

December 2005

HAZARDOUS WASTE

EPA Needs to Clarify the Types of Mercury Waste That Can Be Treated and Disposed of Using the Debris Regulations



GAO

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HAZARDOUS WASTE

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Why GAO Did This Study

The Environmental Protection Agency (EPA) is responsible for regulating hazardous wastes (such as mercury) under the Resource Conservation and Recovery Act (RCRA). Under RCRA, mercury-containing hazardous waste must meet specific treatment standards before land disposal. But, certain difficult to manage waste due, in part, to its large particle size, can follow alternate “debris” standards that provide diverse treatment options. This report examines (1) the mechanisms that EPA uses to track the treatment and disposal of mercury-contaminated debris and the quantity of this waste, (2) the extent to which EPA, states, and industry share a common understanding of the types of mercury-containing wastes that can be treated and disposed of as debris, and (3) EPA and state controls that are in place to monitor compliance with EPA’s treatment and disposal requirements for mercury-contaminated debris.

What GAO Recommends

GAO recommends that EPA (1) clarify and better describe the types of waste that can and cannot be reported under the “debris” reporting category and (2) conduct further outreach to communicate the types of mercury-containing wastes that can be treated and disposed of according to the alternative treatment standards for debris. In oral comments on a draft of this report, EPA agreed with GAO’s recommendations.

www.gao.gov/cgi-bin/getrpt?GAO-06-99.

To view the full product, including the scope and methodology, click on the link above. For more information, contact John B. Stephenson at (202) 512-3841 or stephensonj@gao.gov.

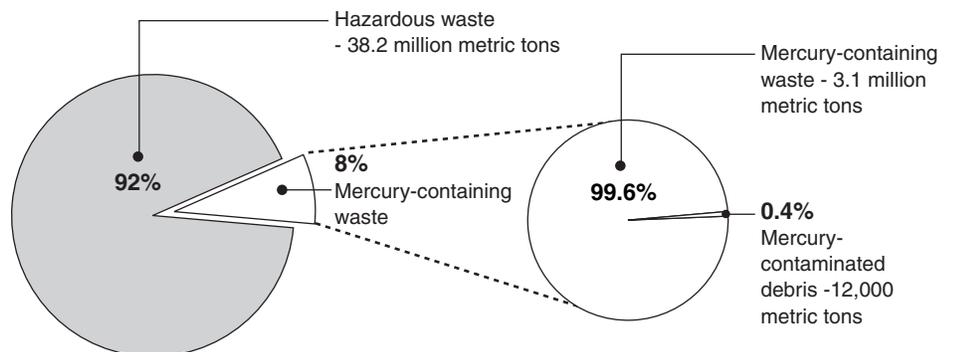
What GAO Found

EPA uses its RCRAInfo database to maintain information on all hazardous waste, including mercury-contaminated debris. EPA reported that in 2003, mercury-contaminated debris constituted about 12,000 metric tons—or about 0.4 percent of all mercury-containing waste and about 0.03 percent of all hazardous waste. However, EPA’s data on mercury-contaminated debris may be incomplete. Reporting on the physical form of the waste (debris is one of many physical forms) is optional, and businesses did not submit this optional information in about 9 percent of instances when they reported treating and disposing of mercury-containing waste in 2003. In addition, EPA’s reporting category for debris does not provide a complete list of items that EPA considers to be debris, and debris can be reported in other categories.

The 48 states and the District of Columbia and the 14 commercial hazardous waste landfill operators that responded to our survey do not share a common understanding of the types of mercury-containing waste that EPA allows to be treated and disposed of as debris. For example, in their responses, officials in 21 states and operators of 6 commercial hazardous waste landfills identified as debris waste that is explicitly not debris, such as intact devices containing mercury, and may have used the debris regulations for such waste. Consequently, EPA cannot be certain that businesses are appropriately managing their mercury-containing waste as debris.

EPA’s mandatory waste tracking and documentation requirements serve as controls to monitor compliance with EPA’s treatment and disposal requirements for mercury-contaminated debris. EPA and state oversight inspections and enforcement programs provide additional compliance monitoring with the alternative treatment standards for debris.

Percentage of Hazardous Waste with Mercury and the Portion of the Mercury-Containing Waste That Was Debris in 2003



Source: GAO analysis of EPA’s RCRAInfo data.

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Abbreviations

C.F.R.	Code of Federal Regulations
EPA	Environmental Protection Agency
RCRA	Resource Conservation and Recovery Act

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United States Government Accountability Office
Washington, D.C. 20548

December 16, 2005

The Honorable Sherwood Boehlert
Chairman
Committee on Science
House of Representatives

The Honorable Gil Gutknecht
House of Representatives

Mercury is a toxic element used in numerous products (such as thermometers and dental amalgam) and industrial processes (such as chlorine production). According to the Environmental Protection Agency (EPA), if mercury is released into the environment, it could pose a risk to human health. For example, consuming mercury-contaminated fish can cause neurological disorders in children.

The Resource Conservation and Recovery Act (RCRA) governs the management of hazardous waste. Under RCRA, EPA may authorize a state to implement its own hazardous waste management program in lieu of the federal RCRA program, so long as the state program is at least as stringent. In addition, hazardous waste must generally be treated to reduce its toxicity or mobility, so that threats to human health and the environment are minimized, before it can be disposed of in a hazardous waste landfill.¹

The treatment standards for wastes containing mercury (mercury-specific standards) are based on the level of mercury concentration in the waste. Wastes containing more than 260 milligrams per kilogram of total mercury (high mercury-containing waste) must generally undergo retorting—a process that heats the waste to separate and recover the mercury from the rest of the waste—or incineration, if the waste includes organic (e.g., carbon-based) material. Wastes containing less than 260 milligrams per kilogram of total mercury (low mercury-containing waste), must have their toxicity reduced to specified numerical levels, which can generally be met

¹Household and certain businesses that generate small quantities of hazardous waste, including mercury-containing waste, are exempt from RCRA hazardous waste requirements and can generally dispose of their waste in a municipal landfill.

by stabilization (a process that involves mixing the hazardous waste with a chemical bonding material, such as Portland cement).²

In 1992, EPA developed alternative treatment standards for hazardous waste debris—the debris treatment standards—because the physical characteristics of debris make it difficult to meet the treatment standards for the waste contaminating the debris.³ Specifically, EPA defines debris as a solid material exceeding a 60 millimeter particle size (roughly the size of a tennis ball) that is intended for land disposal and that is a manufactured object, plant or animal matter, or natural geologic material. The alternative debris treatment standards do not apply to certain items specifically excluded from the debris definition or to waste types that have their own alternative treatment standards, such as contaminated soil. Hazardous debris, such as mercury-contaminated debris, must be treated prior to land disposal under either the hazardous waste treatment standard applicable to the waste contaminating the debris, or in accordance with the alternative treatment standards for hazardous debris, which, according to EPA, are also generally more cost-effective to use.

Thus, mercury-contaminated hazardous waste debris (such as bricks, pipes, ruptured metal drums, or large chunks of concrete) may either be treated according to (a) the mercury-specific treatment standards described above (including retorting for high-mercury containing hazardous waste), or (b) stabilization or encapsulation (fully enclosing the hazardous waste in another material, such as a high-density plastic container), regardless of the mercury concentration level.⁴ In 2003, EPA issued guidance to states that, among other things, clarified the types of waste that are eligible for treatment and disposal under the alternative treatment standards for debris. EPA recently reported that it has not found any evidence that there is a significant environmental problem associated

²EPA typically uses the term “microencapsulation” to refer to what we call stabilization in this report.

³Debris can be either hazardous or non-hazardous. Non-hazardous debris is not covered by EPA’s hazardous waste regulations and is not the object of this report. Terms used in this report such as “mercury-contaminated debris,” “mercury-containing wastes,” and “hazardous waste debris,” refer to those wastes that are subject to the hazardous waste regulations of RCRA.

⁴EPA typically uses the term “macroencapsulation” to refer to what we call encapsulation in this report. EPA notes that this treatment method cannot be used for waste debris that contains free liquid mercury.

with the treatment and disposal of mercury-contaminated debris under its current rules.⁵

Most businesses that generate, treat, and dispose of hazardous waste are required under RCRA to report on their hazardous waste activities biennially to their states, which, in turn, submit information to EPA. EPA compiles and summarizes the data on the amount of hazardous waste generated, treated, and disposed of in a biennial report, which is information collected and stored in EPA's RCRAInfo data system. EPA's most recent biennial Hazardous Waste Report for 2003 was released in April 2005.

Our report examines (1) the mechanisms that EPA uses to track the treatment and disposal of mercury-contaminated debris and the quantity of mercury-contaminated debris that is disposed of, (2) the extent to which EPA, states, and industry share a common understanding of the types of mercury-containing wastes that can be treated and disposed of as debris, and (3) EPA and state controls that are in place to monitor compliance with EPA's treatment and disposal requirements for mercury-contaminated debris.

To address these objectives, we analyzed 2001 and 2003 information from EPA's RCRAInfo database, which contains the state-provided data from businesses that generate, treat, and dispose of hazardous waste. We assessed the reliability of the data and found that they were sufficiently reliable for our use. In addition, we surveyed the 50 states and the District of Columbia and the 19 commercial hazardous waste landfills in the United States to gather information on, among other things, states' and hazardous waste landfills' current practices for treating and disposing of certain mercury-containing wastes using EPA's alternative treatment standards for debris and any violations involving mercury-containing waste. We obtained a list of state contact officials for hazardous waste from the Association of State and Territorial Solid Waste Management Officials and the Environmental Council of the States. We confirmed with each official, that he or she was the appropriate state official to complete our survey on mercury-contaminated debris or obtained the name of another official and

⁵According to EPA, in 2003, the agency consulted extensively with the Association of State and Territorial Solid Waste Management Officials and the Northeast Waste Management Officials' Association; EPA also consulted with its regional staff and held discussions with representatives from the mercury treatment industry and the environmental community on this issue.

confirmed with that official. We obtained the list of hazardous waste landfill operators from EPA and confirmed that each was the appropriate individual to complete our survey on mercury-contaminated debris. Before distributing the surveys, we conducted pretests with officials in 7 states and operators of 2 hazardous waste landfills to ensure the validity of the questions; we modified the surveys in response to their comments. We also conducted follow-up interviews with the state officials who reported violations with treating and disposing of mercury-containing wastes, including mercury-contaminated debris, to discuss the nature of these violations and the corrective actions taken. We reviewed EPA's requirements and policies governing the treatment and disposal of mercury-contaminated debris and EPA documents related to the agency's rationale for developing the alternative treatment standards for debris. We discussed the effectiveness of these requirements and policies for protecting human health and the environment with EPA officials, representatives from hazardous waste landfills, businesses that retort mercury-contaminated debris, and environmental organizations. We performed our work between March 2005 and November 2005, in accordance with generally accepted government auditing standards, which included an assessment of data reliability and internal controls. Appendix I provides a detailed description of our objectives, scope, and methodology.

Results in Brief

EPA uses the biennial Hazardous Waste Report, which is based on RCRAInfo data, to track the information that states report on the treatment and disposal of all types of hazardous waste, including mercury-contaminated debris. According to EPA's data, businesses treated and disposed of about 38.2 million metric tons of hazardous wastes in 2003. About 3.1 million metric tons (about 8.2 percent) of the total quantity of hazardous waste contained mercury. Mercury-contaminated debris constituted about 12,000 metric tons—or about 0.4 percent of all mercury-containing waste and about 0.03 percent of all hazardous waste, according to RCRAInfo data. However, EPA's data on mercury-contaminated debris may be incomplete because reporting on the physical form of the waste (such as the portion that was debris) in the biennial Hazardous Waste Report is optional. According to our analysis, in about 9 percent of the reported instances in which businesses treated and disposed of mercury-containing waste in 2003, businesses did not submit the optional information on the physical form of the waste. These instances accounted for less than 1 percent of the total quantity of mercury-containing waste treated and disposed of in 2003. If a portion of a business's mercury-containing waste was treated and disposed of as debris,

that portion was unknown to the state and, hence, not reported to EPA. In addition, EPA's data on mercury-contaminated debris may not be accurate. EPA's debris reporting category for its biennial data collection does not provide a complete list of debris items, and debris items can be reported in other categories. For example, ruptured metal drums are typically considered to be debris, but are not included in the list of items in EPA's debris category description in the biennial Hazardous Waste Report instructions and there is a separate "metal drum" category. As a result, businesses may have reported ruptured metal drums in the debris category or in the metal drum category, which does not include debris. EPA said that it intended the debris category to capture information on all waste identified as hazardous waste debris.

The 48 states, the District of Columbia, and 14 commercial hazardous waste landfill operators that responded to our survey do not share a common understanding of the types of mercury-containing waste that EPA allows to be treated and disposed of as debris. Consequently, businesses may be treating and disposing of items as debris even though these items may not meet EPA's definition of debris. In response to our survey, officials in 21 states and operators of 6 commercial hazardous waste landfills inaccurately identified one or more nondebris mercury-containing wastes as being debris. For example, some states' officials and hazardous waste landfill operators told us that they would apply the alternative treatment standards for debris to intact mercury-containing devices, such as regulators and thermometers. However, these intact devices are excluded from the definition of debris under the debris regulations and may contain high levels of mercury. Although EPA provided guidance in 2003 on when the alternative treatment standards for debris can be used, our survey results suggest that the guidance may not be sufficiently clear. Any confusion about what is or is not debris is particularly problematic if high mercury-containing waste is not treated and disposed of properly. Because states and industry may not share EPA's understanding of debris, EPA cannot be certain that businesses that manage mercury-containing waste are appropriately using the alternative treatment standards for debris. When we discussed these findings with EPA, officials agreed that clarifying guidance may be warranted.

EPA and states have certain controls in place to monitor compliance with the hazardous waste debris regulations by businesses that generate, treat, and dispose of hazardous waste. EPA's hazardous waste manifest system tracks the transportation of all hazardous waste, including mercury-contaminated debris, from its generation to its disposal. The key

component of this system is the uniform hazardous waste manifest, which is a form prepared by all businesses that generate, transport, treat, or otherwise take physical custody of the waste. The manifest contains information on the type and quantity of the waste being transported, instructions for handling the waste, and signature lines for all parties involved in the disposal process. Once the waste reaches its final destination, a signed copy of the manifest is returned to the business that generated the waste. In addition to the manifest, businesses that handle hazardous waste must notify the next party that receives the waste how the waste must be treated to meet the treatment standard or if it can be disposed of without treatment. EPA and state enforcement programs also provide oversight and compliance monitoring with the alternative treatment standards for debris. Oversight inspections have resulted in enforcement actions, such as fines and imprisonment for violations. Lastly, EPA and most states have hotlines that afford citizens the opportunity to report possible violations of the hazardous waste treatment and disposal regulations.

We are making recommendations to EPA to (1) clarify and better describe the types of waste that can and cannot be reported under the “debris” category and (2) conduct further outreach to communicate to states and hazardous waste landfills the types of mercury-containing wastes that can be treated and disposed of according to the alternative treatment standards for debris.

In oral comments on a draft of this report, EPA agreed with our recommendations and provided technical comments, which we incorporated into the report as appropriate.

Background

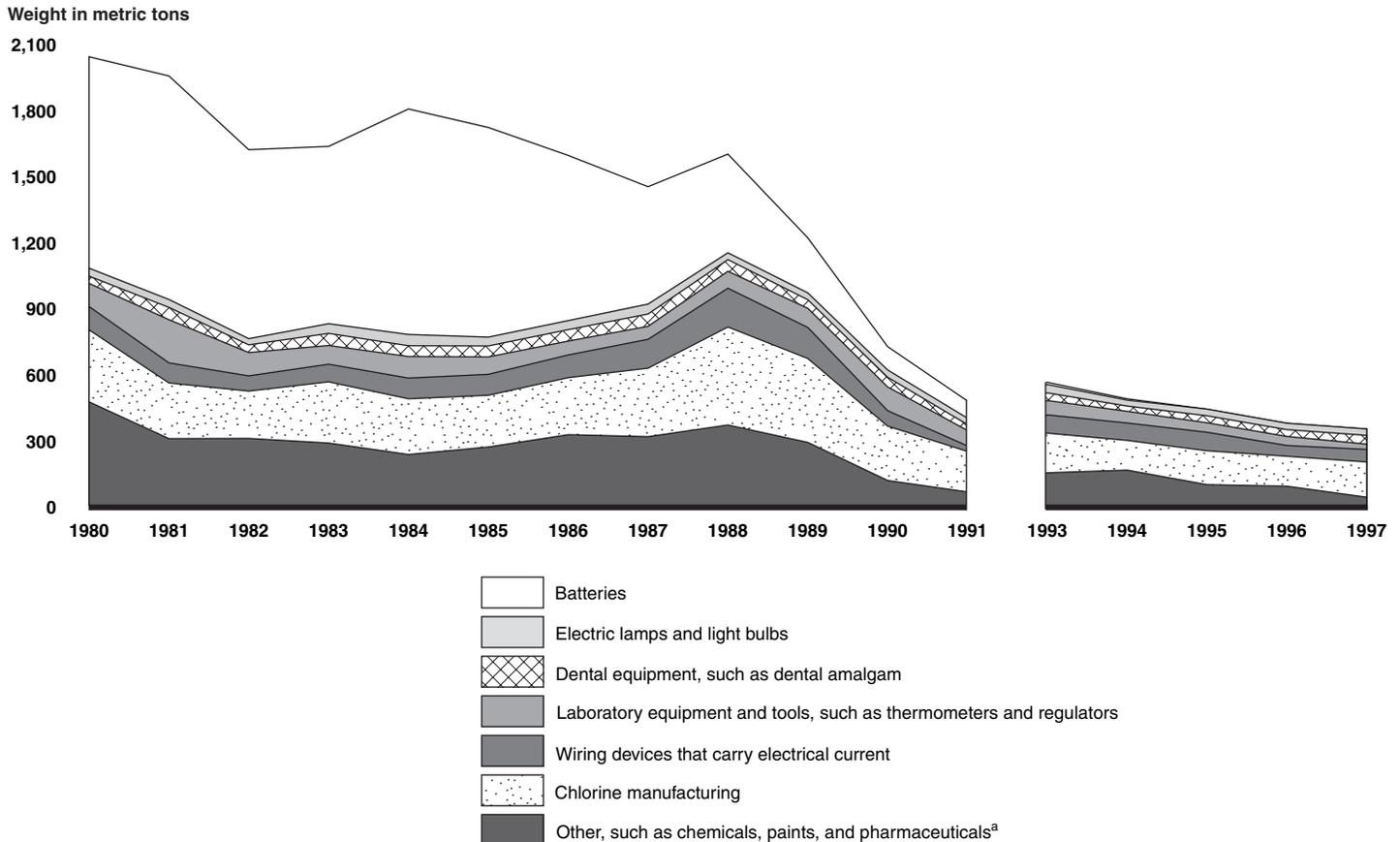
Mercury is a naturally occurring toxic metallic substance that exists as a liquid or vapor in its elemental form and can be a solid or liquid in its compound form. Elemental mercury is used in producing chlorine liquid and caustic soda, in extracting gold from ore or materials that contain gold, and in thermometers, barometers, and electrical switches. Silver-colored dental fillings (known as dental amalgam) typically contain about 50 percent metallic mercury.

Mercury forms inorganic compounds when combined with elements such as chlorine, sulfur, or oxygen. Inorganic mercury compounds are used in fungicides, skin-lightening creams, topical antiseptic or disinfectant agents, antibacterials, preservatives in some prescription and over-the-counter

medicines, coloring paints, and tattoo dyes. In combination with carbon, mercury forms organic compounds, the most common of which is methylmercury, which can build up in certain edible freshwater and saltwater fish and marine mammals.

In recent years, mercury use has declined as the availability of nonmercury-based materials has been developed. For example, the large lamps that light parking lots used to be made with mercury, but are increasingly being made without it. Also, the Mercury-Containing and Rechargeable Battery Management Act of 1996 severely restricted the mercury content in batteries sold after the act's enactment date of May 13, 1996. Today, the predominant uses of mercury are for the production of chlorine-related products, the amalgam used in dental fillings, and wiring devices that carry electrical current. As figure 1 shows, mercury use in the United States generally declined between 1980 and 1997, according to the U.S. Geological Survey, which compiled those data until 1997.

Figure 1: Use of Mercury in U.S. Products, 1980 to 1997



Sources: U.S. Geological Survey's Minerals Yearbooks: 1980, 1985, 1989-1991, 1994, 1996, and 1998.

Note: Data were not available for 1992.

^aFor 1980 and 1994 to 1997, the "other" category also includes data on mercury use that the reporting businesses deemed to be confidential business information.

Debris Regulatory Framework

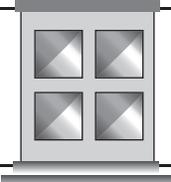
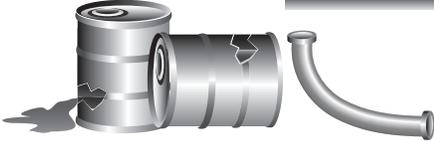
Debris contaminated with mercury can come from various sources—often from a cleanup effort (such as a mercury spill) or demolition of a mercury-contaminated building (such as a laboratory). It can also include structural steel, glass, wooden pallets, cloth, and ruptured containers and devices. When debris contains hazardous amounts of mercury or other hazardous wastes, the hazardous waste debris must be treated to address each of the hazardous wastes.

The debris definition excludes the following materials:

- any material for which a specific treatment standard is provided in 40 C.F.R. Part 268, Subpart D (namely lead acid batteries, cadmium batteries, and radioactive lead solids);
- process residuals such as smelter slag and residues from the treatment of waste, wastewater, sludges, or air emission residues; and
- intact containers of hazardous waste that are not ruptured and that retain at least 75 percent of their original volume.

A mixture of debris and other material (such as soil or sludge) is subject to the hazardous waste debris regulations if the mixture is comprised primarily of debris, by volume, based on visual inspection. Figure 2 provides a general description of categories of waste that EPA typically classifies as debris and that could be contaminated with mercury.

Figure 2: General Categories of Debris That Could Be Contaminated with Mercury

<p>Brick, concrete, rock, and pavement</p>		
<p>Glass, such as broken glass or windows</p>		
<p>Metal objects, such as ruptured drums and tanks, pipes, and bars</p>		
<p>Rubber and plastic, such as tires, hoses, PVC piping, and plastic sheets</p>		
<p>Paper and cloth, such as cardboard, paper insulation, rags, and personal protective equipment</p>		
<p>Wood, such as pallets, plywood, and wood flooring</p>		
<p> Debris items are greater than 60 millimeters in size (approximately the size of a tennis ball).</p>		

Sources: 57 Fed. Reg. 983, (January 9, 1992); GAO.

Mercury-contaminated debris (such as bricks, pipes, ruptured metal drums, or large chunks of concrete) may either be treated according to (a) the mercury-specific standards described above (primarily including retorting

for high-mercury containing waste), or (b) encapsulated or stabilized,⁶ regardless of the mercury concentration level. If managed using the mercury-specific standards, the waste or residue from the retorting process must have their toxicity reduced to specified numerical levels before it can be land disposed.⁷ Waste managed according to the alternative treatment standards for hazardous debris does not generally have to be tested before it is land disposed because, according to EPA, obtaining a representative sample is often impractical. In addition, the leach test, which requires grinding as part of the test procedure, may not be appropriate for certain debris treatment technologies, such as encapsulation, since the grinding step would defeat the protective mechanism of the treatment technology.

According to EPA officials, the agency encourages businesses that generate mercury-contaminated debris to remove the mercury contaminated material from the debris—a process referred to as source separation. Also, according to EPA and industry, there are some debris items (such as debris contaminated with mixtures of mercury and organic chemicals) that remain difficult to retort; as such, the debris regulations are needed to ensure that such debris is treated and disposed of properly. Table 1 summarizes EPA's debris regulations and definitions of debris.

⁶Free liquids, including liquid mercury, are prohibited from disposal in stabilized debris.

⁷EPA measures toxicity using the Toxicity Characteristic Leaching Procedure (leach test), an analytical method to simulate leaching through a landfill.

Table 1: EPA’s Debris Regulations and Definitions

Code of Federal Regulations (C.F.R.)	Description
Debris regulations at 40 C.F.R. 268.45	In 1992, EPA promulgated the final debris regulations, which established alternative treatment standards for hazardous debris, regardless of concentration level. The regulations provide several treatment options for mercury-contaminated debris, including stabilization and encapsulation.
Debris defined at 40 C.F.R. 268.2 (g)	<i>Debris</i> means solid material exceeding a 60-millimeter particle size that is intended for disposal and that is: A manufactured object; or plant or animal matter; or natural geologic material. The following materials are not debris: any material for which a specific treatment standard is provided in Subpart D, Part 268, namely lead acid batteries, cadmium batteries, and radioactive lead solids; process residuals such as smelter slag and residues from the treatment of waste, wastewater, sludges, or air emission residues; and intact containers of hazardous waste that are not ruptured and that retain at least 75 percent of their original volume. A mixture of debris that has not been treated to the standards provided by § 268.45 and other material is subject to regulation as debris if the mixture is comprised primarily of debris, by volume, based on visual inspection.
Hazardous debris defined at 40 C.F.R. 268.2 (h)	<i>Hazardous debris</i> means debris that contains a hazardous waste listed in Subpart D of Part 261 of this chapter, or that exhibits a characteristic of hazardous waste identified in Subpart C of Part 261 of this chapter. Any deliberate mixing of prohibited hazardous waste with debris that changes its treatment classification (i.e., from waste to hazardous debris) is not allowed under the dilution prohibition in § 268.3.

Source: 40 C.F.R. Part 268.

In 1999, EPA issued an advance notice of proposed rulemaking to conduct a comprehensive review of the RCRA hazardous waste treatment regulations for mercury-containing wastes. EPA had identified mercury as one of the more persistent toxic chemicals regulated under RCRA. EPA stated that potential revisions, if any, would be based on the comments that it received and data obtained from ongoing studies and other sources. Among other issues, EPA requested comments on whether to (1) allow alternative treatment options to retorting for high mercury-containing waste and (2) require retorting for high mercury-containing waste that meets the definition of debris.

With respect to allowing alternative treatment options to retorting for high mercury-containing waste, EPA made available data to the public in 2003 on two studies that assessed the feasibility of land disposal for elemental mercury and for difficult-to-treat high mercury-containing waste that had been treated by stabilization. From these studies, EPA concluded that treatment by stabilization may not result in a waste that is stable under some hazardous waste landfill conditions. According to EPA officials, the agency was concerned about using stabilization for elemental mercury in certain landfill conditions where leaching was more likely to occur. EPA

did not change the existing hazardous waste regulations for mercury-containing waste.⁸

With respect to requiring that high mercury-containing waste that meets the definition of debris be retorted, all of the comments that EPA received, except one, expressed the view that EPA should not modify the alternative treatment standards for debris to require the retorting of debris with high concentration levels of mercury because debris is not always amenable to retorting and because the alternative treatment standards for debris provide needed flexibility to manage difficult-to-treat wastes.⁹ EPA did not modify the debris regulations.

In 2003, EPA collaborated with the Association of State and Territorial Solid Waste Management Officials and the Northeast Waste Management Officials' Association to discuss potential mismanagement of mercury-contaminated debris.¹⁰ Based on those discussions, EPA issued a debris memorandum in October 2003 to state waste managers that provided guidance for managing mercury-contaminated debris.¹¹ In that guidance memorandum, EPA sought to clarify the types of waste that are eligible for treatment under the alternative treatment standards for debris, provide information on the improved capabilities of mercury "retorters" to accept and recover mercury from debris-like waste, and describe how to meet the performance standards for several debris treatment technologies. In a May 2004 follow-up letter, the Administrator of EPA stated that EPA had not found any evidence that there is a significant environmental problem associated with the management of mercury-contaminated debris under EPA's current rules.

Figure 3 shows that mercury-containing waste comes from industrial and nonindustrial sources. EPA requires the collection of data on hazardous

⁸EPA published the study results in a notice of data availability in the *Federal Register*, 68 Fed. Reg. 28949 (January 29, 2003).

⁹One commenter suggested that EPA consider requiring retorting for high mercury-contaminated debris in order to encourage the development of new retorting technologies, but also noted concern about incomplete breakdown of hazardous organic compounds in retorters.

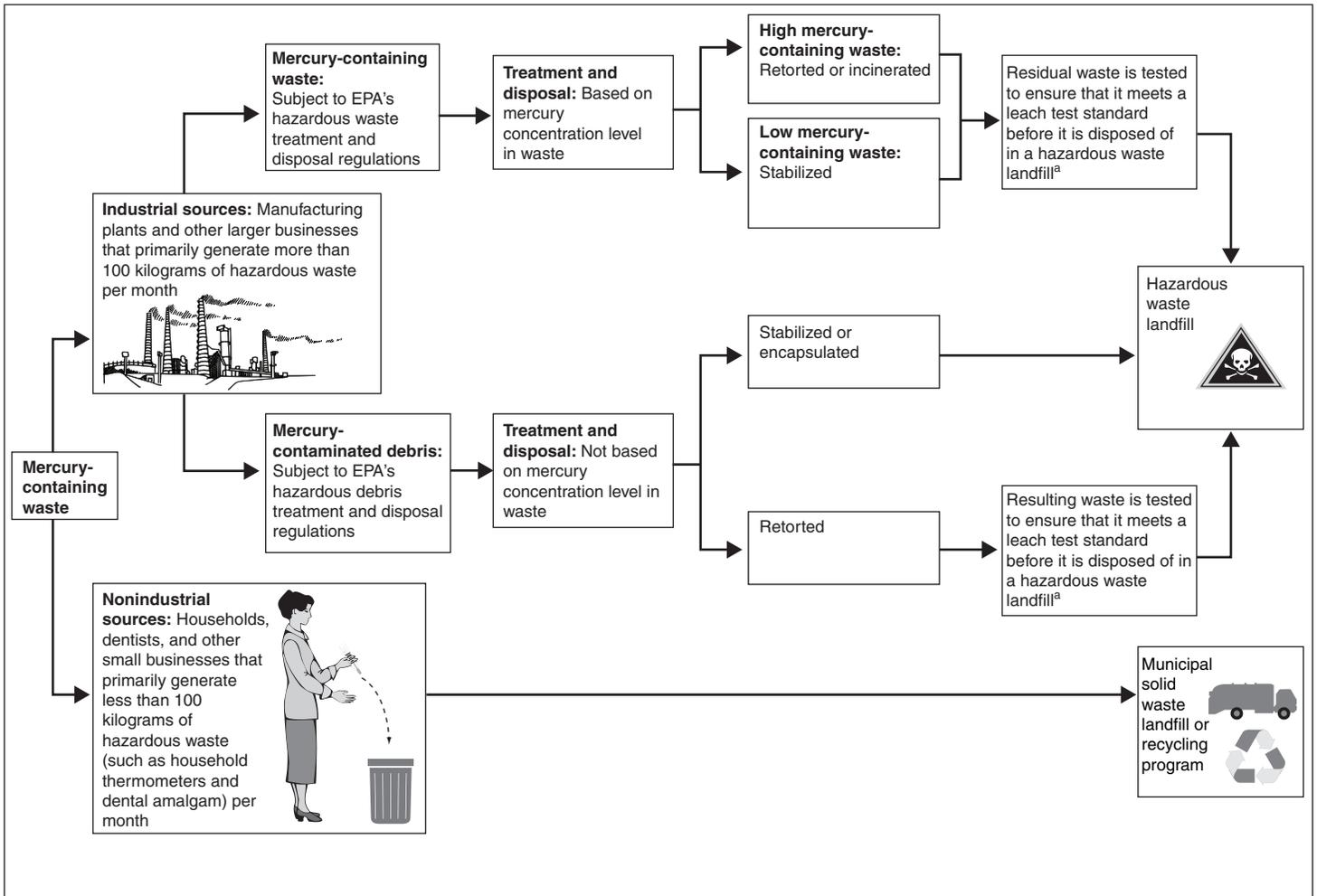
¹⁰These discussions were prompted by allegations of mismanagement raised by one retorting company.

¹¹October 23, 2003 EPA memorandum on treatment standards for mercury-containing debris.

waste activities from industrial sources, but not from nonindustrial sources. Nonindustrial sources generate mercury-containing waste, such as household thermometers and dental amalgam, which may, if not recycled, be generally disposed of in municipal solid waste landfills.¹²

¹²Under Subtitle D, state and local governments are the primary planning, permitting, regulating, implementing, and enforcement agencies for management and disposal of household and industrial (or commercial non-hazardous) solid wastes. Some states and municipalities do not allow for disposal of certain mercury-containing waste in municipal solid waste landfills.

Figure 3: Treatment and Disposal of Mercury-Containing Waste



Sources: GAO analysis of EPA data and documents; Art Explosion (clip art).

^aCertain treated hazardous waste and debris that do not exhibit any hazardous characteristic (such as toxicity) after treatment may be disposed of in a municipal solid waste landfill.

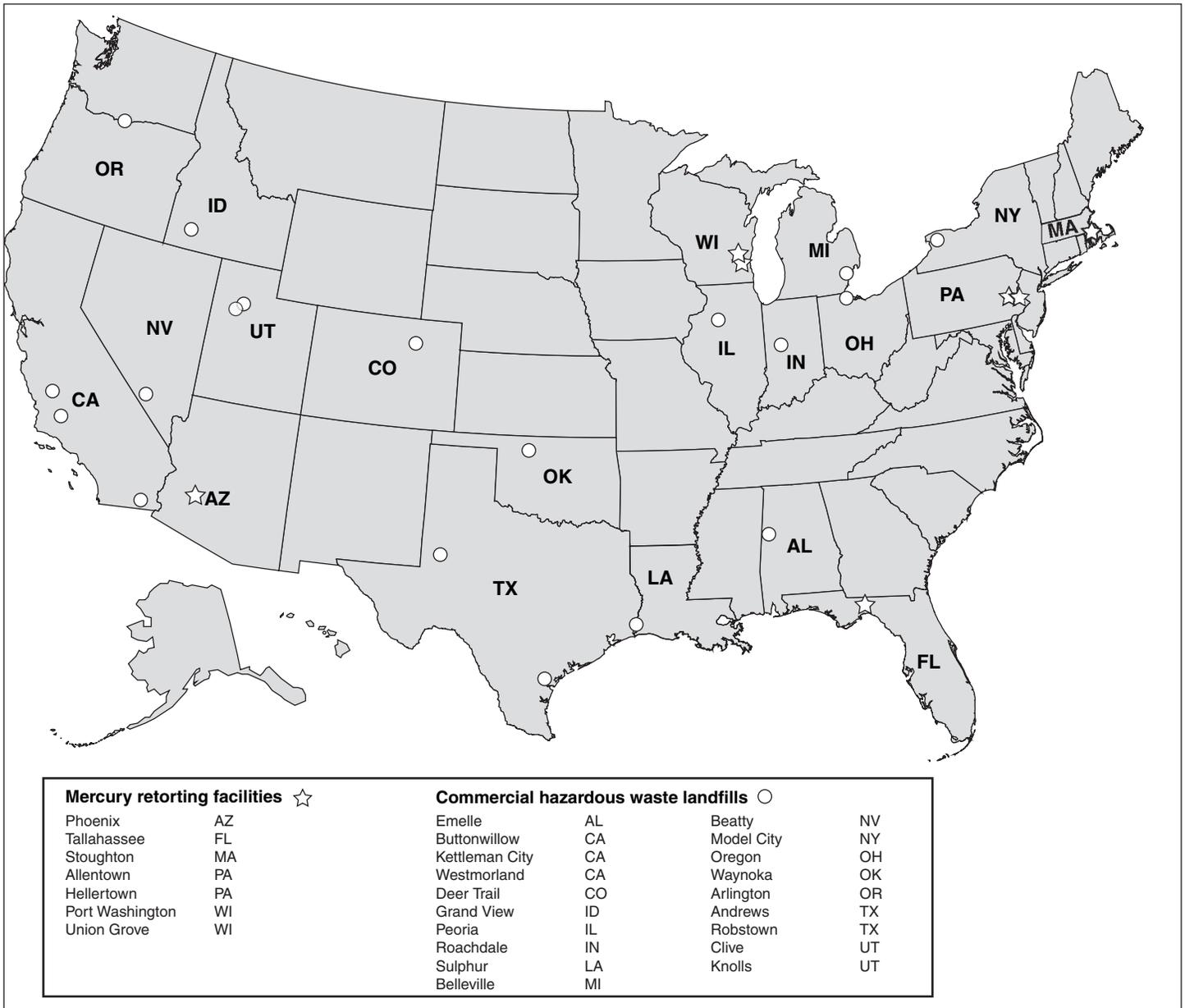
Under RCRA, hazardous waste landfills and businesses that retort mercury-contaminated debris must meet federal standards designed to protect public health and the environment. Among other standards, hazardous waste landfills must meet minimum technological requirements, including double composite liners, a leachate collection and removal system, and a leak detection system, as well as provide for groundwater monitoring. In addition, hazardous waste landfills may not operate without

a RCRA permit. Landfills must also meet other more stringent state requirements, if any, which often include on-site state inspectors and additional groundwater monitoring wells. According to EPA's RCRAInfo data, there are 19 commercial hazardous waste landfills in the United States, most of which accept mercury-containing waste.¹³ Facilities that retort mercury-contaminated debris may only retort wastes below specified organic concentration limits or above specified heating values. In addition, the facilities must comply with waste sampling and analysis requirements. As of 2005, four companies reported that they operate seven facilities that retort mercury-contaminated debris.¹⁴ Figure 4 show the locations of the 19 commercial hazardous waste landfills and seven retorting facilities in the United States.

¹³Private businesses and the Department of Energy also owned and operated noncommercial hazardous waste landfills in 2003 that could accept mercury-containing waste, according to RCRAInfo 2003 data.

¹⁴There are other private businesses that operate retorting facilities for mercury-containing waste, such as lamp recycling facilities.

Figure 4: Commercial Hazardous Waste Landfills and Mercury Retorting Facilities, as of April 2005



Sources: GAO analysis of EPA's RCRAInfo and industry data; MapArt (image).

EPA's Reporting Requirements

Every 2 years, EPA compiles and summarizes data on the amount of hazardous waste generated, treated, and disposed of. For this biennial report, EPA requires businesses to submit information to the states on each waste generated, treated, and/or disposed of. Among other things, businesses report on the type of hazardous constituent(s) present in the waste, the process (such as chlorine production) or activity (such as demolition) that generated the hazardous waste, and the treatment or disposal method used in managing the hazardous waste. EPA also requests, but does not require, that businesses submit certain additional information about the waste, including the portion of the waste that is debris. EPA maintains the data in its RCRAInfo database. The states conduct data reliability assessments (such as checking for missing values, out-of-range values in each field, and inconsistencies and errors in the data) before entering the information into RCRAInfo; EPA also conducts data reliability assessments of RCRAInfo data.

EPA Tracks the Quantity of Mercury-Containing Waste Through Its RCRAInfo Data System, but the Information It Collects on Debris May Be Incomplete

EPA uses its RCRAInfo database, which began in 1999, to maintain data on hazardous waste submitted by states. According to EPA officials, RCRAInfo was designed specifically to track national trends of hazardous waste generation, treatment, and disposal.¹⁵ In 1991, EPA began producing its biennial reports, and it began collecting data on debris as a separate category of physical form in 2001. EPA's most recent biennial hazardous waste report, for the 2003 reporting cycle, was released in April 2005.

According to RCRAInfo data, in 2003, mercury-contaminated debris constituted about 12,000 metric tons of the mercury-containing waste; about 0.4 percent of all mercury-containing waste and about 0.03 percent of all hazardous waste in 2003.¹⁶ Table 2 summarizes RCRAInfo's data on the total quantities of the hazardous waste, mercury-containing waste, and mercury-contaminated debris treated and disposed of in 2001 and 2003. Appendix II provides more information on mercury-contaminated debris,

¹⁵EPA requires businesses that generate more than 1,000 kilograms of hazardous waste per month or that treat, store, or dispose of hazardous waste to submit biennial information on their hazardous waste activities to their state. Prior to 1999, EPA maintained hazardous waste data in its biennial reporting system.

¹⁶According to our survey, officials in 26 states reported that they collect hazardous waste data more frequently than required by EPA, including 14 states that collected data on mercury-contaminated debris.

such as the types of businesses and industry processes that generated the debris and the total quantity of debris that was generated, treated, and disposed of in each state.

Table 2: Total Quantity of Hazardous Waste, Mercury-Containing Waste, and Mercury-Contaminated Debris Treated and Disposed of, 2001 and 2003

Weight in metric tons				
	2001	Percent of hazardous waste	2003	Percent of hazardous waste
Hazardous waste ^a	41,210,698	n/a	38,188,449	n/a
Mercury-containing waste ^b	1,124,900	2.73	3,145,726	8.24
Mercury-contaminated debris ^c	10,484	0.03	12,029	0.03

Source: GAO analysis of EPA's RCRAInfo data.

Note: According to EPA, businesses concerned about potential liability that are unsure about which hazardous materials are in their waste may report multiple hazardous contaminants in order to protect themselves from reporting violations.

^aThese data (also reported in EPA's 2001 and 2003 biennial reports) exclude wastes that were stored and transferred with no treatment or recovery or disposal.

^bThese data include waste that contains any mercury waste code. See appendix I for details.

^cThese data include waste that contains any mercury waste code and were reported under EPA's debris reporting category. See appendix I for details.

RCRAInfo data on mercury-contaminated debris may be incomplete. EPA does not require businesses to report to their states on the physical form of the waste, including the portion of their mercury-containing waste that they treated and disposed of as debris. Since reporting the physical form of the waste is optional, the portion of a state's mercury-containing waste that was treated and disposed of as debris is not known for businesses that did not submit such information. Our analysis of the 2003 RCRAInfo data showed that businesses did not report the optional information on the physical form of the waste in about 9 percent of the instances in which mercury-containing waste was treated and disposed of. These instances accounted for less than 1 percent of the total quantity of mercury-containing waste (10,011 metric tons of the 3,145,726 metric tons of mercury-containing waste). If businesses did not report the optional debris information to states, then the states could not report it to EPA. Businesses that did not submit optional information may have managed a portion of the waste as debris or they may have managed none of this waste as debris.

In 2001, the first year businesses reported on debris, RCRAInfo data showed that businesses did not submit the optional information on the physical form of a waste (including debris) in about 14 percent of instances when they treated and disposed of mercury-containing waste. Specifically, these instances accounted for about 4.5 percent of the total quantity of mercury-containing waste treated and disposed of (about 51,179 metric tons of the 1,124,900 metric tons of mercury-containing waste).

Furthermore, EPA's biennially collected data on debris may be reported incorrectly. The directions EPA gave states and businesses for reporting data was ambiguous. EPA had a "debris" category in the Hazardous Waste Report instructions, but it did not provide a complete list of debris items. For example, ruptured metal drums are typically considered debris, but are not included in the list of items in the debris category description and there is a separate "metal drum" category. Thus, if businesses were reporting ruptured metal drums, they might report ruptured drums in the debris category or in the metal drums category. EPA told us that it intended businesses to use the debris category to report all waste identified as hazardous waste debris.

EPA, States, and Industry Do Not Share a Common Understanding of the Types of Mercury-Containing Waste That Can Be Treated and Disposed of as Debris

Businesses that generate, treat, and dispose of mercury-containing waste are unclear about the types of mercury-containing waste items that can be treated and disposed of as debris. In response to our survey, officials in 21 states and 6 hazardous waste landfill operators identified one or more items as debris that do not typically meet EPA's debris definition. For example, state officials frequently identified intact fluorescent light bulbs, soil, and intact containers (other than batteries), that include intact devices such as regulators and thermometers, which may contain high levels of mercury, as being subject to the alternative treatment standards for debris.¹⁷ Intact containers (which are excluded from the definition of debris) and the other items (which do not fit the definition of debris) must be treated in accordance with RCRA's mercury-specific hazardous waste treatment standards. In addition, although EPA's definition of debris states that "debris means solid material exceeding a 60 millimeter particle size," officials in 3 states classified ruptured devices and batteries with particle size less than 60 millimeters as debris. These ruptured mercury-containing items may be high mercury-containing waste, which would require

¹⁷According to EPA, the majority of fluorescent light bulbs are generated by RCRA-exempt entities.

retorting. However, if these items were managed according to the alternative treatment standards for debris, they could be encapsulated or stabilized and then disposed of in a hazardous waste landfill. EPA prohibits this treatment and disposal method for high mercury-containing waste, which must generally be retorted; the residual that remains must meet a leach test standard before it can be land disposed. Figure 5 lists the mercury-containing wastes that would typically not be eligible for treatment and disposal using the alternative treatment standards for debris.

Figure 5: Mercury-Containing Wastes That EPA Typically Does Not Classify as Debris

Mercury waste	Reason waste is typically not debris
 <p>Automobile switches^a</p>	<ul style="list-style-type: none"> • Primarily generated by entities that are generally exempt from RCRA hazardous waste treatment and disposal regulations • Waste does not typically meet the debris definition
 <p>Batteries</p>	<ul style="list-style-type: none"> • Waste does not typically meet the debris definition • Certain batteries are specifically excluded from the debris definition
 <p>Dental amalgam</p>	<ul style="list-style-type: none"> • Primarily generated by entities that are generally exempt from RCRA hazardous waste treatment and disposal regulations • Waste does not typically meet the debris definition
 <p>Intact containers</p>	<ul style="list-style-type: none"> • Waste is specifically excluded from the debris definition • Waste has its own specific alternative treatment standard
 <p>Lab pack^b</p>	<ul style="list-style-type: none"> • Waste has its own specific alternative treatment standard
 <p>Mercury-containing devices (such as thermometers and barometers)</p>	<ul style="list-style-type: none"> • Waste does not typically meet the debris definition
 <p>Intact mercury-containing lamps such as, fluorescent light bulbs</p>	<ul style="list-style-type: none"> • Waste does not typically meet the debris definition
<p>Process residuals</p>	<ul style="list-style-type: none"> • Waste is specifically excluded from the debris definition
 <p>Soil</p>	<ul style="list-style-type: none"> • Waste has its own specific alternative treatment standard

Sources: GAO analysis based on EPA information; Art Explosion (clip art).

^aOlder automobiles may contain convenience light switches under the hood and in the trunk that contain mercury. Mercury-containing automobile switches are no longer being used in automobiles manufactured in the United States.

^bA lab pack is typically a steel or fiber drum that contains small containers of compatible waste surrounded by absorbent materials, such as vermiculite, to cushion the containers and to absorb any spilled or leaked waste.

Table 3 summarizes the views of the state officials we surveyed on whether they would classify certain types of mercury-containing wastes as debris. The wastes listed in table 3 would not typically meet EPA’s definition of debris. However, as the table shows, officials in several states identified nondebris items as being debris, and officials in 21 states reported that they would treat and dispose of at least one item listed in the table as debris although the item would not typically meet EPA’s definition of debris. Appendix III summarizes the state officials’ responses to our survey on mercury-containing waste treatment and disposal practices.

Table 3: State Officials’ Views Concerning Wastes That Do Not Typically Meet EPA’s Debris Definition

Mercury-containing waste	Number of respondents that classify waste as being subject to the debris standards	Number of respondents that classified waste as being subject to the hazardous waste standards	Number of respondents that were uncertain	Number of respondents that believed that the waste is neither hazardous debris nor hazardous waste
Intact drums with at least 75 percent of their original volume	3	37	3	0
Intact fluorescent light bulbs	11	31	1	5
Ruptured fluorescent light bulbs ^a	8	37	2	0
Intact batteries	4	33	2	3
Ruptured batteries with particle size less than or equal to 60 millimeters	3	35	4	0
Other intact devices (for example, thermometer, regulator)	8	31	2	5
Other ruptured devices with particle size less than or equal to 60 millimeters	3	37	2	0
Process residuals	3	39	2	0
Soil	8	36	2	1

Source: GAO analysis of survey results.

Note: We received responses from 48 states and the District of Columbia, but not everyone provided responses to each waste item. Rows cannot be totaled because respondents could check as many standards as they believed applied.

^aAccording to EPA, ruptured fluorescent light bulbs would be debris if the ruptured pieces exceeded 60 millimeters.

In addition to these nondebris items listed in table 3, our survey also asked about three debris items: ruptured drums, ruptured batteries with particle size exceeding 60 millimeters, and other ruptured devices with particle size exceeding 60 millimeters. According to our survey results, only one state's official considered as debris these three items that EPA would also typically consider to be debris. Officials in 9 other states reported that they classify all of the items on our list as hazardous waste and did not classify any of these items as debris. For example, ruptured drums and ruptured devices were wastes that these states typically classified as hazardous waste, but which EPA classifies as debris.

Four of the 14 commercial hazardous waste landfill operators that responded to our survey identified intact fluorescent light bulbs as debris and 3 of the 14 identified intact devices as debris. These items would generally be considered intact containers and therefore be specifically excluded from EPA's debris definition. The landfill operators responded correctly about particle size requirements for debris. None of the landfill operators identified intact drums as debris.

Table 4 summarizes the landfill operators' views on whether they would classify certain types of mercury-containing wastes as debris. The wastes listed in table 4 would not typically meet EPA's definition of debris. However, as the table shows, some landfill operators identified nondebris items as being debris, and 6 landfill operators reported that they would treat and dispose of at least one item listed in the table as debris although the item would not typically meet EPA's definition of debris. Appendix IV summarizes the commercial hazardous waste landfill operators' responses to our survey on mercury-containing waste treatment and disposal practices.

Table 4: Commercial Hazardous Waste Landfill Operators' Views Concerning Wastes That Do Not Typically Meet EPA's Debris Definition

	Number of respondents that stated waste could be treated and disposed of with debris standards	Number of respondents that stated waste could not be treated and disposed of with debris standards	Number of respondents that were uncertain whether waste could be treated and disposed of with debris standards
Mercury-containing waste			
Intact drums with at least 75 percent of their original volume	0	12	1
Intact fluorescent light bulbs	4	10	0
Ruptured fluorescent light bulbs ^a	2	11	1
Intact batteries	1	11	2
Ruptured batteries with particle size less than or equal to 60 millimeters	0	13	1
Other intact devices (for example, thermometer, regulator)	3	11	0
Other ruptured devices with particle size less than or equal to 60 millimeters	0	13	1
Process residuals	1	13	0
Soil	1	13	0

Source: GAO analysis of survey results.

Note: We received responses from 14 commercial hazardous waste landfill operators that covered 15 commercial hazardous waste landfills. For one item, 13 of the 14 respondents provided a response; 1 respondent chose not to answer this question.

^aAccording to EPA, ruptured fluorescent light bulbs would be debris if the ruptured pieces exceeded 60 millimeters.

In addition to these nondebris items listed in table 4, our survey also asked about three debris items: ruptured drums, ruptured batteries with particle size exceeding 60 millimeters, and other ruptured devices with particle size exceeding 60 millimeters. According to our survey results, only one landfill considered as debris these three items that EPA would also typically consider to be debris. Furthermore, while EPA allows certain mercury-containing waste to be managed as debris, the commercial hazardous waste landfill operators were sometimes stricter in what they allowed. Specifically,

- two landfill operators do not allow any mercury-containing waste that we listed in our survey to be managed as debris;
- two other landfill operators only allow one mercury item (ruptured drums or ruptured batteries with particle size exceeding 60 millimeters)

to be treated and disposed of according to the alternative treatment standards for debris; and

- two landfill operators send debris with high levels of mercury (i.e., greater than 260 milligrams per kilogram) to retorting facilities, including one who reported receiving mercury-containing waste inappropriately labeled as debris, which they sent to a retorting facility for treatment.

While our survey results show that officials in many states and most landfill operators have a good understanding of the debris rule, there are some instances in which states and landfill operators identified items as debris that would not typically meet EPA's debris definition. Since the 2001 Hazardous Waste Report cycle, there is a separate category called "debris" and businesses that determine that their waste is "debris" will naturally use the debris category to report their debris data. However, as discussed earlier, there is confusion about the debris category and more wastes have been reported as debris than EPA considers to be debris.

With respect to treatment methods that have been used for debris, EPA's RCRAInfo data showed considerable differences between the 2001 and 2003 cycles. For this analysis, we used the data reported for debris contaminated only with mercury. We did not use data for debris that contained mercury and other hazardous constituents because the method used to treat the mercury was not readily discernable from the RCRAInfo data. As shown in table 5, in 2001, businesses that generated mercury-only contaminated debris treated most of the debris by metals recovery such as retorting; in 2003, most of the debris was treated by encapsulation or stabilization before land disposal. Most of that 2003 debris that was encapsulated or stabilized before land disposal came from one facility.

Table 5: Quantity of Mercury-Only Contaminated Debris Reported by Treatment Method, 2001 and 2003

Weight in metric tons

	Metals recovery such as retorting	Incineration	Encapsulation	Stabilization	Land disposal of previously encapsulated or stabilized material	Other ^a	Total
2001	279	33	6	0	123	1	442
2003	361	28	<1	1	1,101	5	1,496

Source: GAO analysis of EPA's RCRAInfo data.

^aThe "other" category includes treatment methods such as energy recovery.

EPA officials were surprised to learn from us that most debris was not coming from hazardous material spill sites or cleanup sites that typically have on-site state or federal oversight in treatment and disposal decisions. According to our analysis of RCRAInfo's 2003 data, debris was generated as follows:

- about 25 percent from ongoing routine processes, such as replacing pipes at a chlorine plant;
- about 41 percent from intermittent events, such as demolishing a production plant;
- about 17 percent from EPA or state-managed sites, such as hazardous material spills or cleanup efforts; and
- about 16 percent from pollution control and waste management process residuals.

Although businesses determine how to manage the majority of mercury-contaminated debris, EPA officials told us they believe that treatment and disposal decisions were made appropriately because of the multiple oversight mechanisms in place. They specifically cited the hazardous waste manifest system and the EPA and state inspection and enforcement programs, discussed below. In addition, they noted that in order to comply with RCRA, hazardous waste landfill operators must, among other things, obtain a RCRA permit and develop a waste analysis plan that documents the procedures the operator will follow to ensure the facility only handles waste it is permitted to and to ensure proper waste disposal. They also noted that hazardous waste landfills must meet

minimum technological requirements, including double composite liners, a leachate collection and removal system, and a leak detection system.

Programs Are in Place to Monitor All Types of Hazardous Waste, Including Mercury-Contaminated Debris

EPA and the states oversee compliance with treatment and disposal requirements for mercury-contaminated debris as part of their efforts to monitor multiple types of hazardous waste. We identified four mechanisms that monitor compliance with hazardous waste regulations, including the debris regulations.

First, to ensure hazardous waste is properly managed, EPA established a tracking system to monitor hazardous waste from its generation to its disposal.¹⁸ The critical component of this system is the uniform hazardous waste manifest, which is a form prepared by all businesses that generate, transport, or offer for transport, hazardous waste for off-site treatment, recycling, storage, or disposal. The manifest contains information on the type and quantity of the waste being transported, instructions for handling the waste, and signature lines for all parties involved in the disposal process. Each party that handles the waste signs the manifest and retains a copy for themselves. Once the waste reaches its destination, the receiving facility returns a signed copy of the manifest to the business that generated the waste, confirming that the waste has been received by the designated facility. Each of these documents must generally be retained for 3 years.

Second, EPA requires businesses that generate, treat, and dispose of hazardous waste to retain certain other records for 3 years. Businesses that generate hazardous waste must send a notification with the initial shipment of every waste. The information that the notification must include varies according to the status of the waste. Facilities that treat hazardous waste are required to send similar notifications along with shipment of the treated wastes to facilities that dispose of hazardous waste. A certification normally accompanies this notification stating that the waste meets its treatment standards and may be land disposed. Facilities that dispose of hazardous waste are the final link in the waste management chain. As a result, these facilities have to test the waste residue that they receive to ensure that it meets the treatment standards.

¹⁸This tracking system also meets a Department of Transportation requirement for monitoring the transportation of hazardous waste.

Third, EPA and states' hazardous waste enforcement programs periodically monitor compliance with EPA regulations, primarily through oversight inspections of facilities and enforcement actions (such as fines and imprisonment) to correct violations.¹⁹ As part of its oversight, EPA provides compliance assistance and incentive programs to encourage businesses to "self-police" and voluntarily discover, disclose, and correct violations of RCRA requirements. In response to our survey, 29 states reported violations related to the treatment and disposal of mercury-containing waste during the past 5 years. Generally, the states discovered the violations during inspections, and most of the violations concerned the treatment and disposal of mercury-containing lamps, such as fluorescent light bulbs. We confirmed in our followup conversations with these states that very few of their reported violations were related to the treatment and disposal of mercury-contaminated debris. In one instance, however, a state agency fined a university \$18,000 for hazardous waste violations, such as inappropriately disposing of mercury-contaminated debris. The university had failed to sample a building for mercury contamination before renovating it, and mercury was discovered in several areas after the demolition debris from the renovation had been removed.

Lastly, EPA and many states provide citizens with telephone hotlines, Web sites, and forms to file complaints or report potential hazardous waste violations. Some states that responded to our survey stated that some mercury-containing waste violations were reported by citizens' tips.

Conclusions

We recognize that EPA developed the debris regulations to manage waste that could not be readily addressed with the existing RCRA regulations. With respect to mercury-contaminated debris, EPA has assessed the potential environmental risks and determined that the debris standards can be used for mercury-containing waste that meets the debris definition. EPA also provided a guidance memorandum to states intended to clarify the types of wastes that can be managed using the debris standards. However, our analysis showed that states and industry in some instances considered items to be debris that typically do not meet EPA's definition of debris. As a result, EPA's information on debris may not be entirely accurate. We believe EPA would have better information on debris in RCRAInfo if EPA would clarify and provide a better description of the types of waste that should

¹⁹Businesses that treat, store, or dispose of hazardous waste are inspected at least once every 2 years; and federal- and state-owned facilities are inspected on an annual basis.

and should not be reported in the debris category in the instructions for submitting biennial data.

In addition, we recognize that mercury-contaminated debris represents a very small portion of the hazardous waste that is treated and disposed of annually in the United States. However, we are concerned that officials in several states and operators of some commercial hazardous waste landfills that responded to our survey reported that in some instances they would consider items to be debris that typically do not meet EPA's definition of debris. EPA's debris definition specifically excludes some of these items. Thus, some waste items might be disposed of inappropriately and in a more risky manner. EPA did not consider the impact of states and industry misunderstanding the debris standards when it examined the use of the debris regulations for high mercury-containing waste. Since there is apparent confusion about what constitutes debris, we believe that EPA should begin an outreach effort to communicate and clarify the types of mercury-containing hazardous wastes that can be treated and disposed of using the debris treatment standards.

Recommendations for Executive Action

To better ensure that the businesses that generate, treat, and dispose of hazardous waste are properly managing and reducing the risk of their mercury-containing waste, we are making the following two recommendations to the Administrator of the Environmental Protection Agency:

- clarify and better describe the types of waste that can and cannot be reported under the “debris” reporting category and include the definition of debris in the instructions for the Hazardous Waste Report and
- conduct further outreach to communicate to states and hazardous waste landfills the types of mercury-containing wastes that can be treated and disposed of according to the alternative treatment standards for debris.

Agency Comments

We provided EPA with a draft of this report for review and comment. In oral comments, EPA stated that it agreed with our recommendations. EPA also provided technical comments, which we incorporated into the report as appropriate.

As agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the date of this letter. At that time, we will send copies of this report to the Administrator of the Environmental Protection Agency and other interested officials. We will also provide copies to others upon request. In addition, the report will be available at no charge on GAO's Web site at <http://www.gao.gov>.

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

A handwritten signature in black ink, reading "John B. Stephenson". The signature is written in a cursive style with a long horizontal flourish extending to the right.

John B. Stephenson
Director, Natural Resources
and Environment

Objectives, Scope, and Methodology

The objectives of our review were to determine (1) the mechanisms that the Environmental Protection Agency (EPA) uses to track the treatment and disposal of mercury-contaminated debris and the quantity of mercury-contaminated debris that is disposed of, (2) the extent to which EPA, states, and industry share a common understanding of the types of mercury-containing wastes that can be treated and disposed of as debris, and (3) EPA and state controls that are in place to monitor compliance with EPA's treatment and disposal requirements for mercury-contaminated debris.

For the purpose of this report, we used the following terms:

- businesses that generate mercury-containing waste—includes private companies and government and university facilities and laboratories;
- mercury-containing waste—includes hazardous waste that contained any of the six mercury waste codes: (1) D009—mercury; (2) K071—brine purification muds from the mercury cell process in chlorine, in which separately prepurified brine is not used; (3) K106—wastewater treatment sludge from the mercury cell process in chlorine production; (4) P065—mercury fulminate; (5) P092—phenylmercury acetate; and/or (6) U151—mercury; and
- mercury-contaminated debris—includes mercury-containing waste and was reported under EPA's debris reporting category.

To determine the mechanisms that are used to track the treatment and disposal of mercury-contaminated debris, we reviewed EPA documents and reports (such as EPA's biennial hazardous waste reports) and EPA regulations and policies. We also interviewed officials at EPA, Ohio's Environmental Protection Agency, the Association of State and Territorial Solid Waste Management Officials, the Environmental Council of the States, the Environmental Technology Council, and the Northeast Waste Management Officials' Association. In addition, we met with officials from the departments of Defense and of Energy to discuss the types of mercury-contaminated debris that they generate. To identify the quantity of the hazardous waste that is disposed of as mercury-contaminated debris, we obtained RCRAInfo hazardous waste data for the 2001 and 2003 reporting cycles. We assessed the reliability of the data and found that they were sufficiently reliable for our use. We also developed a survey to gather information from the 50 states and the District of Columbia on, among other things, their treatment and disposal practices for mercury-

contaminated debris and whether they collected data more frequently than required by EPA's biennial hazardous waste reports.

To determine the extent to which EPA, states, and industry share a common understanding of the types of mercury-containing wastes that can be treated and disposed of as hazardous debris, we used two surveys to gather information on, among other things, states' and hazardous waste landfills' current practices for treating and disposing of certain mercury-containing wastes using EPA's alternative treatment standards for debris. We surveyed the 50 states and the District of Columbia. We obtained a list of state hazardous waste officials from the Association of State and Territorial Solid Waste Management Officials and the Environmental Council of the States. We confirmed with each state official, that he or she was the appropriate state official to complete our survey on mercury-contaminated debris or obtained the name of another official and confirmed with that official. In addition, we surveyed businesses that treat and dispose of mercury-containing waste. We included in this survey, the 19 U.S. commercial hazardous waste landfills identified by EPA. We obtained the list of hazardous waste landfills by using 2001 and 2003 information from EPA's RCRAInfo Permit Module. We confirmed with each landfill operator that he or she was the appropriate individual to complete our survey on mercury-contaminated debris. We did not survey federal and private facilities that could also treat and dispose of this waste and facilities that primarily retort mercury-containing waste, such as fluorescent light bulbs.

Before distributing the surveys, we conducted pretests of the questions with officials who would be responding to the surveys in order to ensure the validity of the survey questions. For the state survey, we conducted pretests with seven states (Maryland, Nevada, Ohio, Oklahoma, New Hampshire, Montana, and Delaware) located in six EPA regions. For the landfill survey, we conducted pretests with commercial hazardous waste landfill operators in Texas and New York. As part of each pretest, we interviewed the respondents after they had filled out a survey to ensure that the questions were clear, unambiguous, and unbiased and that completing the survey would not place an undue burden on the officials completing it. On the basis of the feedback from the pretests, we modified the questions, as appropriate. For the state survey, we received responses from 48 states and the District of Columbia. We did not receive responses from Alaska and Iowa because EPA has not provided these states with the authority to implement RCRA requirements, and EPA has the lead for all RCRA activities in these states. We received responses from 14 hazardous

waste landfill operators in 7 companies that manage 15 of the 19 landfills. Two companies that manage four landfills chose not to participate in our survey. We also interviewed officials at EPA, Ohio's Environmental Protection Agency, the Association of State and Territorial Solid Waste Management Officials, the Environmental Technology Council, the Northeast Waste Management Officials' Association, the Chlorine Institute, and the four companies that retort mercury-contaminated debris. Our interviews included questions about the types of mercury-containing wastes that they classify as mercury-contaminated debris.

To determine the controls that are in place to monitor compliance with EPA's treatment and disposal requirements for mercury-contaminated debris, we conducted follow-up interviews with officials in 29 states (Alabama, Arizona, Arkansas, California, Connecticut, Delaware, Florida, Hawaii, Idaho, Illinois, Indiana, Louisiana, Maine, Minnesota, Mississippi, Missouri, Nebraska, Nevada, New Hampshire, North Carolina, New York, Ohio, Pennsylvania, Rhode Island, Texas, Vermont, Virginia, Washington, and Wisconsin) that had identified violations in the treatment and disposal of mercury-containing waste. Our interviews included questions about the type of mercury-containing waste involved in the violations that they reported, the type of business or industry that committed the violation, the way the violations were uncovered, and the type of enforcement actions taken. We also conducted Internet searches on mercury-containing waste violations and reviewed EPA's requirements and policies for treating and disposing of mercury-contaminated debris and EPA documents related to the development of the debris regulations, such as *Federal Register* notices. We discussed the effectiveness of these requirements and policies for protecting human health and the environment with officials at EPA, representatives from hazardous waste landfills, Ohio's Environmental Protection Agency, the Association of State and Territorial Solid Waste Management Officials, the Environmental Technology Council, the Northeast Waste Management Officials' Association, the Chlorine Institute, and the four companies that retort mercury-contaminated debris.

We performed our work between March 2005 and November 2005, in accordance with generally accepted government auditing standards, which included an assessment of data reliability and internal controls.

Data on Mercury-Contaminated Debris

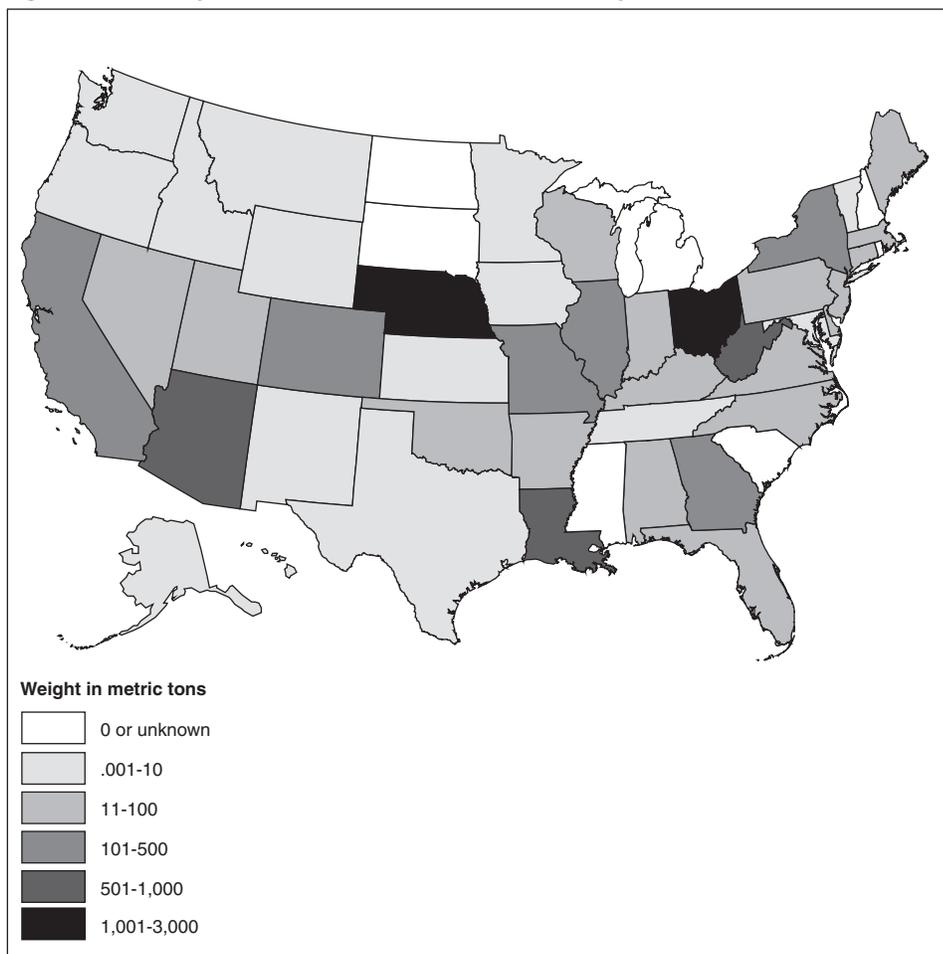
This appendix provides additional information from RCRAInfo on activities related to the generation, treatment, and disposal of hazardous debris contaminated with mercury (mercury-contaminated debris)¹ in the United States during 2001 and 2003. In the first section, we discuss activities related to the generation of mercury-contaminated debris, such as the states where debris was generated and the types of industries that generated the debris. In the second section, we discuss treatment and disposal activities related to mercury-contaminated debris, such as the quantity of mercury-contaminated debris treated and disposed of in each state.

Mercury-Contaminated Debris Generation

According to RCRAInfo data, many states generate mercury-contaminated debris. In 2001, 43 states and the District of Columbia generated 8,028 metric tons of mercury-contaminated debris. Nebraska, Ohio and West Virginia generated about 59 percent of the total (about 4,771 metric tons). Figure 6 shows the quantity of mercury-contaminated debris generated by state in 2001.

¹Mercury-contaminated debris includes debris with only mercury contamination as well as debris contaminated with mercury and other contaminants (e.g., other metals or organic compounds).

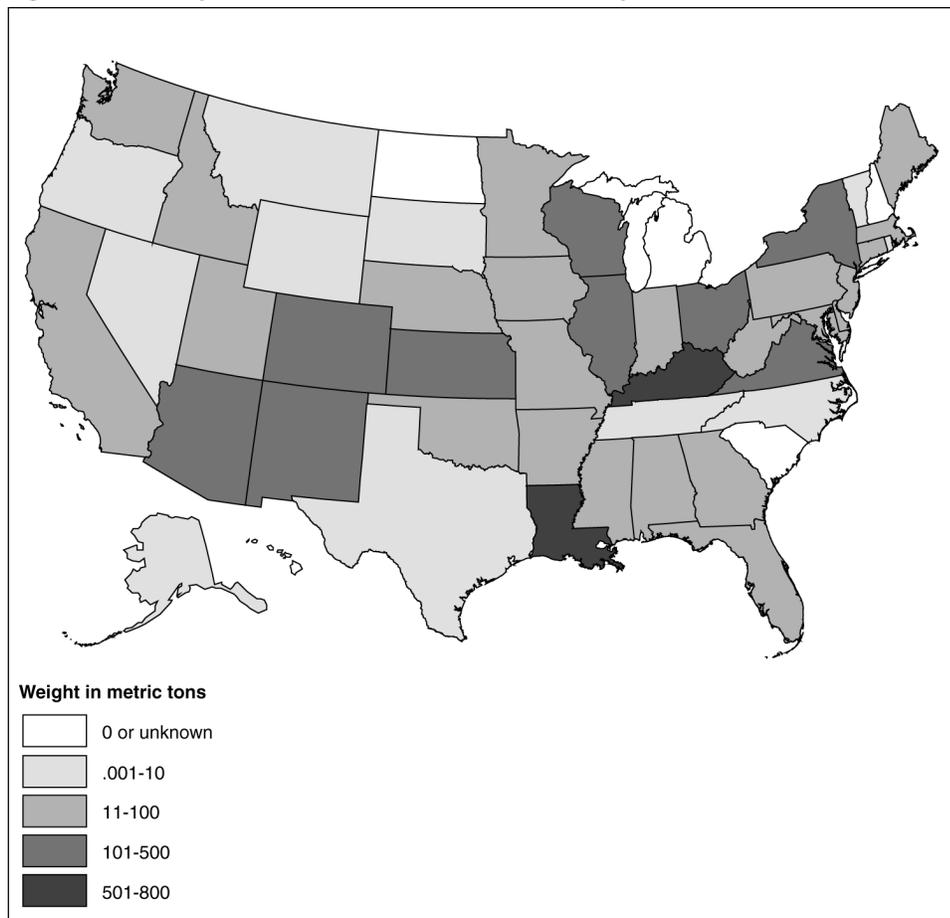
Figure 6: Mercury-Contaminated Debris Generation, by State, 2001



Sources: GAO analysis of EPA's RCRAInfo data; MapArt (image).

In 2003, according to RCRAInfo data, 45 states and the District of Columbia reported generating 3,966 metric tons of mercury-contaminated debris. Kentucky, Louisiana, Ohio, Arizona, and New York generated about 52 percent of the total (about 2,076 metric tons). Figure 7 shows the quantity of mercury-contaminated debris generated by state in 2003.

Figure 7: Mercury-Contaminated Debris Generation, by State, 2003



Sources: GAO analysis of EPA's RCRAInfo data; MapArt (image).

According to RCRAInfo data, in 2001, about 95 percent of the total quantity of mercury-contaminated debris (about 7,589 metric tons) was generated by industries representing remediation and waste management services, manufacturing (such as the textile and metals industries), wholesale trade (such as businesses that sell mining products), mining (such as gold ore mining), and utilities (such as power generation and replacing water supply

and sewage system equipment).² Table 6 summarizes the total quantity of mercury-contaminated debris generated by type of industry in 2001.

Table 6: Mercury-Contaminated Debris Generation, by Industry Type, 2001

Weight in metric tons	
Industry type	Quantity
Remediation and waste management services	4,454
Manufacturing, such as textiles	1,055
Wholesale trade, such as mining products	713
Manufacturing, such as metals	523
Mining, such as gold ore mining	464
Utilities, such as electric power generation and removing water supply and sewage system equipment	380
Other, such as health care and government activities	439
Total	8,028

Source: GAO analysis of EPA's RCRAInfo data.

In 2003, according to RCRAInfo data, about 95 percent of the total quantity of mercury-contaminated debris (about 3,781 metric tons) was generated by industries representing manufacturing (such as the textile and metals industries, remediation and waste management services, educational services (such as colleges and universities), utilities (such as electric power generation and replacing water supply and sewage system equipment), and government activities. Table 7 summarizes the total quantity of mercury-contaminated debris generated by industry type in 2003.

²These industries are identified in RCRAInfo by the North American Industry Classification System codes.

Appendix II
Data on Mercury-Contaminated Debris

Table 7: Mercury-Contaminated Debris Generation, by Industry Type, 2003

Weight in metric tons	
Industry type	Quantity
Manufacturing, such as textiles	1,766
Remediation and waste management services	914
Manufacturing, such as metals	400
Educational services, such as colleges and universities	269
Utilities, such as power generation and replacing water supply and sewage system equipment	255
Government activities	177
Other, such as gold ore mining and wholesale trade of mining products	185
Total	3,966

Source: GAO analysis of EPA's RCRAInfo data.

With respect to the process or activity that generated the mercury-contaminated debris, RCRAInfo's 2001 data reported that about 50 percent of the debris (about 4,006 metric tons) came from ongoing production and service processes. Remediation of past contamination and other intermittent events or processes generated about 19 percent (about 1,529 metric tons) and 13 percent (about 1,073 metric tons), respectively. Table 8 provides more information on the types of processes and activities that generated mercury-contaminated debris in 2001.

Appendix II
Data on Mercury-Contaminated Debris

Table 8: Type of Process or Activity That Generated Mercury-Contaminated Debris, 2001

Weight in metric tons	
Description of process or activity that generated mercury-contaminated debris	Quantity
Wastes from ongoing production and service processes (waste from general day to day manufacturing, production, or maintenance activities)	4,006
Remediation of past contamination	1,529
Other intermittent events or processes (except waste from ongoing production and service processes)	1,073
Pollution control and waste management process residuals	560
Spills and accidental releases	855
Hazardous waste received from a foreign country	6
Total	8,029

Source: GAO analysis of EPA's RCRAInfo data.

In 2003, according to RCRAInfo data, the majority of the mercury-contaminated debris came from ongoing production and service processes and other intermittent events or processes, about 25 percent (about 1,001 metric tons) and about 41 percent (about 1,639 metric tons), respectively. Table 9 provides more information on the processes or activities that generated mercury-contaminated debris in 2003.

Table 9: Type of Process or Activity That Generated Mercury-Contaminated Debris, 2003

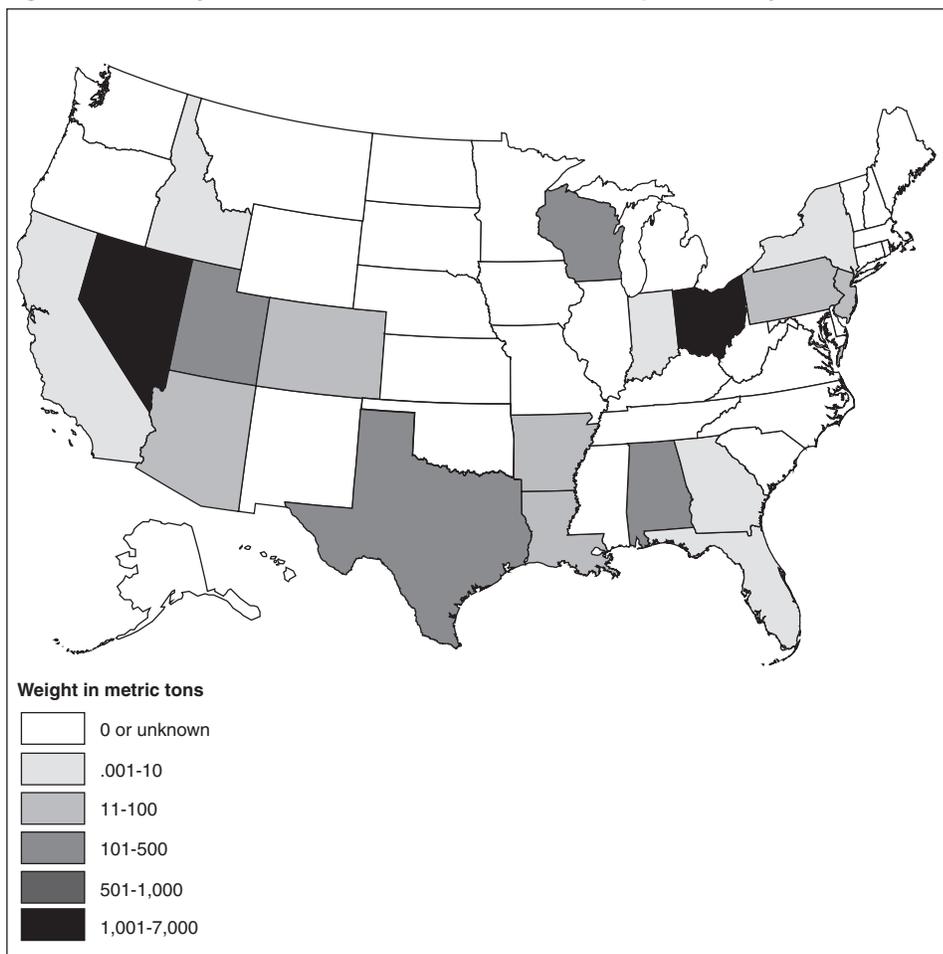
Weight in metric tons	
Description of process or activity that generated mercury-contaminated debris	Quantity
Other intermittent events or processes (except waste from ongoing production and service processes)	1,639
Wastes from ongoing production and service processes (waste from general day to day manufacturing, production, or maintenance activities)	1,001
Pollution control and waste management process residuals	634
Remediation of past contamination	526
Spills and accidental releases	165
Total	3,965

Source: GAO analysis of EPA's RCRAInfo data.

Mercury-Contaminated Debris Treatment and Disposal

According to RCRAInfo data, 18 states treated and disposed of 10,484 metric tons of mercury-contaminated debris in 2001. Ohio and Nevada treated and disposed of about 86 percent of the total quantity of mercury-contaminated debris (about 8,979 metric tons). Figure 8 compares the quantity of mercury-contaminated debris treated and disposed by state in 2001.

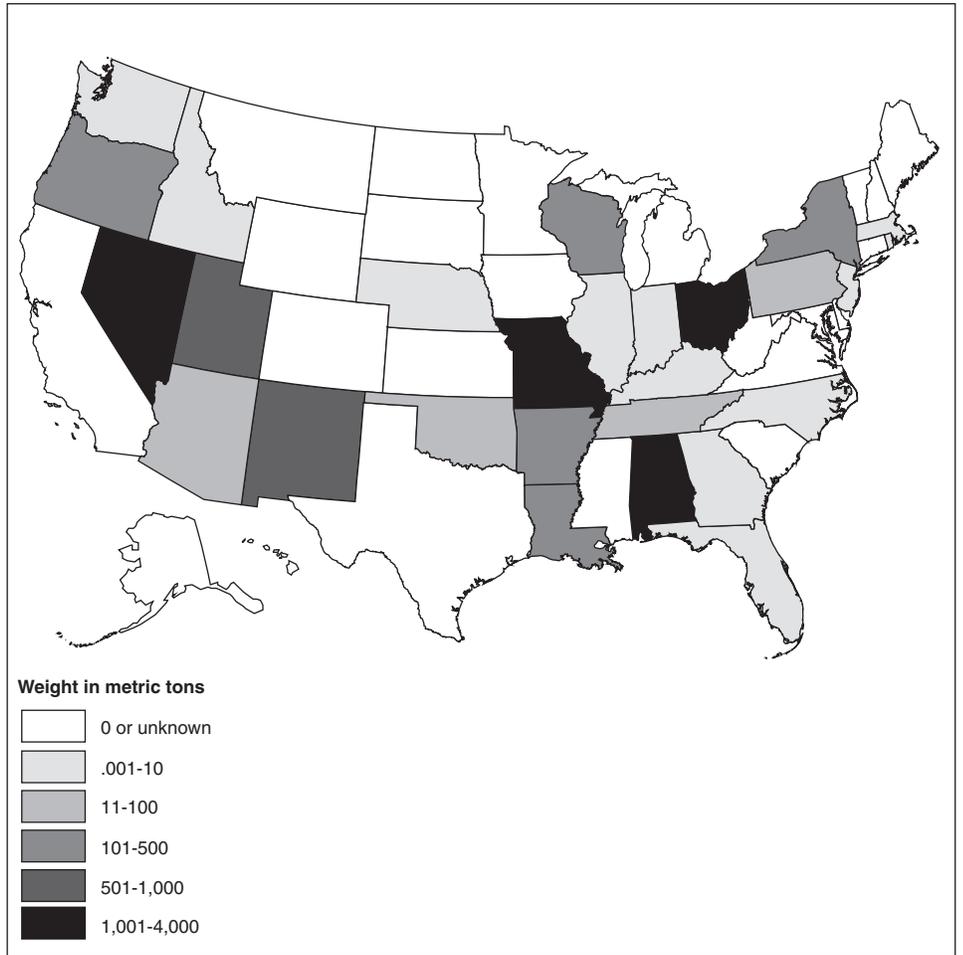
Figure 8: Mercury-Contaminated Debris Treated and Disposed of, by State, 2001



Sources: GAO analysis of EPA's RCRAInfo data; MapArt (image).

In 2003, 26 states treated and disposed of 12,029 metric tons of mercury-contaminated debris, according to RCRAInfo data. Alabama, Missouri, Nevada, and Ohio treated and disposed of about 75 percent of the total quantity of mercury-contaminated debris (about 9,078 metric tons). Figure 9 summarizes the quantity of mercury-contaminated debris treated and disposed in each state during 2003.

Figure 9: Mercury-Contaminated Debris Treated and Disposed of, by State, 2003



Sources: GAO analysis of EPA's RCRAInfo data; MapArt (image).

State Officials' Responses to GAO's Survey on Mercury-Containing Waste Treatment and Disposal

Q1. Which of the following hazardous debris treatment standards has your state implemented?

Hazardous debris treatment standards that EPA has authorized under RCRA (percent)	Hazardous debris treatment standards that have not received EPA authorization, regardless of whether or not authorization has been applied for (percent)	Our state has no hazardous debris treatment standards (percent)	No Answer (percent)	Number of respondents
75.0	10.4	10.4	4.2	48

Q2. Assume that the items listed below are different types of mercury-containing hazardous waste (D009, U151). Does your state allow treatment and/or disposal of the following wastes using hazardous debris or hazardous waste treatment standards?

a. Automobile switches

	Percent	Number of respondents
Hazardous Debris Standards	17.1	41
Hazardous Waste Standards	78.0	41
Uncertain	9.8	41
Not Applicable	9.8	41

**Appendix III
State Officials' Responses to GAO's Survey
on Mercury-Containing Waste Treatment and
Disposal**

Q2. Assume that the items listed below are different types of mercury-containing hazardous waste (D009, U151). Does your state allow treatment and/or disposal of the following wastes using hazardous debris or hazardous waste treatment standards?

b. Dental amalgam

	Percent	Number of respondents
Hazardous Debris Standards	14.6	41
Hazardous Waste Standards	87.8	41
Uncertain	2.4	41
Not Applicable	7.3	41

Q2. Assume that the items listed below are different types of mercury-containing hazardous waste (D009, U151). Does your state allow treatment and/or disposal of the following wastes using hazardous debris or hazardous waste treatment standards?

c. Intact empty drums

	Percent	Number of respondents
Hazardous Debris Standards	24.4	41
Hazardous Waste Standards	41.5	41
Uncertain	14.6	41
Not Applicable	26.8	41

**Appendix III
State Officials' Responses to GAO's Survey
on Mercury-Containing Waste Treatment and
Disposal**

Q2. Assume that the items listed below are different types of mercury-containing hazardous waste (D009, U151). Does your state allow treatment and/or disposal of the following wastes using hazardous debris or hazardous waste treatment standards?

d. Intact drums with at least 75% of their original volume

	Percent	Number of respondents
Hazardous Debris Standards	7.3	41
Hazardous Waste Standards	90.2	41
Uncertain	7.3	41
Not Applicable	0.0	41

Q2. Assume that the items listed below are different types of mercury-containing hazardous waste (D009, U151). Does your state allow treatment and/or disposal of the following wastes using hazardous debris or hazardous waste treatment standards?

e. Ruptured drums

	Percent	Number of respondents
Hazardous Debris Standards	41.5	41
Hazardous Waste Standards	65.8	41
Uncertain	9.8	41
Not Applicable	0.0	41

**Appendix III
State Officials' Responses to GAO's Survey
on Mercury-Containing Waste Treatment and
Disposal**

f. Intact fluorescent light bulbs

	Percent	Number of respondents
Hazardous Debris Standards	26.8	41
Hazardous Waste Standards	75.6	41
Uncertain	2.4	41
Not Applicable	12.2	41

Q2. Assume that the items listed below are different types of mercury-containing hazardous waste (D009, U151). Does your state allow treatment and/or disposal of the following wastes using hazardous debris or hazardous waste treatment standards?

g. Ruptured fluorescent light bulbs

	Percent	Number of respondents
Hazardous Debris Standards	19.5	41
Hazardous Waste Standards	90.2	41
Uncertain	4.9	41
Not Applicable	0.0	41

**Appendix III
State Officials' Responses to GAO's Survey
on Mercury-Containing Waste Treatment and
Disposal**

Q2. Assume that the items listed below are different types of mercury-containing hazardous waste (D009, U151). Does your state allow treatment and/or disposal of the following wastes using hazardous debris or hazardous waste treatment standards?

h. Intact batteries

	Percent	Number of respondents
Hazardous Debris Standards	9.8	41
Hazardous Waste Standards	80.5	41
Uncertain	4.9	41
Not Applicable	7.3	41

Q2. Assume that the items listed below are different types of mercury-containing hazardous waste (D009, U151). Does your state allow treatment and/or disposal of the following wastes using hazardous debris or hazardous waste treatment standards?

i. Ruptured batteries with particle size exceeding 60 mm

	Percent	Number of respondents
Hazardous Debris Standards	36.6	41
Hazardous Waste Standards	73.2	41
Uncertain	4.9	41
Not Applicable	0.0	41

**Appendix III
State Officials' Responses to GAO's Survey
on Mercury-Containing Waste Treatment and
Disposal**

Q2. Assume that the items listed below are different types of mercury-containing hazardous waste (D009, U151). Does your state allow treatment and/or disposal of the following wastes using hazardous debris or hazardous waste treatment standards?

j. Ruptured batteries with particle size less than or equal to 60 mm

	Percent	Number of respondents
Hazardous Debris Standards	7.3	41
Hazardous Waste Standards	85.4	41
Uncertain	9.8	41
Not Applicable	0.0	41

Q2. Assume that the items listed below are different types of mercury-containing hazardous waste (D009, U151). Does your state allow treatment and/or disposal of the following wastes using hazardous debris or hazardous waste treatment standards?

k. Other intact devices (for example, thermometer, regulator)

	Percent	Number of respondents
Hazardous Debris Standards	19.5	41
Hazardous Waste Standards	75.6	41
Uncertain	4.9	41
Not Applicable	12.2	41

**Appendix III
State Officials' Responses to GAO's Survey
on Mercury-Containing Waste Treatment and
Disposal**

Q2. Assume that the items listed below are different types of mercury-containing hazardous waste (D009, U151). Does your state allow treatment and/or disposal of the following wastes using hazardous debris or hazardous waste treatment standards?

l. Other ruptured devices with particle size exceeding 60 mm (for example, regulator)

	Percent	Number of respondents
Hazardous Debris Standards	43.9	41
Hazardous Waste Standards	65.8	41
Uncertain	7.3	41
Not Applicable	0.0	41

Q2. Assume that the items listed below are different types of mercury-containing hazardous waste (D009, U151). Does your state allow treatment and/or disposal of the following wastes using hazardous debris or hazardous waste treatment standards?

m. Other ruptured devices with particle size less than or equal to 60 mm (for example, thermometer)

	Percent	Number of respondents
Hazardous Debris Standards	7.3	41
Hazardous Waste Standards	90.2	41
Uncertain	4.9	41
Not Applicable	0.0	41

**Appendix III
State Officials' Responses to GAO's Survey
on Mercury-Containing Waste Treatment and
Disposal**

Q2. Assume that the items listed below are different types of mercury-containing hazardous waste (D009, U151). Does your state allow treatment and/or disposal of the following wastes using hazardous debris or hazardous waste treatment standards?

n. Process residuals (for example, smelter slag)

	Percent	Number of respondents
Hazardous Debris Standards	7.3	41
Hazardous Waste Standards	95.1	41
Uncertain	4.9	41
Not Applicable	0.0	41

Q2. Assume that the items listed below are different types of mercury-containing hazardous waste (D009, U151). Does your state allow treatment and/or disposal of the following wastes using hazardous debris or hazardous waste treatment standards?

o. Soil

	Percent	Number of respondents
Hazardous Debris Standards	19.5	41
Hazardous Waste Standards	87.8	41
Uncertain	4.9	41
Not Applicable	2.4	41

Q3. If there are others types of mercury-containing hazardous debris treated and/or disposed in your state, please provide a brief description in the box below.

Writing comment (percent)	Number of respondents
26.5	49

**Appendix III
State Officials' Responses to GAO's Survey
on Mercury-Containing Waste Treatment and
Disposal**

Q4. Does your state collect data on hazardous waste more frequently than required for EPA's Biennial Hazardous Waste Report?

Yes (percent)	No (percent)	Uncertain (percent)	No Answer (percent)	Number of respondents
53.1	46.9	0.0	0.0	49

Q5. Does your state collect data on mercury-containing debris (as part of your state's hazardous waste data collection effort) more frequently than required for EPA's Biennial Hazardous Waste Report?

Yes (percent)	No (percent)	Uncertain (percent)	No Answer (percent)	Number of respondents
53.8	34.6	7.7	3.8	26

Q6. For EPA's Biennial Hazardous Waste Reports, do you require your state's generators of less than 100 kg of hazardous waste per month to submit data?

Yes (percent)	No (percent)	Uncertain (percent)	No Answer (percent)	Number of respondents
8.2	91.8	0.0	0.0	49

Q7. For EPA's Biennial Hazardous Waste Report, do you require your state's generators of between 100 to 1000 kg of hazardous waste per month to submit data?

Yes (percent)	No (percent)	Uncertain (percent)	No Answer (percent)	Number of respondents
26.5	73.5	0.0	0.0	49

Q8. With respect to EPA's 2003 Biennial Hazardous Waste Report, approximately how many respondents from your state participated?

Mean	Minimum	Maximum	Number of respondents
550	19	2,500	47

**Appendix III
State Officials' Responses to GAO's Survey
on Mercury-Containing Waste Treatment and
Disposal**

Q9. Of those respondents from your state who participated in 2003, how many sent in their information electronically?

Mean	Minimum	Maximum	Number of respondents
217	0	2,066	41

Q10. Which of the following data reliability assessments were done by your state on data received by your state for EPA's Biennial Hazardous Waste Reports? Did you check for . . .

	Percent	Number of respondents
Missing values in each field (category)	93.9	49
Out-of-range values in each field	91.8	49
Consistency in data	79.6	49
Accuracy of id numbers for generators and receiving facilities	89.8	49
Errors in data (e.g., FY 2008 entered as year an action was completed)	87.8	49

**Appendix III
State Officials' Responses to GAO's Survey
on Mercury-Containing Waste Treatment and
Disposal**

Q11. Which of the following assessments were done by your state on data you submitted to EPA for EPA's Biennial Hazardous Waste Reports?

	Percent	Number of respondents
Automatic edit checks in data entry program your state used to enter data	89.8	49
Check for missing values in each field (category)	93.8	48
Check for out-of-range values in each field	87.5	48
Errors in data (e.g., FY 2008 entered as year an action was completed)	87.5	48

Q12. During the past five years, has your state identified any violations related to treatment and disposal of mercury-containing waste?

Yes (percent)	No (percent)	Uncertain (percent)	No answer (percent)	Number of respondents
59.2	20.4	20.4	0.0	49

Q13. During the past five years, has your state identified any violations of hazardous debris treatment standards related to the treatment and disposal of mercury-containing waste?

Yes (percent)	No (percent)	Uncertain (percent)	No answer (percent)	Number of respondents
17.2	58.6	24.1	0.0	29

Hazardous Waste Landfill Operators' Responses to GAO's Survey on Mercury-Containing Waste Treatment and Disposal

1. During the past 5 years has your landfill accepted any hazardous mercury-containing waste (D009, K071, K106, U151, P065, P092)? (Please check one.)

14 Yes → Please continue to Question 2 on the next page.

0 No → You do not need to complete additional questions. Please fax this page to: 202-512-2502 or 202-512-2514. Attention: Diana Cheng. For your convenience, a fax cover sheet is on the last page.

Note: Number of respondents giving an answer is to the left of that answer.

2. Assume that the items listed below are different types of mercury-containing hazardous waste (D009, U151) and that these wastes were received from facilities that generated 1,000 kg or more of hazardous waste per month. Would your facility treat and/or dispose of any of the following wastes according to alternative debris treatment standards? (Please check one answer in each row.)

	Type of Mercury-Containing Waste	Would this waste be treated and/or disposed of according to alternative debris treatment standards?		
		Yes	No	Uncertain
a.	Automobile switches	1	11	2
b.	Dental amalgam	1	13	0
c.	Intact empty drums	4	9	1
d.	Intact drums with at least 75% of their original volume	0	12	1
e.	Ruptured drums	6	4	3
f.	Intact fluorescent light bulbs	4	10	0
g.	Ruptured fluorescent light bulbs	2	11	1
h.	Intact batteries	1	11	2
i.	Ruptured batteries with particle size exceeding 60 mm	5	7	2
j.	Ruptured batteries with particle size less than or equal to 60 mm	0	13	1
k.	Other intact devices (for example, thermometer, regulator)	3	11	0
l.	Other ruptured devices with particle size exceeding 60 mm (for example, regulator)	5	8	1
m.	Other ruptured devices with particle size less than or equal to 60 mm (for example, thermometer)	0	13	1
n.	Process residuals (for example, smelter slag)	1	13	0

**Appendix IV
Hazardous Waste Landfill Operators'
Responses to GAO's Survey on Mercury-
Containing Waste Treatment and Disposal**

o, Soil	1	13	0
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Note: The numbers in the table indicate the number of respondents giving that answer. Not all respondents answered all questions, therefore the number of responses for some types of mercury-containing waste do not equal 14.

3. In the space below, please add any comments you wish to make concerning your answers in Question 2.

11 respondents provided comments.

4. During the past 5 years, has your landfill had any instances where you refused to accept mercury-containing debris?

5 Yes → Please go to Question 5

5 No → Please go to "Instructions for Returning" at the bottom of this page.

4 Uncertain → Please go to "Instructions for Returning" at the bottom of this page.

Note: Number of respondents giving an answer is to the left of that answer.

5. (If Yes to Question 4.) Please describe those instances when your landfill refused to accept mercury-containing debris. If possible, please include a description of the material(s) involved and the reason(s) for refusing the material(s). (You may use the space below, or attach another page.)

Materials Involved	Reason for Refusal
<p>Five respondents answered Question 4. The materials involved included:</p> <ol style="list-style-type: none"> High mercury wastes such as fluorescent light bulbs, switches, and batteries (N=5). Mercury waste from medical, biological, or infectious waste (N=1). 	<p>Reasons cited by respondents included one or more of the following:</p> <ol style="list-style-type: none"> Landfill does not accept wastes containing a mercury concentration greater than 260 milligrams per kilogram. Landfill does not accept metallic mercury. Landfill permit prohibits medical waste in landfill.

GAO Contact and Staff Acknowledgments

GAO Contact

John B. Stephenson (202) 512-3841 or stephensonj@gao.gov

Staff Acknowledgments

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