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EPA EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT - SECTION 313:

Guidance for Reporting Toxic Chemicals: Mercury and Mercury Compounds Category

Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) requires certain facilities manufacturing, processing, or otherwise using listed toxic chemicals to report the annual quantity of such chemicals entering each environmental medium. Such facilities must also report pollution prevention and recycling data for such chemicals, pursuant to section 6607 of the Pollution Prevention Act, 42 U.S.C. 13106. When enacted, EPCRA Section 313 established an initial list of toxic chemicals that was comprised of more than 300 chemicals and 20 chemical categories. EPCRA section 313(d) authorizes EPA to add chemicals to or delete chemicals from the list, and sets forth criteria for these actions. EPCRA Section 313 currently requires reporting on over 600 chemicals and chemical categories.

CONTENTS

CONTENTS (Continued)

LIST OF TABLES

DISCLAIMER

This guidance document is intended to assist industry with EPCRA Section 313 reporting for mercury and mercury compounds. In addition to providing an overview of aspects of the statutory and regulatory requirements of the EPCRA Section 313 program, this document also provides recommendations and emission factors to assist industry with EPCRA reporting. These recommendations do not supersede any statutory or regulatory requirements, are subject to change, and are not independently binding on either EPA or covered facilities. Additionally, if a conflict exists between guidance on this site and the statutory or regulatory requirements, the conflict must be resolved in favor of the statute or regulation. Although EPA encourages industry to consider these recommendations and emission factors, in reviewing this document, industry should be aware that these recommendations and emission factors were developed to address common circumstances at typical facilities. The circumstances at a specific facility may significantly differ from those contemplated in the development of this document. Thus individual facilities may find that the recommendations and emission factors provided in this document are inapplicable to their processes or circumstances, and that alternative approaches or information are more accurate and/or more appropriate for meeting the statutory and regulatory requirements of EPCRA Section 313. To that end, industry should use facility specific information and process knowledge, where available, to meet the requirements of EPCRA Section 313. Facilities are encouraged to contact the Agency with any additional or clarifying questions about the recommendations and emission factors in this document, or if the facility believes that EPA has incorrectly characterized a particular process or recommendation. Additional guidance documents, including industry specific and chemical specific guidance documents, are also available at the EPA TRI website: <http://www.epa.gov/tri>.

SECTION 1.0 INTRODUCTION

Section 1.1 Background

On October 29, 1999, EPA promulgated the final rule on Persistent, Bioaccumulative, and Toxic (PBT) chemicals (64 FR 58666). This rule modified the reporting requirements for mercury and mercury compounds under Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA). The reporting threshold for mercury (Chemical Abstract Service (CAS) Registry Number 7439-97-6) and the mercury compound category was lowered to 10 pounds per year for manufacturing, processing, or otherwise use.

The purpose of this document is to assist facilities in complying with the reporting requirements of EPCRA Section 313 for mercury and the mercury compounds category. Facilities that meet the EPCRA Section 313 employee threshold and SIC code requirements, and that exceed the ten pound reporting threshold for mercury or the mercury compounds category are subject to the EPCRA Section 313 annual reporting requirements beginning with reporting year 2000, with the first reports due by July 1, 2001.

This document explains the EPCRA Section 313 reporting requirements, and provides guidance on how to estimate annual releases and other waste management quantities of mercury and mercury compounds from certain industries and industrial activities. Because each facility is unique, the recommendations presented may have to be adjusted to the specific nature of operations at your facility or industrial activity.

A primary goal of EPCRA is to increase the public's knowledge of, and access to, information on the presence and release and other waste management activities of EPCRA Section 313 toxic chemicals in their communities. Under EPCRA Section 313, certain facilities exceeding reporting thresholds are required to submit annual toxic release forms. These forms must be submitted to EPA and State or Tribal governments, on or before July 1, for activities in the previous calendar year. The

owner/operator of the facility on July 1 of the reporting deadline is primarily responsible for the report, even if the owner/operator did not own the facility during the reporting year. EPCRA mandates that EPA establish and maintain a publicly available database consisting of the information reported under Section 313. This database, known as the Toxics Release Inventory (TRI), can be accessed through the following sources:

- EPA's Internet site, www.epa.gov/tri;
- TRI Explorer Internet site, www.epa.gov/triexplorer;
- Envirofacts Warehouse Internet site, www.epa.gov/enviro/html/tris/tris_overview.html; and
- EPA's annual TRI data release materials (summary information).

The objectives of this guidance document are to:

- Provide explanation and assistance on EPCRA Section 313 reporting requirements for mercury and the mercury compounds category;
- Promote consistency in the method of estimating annual releases and other waste management quantities of mercury for certain industries and industrial classes; and
- Reduce the level of effort expended by those facilities that prepare an EPCRA Section 313 report for mercury and/or the mercury compounds category.

Section 1.2 Who Must Report?

To understand the following discussion you must first understand how EPCRA defines a facility. The term "facility" is defined as, "all buildings, equipment, structures, and other stationary items which are located on a single site or on contiguous or adjacent sites and which are owned or operated by the same person (or by any person which controls, which is controlled by, or which is under common control with such person)." (EPCRA Section 328(4)). A facility may contain more than one "establishment" (40 CFR 372.3). An "establishment" is defined as, "an economic unit, generally at a single physical location, where business is conducted or where services or industrial operations are performed" (40 CFR 372.3).

EPA recognizes that for business reasons it may be easier and more appropriate for establishments at one facility to report separately. However, the combined quantities of EPCRA Section 313 chemicals and chemical categories manufactured, processed, or otherwise used in all establishments making up that facility must be considered for threshold determinations. Also, the combined release and other waste management activities reported singly for each establishment must total those for the facility as a whole (40 CFR 372.30(c)).

Note that if a facility is comprised of more than one establishment, once an activity threshold is met by the facility, provided that the facility meets the SIC Code and employee threshold criteria, release and other waste management activities from all establishments at the facility must be reported (40 CFR 372.30(c)).

A facility is subject to the provisions of EPCRA Section 313, if it meets all three of the following criteria:

- It is included in Standard Industrial Classification (SIC) codes 20 through 39; SIC code 10 (except SIC codes 1011, 1081, and 1094); SIC code 12 (except SIC code 1241); SIC code 4911 (limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce), SIC code 4931 (limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce), SIC code 4939 (limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce); SIC code 4953 (limited to facilities regulated under the Resource Conservation and Recovery Act, subtitle C, 42 U.S.C. section 6921 *et seq.*); SIC code 5169; SIC code 5171; or SIC code 7389 (limited to facilities primarily engaged in solvent recovery services on a contract or fee basis); and

- It has 10 or more full-time employees (or the equivalent of 20,000 hours per year); and

- It manufactures (includes imports), processes, or otherwise uses any of the toxic chemicals listed on the EPCRA Section 313 list in amounts greater than the threshold quantities established in 40 CFR 372.25, 372.28. See Section 1.3.

These three criteria alone, not a facility's release and other waste management quantities, determine whether a facility must prepare an EPCRA Section 313 report. A facility that meets these three criteria is still required to prepare an EPCRA Section 313 report even if that facility has no releases or other waste management quantities of EPCRA Section 313 chemicals or chemical categories.

In addition, pursuant to Executive Order 13148 entitled "Greening the Government Through Leadership in Environmental Management," federal facilities are required to comply with the reporting requirements of EPCRA Section 313. This requirement is mandated regardless of the federal facility's SIC code.

Section 1.3 What are the Reporting Thresholds?

Thresholds are specified amounts of listed toxic chemicals manufactured, processed, or otherwise used during the calendar year that trigger reporting requirements. EPCRA Section 313 establishes default reporting thresholds, but authorizes EPA to establish lower thresholds for particular chemicals, classes of chemicals, or categories of facilities, if a different threshold is warranted. EPA has used this authority to establish lower thresholds for Persistent Bioaccumulative Toxic (PBT) chemicals. See 40 CFR 370.28, 64 FR 58666. The thresholds are determined separately for mercury (using the weight of the metal) and for mercury compounds (using the weight of the entire compound). Therefore, provided that the facility meets the SIC code and employee threshold criteria, reporting for mercury is required:

- If a facility *manufactures* more than 10 pounds of mercury during the calendar year.
- If a facility *processes* more than 10 pounds of mercury during the calendar year.
- If a facility *otherwise uses* more than 10 pounds of mercury during the calendar year.

Provided that the facility meets the other two reporting requirements, reporting for the mercury compounds category is required:

- If a facility *manufactures* more than 10 pounds of mercury compounds during the calendar year.
- If a facility *processes* more than 10 pounds of mercury compounds during the calendar year.
- If a facility *otherwise uses* more than 10 pounds of mercury compounds during the calendar year.

If a threshold is exceeded for both mercury and the mercury compounds category, only a single Form R needs to be prepared. The terms manufacture, process, and otherwise use are defined in 40 CFR 372.3 as:

> *Manufacture* means to produce, prepare, import, or compound a toxic chemical. Manufacture also applies to a toxic chemical that is produced coincidentally during the manufacture, processing, otherwise use, or disposal of another chemical or mixture of chemicals, including a toxic chemical that is separated from that other chemical or mixture of chemicals as a byproduct, and a toxic chemical that remains in that other chemical or mixture of chemicals as an impurity.
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> *Process* means the preparation of a toxic chemical, after its manufacture, for distribution in commerce: (1) In the same form or physical state as, or in a different form or physical state from, that in which it was received by the person so preparing such substance, or (2) As part of an article containing the toxic chemical. Process also applies to the processing of a toxic chemical contained in a mixture or trade name product.
>
> *Otherwise use* means any use of a toxic chemical, including a toxic chemical contained in a mixture or other trade name product or waste, that is not covered by the terms "manufacture" or "process." Otherwise use of a toxic chemical does not include disposal, stabilization (without subsequent distribution in commerce), or treatment for destruction unless:
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> (1) The toxic chemical that was disposed, stabilized, or treated for destruction was received from off site for the purposes of further waste management; or

(2) The toxic chemical that was disposed, stabilized, or treated for destruction was manufactured as a result of waste management activities on materials received from off site for the purposes of further waste management activities. Relabeling or redistributing of the toxic chemical in which no repackaging of the toxic chemical occurs does not constitute otherwise use or processing of the toxic chemical.

The quantities of mercury and mercury compounds included in threshold determinations are not limited to the amounts released to the environment. All mercury and mercury compounds manufactured, processed, or otherwise used must be counted toward threshold determinations. (EPCRA Section 313(a)). This may include mercury compounds that are generated in closed systems. To assist facilities in determining if they may need to report, Table 1-1 below lists potential industry and process sources of mercury and mercury compounds. For more information on threshold determinations, see Section 2.0.

Table 1-1

Industry and Process Sources of Mercury and Mercury Compounds

Industry/Process	EPCRA Section 313 Activity	Mercury or Mercury Compounds	Reference[1]
Metal mining: trace constituent in ore	Processed, manufactured (by-product)	Mercury and mercury compounds	2
Coal mining: trace constituent in ore	Processed	Mercury compounds	2
Paper manufacturing: present in wood and chemicals	Processed	Mercury	2, 3
Chlor-alkali production by mercury cell process	Otherwise used	Mercury	2, 3
Plastic materials and resin manufacture: formulation component	Processed	Mercury compounds	2
Importing of cadmium-mercury pigments (no domestic production)	Manufactured (import), processed	Mercury	16
Special paper coatings: mercury bromide and mercury acetic acid used in paper and film with cathode ray tubes	Processed	Mercury compounds	16
Chemical manufacture: mercury compound production, reactants, pharmaceuticals, and catalysts	Manufactured, processed, otherwise used	Mercury and mercury compounds	2, 16
Carbon black production: trace constituent in crude oil	Processed	Mercury compounds	2, 3

Industry/Process	EPCRA Section 313 Activity	Mercury or Mercury Compounds	Reference[1]
Petroleum refining: trace constituent in petroleum crude	Processed, manufactured (by-product or impurity)	Mercury compounds	2, 3
Cement and clay products: trace constituent in raw materials	Processed	Mercury	2, 3
Steel industry: coke production, trace constituent in coal	Processed	Mercury compounds	2, 3
Smelting and refining: trace constituent in sulfide ore	Processed, manufactured (by-product)	Mercury	2, 3
Fabricated metal products: article component (e.g., high purity copper foil)	Processed	Mercury and mercury compounds	2, 16
Electronic product component (e.g, bulbs, switches, batteries)	Processed	Mercury	2, 3
Other product components (e.g., thermometers, dental amalgam fillings)	Processed	Mercury	2, 3
Coal, oil, wood combustion (electric utilities, other facility electricity generation): traces in fuels	Otherwise used, manufactured (by-product)	Mercury and mercury compounds	2, 3
Waste treatment and solvent recovery: trace constituent in waste stream	Processed, otherwise used	Mercury and mercury compounds	2
Wholesale distribution of mercury chemicals and compounds	Processed	Mercury and mercury compounds	2
Bulk petroleum stations: trace constituent in petroleum products	Processed	Mercury compounds	2

[1]Numbers correspond to the references listed in Section 5.0.

Section 1.4 What Other Changes to the EPCRA Section 313 Reporting Requirements Apply to Mercury and the Mercury Compounds Category?

EPA has also made modifications and/or clarifications to certain reporting exemptions and requirements for the PBT chemicals that are subject to the lower reporting thresholds; this includes mercury and the mercury compounds category. Each of the changes as they apply to mercury and the mercury compounds category is discussed in the following subsections.

1.4.1 *De Minimis* Exemption

The *de minimis* exemption allows facilities to disregard certain minimal concentrations of toxic chemicals in mixtures or other trade name products they process or otherwise use when making threshold determinations and release and other waste management calculations.

EPA eliminated the *de minimis* exemption for EPCRA Section 313 PBT chemicals, including mercury and the mercury compounds category. This means that facilities are required to include all amounts of mercury and mercury compounds in threshold determinations and all amounts of mercury and the metal portion of mercury compounds in release and other waste management calculations regardless of the concentration of mercury and mercury compounds in mixtures or trade name products (40 CFR 372.38(a)). However, the elimination of the *de minimis* exemption for reporting PBT chemicals does not affect the applicability of the *de minimis* exemption to the supplier notification requirements.

1.4.2 Alternate Reporting Threshold (One Million Pounds) and Form A

The "Alternate Threshold for Facilities with Low Annual Reportable Amounts," provides facilities otherwise meeting EPCRA Section 313 reporting thresholds the option of certifying on a Form A (a two-page certification statement) that they do not exceed 500 pounds for the total annual reportable amount for that chemical, and that their amounts manufactured, processed, or otherwise used for that chemical do not exceed one million pounds.

EPA has excluded EPCRA Section 313 PBT chemicals, including mercury and the mercury compounds category, from eligibility for the "Alternate Threshold for Facilities with Low Annual Reportable Amounts" (40 CFR 372.27(c)). Therefore, the alternate threshold of one million pounds and the Form A certification statement are not options for mercury and the mercury compounds category.

1.4.3 Range Reporting

For facilities with total annual releases or off-site transfers of an EPCRA Section 313 chemical of less than 1,000 pounds, EPA generally allows the amounts to be reported on the Form R either as an estimate or by using ranges.

EPA has eliminated the range reporting option for releases and other waste management activities for EPCRA Section 313 PBT chemicals, including mercury and the mercury compounds category. This means that for those sections of the Form R for which range reporting is an option, the option cannot be used when reporting on mercury and/or the mercury compounds category (40 CFR 372.85(b)(15)(i)). Thus, facilities are required to report an actual number rather than a selected range. However, the elimination of range reporting for PBT chemicals for releases and transfers does not affect the applicability of range reporting for the maximum amount on site as required by EPCRA Section 313(g).

1.4.4 Data Precision

Facilities should report for mercury and the mercury compounds category at a level of precision supported by the data and the estimation techniques on which the estimate is based. However, the smallest quantity that need be reported on the Form R for mercury or mercury compounds is 0.1 pounds.

SECTION 2.0 GUIDANCE ON ESTIMATING ENVIRONMENTAL RELEASES OF MERCURY AND MERCURY COMPOUNDS

Section 2.1 General Guidance

EPA is providing the following guidance for use by facilities in estimating and reporting annual releases and other waste management quantities for mercury and the mercury compounds category. It is not designed to provide exhaustive guidance for all situations involving mercury and mercury compounds. Please consult industry specific guidance documents applicable to your facility for more detailed guidance. Additional information and guidance is also available from the EPA's EPCRA Hotline, **1-800-424-9346**, and the Toxics Release Inventory (TRI) website at **http://www.epa.gov/tri**. EPA also publishes an annual guidance document for EPCRA Section 313 reporting entitled *Toxic Chemical Release Inventory Reporting Forms and Instructions*. You should consult the most current version before preparing any report for your facility.

This document includes concentration and emission factor data which may be used as default values in calculating activity thresholds, releases and other waste management quantities. EPA recommends that facilities complete these calculations using best readily available information applicable to their operations, even when it differs from the data provided herein. EPA also recommends that facilities maintain documentation of the basis for making these estimates. Facilities are not required to perform additional testing for EPCRA Section 313 reporting.

2.1.1 Threshold Determination

As mentioned in Section 1.3, EPA lowered the reporting threshold for mercury and the mercury compounds category to 10 pounds per year for each of the reporting activities (manufacturing, processing, and otherwise use). Each activity threshold is determined independently. When determining if a threshold is exceeded for mercury, you should calculate the amount of mercury manufactured, the amount of mercury processed, and the amount of mercury otherwise used. To determine if a threshold

is exceeded for the mercury compounds category, use the entire weight of the mercury compounds for each threshold determination. Quantities required to meet the threshold for fuels and other materials may be found in tables 3-1 through 3-4. The following example illustrates key points in determining if a threshold has been exceeded for mercury or the mercury compounds category.

Example - Threshold Determination.

Your facility processes 1,000 pounds of mercury during the calendar year, otherwise uses 8 pounds of mercury, and manufactures 5 pounds of a mercury compound as a by-product. Your facility did not exceed the otherwise use threshold for mercury, nor the manufacturing threshold for mercury compounds. Your facility did exceed the processing threshold for mercury, and must prepare a Form R report for mercury. (Note: if your facility had exceeded an activity threshold for both mercury and mercury compounds, you need only prepare one Form R.)

Since you determined that you must submit an EPCRA Section 313 Form R report for mercury, you must calculate all releases and other waste management activity quantities of mercury from your facility, including releases and other waste management quantities of mercury from the otherwise use activity. You are not required to submit a Form R for mercury compounds.

If you do not know in what form mercury is present in a material, EPA recommends in most cases assuming elemental mercury. For fuels, assume that mercury is present as mercury compounds. In the absence of other data, EPA recommends assuming the mercury compound is Hg_2O for threshold calculations. If you burn fuels on site, elemental mercury emissions are coincidentally manufactured. The amount of mercury emissions should be applied to the manufacturing threshold for elemental mercury.

The concentration of mercury or mercury compounds may be known as a specific concentration, as an average, as a range, or as an upper or lower boundary. If you know the specific concentration of the mercury or mercury compounds in the stream, you must use that value (40 CFR 372.30 (b)(i). If only an average concentration is provided (e.g., by the supplier), use that value in the threshold calculation. If only the upper bound concentration is known, you must use that value in the threshold calculation (40 CFR 372.30(b)(3)(ii)). If only the lower bound concentration is known, or the concentration is given as a range of an upper and lower boundary, EPA has developed the following guidance on the use of this type of information in threshold determinations.

- If the concentration is given as a range or an upper and lower boundary, EPA recommends that you use the mid-point in your calculations.

- If only the lower bound concentration of mercury or mercury compounds is given and the concentrations of the other components are given, EPA recommends that you subtract the other component total from 100% to calculate the upper bound of the mercury or mercury compound(s). EPA then recommends that you determine the mid-point for use in your calculations.

- If only the lower bound concentration of mercury or mercury compounds is given and the concentration of the other components is not given, EPA recommends that you assume the upper bound for the mercury or mercury compounds is 100% and use the mid-point. Alternatively, product quality requirements or information available from the most similar process stream may be used to determine the upper bound of the range.

Example - Using a Typical Concentration to Determine Amount Processed During Carbon Black Production

Your facility manufactures carbon black. Using inventory records, you know that 30 million pounds of crude oil was processed through your facility. Using a mercury concentration of 1.5 ppm in the crude oil, you determine if you have exceeded the processing threshold.

$$(1.5 \text{ lb mercury} / 1 \times 10^6 \text{ lb crude oil}) \times (30{,}000{,}000 \text{ lb crude oil}) = 45 \text{ lb/yr}$$

Your facility exceeded the 10 lb/yr threshold and you must prepare a Form R for that year.

Chemical production facilities may manufacture mercury compounds for other industry use. Production records are a great source for determining the amount manufactured. You must also include the importing of mercury or mercury compounds in your manufacturing threshold determination. (EPCRA Section 313(b)(1)(C)(i)). You can obtain these amounts from purchasing records.

2.1.2 Exemptions

EPA has established four classes of exemptions: *de minimis*, article, facility/laboratory related, and activity related. EPCRA Section 313 chemicals or chemical categories that qualify for these exemptions may be excluded from threshold determinations and release or other waste management estimations.

The PBT chemical final rule states that the *de minimis* exemption does not apply to PBT chemicals or chemical categories (40 CFR 372.38(a)).

For the purpose of the article exemption, an article is defined as a manufactured item that:

- Is formed to a specific shape or design during manufacture;
- Has end-use functions dependent in whole or in part upon its shape or design; and
- Does not release an EPCRA Section 313 chemical or chemical category under normal conditions of processing or otherwise use of the item at the facility (40 CFR 372.3).

If you receive a manufactured article from another facility (e.g., a thermostat containing mercury), the mercury in that article may be exempt from threshold determinations and release and other waste management calculations if you meet the following criteria:

- You process or otherwise use it without changing the shape or design; and
- Your processing or otherwise use does not result in the release of more than 0.5 pounds of mercury or any other TRI chemical in a reporting year from all like articles.

Recycling of releases from articles allows them to remain as exempt articles.

Any mercury or mercury compounds manufactured, processed, or otherwise used in laboratories under the supervision of a technically qualified individual may be exempt from threshold determinations and release and other waste management calculations (40 CFR 372.38(d)). Note that the laboratories exemption does not apply in the following cases:

1) Specialty chemical production;
2) Manufacture, processing, or use of toxic chemicals in pilot plant scale operations; and,
3) Activities conducted outside the laboratory.

The activity-related exemptions are available for mercury and mercury compounds (40 CFR 372.38(c)).

In addition to the four exemptions discussed above, EPA has established guidance for two special circumstances that may apply to facilities manufacturing, processing, or otherwise using mercury and mercury compounds. This guidance applies to coal extraction and metal mining activities. Regarding coal extraction, per 40 CFR 372.38(g), if a toxic chemical is manufactured, processed, or otherwise used in extraction by facilities in SIC code 12, a person is not required to consider the quantity of the toxic chemical so manufactured, processed, or otherwise used when determining whether an applicable threshold has been met under § 372.25, § 372.27, or § 372.28, or determining the amounts to be reported under § 372.30. For additional information regarding coal extraction, refer to *Section 313 Emergency Planning and Community Right-to-Know Act Guidance for Coal Mining Facilities*.

Regarding metal mining overburden, per 40 CFR 372.38(h), if a toxic chemical that is a constituent of overburden is processed or otherwise used by facilities in SIC code 10, a person is not required to consider the quantity of the toxic chemical so processed, or otherwise used when determining whether an applicable threshold has been met under § 372.25, § 372.27, or § 372.28, or determining the amounts to be reported under § 372.30. For additional information regarding metal mining, refer to *Section 313 Emergency Planning and Community Right-to-Know Act Guidance for Metal Mining Facilities*.

Section 2.2 Methods for Calculating Annual Releases and Other Waste Management Quantities of Mercury and Mercury Compounds

When reporting for mercury or the mercury compound category, only the amount of metal mercury needs to be reported on the Form R. EPA recommends that you calculate mercury releases and other waste management activities by following these steps:

1. Identify the processes/operations where mercury or mercury compounds may be manufactured, processed, or otherwise used.

2. Determine potential sources of releases and other waste management activities from these processes (e.g., process wastewater discharge, emissions from operations).

3. Identify the types of releases and other waste management activities. These types correspond to the Form R (e.g., stack emissions, sent off site for recycling).

4. Determine the most appropriate estimation method(s) and calculate the estimates for release and other waste management quantities.

During threshold determinations, you should have identified the processes and operations in which mercury (and mercury compounds) are found. Potential release and other waste management sources of mercury include the following:

- Accidental spills and releases;
- Air pollution control devices (e.g., baghouses, electrostatic precipitators, and scrubbers)
- Clean up and housekeeping practices;
- Combustion by-products;
- Container residues;
- Fittings;
- Process discharge stream;
- Pumps;
- Recycling and energy recovery by-products;
- Storage tanks;
- Tower stacks;
- Transfer operations;
- Treatment sludge;
- Volatilization from processes; and
- Waste treatment discharges.

After determining the release and other waste management activity sources of mercury and mercury compounds, you are ready to determine the types of releases and other waste management activities. These final destinations of mercury (not including incorporation into a final product) correspond to elements of the Form R. The potential types of releases and other waste management activities include:

- Fugitive or nonpoint air emissions (Part II, Section 5.1 of Form R): Mercury emissions are considered to be fugitive if not released through stacks, vents, ducts, pipes, or any other confined air stream. You must include (1) fugitive equipment leaks from valves, pump seals, flanges, compressors, sampling connections, open-ended lines, etc.; (2) evaporative losses from surface impoundments and spills; (3)

releases from building ventilation systems; and (4) any other fugitive or non-point air emissions.

- Stack or point air emissions (Part II, Section 5.2 of Form R): Mercury emissions are considered to be stack if released through stacks, confined vents, ducts, pipes, or other confined air streams. You must include storage tank emissions. Air releases from air pollution control equipment would generally fall in this category. Using the control efficiency of an air pollution control device, you can determine how much mercury is released through the air device.

- Discharges to receiving streams or water bodies (Part II, Section 5.3 of Form R): Mercury may be released in wastewater directly from the process or from a treatment system. Monitoring is often performed at either type of outfall. This information can be used to determine the concentration of mercury leaving the facility.

- Underground injection on site (Part II, Section 5.4 of Form R): This waste management type is not common for mercury and mercury compounds.

- Disposal to land on site (Part II, Section 5.5 of Form R): This type of release may occur if materials containing mercury or mercury compounds are spilled during processing or transfer operations.

- Disposal of mercury or mercury compounds in a landfill.

- Discharges to Publicly Owned Treatment Works (POTW) (Part II, Section 6.1 of Form R): As with the receiving stream discharge, monitoring may be available to determine the mercury concentration in a waste stream from a process or from a treatment operation.

- Transfers to other off-site locations (Part II, Section 6.2 of Form R): This type includes transferring mercury off site for recovery. Other sources include used baghouse wastes sent to landfills, or other mercury wastes sent off site for disposal, treatment, or recycling.

- On-site waste treatment (Part II, Section 7A of Form R): You should report the amount of mercury treated by your facility. Following treatment, mercury may be present in sludge or the water.

- On-site energy recovery (Part II, Section 7B of Form R): EPA believes that chemicals that do not contribute significant heat energy during the combustion process should not be considered for energy recovery. Therefore, mercury and the

metal portion of mercury compounds should not be reported as combusted for energy recovery (rather consider mercury as undergoing on-site treatment).

- On-site recycling (Part II, Section 7C of Form R). If you perform mercury or mercury compound recycling (for example at the mercury cell process), you should report the amount recycled in Section 7C of the Form R.

After you have identified all of the potential sources for release and other waste management activity types, you must estimate the quantities of mercury and the mercury portion of mercury compounds released and otherwise managed as waste. EPA has identified four basic methods that may be used to develop estimates (each method has been assigned a code that must be included when reporting). The methods and corresponding codes are:

- Monitoring Data or Direct Measurement (M);
- Mass Balance (C);
- Emission Factors (E); and,
- Engineering Calculations (O).

Descriptions of these techniques are provided in the U.S. EPA publication, *Estimating Releases and Waste Treatment Efficiencies for the Toxic Chemical Release Inventory Forms* (1).

Many data sources exist for these (and other) methods of developing estimates. Table 2-1 presents potential data sources and the estimation methodology in which each estimation source is most likely to prove useful. Based on site-specific knowledge and potential data sources available, you should be able to determine the best method for calculating each release and other waste management activity quantity.

Table 2-1

Potential Data Sources for Release and Other Waste Management Calculations

DATA SOURCES	
Monitoring Data	**Mass Balance**
• Air permits • Continuous emission monitoring • Effluent limitations • Hazardous waste analysis • Industrial hygiene monitoring data • NPDES[1] permits • Outfall monitoring data • POTW pretreatment standards • RCRA[2] permit • Stack monitoring data • New Source Performance Standards • Title V Permit Data • MACT Standards	• Air emissions inventory • Hazardous material inventory • Hazardous waste manifests • MSDSs[4] • Pollution prevention reports • Spill event records • Supply and purchasing records
Emission Factors	**Engineering Calculations**
• AP-42[3] chemical specific emission factors • Facility or trade association derived chemical-specific emission factors	• NTI[6] database • Facility non-chemical specific emission factors. • Henry's Law • Raoult's Law • SOCMF[5] or trade association non-chemical specific emission factors • Solubilities • Volatilization rates

[1]National Pollutant Discharge Elimination System.
[2]Resource Conservation Recovery Act.
[3]Compilation of Emission Factors, U.S. EPA.
[4]Material Safety Data Sheets.
[5]Synthetic Organic Chemicals Manufacturing Industry.
[6]National Toxic Inventory.
[7]Maximum Achievable Control Technology.

SECTION 3.0 SOURCES OF MERCURY AND MERCURY COMPOUNDS

This section provides an overview of where EPA believes mercury and mercury compounds are likely to be found at facilities and what operations may manufacture, process, or otherwise use mercury or mercury compounds. You should determine if these sources apply to your facility.

Section 3.1 Mercury in Raw Materials

Raw materials processed by facilities may contain metal mercury or mercury compounds as a trace constituent in chemicals (e.g., chlorine), metal ores, petroleum products, and coal.

Mercury and mercury compounds are present in metal ores, such as copper, lead, zinc, gold, and silver. Mercury and its compounds are also trace constituents in coal, oil, or wood that is processed or otherwise used by a facility. Table 3-1 lists some common concentrations of mercury in the above mentioned sources, and Table 3-2 lists average mercury concentrations from coal sampled at electric utilities. Note that the concentrations of mercury in metal ores vary from mine to mine.

Table 3-1

Quantity of Raw Materials Required to Meet the Reporting Threshold

Raw Material	Concentration Mercury, ppm	Reference[1]	Quantity Needed to Meet Threshold (pounds for ores, gallons for oil)[3]
Copper ores	0.5	11	2.00×10^7
Gold ores	9	11	1.11×10^6
No. 2 fuel oil[2]	0.001	13	1.41×10^9
No. 6 fuel oil[2]	0.00067	12	1.89×10^9

[1]Numbers correspond to the references listed in Section 5.0.
[2]Constituents are most likely metal compounds rather than elemental mercury. Mercury is listed in this table because concentration data are for only the metal occurring in the fuel. Concentrations for metal compounds would be somewhat higher depending on the metal compound.
[3]Assumes the following densities: No. 2 Fuel Oil - 7.1 lb/gallon; No. 6 fuel Oil - 7.9 lb/gallon.

Table 3-2

Quantity of Solid Fuels Required to Meet the Reporting Threshold

Coal Type	Average Mercury[1] Content, ppm	Quantity Needed to Meet Threshold (pounds)
Anthracite	0.16	6.25×10^7
Bituminous	0.11	9.09×10^7
High Sulfur Bituminous	0.10	1.00×10^8
Low Sulfur Bituminous	0.09	1.11×10^8
Lignite	0.11	9.09×10^7
Petroleum Coke	0.05	2.00×10^8
Subbituminous Coal	0.07	1.43×10^8
Tires	0.06	1.67×10^8
Waste Anthracite	0.19	5.26×10^7
Waste Bituminous Coal	0.46	2.17×10^7
Waste Subbituminous Coal	0.12	8.33×10^7

Source: USEPA, *Electric Utility Steam Generating Units Hazardous Air Pollutant Emission Study: Data - Coal Analysis Results (Mercury Information Collection Request (ICR)*, 1999). Office of Air Quality Planning and Standards, Unified Air Toxics Website. December 2000. http://www.epa.gov/ttn/uatw/combust/utiltox/utoxpg.html

[1]Mercury is expected to be present in coal as metal compounds, and consequently, are expected to be at higher concentrations than reported in the table.

The scientific literature indicates that the concentration of mercury has been measured in many sources of crude oil. In one recent article, 76 crude samples were measured with an average concentration of 1.5 ppm (12). The actual concentrations varied over four orders of magnitude. EPA recognizes that this is enormous variability, and that many facilities use crude oils with a mercury concentration well below 1.5 ppm. In the absence of site-specific information, EPA recommends that facilities contact their trade association or other facilities to determine whether mercury concentration data is available for the type of crude oil they use. The mean of 1.5 ppm may be used as a default value. In the absence of data about the specific form of mercury, EPA recommends that facilities assume all mercury is in the form of mercurous oxide, or Hg_2O. As always, facilities should use the best readily available information that is applicable to their operations.

Coal and oil are common fuel sources at many facilities covered under EPCRA Section 313, and are used especially for electric power generation. Coal is processed at coal mining and coke production facilities. Oil feedstocks (including crude oil, No. 2 fuel oil, and No. 6 fuel oil) are processed through carbon black production facilities, petroleum refining facilities, and bulk stations and terminals.

Portland cement facilities may process mercury or mercury compounds as an impurity in raw materials, and otherwise use mercury compounds during fuel combustion. Some typical concentrations of mercury in cement manufacturing process streams are listed in Table 3-3.

Table 3-3

Quantity of Cement Manufacturing Streams Required to Meet the Reporting Threshold

Process Stream	Mercury Concentration	Quantity Needed to Meet Threshold (pounds)
Raw mix	<0.01 ppm	1.00×10^9
Waste-derived fuels	<1.5 ppm	6.67×10^6
Clinker product	<0.01 ppm	1.00×10^9
Cement kiln dust	< 0.5 ppm	2.00×10^7

Source: Radian Corporation, *Trial Burn Report*. 1995.

Mercury or mercury compound impurities may be present in chemicals used by your facility. For example, chlorine used by a pulp mill may contain a mercury impurity if manufactured by the mercury cell process.

Copper and lead smelting and refining facilities may process mercury or mercury compounds as an impurity in the sulfide ore. At primary lead smelting operations, the amount of mercury present in the ore is approximately 0.0004 pounds per ton of ore concentrate (5, p. 4-60).

Section 3.2 Mercury Recovery Operations

The manufacture and subsequent processing of mercury may result from a facility's mercury recovery activities. A facility may recover liquid mercury from dismantled equipment, or recover mercury from scrap and industrial wastes using a thermal or chemical extractive process. Major sources of recycled or recovered mercury include scrap from instrument and electrical devices (lamps and switches), wastes and sludges from electrolytic refining plants, and mercury batteries. Secondary smelting operations may recover mercury from scrap for reuse or sale, and gold mining facilities may manufacture mercury as a by-product.

Section 3.3 Mercury Components

Mercury may be incorporated into final products such as lamps, switches, and batteries. Although the use of mercury has declined, facilities may still exceed the 10-pound processing or otherwise use threshold.

Electrical apparatus manufacturing facilities may process mercury as an article component in products such as electrical switches, thermal-sensing devices, fluorescent lamps, and copper foil. The electrical apparatus manufacturing industry primarily uses mercury as an electrical contact in electric switch production. High-purity copper foil production also uses mercury as an electrical contact. Mercury may be a component in thermal sensing devices, in which it expands upon heating, activating the controls. Fluorescent lamp manufacturers inject mercury vapor into lamps.

In addition, mercury and mercury compounds may be processed by facilities as a component in thermometers, dental amalgams, and batteries. Mercury is a component in mercuric oxide, silver oxide, zinc-air, carbon-zinc, and alkaline batteries. As of 1996, mercury is legally prohibited from being added as a corrosion inhibitor in most alkaline batteries (8). However, it is present in alkaline battery casings still in use as a side reaction inhibitor and corrosion inhibitor. Table 3-4 lists the concentration of mercury in common articles.

Table 3-4

Quantity of Common Articles Containing Mercury Required to Meet the Reporting Threshold

Article Type	Mercury Content (per article)	Reference	Number of Articles Required to Meet Threshold
Mercuric oxide battery	30 - 40%	5, p. 4-20	a
Silver oxide battery	7.7×10^{-6} lb	15	1.30×10^{6}
Zinc - Air battery	1.99×10^{-5} lb	15	5.03×10^{5}
Carbon - Zinc	0.01%	30	a
Alkaline manganese button battery	2.4×10^{-5} lb	15	4.17×10^{5}
4' Fluorescent Lamp	2.56×10^{-5} lb	14	3.91×10^{5}
Ampoules[b]	6.2×10^{-3} lb	17	1.61×10^{3}
Thermostats[b]	8.8×10^{-3} lb	17	1.14×10^{3}

[a]No information on the weight of mercuric oxide or carbon-zinc batteries is available.
[b] Thermostats may contain multiple ampoules. The mercury content provided is an average value.

Although mercuric oxide batteries are the only batteries currently manufactured with mercury and mercury compounds as main components, mercury may be recovered from the other battery types.

Section 3.4 Mercury and Mercury Compounds in the Chemical Industry

Facilities covered by EPCRA Section 313 reporting requirements include chemical facilities that manufacture, process, or otherwise use mercury or mercury compounds. Some industries include chlor-alkali manufacturing, inorganic or organic mercury compound production, and custom compound resins manufacture.

Chlor-alkali production using the mercury cell process accounts for the largest percentage of commercial consumption of mercury. However, the amount of chlorine produced using the mercury cell process has declined significantly over the last 20 years. The chlor-alkali industry now

favors a membrane cell process that uses no mercury, is more energy-efficient, and produces mercury-free products.

Inorganic chemical and industrial chemical production plants may manufacture mercury compounds. The amount of mercury used as a raw material should be included in the processing threshold determination. The amount of mercury compounds produced should be included in the manufacturing threshold.

In addition to facilities manufacturing mercury compound products, other facilities may import, process, or otherwise use mercury reagents or catalysts. If a reaction occurs, mercury compounds may be manufactured. Mercury may also be present in industrial or commercial grade sulfuric acid.

Mercury and mercury compounds may be contained in waste streams received by facilities covered under EPCRA Section 313. A facility must consider the treatment or combustion of these waste streams containing mercury or mercury compounds during threshold determinations. The concentration in the waste stream will vary.

Section 3.5 Combustion of Fuels Containing Mercury

All EPCRA Section 313 chemicals contained in fuels combusted for energy production are considered otherwise used. The amount of mercury and mercury compounds present in the fuel (e.g., coal, fuel oil) should be included in the otherwise use threshold. If you do not know the mercury compound present in the fuel, EPA recommends using Hg_2O for threshold calculations of otherwise use. Recall that mercury and mercury compounds are separately listed substances, and threshold calculations should be made for them separately.

Current information indicates that elemental mercury and mercury compounds found in coal may be either converted to other mercury compounds or to elemental mercury during the

combustion process. The percent conversion is likely a function of several variables. (Study of Hazardous Air Pollutant Emissions from Electricity Generating Units - Final Report to Congress, February 1998). In the absence of better information, EPA recommends that facilities assume that the form of mercury in the coal is mercurous oxide (Hg_2O). The estimated quantity of mercurous oxide is then applied towards the ten pound otherwise use threshold determination. EPA also recommends that facilities assume that all releases and other waste management quantities of mercury from the combustion of coal are in the form of elemental mercury. These estimates of elemental mercury are then used toward ten pound manufacturing threshold determinations.

For fuels other than coal, EPA recommends using the same assumptions. Unless facilities have information to indicate otherwise, EPA recommends they assume that they manufacture elemental mercury during combustion, and that 100% of the mercury compounds in the fuel are converted to elemental mercury. As with coal, apply the weight of the metal, rather than the metal compound toward the manufacturing threshold for mercury.

SECTION 4.0 RELEASE AND OTHER WASTE MANAGEMENT CALCULATIONS

The release and other waste management calculations provided in this section demonstrate some available techniques you can use to calculate your facility's releases and other waste management quantities of mercury and metal portions of mercury compounds. You should determine the best information available for your operation and decide which calculation method works best for you.

Section 4.1 Mercury and Mercury Compound Emissions

Fuel combustion activities and other heated processes that process or otherwise use mercury and mercury compounds can generate mercury emissions. Following air treatment, mercury emissions may still be released from the stack. The type of air pollution devices used at your facility may dictate the final destination of the controlled mercury (e.g., dust in a baghouse or part of scrubber wastewater). Table 4-1 presents some common operation sources of mercury emissions.

Table 4-1

Sources of Mercury Emissions

Facility/Process Type	Operation Sources of Mercury Emissions
Gold mining	Pretreatment roaster, Retort
Secondary mercury recovery: thermal treatment	Retort or furnace operations, Distillation, After charcoal filters
Mercury compound production	Reactor, Drier, Filter, Grinder, Transfer operations
Chlorine production using the mercury cell process	By-product hydrogen stream, End box and cell room ventilation
Mercuric oxide battery manufacturing	Grinding, Mixing, Sieving, Pelleting, Consolidating
Electrical switch manufacturing	Welding, Filling, Transfer operations, Testing, Spills or breaks
Tungsten bar sintering	Sintering, Final density measurement
Copper foil production	Drum room, Treating room
Fluorescent lamp manufacturing	Mercury purification and transfer, Parts repair, Mercury injection, Broken lamps, and Spills

Table 4-1 (Continued)

Facility/Process Type	Operation Sources of Mercury Emissions
Fluorescent lamp recycling	Collection, Crushing
Thermometer manufacturing	Mercury purification and transfer, Filling, Heating-out process
Coal and oil combustion	Utility boiler exhaust, Bottom and fly ash handling
Waste combustion	Exhaust stack, Bottom and fly ash handling
Coke production	Coal preparation and handling, Fugitive emissions from oven
Primary lead smelting	Sintering, Blast furnace
Copper smelting	Roasting, Smelting furnace
Petroleum refining	Distillation, Cracking, Conversion steps
Pulp and paper production	Chemical recovery

Using emission factors is the most common way to determine the amount of mercury released to air. If your facility uses an air pollution control device, you can use the capture and control efficiency to determine the quantity of fugitive and stack emissions. Depending on the type of device, the controlled mercury air emissions may become part of a wastewater stream or baghouse dust. Sources of emission factors include U.S. EPA's Compilation of Emission Factors (AP-42) (9), trade association chemical-specific factors, and other literature values.

The Unified Air Toxics Website: Electric Utility Steam Generating Units Hazardous Air Pollutant Emission Study (http://www.epa.gov/ttn/uatw/combust/utiltox/utoxpg. html) provides speciated mercury testing data for coal combustion collected for the 1999 Information Collection Request (ICR) . Although the data were collected from utility boilers, it may be used for non-utility boilers. Table 4-2 provides the percent of the mercury present in the coal which is released to the air based on coal type, boiler type, and air pollution control device. When determining mercury emissions to air, EPA recommends using data with the same (or most similar) fuel type, boiler type, and control devices. For more details on the data provided, refer to the website.

Table 4-2

Percent Mercury Present in Coal Which is Released to Air

Coal Type	Boiler Type	Air Pollution Control Device	% Mercury Present in Coal Which is Released to Air
Bituminous	PC Boiler	CS-ESP	53.52
Bituminous and Pet Coke	PC Boiler	CS-ESP	45.72
Sub-bituminous	PC Boiler	CS-ESP	85.52
Lignite	PC Boiler	CS-ESP	98.53
Lignite	Cyclone Boiler	CS-ESP	80.09
Bituminous	PC Boiler	HS-ESP	87.98
Sub-bituminous	PC Boiler	HS-ESP	86.54
Sub-bituminous	Cyclone Boiler	HS-ESP	99.96
Bituminous	PC Boiler	FF	16.90
Sub-bituminous	PC Boiler	CS-FF	27.57
Bituminous	PC Boiler	PM Scrubber	85.87
Sub-bituminous	PC Boiler	PM Scrubber	91.63
Lignite	PC Boiler	PM Scrubber	67.23
Bituminous	Cyclone Boiler	PM Scrubber	76.71
Lignite	PC Boiler	CS-ESP and FF (COHPAC)	95.07
Lignite	Cyclone Boiler	Mechanical Collector	99.89
Bituminous	PC Boiler	SDA/FF	1.78
Sub-bituminous	PC Boiler	SDA/FF	74.60
Lignite	PC Boiler	SDA/FF	82.62
Lignite	Cyclone Boiler	SDA/FF	90.68
Sub-bituminous	PC Boiler	CS-ESP/SDA	62.06
Bituminous	PC Boiler	DSI and CS-ESP	55.11
Bituminous	PC Boiler	SCR and SDA/FF	2.44
Bituminous	PC Boiler	SNCR and CS-ESP	9.1
Bituminous	PC Boiler	CS-ESP and Wet FGD Scrubber	18.77

Table 4-2 (Continued)

Coal Type	Boiler Type	Air Pollution Control Device	% Mercury Present in Coal Which is Released to Air
Bituminous	Cyclone Boiler	CS-ESP and Wet FGD Scrubber	43.70
Bituminous	PC Boiler	HS-ESP and Wet FGD Scrubber	44.95
Sub-bituminous	PC Boiler	CS-ESP and Wet FGD Scrubber	64.88
Sub-bituminous	PC Boiler	HS-ESP and Wet FGD Scrubber	67.38
Lignite	PC Boiler	CS-ESP and Wet FGD Scrubber	62.52
Bituminous	PC Boiler	CS-FF and Wet FGD Scrubber	3.59
Bituminous/Waste	FBC	CS-FF	0.11
Bituminous	FBC	SCR and CS-FF	24.19
Lignite	FBC	CS-ESP	61.71
Lignite	FBC	CS-FF	42.95
Waste Anthracite	FBC	CS-FF	0.26
Bituminous	Stoker	CS-FF/SDA	5.75
Bituminous	Stoker	CS-ESP and Wet FGD Scrubber	31.64

PC: Pulverized coal
FBC: Fluidized bed combustor
CS-ESP: Cold-side electrostatic precipitator
HS-ESP: Hot-side electrostatic precipitator
FF: Fabric filter
PM: Particulate matter
FF(COHPAC): Fabric filter pilot unit (compact hybrid particulate collector)
SDA: Spray dryer absorber (dry scrubber)
DSI: Duct sorbent injection
SCR: Selective catalytic reduction
FGD: Flue gas desulfurization
SNCR: Selective non-catalytic reduction

Source: U.S. EPA. *Electric Utility Steam Generating Units Hazardous Air Pollutant Emission Study (Mercury ICR).* Office of Air Quality Planning and Standards. Unified Air Toxics Website-Control Device Analysis. December 2000. http://www.epa.gov/ttn/uatw/combust/utiltox/utoxpg.html

The data provided in Table 4-2 is derived from information which may be found on the Unified Air Toxics Website (http://www.epa.gov/ttn/uatw/combust/utiltox/utoxpg.html). This data may be incorporated into AP-42 at some future date. As always, if a facility has other means of estimating emissions which are more applicable to that site, they may be used.

After determining the quantity of mercury released to the air, facilities must also determine the quantity of mercury in the bottom ash and collected by the control device. A mass balance calculation using the total amount of mercury in coal (see Table 3-2) may be used to determine these quantities. The release or waste management of the mercury in bottom ash or from the control device (e.g., effluent from a wet scrubber) must be reported on the Form R.

If the data in Table 4-2 do not apply to your boiler, you may use an uncontrolled emission factor for coal combustion of 16 lb/10^{12} Btu, as provided in AP-42(9).

The following example shows how you can use Table 4-2 to estimate mercury emissions from coal combustion.

Example - Mercury Emission Calculation

Your facility combusts lignite coal in a fluidized bed combustor. You feed 0.5 million tons of lignite coal into the boiler during the reporting year. You control boiler emissions using a cold-side electrostatic precipitator (CS-ESP). The ash is sent to an on-site landfill.

First, you complete the activity threshold determinations for otherwise use and manufacturing. Table 3-2 lists the average mercury concentration in lignite coal as 0.11 ppm.

A) Otherwise use: According to EPA's recommendation, assume the mercury in the coal is in the form of mercurous oxide, or Hg_2O.

Amount of mercury compound otherwise used:

$(0.5 \times 10^6$ tons coal) × (2,000 lb/ton) × (0.11 lb mercury/ 1×10^6 lb coal) × (1.04 lb Hg_2O/lb Hg) = 114 lb mercurous oxide

This is the amount of mercurous oxide in the coal. Since the mass of this mercury compound is higher than 10 lb, your facility exceeds the reporting threshold for mercury compounds.

B) Manufacturing: In performing the manufacturing threshold calculations, assume the form of mercury manufactured in the combustion chamber is elemental mercury.

Amount of mercury manufactured:

$(0.5 \times 10^6$ tons coal) × (2,000 lb/ton) × (0.11 lb mercury/ 1×10^6 lb coal) = 110 lbs. mercury

This is the amount of mercury manufactured as a result of the combustion of coal. Since this value is greater than 10 lb, your facility exceeds the reporting threshold for mercury.

Although your facility exceeds activity thresholds for both mercury compounds and mercury, EPA recommends that you submit one combined Form R. When filing Section 1 of Form R, identify the chemical reported as mercury compounds. Releases and other waste management quantities are to be calculated as elemental mercury.

To estimate mercury releases to air, you use the data provided in Table 4-2. Table 4-2 lists the percent of mercury in coal emitted to the air from lignite coal in a fluidized bed combustor (FBC) with a cold-side electrostatic precipitator as 61.71 percent.

Mercury air emissions:

(110 lb mercury) × (61.71%) = 68 lb/yr mercury

You should report this quantity in Section 5.2 of the Form R.

The remaining 42 lb of the mercury emitted is collected from the control device and bottom ash, and is sent to an on-site landfill. You should report this quantity in Section 5.5 of the Form R.

AP-42 includes emission factors for fuel oil and wood combustion. Mercury emissions from distillate fuel oil combustion can be calculated using an emission factor of 3.0 lb/10^{12} BTU (uncontrolled). The average mercury emission factor from No. 6 fuel oil combustion is 0.000113 lb/1,000 gal (uncontrolled). Mercury emissions from wood combustion operations with particulate matter control average 0.00000515 lb/ton (wet, 50% moisture; >4500 Btu/lb heating value; miscellaneous control devices). The following example shows how to calculate mercury emissions using emission factors.

Example - Mercury Emission Calculation Using Emission Factors

Your facility uses 100 million gallons of No. 6 fuel oil to generate electricity during the reporting year. You have determined that you exceed the 10-pound reporting threshold for mercurous oxide and must calculate all releases and other waste management activity amounts.

After evaluating your options, you decide to use an AP-42 emission factor for your calculation.

Calculate the amount of mercury emissions using the AP-42 emission factor: 0.000113 lb/1000 gal.

Amount of mercury emissions:

(100,000,000 gal/yr) × (0.000113 lb/1000 gal) = 11 lb/yr

If you do not have any controls on the boiler, you should report this amount plus any additional mercury fugitive emission amounts in Section 5.1 and 8.1 of the 2000 Form R.

Pulp and paper mill mercury emissions occur primarily at chemical recovery operations. Table 4-3 lists emission factors for the combustion sources.

Table 4-3

Mercury Emission Factors for Kraft Combustion Sources

Kraft Combustion Source	Average Mercury Emission Factor (lb/ton)
Recovery furnace, NDCE[1]	2.2×10^{-6}
Recovery furnace, DCE[1]	ND (1.0×10^{-5})
Smelt dissolving tank[1]	3.3×10^{-7}
Lime kiln, with ESP[2]	4.7×10^{-6}
Lime kiln, with scrubbers[2]	ND (9.0×10^{-5})

ND = non-detect
ESP = Electrostatic Precipitator
[1]Emission factors are per ton of black liquor solids fired in the recovery furnace.
[2]Emission factors are per ton of lime produced in lime kiln.
Source: Letter from R.C. Kaufmann, National Council of the Paper Industry for Air and Stream Improvement, to Jeff Telander, U.S. EPA. Data provided to EPA's Office of Air Quality Planning and Standards in connection with the MACT II rulemaking activity for pulp and paper combustion sources. February 10, 1999.

Portland cement kiln emission factors listed in AP-42 (Reference 9, Table 11.6-9) are based on the type of control. The average emission factor for mercury with an electrostatic precipitator air pollution control device is 0.00022 lb/ton. If a fabric filter (e.g., baghouse) is used, the average emission factor for mercury is 0.000024 lb/ton. Table 4-4 lists the AP-42 mercury emission factors from brick manufacturing operations.

Table 4-4

Mercury Emission Factors from Brick Manufacturing

Source	Mercury Emission Factor, lb/ton[1]
Coal-fired kiln (SCC 3-05-003-13)	9.6×10^{-5}
Natural gas-fired kiln (SCC 3-05-003-11)	7.5×10^{-6}
Sawdust-fired kiln (SCC 3-05-003-10)	7.5×10^{-6}
Sawdust-fired kiln and sawdust dryer (SCC 3-05-003-61)	1.1×10^{-5}

SCC = Source Classification Code
[1]Per ton of fired brick produced.
Source = US EPA, *Compilation of Air Pollutant Emission Factors, AP-42. Table 11.3-7,* Fifth Edition, OAQPS.

Locating and Estimating Air Emissions from Sources of Mercury and Mercury Compounds (EPA-454/R-97-012) contains additional information on emissions from manufacturing and miscellaneous sources (3).

Treatment and disposal facilities may emit mercury when waste is incinerated. The primary source of mercury emissions is the combustion gas exhaust stack. Small quantities of mercury may be emitted with the fugitive particulates generated from bottom and fly ash handling procedures. Mercury in the remainder of the ash should be reported as a release to land. At facilities processing

metal and sulfide ores or coal, mercury particulate emissions may be gener-ated during material processing. Table 4-5 lists additional emissions factors for certain processes.

Table 4-5

Mercury Emission Factors

Process and Emission Control Type	Average Mercury Emission Factor	Reference[1]
Chlor-alkali mercury cell process - hydrogen vent (uncontrolled)	3.3×10^{-3} lb/ton Chlorine (Cl) produced	(9)
Chlor-alkali mercury cell process - hydrogen vent (controlled)	1.2×10^{-3} lb/ton Cl produced	(9)
Chlor-alkali mercury cell process - end box	1.0×10^{-2} lb/ton Cl produced	(9)
Electrical switch manufacturing (uncontrolled)	8 lb/ton mercury	(3)
Fluorescent lamp manufacturing (uncontrolled)	8 lb/ton mercury	(3)
Fluorescent lamp recycling (fabric filter, carbon adsorber)	1.9×10^{-9} lb/lamp	(3)
Instrument manufacturing (uncontrolled)	18 lb/ton mercury	(3)
By-product Coke production (fabric filter, ESP)	6.0×10^{-5} lb/ton coke[2]	(3)
Primary copper smelting, acid plant or wet scrubber controls	7.8×10^{-5} lb/ton metal*	(10)
Petroleum refining - process heaters, uncontrolled	2.73×10^{-6} lb/MMBtu	(28)
Petroleum refining - asphalt blowing, uncontrolled	8.3×10^{-6} lb/MMBtu	(29)
Lime manufacture, coal-fired rotary kilns	1.5×10^{-5} lb/ton lime	(3)
Lime manufacture (fabric filter), natural-gas fired vertical kilns	3.0×10^{-6} lb/ton lime	(3)
Batch mix hot mix asphalt plants - dryer, hot screens, and mixer (fabric filter)	4.1×10^{-7} lb/ton hot mix asphalt (HMA) produced	(9)
Drum mix hot mix asphalt plants - natural gas or propane-fired dryer (fabric filter)	2.4×10^{-7} lb/ton HMA produced	(9)
Drum mix hot mix asphalt plants - oil-fired dryer (fabric filter)	2.6×10^{-6} lb/ton HMA produced	(9)
Hot mix asphalt - rotary dryer (wet scrubber)	3.9×10^{-6} lb/ton HMA produced	(24)
Hot mix asphalt - rotary dryer (multiple cyclone)	5.7×10^{-6} lb/ton HMA produced	(24)
Hot mix asphalt - rotary dryer (knock out box, baghouse)	4.73×10^{-7} lb/ton HMA produced	(24)
Hot mix asphalt - rotary dryer (single cyclone, wet scrubber)	1.63×10^{-6} lb/ton HMA produced	(25)
Hot mix asphalt - rotary dryer (single cyclone, baghouse)	$<4.0 \times 10^{-8}$ lb/ton HMA produced	(26)
Hot mix asphalt - rotary dryer (knock out box, venturi scrubber)	7.4×10^{-6} lb/ton HMA produced	(23)
Hot mix asphalt - drum dryer (uncontrolled)	7.4×10^{-9} lb/ton HMA produced	(27)
Portland cement kiln (ESP)	2.2×10^{-4} lb/ton clinker produced	(9)
Portland cement kiln (fabric filter)	2.4×10^{-5} lb/ton clinker produced	(9)
Carbon black manufacture (fabric filter)	3.0×10^{-4} lb/ton carbon black	(3)
Dental alloy production (uncontrolled)	40 lb/ton mercury	(3)
Steel mill - Electric arc furnace (EAF)	7.2×10^{-5} lb/ton scrap feed*	(10)
Grey Iron foundries - cupola (uncontrolled)	3.48×10^{-4} lb/ton cast pipe produced	(21)

Table 4-5 (Continued)

Process and Emission Control Type	Average Mercury Emission Factor	Reference[1]
Grey Iron foundries - cupola (baghouse)	1.587×10^{-4} lb/ton cast pipe produced	(21)
Ferroalloy (FeSi alloy) production - open EAF (uncontrolled)	3.8×10^{-5} lb/ton alloy*	(10)
Ferroalloy (SiMn alloy) production - closed EAF (uncontrolled)	5.6×10^{-4} lb/ton alloy*	(10)
Ferroalloy (FeMn alloy) production - closed EAF (uncontrolled)	1.68×10^{-6} lb/ton alloy*	(10)
Ferroalloy (FeMn alloy) production - semi-covered EAF (venturi scrubber)	9.3×10^{-5} lb/MWh	(20)
Ferroalloy (FeMn alloy) production - semi-covered EAF (uncontrolled)	2.7×10^{-3} lb/MWh	(20)
Ferroalloy (other alloy) production - semi-covered EAF (uncontrolled)	8.36×10^{-6} lb/MWh	(20)
Secondary aluminum production - burning/drying (venturi scrubber)	2.0×10^{-8} lb/lb cans processed	(22)
Secondary aluminum production - burning/drying (baghouse)	2.8×10^{-9} lb/lb cans processed	(22)
Secondary lead production - blast furnace (controlled)	2.2 lb/ton lead produced	(23)
Secondary lead production - kettle refining fugitive emissions (controlled)	4.7×10^{-6} lb/ton lead produced	(23)
Glass manufacture (particulate control)	1.0×10^{-4} lb/ton silica*	(10)
Brick manufacture	See Table 4-4	(9)
Pulp and paper - kraft combustion sources	See Table 4-3	(4)
Battery manufacturing - button cell process	See Reference 3, page 5-10, for individual unit operations	(3)
Distillate fuel oil combustion (uncontrolled)	3.0 lb/10^{12} Btu	(9)
No. 6 fuel oil combustion (uncontrolled)	1.13×10^{-4} lb/1,000 gallons	(9)
Electric utilities (power generation) - residual oil (controlled)	0.057 lb/ 1×10^{6} gallons residual oil burned*	(10)
Industrial wood waste combustion (controlled)	5.15×10^{-6} lb/ton wood waste burned (wet, 50% moisture)	(9)
Industrial wood waste combustion (uncontrolled)	6.9×10^{-6} lb/ton wood waste burned (dry)	(19)
Coal combustion (uncontrolled)[3]	16 lb/10^{12} Btu	(9)

ESP = Electrostatic precipitator
MMBtu = Million BTUs
[1]Numbers correspond to the references listed in Section 5.0.
[2]Emission factor based on German coke ovens. If no other data available, assume coal cleaning reduces emissions by 20% (3).
[3]Facilities with industrial coal-fired boilers may refer to the Unified Air Toxics Website, http://www.epa.gov/ttn/uatw/combust/utiltox/utoxpg.html, for concentrations of mercury in various types of coal.
*Emission factor converted from metric units.

Mercury emissions may also be calculated using monitoring data. For instance, your facility might continuously monitor stack emissions, or data might be available from short-term testing performed at the facility. Engineering calculations, for example Raoult's law, may also be used for calculations. Mass balances are not typically used to calculate emissions, but can be used if all other quantities (e.g., leaving with the product, released with wastewater, disposed with solid waste) are known, as demonstrated in the following example.

Example - Emission Estimate Using Mass Balance

Your facility manufactures mercury compound products. Based on purchase and import records, the amount of mercury brought on site totals 200,000 pounds per year. The amount of mercury leaving with the product is calculated to be 198,500 pounds per year.

Your facility wastewater from washdowns, tank cleanings, and scrubber operations is discharged to a POTW. You monitor the wastewater to comply with the POTW pretreatment permit. The concentration of mercury in the water is 3 ppmv. The volume of water discharged to the POTW during the reporting year is 250,000 gallons. The specific gravity of mercury is 13.6.

Using the specific gravity, the density of mercury is calculated:

13.6 × (8.345 lb water / gal water) = 113.5 lb/gal mercury

The amount of mercury discharged to the POTW is calculated below:

(250,000 gal water) × (3 gal mercury/1 × 10^6 gal water) × (113.5 lb mercury/gal mercury) = 85 lb mercury

This quantity should be reported in Part II, Section 6.1 and Section 8.1 of the 2000 Form R.

No solid waste sources of mercury were identified at your facility, therefore, you assume the remaining quantity of mercury is released as fugitive emissions. The mercury fugitive emissions are calculated using the following mass balance:

$[200{,}000\ \text{lb}]_{in} = [198{,}500\ \text{lb} + 85\ \text{lb} + \text{fugitive emissions lb}]_{out}$

Mercury emissions = [200,000-198,500-85] lbs = 1,415 lb/yr

This quantity should be reported in Part II, Section 5.1 and Section 8.1 of the 2000 Form R.

Air emission monitoring for PBT chemicals may be required under industry National Emission Standards for Hazardous Air Pollutants (NESHAPs), referred to as Maximum Achievable Control Technology (MACT) Standards. The HAP list includes mercury compounds. Standards have been finalized for some industry source categories and additional categories are upcoming.

Section 4.2 Mercury in Wastewater

Wastewater sources of mercury include area washdowns and tank clean outs of processes in which mercury or mercury compounds are manufactured, processed, or otherwise used. If a wet air pollution control device (e.g., scrubber) is used at a process generating mercury emissions, mercury can be transferred from the air stream to the water stream. This wastewater may be treated on site, discharged to surface water or a POTW, or transferred off site for other activities. In addition to the sources listed above, spills and one-time events may also generate a mercury-containing waste stream.

If your facility discharges to surface water, you most likely have a NPDES or state discharging permit. This permit may require you to monitor for mercury. You can use this information to calculate the amount of mercury discharged to surface water. Discharges to POTWs may also require mercury monitoring. The example below shows an approach to calculating mercury amounts using monitoring information.

Example - Mercury Discharged to a POTW - Monitoring Information Calculations

Your facility processes mercury in quantities greater than 10 pounds per year. Your facility is required to perform monitoring for certain chemicals, including mercury, two times each year. The results of the monitoring were:

April 4: 2 ppm mercury (Jan - Jun)
October 5: 2.4 ppm mercury (Jul - Dec)

For the reporting year, the following water volumes were discharged to the POTW:

Jan through Mar: 425,000 gal
April through June: 555,000 gal
July through September: 345,000 gal
October through December: 390,000 gal

Convert the water flows to pounds, using a density of 8.345 lb/gal:

425,000 gal × (8.345 lb/gal) = 3,550,000 lb
555,000 gal × (8.345 lb/gal) = 4,630,000 lb
345,000 gal × (8.345 lb/gal) = 2,880,000 lb
390,000 gal × (8.345 lb/gal) = 3,250,000 lb

Using the corresponding mercury concentrations, the amount of mercury discharged to the POTW is:

$$(2 \text{ lb mercury} / 1 \times 10^6 \text{ lb water}) \times (3{,}550{,}000 + 4{,}630{,}000 \text{ lb}) +$$

$$(2.4 \text{ lb mercury} / 1 \times 10^6 \text{ lb water}) \times (2{,}880{,}000 + 3{,}250{,}000) \text{ lb}$$

$$= 31 \text{ lb/yr mercury}$$

This quantity should be reported in Part II, Section 6.1 and Section 8.1 of the 2000 Form R.

Mass balances and engineering calculations can also be used to determine the amount of mercury in the wastewater. If your facility treats wastewater on site, you may need to perform engineering calculations to determine how much mercury becomes part of the waste sludge and how much is discharged.

Section 4.3 Mercury Spills and Solid Waste Calculations

Mercury spills can include dust or solid raw materials being spilled during transfer or process operations. Mercury or mercury compounds contained in solution, such as petroleum products, may also be splashed or spilled. Other solid waste sources include sludge from on-site treatment, bags or filters from air pollution control devices, and ash from combustion operations. Solid material spills

and ash may also contribute to fugitive emissions. The amount of mercury in solids is commonly calculated using mass balances from records (such as spill reports). Monitoring data on sludge may be available, but as mentioned in the previous wastewater section, engineering calculations can be performed to determine the mercury content in the sludge.

Facility specific information, such as waste analyses and process knowledge, can be used to estimate amounts of mercury in combustion wastes. In the absence of data determined to be better, facilities can use default values for concentrations of mercury in ash, presented in Table 4-6.

Table 4-6

Mercury Concentration in Combustion Residuals

Combustion Residual	Concentration (ppm)
Coal Fly Ash	12
Coal Bottom Ash	4.2
Oil Ash	1

Source: *Inorganic and Organic Constituents in Fossil Fuel Combustion Residues, Volume I, Critical Review, Batelle Pacific Northwest Laboratory* for EPRI, EA5176, August 1987.

If your facility manufactures a mercury-containing by-product (e.g., at a gold mining facility), you can use a mass balance to determine the quantity of mercury released or otherwise managed as waste. Using facility concentrations, or literature concentrations if facility-specific ones are not available, you can determine the quantity of mercury or mercury compounds processed at your facility from the raw material. Mercury production records indicate how much mercury-containing by-product is manufactured. From process and engineering knowledge, the destination of the mercury releases and other waste management activity quantities can be determined.

Example - Calculating Mercury Quantities using Mass Balances

The amount of gold ore mined by your facility is 1.5 million pounds during the year. The mercury content in your ore is approximately 9 ppmw. The quantity of mercury processed through the facility may be calculated as follows:

$$1{,}500{,}000 \text{ lb ore} \times (9 \text{ lb mercury}/1 \times 10^6 \text{ lb ore}) = 13.5 \text{ lb mercury}$$

Your production records show 10 pounds of mercury is sold as a by-product. The remaining 3.5 lb/yr is assumed to be contained in discarded dusts swept up during area cleaning. The dust is then sent to an off-site landfill. You should report the 3.5 lb/yr in Part II, Section 6.2 and Section 8.1 of the 2000 Form R.

SECTION 5.0 REFERENCES

1. U.S. EPA. *Estimating Releases and Waste Treatment Efficiencies for the Toxic Chemical Release Inventory Forms.* 1999.

2. U.S. EPA. *Economic Analysis of the Final Rule to Modify Reporting of Persistent Bioaccumulative Toxic Chemicals Under EPCRA Section 313.* Office of Pollution Prevention and Toxics. October 1999.

3. U.S. EPA. *Locating & Estimating Air Emissions from Sources of Mercury and Mercury Compounds.* EPA-454/R-97-012. Office of Air Quality Planning and Standards (OAQPS). December 1997.

4. Letter from R.C. Kaufmann, National Council of the Paper Industry for Air and Stream Improvement, to Jeff Telander, U.S. EPA. Data provided to EPA's Office of Air Quality Planning and Standards in connection with the MACT II rulemaking activity for pulp and paper combustion sources. February 10, 1999.

5. U.S. EPA. *Mercury Study Report to Congress Vol. II: An Inventory of Anthropogenic Mercury Emissions in the United States.* Office of Air Quality Planning and Standards, and Office of Research and Development. 1997.

6. U.S. EPA. *Electric Utility Steam Generating Units Hazardous Air Pollutant Emission Study (Mercury ICR).* Office of Air Quality Planning and Standards, Unified Air Toxics Website. December 2000. http://www.epa.gov/ttn/uatw/combust/utiltox/utoxpg.html.

7. Radian Corporation. *Trial Burn Report.* December 1995. (Cited in U.S. EPA. *Economic Analysis of the Final Rule to Modify Reporting of Persistent Bioaccumulative Toxic Chemicals Under EPCRA Section 313.* Office of Pollution Prevention and Toxics. October 1999. page D-17).

8. Public Law 104-142. *Mercury - Containing and Rechargeable Battery Management Act.* 42 USC 14301. May 13, 1996.

9. U.S. EPA. *Compilation of Air Pollutant Emission Factors, AP-42.* Fifth Edition. Office of Air Quality Planning and Standards.

10. Environment Canada. *Supplementary Guide for Reporting to the National Pollutant Release Inventory—Alternate Thresholds-2000, Emission Factors Database.* National Pollutant Release Inventory. January 2001. http://www.ec.gc.ca/pdb/npri/npri_gdocs_e.cfm#gdocs.

11. Van Horn, W. *Materials Balance and Technology Assessment of Mercury and Its Compounds on National and Regional Bases* (U.S. EPA contract 68-01-2931, URS Res. Co.). EPA Rep. 560/3-75-007, Oct. 1975, 401 pp. [Cited in US Department of the Interior: Stephen M. Jasinski. *The Materials Flow of Mercury in the United States*. Bureau of Mines, Information Circular 9412. 1994. page 6, http://greenwood.cr.usgs.gov/pub/min-info-pubs/usbm-ic/ic-9412.]

12. Wilhelm, S. Mark and Nicolas Bloom. *Mercury in Petroleum*. Fuel Processing Technology 63, Elsevier Science, 2000. page 10.

13. Gilkeson, John. *Mercury in Petroleum Refining; Crude Oil and Refined Products Final Report to Legislative Commission on Minnesota Resources*. Minnesota Office of Environmental Assistance. August 20, 1999. page 5.

14. National Electrical Manufacturers Association. *Environmental Impact Analysis: Spent Mercury-Containing Lamps*. January 2000. http://www.nema.org /government/environment/enviimpact.doc.

15. Letter from Ric Erdheim, National Electrical Manufacturers Association, to Scott Cassel, Director of Waste Policy and Planning of Massachusetts Executive Office of Environmental Affairs. September 24, 1996.

16. U.S. EPA and Environment Canada. *Background Information on Mercury Sources and Regulations*. Table 5 and Appendix C. http://www.epa.gov/grtlakes/bnsdocs/ mercsrce/index.html

17. Ric Erdheim, National Electrical Manufacturers Association, Testimony presented to the New Hampshire House Committee on Environment and Agriculture regarding House Bill 675. March 14, 2001.

18. *Inorganic and Organic Constituents in Fossil Fuel Combustion Residues, Volume I, Critical Review, Batelle, Pacific Northwest Laboratory* for EPRI, EA5176, August 1987. (Cited in U.S. EPA. *EPCRA Section 313 Industry Guidance - Electricity Generating Facilities*, EPA-745-B-00-004. Office of Pollution Prevention and Toxics. Washington, DC. February 2000. page 4-43).

19. National Council of the Paper Industry for Air and Stream Improvement, Inc. (NCASI). *Compilation of Air Toxic and Total Hydrocarbon Emissions Data for Sources at Chemical Wood Pulp Mills*. NCASI bulletin No. 701. October 1995. (Cited in U.S. EPA. *Locating & Estimating Air Emissions from Sources of Mercury and Mercury Compounds*. EPA-454/R-97-012. Office of Air Quality Planning and Standards (OAQPS). December 1997. page 6-25)

20. U.S. EPA. *A Review of Standards of Performance for New Stationary Sources - Ferroalloy Production Facilities.* EPA-450/3-80-041. Office of Air Quality Planning and Standards. Research Triangle Park, NC. December 1980. (Available in EPA's Factor Information Retrieval System (FIRE) 6.22 database).

21. *Compliance Testing of a Baghouse to Quantify Foundry Emissions.* December 1990. (Confidential Report No. ERC-59). (Available in EPA's Factor Information Retrieval System (FIRE) 6.22 database).

22. *Source Emission Testing of an Aluminum Shredding and Delacquering System.* March 26, 1992 and April 10, 1992. (Confidential Report No. ERC-8). (Available in EPA's Factor Information Retrieval System (FIRE) 6.22 database).

23. U.S. EPA. *Assessment of the Controllability of Condensible Emissions.* EPA-600/8-90-075. Air and Energy Engineering Research Laboratory. Research Triangle Park, NC. October 1990. (Available in EPA's Factor Information Retrieval System (FIRE) 6.22 database).

24. Eureka Laboratories. *Compilation of Air Toxics Pollutant Emission Factors, Volume II B: Technical Support Information, Asphalt Concrete Plants, 1991 Edition.* Prepared for Central Valley Rock, Sand & Gravel Association. January 1991. (Available in EPA's Factor Information Retrieval System (FIRE) 6.22 database).

25. *Source Emissions Testing of a Dryer.* November 13, 1991. (Confidential Report No. ERC-11). (Available in EPA's Factor Information Retrieval System (FIRE) 6.22 database).

26. *Source Emissions Testing of a Dryer.* December 1991. (Confidential Report No. ERC-12). (Available in EPA's Factor Information Retrieval System (FIRE) 6.22 database).

27. Engineering Science, Inc. *A Comprehensive Emission Inventory Report as Required Under the Air Toxics Hot Spots Information and Assessment Act of 1987.* Prepared for Calmat Co. Fresno No. II Facility. Industrial Asphalt. September 14, 1990. (Available in EPA's Factor Information Retrieval System (FIRE) 6.22 database).

28. Composite. Radian FIRE database 1993 release. (Available in EPA's Factor Information Retrieval System (FIRE) 6.22 database).

29. The Almega Corporation. *AB-2588 Pooled Source Emission Test Program, Volumes I and II.* Report I6551-4. Project I6551. Prepared for Western States Petroleum Association. Glendale, CA. July 1990. (Available in EPA's Factor Information Retrieval System (FIRE) 6.22 database).

30. National Electical Manufacturers Association. *The Diclining Presence of Mercury in Batteries and Municipal Solid Waste.* page 7.