1 butyl 2,4-D and butyl 2,4,5-T	A preliminary series of field evaluations of chemical agents for attacking wheat using a miniature spraying system mounted on light aircraft were performed by USDA.	No
Fort Drum, NY	1959	Orange	The Commanding General, 1st US Army, requested that Ft Detrick assist with defoliation efforts at Ft Drum. Thirteen drums were sprayed there on 4 square miles from a helicopter spray device.	Yes
Stone Valley Experimental Forest in Huntington County and near State College in Centre County, PA	3/1969-10/1970	bromacil, diuron, tandex, fenuron, picloram	Soil- applied herbicides were studied by the U of Pa with Ft Detrick for 18 months for their effectiveness, rapidity of action, and duration of response in native stands of central PA grasses, broadleaf weeds and woody plants. These herbicides were spread or sprayed.	Undetermined
Kingston, RI	7/26/1949, 1950-51	trieth.2,4,5-T, butyl 2,4,5-T,974	The experiments were directed mainly towards the investigation of plant inhibitors applied as sprays or to the soil in the solid form to be taken up by the roots. Experiments were carried out under supervision of T.E. Odland if RI State College. H.T. DeRigo was also there.	Yes

Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

Beaumont, TX	6/1944	LN *phenoxy	Small plot experiments were commenced to test the effectiveness of LN agents. Various trials were done under contract with the USDA, aided by personnel at Camp Detrick. Here, they were testing on rice crops.	No
Marinette, WI, Weslaco, TX	5/1967-1/1969	arsenic compounds, Orange, cacodylic acid, sodium cacodylate	71 new arsenic compounds were tested in primary screening against 6 plant species in greenhouse tests. Then, 5 of the most active compounds were tested in field trials against Red Maple and compared to formulations of cacodylic acid and a 50:50 blend of orange and sodium cacodylate. The Ansul Co. for DoD.	Yes
Beaumont, TX	1950-51	2,4-D	The purpose was to determine means of accomplishing defoliation of tropical forest vegetation by application of a chemical agent. Here, irrigation water studies were done with the agent. Coghill, Hasse, and Yeatner worked here.	Undetermined
Granite Peak, UT	Summer 1945	LN *phenoxy	Small plot experiments were commenced to test the effectiveness of LN agents. Various trials were done under contract with the USDA, aided by personnel at Camp Detrick. Here, it was dropping trials.	Yes
Prosser,WA	1950-51	2,4-D	The purpose was to determine means of accomplishing defoliation of tropical forest vegetation by application of a chemical agent.Here, irrigation water studies were done with the agent. V.F. Burns worked here.	Undetermined
southeastern part of Kompong Cham Province and Dar and Prek Clong plantations, Cambodia	6/1969	Orange	In 6/1969, the US government received notice of charge by Cambodian government that major defoliation damage to the Cambodian rubber plantation near the RVN border had occurred as a result of US defoliation activity. This was confirmed by a team of experts.	Yes
Base Gagetown near Fredericton, New Brunswick, Canada	6/20/1967-6/24/1967	basic desiccants and Orange, Blue, various	During the period of 12/1966 - 10/1967, a comprehensive short-term evaluation was conducted by personnel from Fort Detrick's Plant Science Lab in coordination with contract research on formulations by chemical industry and field tests by USDA and U of HI	Yes

Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

Kumbla, South India	1945-1946	LN compounds *phenoxy	The main objective of the experiments was to determine the feasibility of accomplishing severe injury or destruction of tropical food crops by the application of growth-inhibiting (LN*) compounds in static trials. Field plantings were treated with various agents at different rates in different forms.	Yes
Korea, third Brigade, 2nd Division area	7/23/1968-7/24/1968	Hyvar XWS, tandex, Urox B, Urox Oil concentrate (liquids) bromacil, tandex, Urox 22 (solids)	In 1968, chemicals were sent from the Plant Sciences Lab, Ft Detrick, MD, to the Republic of Korea for the purpose of testing their effectiveness in the control of vegetation.	Yes
Korea,2nd and 4th Brigades, 2nd Division area	8/1968	Hyvar XWS, tandex, Urox B, Urox Oil concentrate (liquids) bromacil, tandex, Urox 22 (solids)	In 1968, chemicals were sent from the Plant Sciences Lab, Ft Detrick, MD, to the Republic of Korea for the purpose of testing their effectiveness in the control of vegetation.	Yes
Korea, third Brigade, 2nd Division area	10/3/1968	Hyvar XWS, tandex, Urox B, Urox Oil concentrate (liquids) bromacil, tandex, Urox 22 (solids)	In 1968, chemicals were sent from the Plant Sciences Lab, Ft Detrick, MD, to the Republic of Korea for the purpose of testing their effectiveness in the control of vegetation.	Yes
Laos	12/1965- 1967	Orange	In December 1965, herbicide operations were begun in Laos, with sorties being flown from Tan Son Nhut and Da Nang. The purpose was the exposure of foot trails, dirt roads and other LOCs that crossed into SVN. This network leads from NVN, through the eastern panhandle, to Combodian border.	Yes
Las Marias, Puerto Rico	2/1967-12/1967	various, including Orange	During the period of 12/1966 - 10/1967, a comprehensive short-term evaluation was conducted by personnel from Fort Detrick's Plant Science Lab in coordination with contract research on formulations by chemical industry and field tests by USDA and U of HI	Yes

Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

Las Mesas Cerros, Mayaguez, Puerto Rico	5/24/1968, 5/26/1968, 5/27/1968	picloram, bromacil, pyriclor	In 1967, the Dow Chemical Company was awarded a DoD research contract. The objective was to prepare as pellets mixtures of various herbicides and to test them on varying vegetation situations for the control of a range of plant species.	Undetermined
Las Mesas and La Jagua experimental areas at Mayaguez, Puerto Rico	2/1956-6/1956	2,4,5-T, 2,4-D, pentachlorophenol, ammate, weedazol, endothal Harvestaid, Butyne -1,4-diol	During February to June, 9 chemicals were evaluated in PR on 16 genera tropical woody plants. The chemicals were applied in highly concentrated solutions with a microsprayer to the leaves.	Yes
Guanica and Joyuda, Puerto Rico	6/1956-9/1956	2,4,5-T, potassium cyanate, amiendo, F-2, 6-Ca-4, Y-F Tree and Brush Kiler, ACP M-118, Shed-A-Leaf	9 chemicals were evaluated on 16 genera of tropical woody between June and September. The chemicals were sprayed to duplicate small branches, using a microsprayer.	Yes
Las Mesas and La Jagua, Mayaguez, Joyuda at Cabo Rojo, and Guanica Insular Forest at Guanica, Puerto Rico	9/1956-12/1956	6-Ca-4,Liojn Oil,2,4,5-T, B-1613, B-1638, Ammate, V-C1-186, endothal, shed-a-leaf, M-118, Y-F,esteron 2,4-D,F3,F4,F5,F6	16 compounds with defoliating properties were evaluated using 28 different tropical woody plants, each representing a separate genus. The chemicals were applied to duplicate small branches with a microsprayer and to single larger branches or whole trees with a 2-gallon knapsack sprayer.	Yes
Las Mesas and La Jagua, Mayaguez, Guanica Beach, Puerto Rico	1/1957-3/1957	V-C 3-105, V-C 1-21, V-C 1-443, F-7, TBP, Phillips 713, V-C 3-173	7 compounds were evaluated on 29 different woody plants to determine their effectiveness as defoliants, desiccants, and as killing agents. They were applied with a microsprayer to the upper leaf surfaces of duplicate small branches.	Yes
Las Mesas and La Jagua, Mayaguez, Guanica Beach, Puerto Rico	4/1957-6/1957	B-1676, B-1638, NP 1098, SD 1369, Ammate, Shed-a-leaf	7 compounds were sprayed on 25 different plants in order to evaluate their effectiveness as defoliants, desiccants, and killing agents. The compounds were applied with a microsprayer to the upper and lower leaf surfaces of duplicate small branches.	Yes
Las Mesas and La Jagua, Mayaguez, Puerto Rico	7/1957-12/1957	MgClO3, Golden Harvest Defoliant, Dow-M562, F-8, F-9, F-10, F-11, F-12	8 different spray formulations were applied to 16 different tropical trees and shrubs in order to evaluate their effectiveness as defoliants, desiccants, and killing agents.	Yes

Information from Department of Defense (DoD) on Herbicide Tests and Storage outside of Vietnam

Near Rio Grande, on the northeast coast of Puerto Rico	8/23/1967, 10/18/1967, 12/21/1967-12/26/1967	picloram, bromacil, pyriclor, and terbacil	In 1967, the Dow Chemical Company was awarded a DoD research contract. The objective was to prepare as pellets mixtures of various herbicides and to test them on varying vegetation situations for the control of a range of plant species.	Undetermined
Loquillo, Puerto Rico	4/1966, 10/1966	Orange	Field tests of defoliants were designed to evaluate such variables as rates, volume of application, season, and vegetation. Data from aerial application tests at several CONUS and OCONUS locations are provided in tables.	Yes
At Sea	Summer 1977	Orange	In 1977, the USAF incinerated 2.22 million gallons of Herbicide Orange at sea in an operation entitled PACER HO. Extensive industrial hygiene sampling efforts supporting the transfer operations at Gulfport, MS and Johnston Island indicated all exposures were inconsequential (2-3 orders of magnitude below the TLVs for 2,4-D and 2,4,5-T).	Yes, Gulfport No, JI
Thailand	1964-1965	Purple, Orange, Others	Sponsored by ARPA; ARPA Order 423, Between the mentioned dates, there was a large-scale test program to determine effectiveness of mentioned agents in defoliation of upland forest or jungle vegetation representative of SEA.	Yes
Thailand	1964-65	Orange, Blue	Field tests of defoliants were designed to evaluate such variables as rates, volume of application, season, and vegetation. Data from aerial application tests at several CONUS and OCONUS locations are provided in tables.	Yes
Replacement raining Center of the Royal Thai Army near Pranburi, Thailand	1964 and 1965	Orange, Purple	An extensive series of tests were conducted by Fort Detrick during 1964 and 1965 in collaboration with the Military Research and Development Center of Thailand. The objective was to perform onsite evaluation of phytotoxic chemicals on vegetation in SE Asia.	Yes

Department of Veterans Affairs 10

Source: DOD's list of testing and storage locations posted on VA's website [accessed on September 18, 2018]. | GAO-19-24.

Appendix V: Comments from the Department of Defense

ASSISTANT SECRETARY OF DEFENSE
3500 DEFENSE PENTAGON
WASHINGTON, DC 20301-3500

SUSTAINMENT

OCT 24 2018

Mr. Brian J. Lepore
Director, Defense Capabilities and Management
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Lepore,

This is the Department of Defense (DoD) response to the Government Accountability Office (GAO) Draft Report, GAO-19-24, "AGENT ORANGE: Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations" dated September 24, 2018 (GAO Code 102077). Detailed comments on the report recommendations are enclosed.

Sincerely,

Robert H. McMahon

Enclosure:
As stated

GAO DRAFT REPORT DATED SEPTEMBER 24, 2018
GAO-19-24 (GAO CODE 102077)

"AGENT ORANGE: ACTIONS NEEDED TO IMPROVE ACCURACY AND COMMUNICATIONS OF INFORMATION ON TESTING AND STORAGE LOCATIONS"

DEPARTMENT OF DEFENSE COMMENTS TO THE GAO RECOMMENDATION

RECOMMENDATION 1: The GAO recommends that the Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment assigns responsibility for ensuring that DoD's list of locations where Agent Orange or its components were tested or stored is as complete and accurate as available records allow.

DoD RESPONSE: *Concur. The Under Secretary of Defense for Acquisition and Sustainment will assign responsibility for DoD's list of locations where Herbicide Orange, or its components, were tested or stored.*

RECOMMENDATION 2: The GAO recommends that the Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment develops a process for updating the revised list as new information becomes available.

DoD RESPONSE: *Concur. The Under Secretary of Defense for Acquisition and Sustainment will develop a process to update the DoD list based on clear and transparent criteria developed with Veterans Affairs in recommendations #3 and 4.*

RECOMMENDATION 3: The GAO recommends that the Secretary of Defense, in collaboration with the Secretary of Veterans Affairs, should ensure that the Under Secretary of Defense for Acquisition and Sustainment develop clear and transparent criteria for what constitutes a location that should be on the list of testing and storage locations.

DoD RESPONSE: *Concur. DoD will be the lead agency for searching, reviewing, and validating documentation to identify DoD locations where the development of chemicals for military use in controlling vegetation and crops in tactical situations were developed, tested, used or stored. DoD, in collaboration with the VA, will develop clear and transparent criteria for what constitutes a location for the list to be provided to the VA.*

Status: DoD has engaged in thorough searches of DoD and other Federal agency records relating to Herbicide Orange and other tactical herbicides. The records discovered thus far are extensive and very useful in evaluating whether a location stored or used Herbicide Orange. DoD continues to seek and review records on these subjects as part of the process that will be developed per recommendation #2.

The DoD and VA subject matter experts (SMEs) are working collaboratively to develop clear and transparent criteria and guidance for what constitutes a location that should be on the VA list.

RECOMMENDATION 5: The GAO recommends that the Secretary of Defense, in collaboration with the Secretary of Veterans Affairs, should develop a formal process for coordinating on how best to communicate information to veterans and the public regarding where Agent Orange was known to have been present outside of Vietnam.

DoD RESPONSE: *Concur. DoD will be the lead agency for producing and updating the list. VA, however, will be the lead agency in providing information to Veterans regarding Herbicide Orange. VA will provide information and coordinate with DoD on the development of a communication plan. The DoD will develop guidance for DoD on directing inquiries regarding Herbicide Orange from Veterans or Veterans families back to the VA.*
DoD SMEs are currently serving on a DoD/VA Herbicide Orange Working Group (HOWG) that is advising the DoD/VA Deployment Health Working Group (DHWG). The HOWG has developed criteria for a location to be included on the list. The DoD has engaged in thorough searches of its and other Federal agencies' records relating to Herbicide Orange and other tactical herbicides to identify locations where Herbicide Orange and other tactical herbicides or their components were tested at, disposed of, transported through, or stored at DoD installations or DoD operational locations. DoD has continuously inter-faced closely with VA subject matter experts in this process.

Appendix VI: Comments from the Department of Veterans Affairs

THE SECRETARY OF VETERANS AFFAIRS
WASHINGTON

October 25, 2018

Mr. J. Alfredo Gomez
Director
Natural Resources and Environment
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Gomez:

The Department of Veterans Affairs (VA) has reviewed the Government Accountability Office's (GAO) draft report: ***"AGENT ORANGE: Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations"*** (GAO-19-24).

The enclosure provides general and technical comments and sets forth the actions to be taken to address the draft report recommendations.

VA appreciates the opportunity to comment on your draft report.

Sincerely,

Robert L. Wilkie

Robert L. Wilkie

Enclosure

THE SECRETARY OF VETERANS AFFAIRS
WASHINGTON

October 25, 2018

Mr. Brian J. Lepore
Director
Defense Capabilities and Management
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Lepore:

The Department of Veterans Affairs (VA) has reviewed the Government Accountability Office's (GAO) draft report: ***"AGENT ORANGE: Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations"*** (GAO-19-24).

The enclosure provides general and technical comments and sets forth the actions to be taken to address the draft report recommendations.

VA appreciates the opportunity to comment on your draft report.

Sincerely,

Robert L. Wilkie

Robert L. Wilkie

Enclosure

Enclosure

Department of Veterans Affairs (VA) Comments to
Government Accountability Office (GAO) Draft Report
"AGENT ORANGE: Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations"
(GAO-19-24)

General Comments:

The Veterans Health Administration (VHA) is strongly committed to developing long-term solutions that mitigate risks to the timeliness, cost-effectiveness, quality, and safety of the Department of Veterans Affairs (VA) health care system. As such, VHA will use the findings of this report to continue to make improvements and fulfill our mission of honoring America's Veterans by providing exceptional health care that improves their health and well-being.

VA has a robust Agent Orange program centered in the Post-Deployment Health Services (PDHS) that coordinates efforts with the Veterans Benefits Administration (VBA) and will be able to respond to the recommendations of this report. Current Agent Orange efforts include the following:

1. PDHS provides oversight for an Agent Orange Registry (AOR), which currently contains more than 710,000 individuals, including more than 16,000 who were enrolled during Fiscal Year 2018. Participation in the AOR includes a comprehensive exam and history. Although the exam is not used specifically to apply for benefits, the information gained can be used as background for that process. PDHS is currently reviewing the data in the AOR to report on possible health effects associated with service during the Vietnam War in the registry participants and to generate ideas for future studies.
2. PDHS provides oversight for and management of a Web site (https://www.publichealth.va.gov/exposures/agentorange/) that covers a range of topics, such as the AOR and its eligibility, 14 conditions that have presumptive status, locations where Agent Orange was stored, used, tested, etc., (currently being revised by the Herbicide Orange Working Group), and links to VBA sites that cover eligibility for benefits and a ships list for Navy and other Veterans that provides information on specific service on ships that qualifies for Agent Orange-related service connection.
3. PDHS produces a newsletter on Agent Orange-related topics annually and sends it to the AOR population and some other Veterans and providers. The most recent newsletter is posted at: https://www.publichealth.va.gov/exposures/publications/agent-orange/agent-orange-2018/index.asp.
4. PDHS has also trained providers and other interested VA staff on Agent Orange in the last year via two webinars and a large, interactive conference in St. Louis, MO. PDHS is continually interfacing with Environmental Health Coordinators and Clinicians on topics related to possible Agent Orange exposure in Veterans.
5. PDHS has contracted with the National Academies of Science, Engineering, and Medicine to produce biennial reports on the evidence supporting associations

Enclosure

Department of Veterans Affairs (VA) Comments to
Government Accountability Office (GAO) Draft Report
"AGENT ORANGE: Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations"
(GAO-19-24)

between exposure to tactical herbicides and a number of disease conditions. The findings of these reports are considered when making determinations on the potential addition of new conditions to the list of those presumed to be caused by exposure to Agent Orange.

6. PDHS has provided advise and materials on Agent Orange to Veterans Service Organizations and/or VA staff to use when providing educational sessions for Veterans.
7. PDHS has created a mobile application, Exposure Ed, that provides real-time information on Agent Orange and other potential exposures encountered during military service.

VA is concerned that the report conflates the terms "commercial herbicides" with "tactical herbicides," which are distinctive from one another. In this regard, VA is concerned that certain testing and storage locations, (e.g., Kelly Air Force Base) added to the list are based on the presence of commercial herbicides or mere components of Agent Orange or other rainbow agents.

It should be noted that exposure to tactical herbicides (those herbicides intended for military operations in Vietnam) is required for VA to grant disability benefits on a presumptive basis for Agent Orange conditions outside of Vietnam. The focus on commercial herbicides, which may include certain Agent Orange components, is not relevant for purposes of determining the list of locations where tactical herbicides were tested, stored, etc. unless such commercial agents were in fact the same form and mixture as the tactical agents used in Vietnam.

According to VA regulations, for purposes of determining diseases associated with exposure to certain herbicide agents, the term herbicide agent means a chemical in an herbicide used in support of the United States and allied military operations in the Republic of Vietnam during the period beginning on January 9, 1962, and ending on May 7, 1975, specifically: 2,4-D, 2,4,5-T, and its contaminant tetrachlorodibenzo-p-dioxin (TCDD); cacodylic acid; and picloram. See 38 Code of Federal Regulations §3.307(a)(6).

VA does not dispute that some of the above-mentioned chemicals found in the VA regulation may be included in certain commercial herbicides listed in the federal supply chain; however, of primary importance, the impetus for the creation of the list of testing and storage is to carry out the administration of providing disability benefits in accordance with the applicable Agent Orange statute and regulations. Thus, unless such commercial herbicides were in fact the same composition, forms, and mixtures as the estimated 77 million liters, or 20 million gallons, of rainbow agents (i.e., tactical herbicides) that were specifically produced for the United States and allied military

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Enclosure

Department of Veterans Affairs (VA) Comments to
Government Accountability Office (GAO) Draft Report
"AGENT ORANGE: Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations"
(GAO-19-24)

operations in Vietnam, then such discussion is misleading and not relevant for the purposes described above. See table below for estimated amounts and chemical compositions of rainbow agents used in Vietnam.

An example of this occurs in the draft report on page ten, paragraph one, where GAO mentions that some of the commercial herbicides in the federal supply system contained one or both of some form of the components of Agent Orange, including at least four that contained some form of 2,4,5-T, the component which contained the contaminant 2,3,7,8-TCDD. It should be noted, however, that such commercial forms do not, for example, equate to the mixtures of the n-butyl forms of 2,4-D (50 percent) and 2,4,5-T (50 percent), which make up herbicide orange. This is further illustrated in the last bullet on page 20, where it is noted that two components of Agent Orange were stored at the former Kelly Air Force Base.

VA recommends GAO analyze its list to ensure that only locations where the presence of tactical herbicides, as contemplated by law in 38 United States Code § 1116 and prescribed in VA regulations, has been confirmed, are included on the list of locations.

TABLE
Herbicides in Vietnam (1961 – 1971)
(National Academies of Sciences, 2014, p. 67)

Code Name	Chemical Constituents	Years Used	Veterans Agent Orange Series Estimate	Revised Estimate
Pink	60% n-butyl ester, 40% isobutyl ester of 2,4,5-T	1961, 1965	464,817 L (122,792 gal)	50,312 L sprayed; 413,852 L additional on procurement records
Green	n-butyl ester of 2,4,5-T	1961, 1965	31,071 L (8,208 gal)	31,026 L on procurement records

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Enclosure

Department of Veterans Affairs (VA) Comments to
Government Accountability Office (GAO) Draft Report
"AGENT ORANGE: Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations"
(GAO-19-24)

Purple	50% n-butyl ester of 2,4-D, 30% n-butyl ester of 2,4,5-T, 20% isobutyl ester of 2,4,5-T	1962-1965	548,883 L (145,000 gal)	1,892,733 L
Orange	50% n-butyl ester of 2,4-D, 50% n-butyl ester of 2,4,5-T	1965-1970	42,629,013 L (11,261,429 gal)	45,677,937 L (could include Agent Orange II)
Orange II	50% n-butyl ester of 2,4-D, 50% isooctyl ester of 2,4,5-T	After 1968	--	Unknown; at least 3,591,000 L shipped
White	Acid weight basis: 21.2% triisopropanolamine salts of 2,4-D, 5.7% picloram	1966-1971	19,860,108 L (5,246,502 gal	20,556,525 L
Blue Powder	Cacodylic acid (dimethylarsinic acid) sodium cacodylate	1962-1964	--	25,650 L
Blue aqueous solution	21% sodium cacodylate + cacodylic acid to yield at least 26% total acid equivalent by weight	1964-1971	4,255,952 L (1,124,307 gal)	4,715,731 L
Total, all formulations	**--**	**--**	**67,789,844 L (17,908,238 gal)**	**76,954,766 L (including procured)**

Enclosure

Department of Veterans Affairs (VA) Comments to
Government Accountability Office (GAO) Draft Report
"AGENT ORANGE: Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations"
(GAO-19-24)

Recommendation 3: The Secretary of Defense, in collaboration with the Secretary of Veterans Affairs, should develop clear and transparent criteria for what constitutes a location that should be included on the listing of testing and storage locations.

VA Comment: The Department of Defense (DoD) is the lead on this recommendation. The Department of Veterans Affairs (VA) agrees to support DoD as the lead.

Recommendation 4: The Secretary of Veterans Affairs, in collaboration with the Secretary of Defense, should develop clear and transparent criteria for what constitutes a location that should be included on the list of testing and storage locations.

VA Comment: Non-Concur. VA does not agree to take the lead on this recommendation. Rather, VA agrees to support DoD as the lead (highlighted in recommendation 3). DoD chairs the Herbicide Orange Working Group (HOWG) and has sole access to the information on storage, transport, and usage of Agent Orange.

Recommendation 6: The Secretary of Veterans Affairs, in collaboration with the Secretary of Defense, should develop a formal process for coordinating on how best to communicate information to veterans and the public regarding where Agent Orange was known to have been present outside of Vietnam.

VA Comment: Concur. VA's subject matter experts (SMEs) are currently serving on a DoD/VA HOWG, which is advising the DoD/VA Deployment Health Work Group (DHWG). The HOWG developed criteria for a location to be included on the list. DoD has engaged in thorough searches of its, and other federal agencies', records to identify locations where Herbicide Orange and other tactical herbicides or their components were used or tested at, disposed of, transported through, or stored at installations or other DoD operational locations. DoD has continuously interfaced with VA SMEs during this process.

While DoD will be the lead agency to produce and update the list, VA will be the lead agency to provide information to Veterans regarding Herbicide Orange. VA will provide information and coordinate with DoD on the development of a communication plan. VA will convene a workgroup comprised of SMEs from the Veterans Health Administration and the Veterans Benefits Administration, as well as Agency communication and public affairs experts, to develop and implement the formal process to communicate where Agent Orange and other tactical herbicides were known to have been present outside of Vietnam. This effort will be closely coordinated with the designated leads at DoD tasked with updating the list. VA's workgroup tasks will also include updating VA Web

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Enclosure

Department of Veterans Affairs (VA) Comments to
Government Accountability Office (GAO) Draft Report
"AGENT ORANGE: Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations"
(GAO-19-24)

sites, producing articles for social media/newsletters, and engaging in communications with Veterans Service Organizations. The working group will brief the HOWG, and then the DHWG, on its progress, and ultimately brief appropriate senior VA leadership before the target completion date. The target completion date is August 2019.

Appendix VII: Comments from the U.S. Department of Agriculture

USDA
United States Department of Agriculture
Research Education Economics
Office of the Under Secretary
Room 216W
Jamie L. Whitten Building
Washington, DC 20250-0110

OCT 17 2018

Mr. Brian Lepore
Director, Defense Capabilities and Management
United States Government Accountability Office
411 G Street NW
Washington, D.C. 20548

Dear Mr. Lepore:

The U.S. Department of Agriculture (USDA) appreciates the opportunity to review and provide comments on the draft Government Accountability Office (GAO) report GA0-19-24, "Agent Orange: Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations." The USDA Agricultural Research Service (ARS) was asked to coordinate the USDA response to this report.

ARS, on behalf of USDA, conducted a review of this report from the viewpoint of agricultural research and programs. Our concurrence with the report findings should not be construed to apply beyond agriculture and related collaborations with the U.S. Department of Defense.

The USDA agrees with the GAO's agriculture related findings communicated in the report. The report's primary focus is on aspects of transport, storage, and possible exposure events of Agent Orange related to warfighters and others engaged in the Vietnam war; legacy locations; and what can be done to provide better information to veterans and the public.

The USDA was involved in 12 of the 71 reported efforts related to research and evaluation of Agent Orange (see Appendix IV). USDA concurs with the reported involvement.

The USDA review of this document included evaluation of its overall contents and the five recommendations provided by the GAO. Four recommendations were made to the Secretary of Defense and one was made to the Secretary of Veteran Affairs. No recommendations were made to the Secretary of Agriculture. The USDA has no comments on any of these recommendations, as they do not formally address or affect the USDA.

Summary: In review of the entire document, USDA does not disagree with any of the information communicated in the GAO report and therefore has no changes to suggest.

Sincerely,

Chavonda Jacobs-Young, Ph.D.
Acting Deputy Under Secretary
Acting Chief Scientist, USDA

Appendix VIII: GAO Contacts and Staff Acknowledgments

GAO Contacts

Brian J. Lepore, (202) 512-4523 or leporeb@gao.gov
J. Alfredo Gómez, (202) 512-3841 or gomezj@gao.gov

Staff Acknowledgments

In addition to the contacts named above, Kristy Williams and Barbara Patterson (Assistant Directors), Karyn Angulo, Emil Friberg, Ashley Grant, Karen Howard, Kelly Husted, Richard Johnson, Amie Lesser, Keegan Maguigan, Jeff Mayhew, Dennis Mayo, Parke Nicholson, Shahrzad Nikoo, Josie Ostrander, Rebecca Parkhurst, Michael Silver, Anne Stevens, Rachel Stoiko, Roger Stoltz, and Cheryl Weissman made key contributions to this report.

Appendix IX: Accessible Data

Agency Comment Letters

Accessible Text for Appendix V: Comments from the Department of Defense

Page 1

Mr. Brian J. Lepore

Director, Defense Capabilities and Management

U.S. Government Accountability Office

441 G Street, NW

Washington, DC 20548

Dear Mr. Lepore,

OCT 24 2018

This is the Department of Defense (DoD) response to the Government Accountability Office (GAO) Draft Report, GAO-19-24, “AGENT ORANGE: Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations” dated September 24, 2018 (GAO Code 102077). Detailed comments on the report recommendations are enclosed.

Sincerely,

Robert H. McMahon

Enclosure: As stated

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GAO DRAFT REPORT DATED SEPTEMBER 24, 2018 GAO-19-24 (GAO CODE 102077)

"AGENT ORANGE: ACTIONS NEEDED TO IMPROVE ACCURACY AND COMMUNICATIONS OF INFORMATION ON TESTING AND STORAGE LOCATIONS"

DEPARTMENT OF DEFENSE COMMENTS TO THE GAO RECOMMENDATION

RECOMMENDATION 1: The GAO recommends that the Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment assigns responsibility for ensuring that DoD's list of locations where Agent Orange or its components were tested or stored is as complete and accurate as available records allow.

DoD RESPONSE: Concur. The Under Secretary of Defense for Acquisition and Sustainment will assign responsibility for DoD's list of locations where Herbicide Orange, or its components, were tested or stored.

RECOMMENDATION 2: The GAO recommends that the Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment develops a process for updating the revised list as new information becomes available.

DoD RESPONSE: Concur. The Under Secretary of Defense for Acquisition and Sustainment will develop a process to update the DoD list based on clear and transparent criteria developed with Veterans Affairs in recommendations #3 and 4.

RECOMMENDATION 3: The GAO recommends that the Secretary of Defense. in collaboration with the Secretary of Veterans Affairs, should ensure that the Under Secretary of Defense for Acquisition and Sustainment develop clear and transparent criteria for what constitutes a location that should be on the list of testing and storage locations.

DoD RESPONSE: Concur. DoD will be the lead agency for searching, reviewing, and validating documentation to identify DoD locations where the development of chemicals for military use in controlling vegetation and crops in tactical situations were developed, tested, used or stored. DoD. in collaboration with the VA. will develop clear and transparent criteria for what constitutes a location for the list to be provided to the VA.

Status: DoD has engaged in thorough searches of DoD and other Federal agency records relating to Herbicide Orange and other tactical herbicides.

The records discovered thus far are extensive and very useful in evaluating whether a location stored or used Herbicide Orange. DoD continues to seek and review records on these subjects as part of the process that will be developed per recommendation #2.

Page 3

The DoD and VA subject matter experts (SMEs) are working collaboratively to develop clear and transparent criteria and guidance for what constitutes a location that should be on the VA list.

RECOMMENDATION 5: The GAO recommends that the Secretary of Defense. in collaboration with the Secretary of Veterans Affairs, should develop a formal process for coordinating on how best to communicate information to veterans and the public regarding where Agent Orange was known to have been present outside of Vietnam.

DoD RESPONSE: Concur. DoD will be the lead agency for producing and updating the list. VA, however. will be the lead agency in providing information to Veterans regarding Herbicide Orange. VA will provide information and coordinate with DoD on the development of a communication plan. The DoD will develop guidance for DoD on directing inquiries regarding Herbicide Orange from Veterans or Veterans families back to the VA. DoD SMEs are currently serving on a DoD/VA Herbicide Orange Working Group (HOWG) that is advising the DoD/VA Deployment Health Working Group (DHWG). The HOWG has developed criteria for a location to be included on the list. The DoD has engaged in thorough searches of its and other Federal agencies' records relating to Herbicide Orange and other tactical herbicides to identify locations where Herbicide Orange and other tactical herbicides or their components were tested at, disposed of transported through, or stored at DoD installations or DoD operational locations. DoD has continuously inter-faced closely with VA subject matter experts in this process.

Accessible Text for Appendix VI: Comments from the Department of Veterans Affairs

Page 1

October 25, 2018

Mr. J. Alfredo Gomez

Director

Natural Resources and Environment

U.S. Government Accountability Office

441 G Street, NW

Washington, DC 20548

Dear Mr. Gomez:

The Department of Veterans Affairs (VA) has reviewed the Government Accountability Office's (GAO) draft report: "AGENT ORANGE: Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations" (GAO-19-24).

The enclosure provides general and technical comments and sets forth the actions to be taken to address the draft report recommendations.

VA appreciates the opportunity to comment on your draft report.

Sincerely,

Robert L. Wilkie

Enclosure

Page 2

October 25, 2018

Mr. Brian J. Lepore

Director

Defense Capabilities and Management

U.S. Government Accountability Office

441 G Street, NW

Washington, DC 20548

Dear Mr. Lepore:

The Department of Veterans Affairs (VA) has reviewed the Government Accountability Office's (GAO) draft report: "AGENT ORANGE: Actions Needed to Improve Accuracy and Communication of Information on Testing and Storage Locations" (GAO-19-24).

The enclosure provides general and technical comments and sets forth the actions to be taken to address the draft report recommendations.

VA appreciates the opportunity to comment on your draft report.

Sincerely,

Robert L. Wilkie

Enclosure

Page 3

General Comments:

The Veterans Health Administration (VHA) is strongly committed to developing long- term solutions that mitigate risks to the timeliness, cost-effectiveness, quality, and safety of the Department of Veterans Affairs (VA) health care system. As such, VHA will use the findings of this report to continue to make improvements and fulfill our mission of honoring America's Veterans by providing exceptional health care that improves their health and well-being.

VA has a robust Agent Orange program centered in the Post-Deployment Health Services (PDHS) that coordinates efforts with the Veterans Benefits Administration (VBA) and will be able to respond to the recommendations of this report. Current Agent Orange efforts include the following:

1. PDHS provides oversight for an Agent Orange Registry (AOR), which currently contains more than 710,000 individuals, including more than 16,000 who were enrolled during Fiscal Year 2018. Participation in the AOR includes a comprehensive exam and history. Although the exam is not used specifically to apply for benefits, the information gained can be used as background for that process. PDHS is currently reviewing the data in the AOR to report on possible health effects

associated with service during the Vietnam War in the registry participants and to generate ideas for future studies.

2. PDHS provides oversight for and management of a Web site (https://www.publichealth.va.gov/exposures/agentorange/) that covers a range of topics, such as the AOR and its eligibility, 14 conditions that have presumptive status, locations where Agent Orange was stored, used, tested, etc., (currently being revised by the Herbicide Orange Working Group), and links to VBA sites that cover eligibility for benefits and a ships list for Navy and other Veterans that provides information on specific service on ships that qualifies for Agent Orange- related service connection.

3. PDHS produces a newsletter on Agent Orange-related topics annually and sends it to the AOR population and some other Veterans and providers. The most recent newsletter is posted at: https://www.publichealth.va.gov/exposures/publications/agent-orange/agent-orange-2018/index.asp.

4. PDHS has also trained providers and other interested VA staff on Agent Orange in the last year via two webinars and a large, interactive conference in St. Louis, MO. PDHS is continually interfacing with Environmental Health Coordinators and Clinicians on topics related to possible Agent Orange exposure in Veterans.

5. PDHS has contracted with the National Academies of Science, Engineering, and Medicine to produce biennial reports on the evidence supporting associations

Page 4

between exposure to tactical herbicides and a number of disease conditions. The findings of these reports are considered when making determinations on the potential addition of new conditions to the list of those presumed to be caused by exposure to Agent Orange.

6. PDHS has provided advise and materials on Agent Orange to Veterans Service Organizations and/or VA staff to use when providing educational sessions for Veterans.

7. PDHS has created a mobile application, Exposure Ed, that provides real-time information on Agent Orange and other potential exposures encountered during military service.

VA is concerned that the report conflates the terms "commercial herbicides" with "tactical herbicides," which are distinctive from one another. In this regard, VA is concerned that certain testing and storage locations, (e.g., Kelly Air Force Base) added to the list are based on the presence of commercial herbicides or mere components of Agent Orange or other rainbow agents.

It should be noted that exposure to tactical herbicides (those herbicides intended for military operations in Vietnam) is required for VA to grant disability benefits on a presumptive basis for Agent Orange conditions outside of Vietnam. The focus on commercial herbicides, which may include certain Agent Orange components, is not relevant for purposes of determining the list of locations where tactical herbicides were tested, stored, etc. unless such commercial agents were in fact the same form and mixture as the tactical agents used in Vietnam.

According to VA regulations, for purposes of determining diseases associated with exposure to certain herbicide agents, the term herbicide agent means a chemical in an herbicide used in support of the United States and allied military operations in the Republic of Vietnam during the period beginning on January 9, 1962, and ending on May 7, 1975, specifically: 2,4-D, 2,4,5-T, and its contaminant tetrachlorodibenzo-p-dioxin (TCDD); cacodylic acid; and picloram. See 38 Code of Federal Regulations §3.307(a)(6).

VA does not dispute that some of the above-mentioned chemicals found in the VA regulation may be included in certain commercial herbicides listed in the federal supply chain; however, of primary importance, the impetus for the creation of the list of testing and storage is to carry out the administration of providing disability benefits in accordance with the applicable Agent Orange statute and regulations. Thus, unless such commercial herbicides were in fact the same composition, forms, and mixtures as the estimated 77 million liters, or 20 million gallons, of rainbow agents (i.e., tactical herbicides) that were specifically produced for the United States and allied military

Page 5

operations in Vietnam, then such discussion is misleading and not relevant for the purposes described above. See table below for estimated amounts and chemical compositions of rainbow agents used in Vietnam.

An example of this occurs in the draft report on page ten, paragraph one, where GAO mentions that some of the commercial herbicides in the federal supply system contained one or both of some form of the components of Agent Orange, including at least four that contained some form of 2,4,5-T, the component which contained the contaminant 2,3,7,8-TCDD. It should be noted, however, that such commercial forms do not, for example, equate to the mixtures of the n-butyl forms of 2,4-D (50 percent) and 2,4,5-T (50 percent), which make up herbicide orange. This is further illustrated in the last bullet on page 20, where it is noted that two components of Agent Orange were stored at the former Kelly Air Force Base.

VA recommends GAO analyze its list to ensure that only locations where the presence of tactical herbicides, as contemplated by law in 38 United States Code § 1116 and prescribed in VI regulations, has been confirmed, are included on the list of locations.

Page 6

Page 7

Recommendation 3: The Secretary of Defense, in collaboration with the Secretary of Veterans Affairs, should develop clear and transparent criteria for what constitutes a location that should be included on the listing of testing and storage locations.

VA Comment: The Department of Defense (DoD) is the lead on this recommendation. The Department of Veterans Affairs (VA) agrees to support DoD as the lead.

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coordinating on how best to communicate information to veterans and the public regarding where Agent Orange was known to have been present outside of Vietnam.

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Page 8

sites, producing articles for social media/newsletters, and engaging in communications with Veterans Service Organizations. The working group will brief the HOWG, and then the DHWG, on its progress, and ultimately brief appropriate senior VA leadership before the target completion date. The target completion date is August 2019.

Accessible Text for Appendix VII: Comments from the U.S. Department of Agriculture

OCT 17 2018

Mr. Brian Lepore

Director, Defense Capabilities and Management

United States Government Accountability Office

411 G Street NW

Washington, D.C. 20548

Dear Mr. Lepore:

The U.S. Department of Agriculture (USDA) appreciates the opportunity to review and provide comments on the draft Government Accountability Office (GAO) report GA0-19-24, "Agent Orange: Actions Needed to Improve Accuracy and Communication of information on Testing and Storage Locations." The USDA Agricultural Research Service (ARS) was asked to coordinate the USDA response to this report.

ARS, on behalf of USDA, conducted a review of this report from the viewpoint of agricultural research and programs. Our concurrence with the repo1i findings should not be construed to apply beyond agriculture and related collaborations with the U.S. Department of Defense.

The USDA agrees with the GAO's agriculture related findings communicated in the report. The report's primary focus is on aspects of transport, storage, and possible exposure events of Agent Orange related to warfighters and others engaged in the Vietnam war; legacy locations; and what can be done to provide better information to veterans and the public.

The USDA was involved in 12 of the 71 reported efforts related to research and evaluation of Agent Orange (see Appendix IV). USDA concurs with the reported involvement.

The USDA review of this document included evaluation of its overall contents and the five recommendations provided by the GAO. Four recommendations were made to the Secretary of Defense and one was made to the Secretary of Veteran Affairs. No recommendations were made to the Secretary of Agriculture. The USDA has no comments on any of these recommendations, as they do not formally address or affect the USDA.

Summary: In review of the entire document, USDA does not disagree with any of the information communicated in the GAO report and therefore has no changes to suggest.

Sincerely,

Chavonda Jacobs-Young, Ph.D.

Acting Deputy Under Secretary

Acting Chief Scientist, USDA

Related GAO Products

Agent Orange: Limited Information Is Available on the Number of Civilians Exposed in Vietnam and Their Workers' Compensation Claims. GAO-05-371. Washington, D.C.: Apr. 22, 2005.

Agent Orange: Persisting Problems with Communication of Ranch Hand Study Data and Results. GAO/T-NSIAD-00-117. Washington, D.C.: Mar. 15, 2000.

Agent Orange: Actions Needed to Improve Communications of Air Force Ranch Hand Study Data and Results. GAO/NSIAD-00-31. Washington, D.C.: Dec. 17, 1999.

Agent Orange Studies: Poor Contracting Practices at Centers for Disease Control Increased Costs. GAO/GGD-90-122BR. Washington, D.C.: Sept. 28, 1990.

Agent Orange: VA Needs To Further Improve Its Examination and Registry Program. GAO/HRD-86-7. Washington, D.C.: Jan. 14, 1986.

VA's Agent Orange Examination Program: Actions Needed To More Effectively Address Veterans' Health Concerns. GAO/HRD-83-6. Washington, D.C.: Oct. 25, 1982.

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