VOLUME II: CHAPTER 1

INTRODUCTION TO STATIONARY POINT SOURCE EMISSION INVENTORY DEVELOPMENT

May 2001

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Prepared for:
Point Sources Committee
Emission Inventory Improvement Program

DISCLAIMER

This document was furnished to the Point Sources Committee, Emission Inventory Improvement Program and the U.S. Environmental Protection Agency by Eastern Research Group, Inc., Morrisville, North Carolina. This report is intended to be a final document and has been reviewed and approved for publication. The opinions, findings, and conclusions expressed represent a consensus of the members of the Emission Inventory Improvement Program.

ACKNOWLEDGMENT

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ABBREVIATIONS, ACRONYMS, AND SYMBOLS

ABBREVIATIONS

ACT	Alternative Control Technology Guideline
AFS	AIRS Facility Subsystem
AIRS	Aerometric Information Retrieval System
ALAPCO	Association of Local Air Pollution Control Officials
APA	Air Pathway Analysis
APTI	Air Pollution Training Institute
ATS	Allowance Tracking System
BACT	Best available control technology
Btu	British thermal unit
CAA	Clean Air Act
CAS	Chemical Abstract Services
CD-ROM	compact disc read-only memory
CEM	Continuous Emissions Monitoring
CERR	Consolidated Emissions Reporting Rule
CFC	Chlorofluorocarbon
CFR	Code of Federal Regulations
CERCLA	Comprehensive Environmental Recovery and Comprehensive Liability Act
CHIEF	Clearinghouse for Inventories and Emission Factors
CMS	Continuous Monitoring System
CO	carbon monoxide
CTC	Control Technology Center
CTG	Control Techniques Guideline
DARS	Data Attribute Rating System
DECIM	Defense Corporate Information Management
DoD	Department of Defense

ABBREVIATIONS, ACRONYMS, AND SYMBOLS (CONTINUED)

DOE	Department of Energy
EA	Environmental assessment
EIIP	Emission Inventory Improvement Program
EIS	Environmental Impact Statement
EMTIC	Emission Measurement Technical Information Center
EPA	U.S. Environmental Protection Agency
ETS	Emissions Tracking System
FIP	Federal Implementation Plan
FIPS	Federal Information Processing System
FR	Federal Register
FIRE	Factor Information Retrieval System
HAP	Hazardous air pollutant
HCFC	Hydrochlorofluorocarbon
ID	Identification
LAER	Lowest achievable emission rate
lb	Pound
MACT	Maximum achievable control technology
MSDS	Material safety data sheets
MWC	Municipal waste combustors
NAAQS	National Ambient Air Quality Standard
NAICS	North American Industrial Classification System
NATICH	National Air Toxics Information Clearinghouse
NEC	Not elsewhere classified
NEDS	National Emissions Database System
NEPA	National Environmental Policy Act
NEI	National Emission Inventory

Abbreviations, Acronyms, and symbols (Continued)

NIF	National Emission Inventory Input Format;
NTI	National Toxics Inventory
NO_x	Nitrogen oxides
NPL	National priority list
NSPS	New Source Performance Standard
NSR	new source review
NTIS	National Technical Information Service
OAQPS	Office of Air Quality Planning and Standards
OMB	Office of Management and Budget
PL	Public Law
PM	Particulate matter
PM_{10}	Particulate matter of aerodynamic diameter less than or equal to 10 micrometers
$PM_{2.5}$	Particulate matter of aerodynamic diameter less than or equal to 2.5 micrometers
POTW	Publicly owned treatment works
PPM	Parts per million
PSD	Prevention of significant deterioration
QA	Quality assurance
QC	Quality control
RACT	Reasonably available control technology
RCRA	Resource Conservation and Recovery Act
RE	rule effectiveness
RFP	reasonable further progress
RP	Rule Penetration
RVP	Reid vapor pressure
SARA	Superfund Amendments and Reauthorization Act
SAEWG	Standing Air Emissions Work Group

ABBREVIATIONS, ACRONYMS, AND SYMBOLS (CONTINUED)

STAPPA	State and Territorial Air Pollution Program Administrators
SCC	Source Classification Code
SIC	Standard Industrial Classification
SIP	state implementation plan
SO_2	sulfur dioxide
TAP	toxic air pollutant
tpy	tons per year
TRIS	Toxic Chemical Release Inventory System
TSDF	treatment, storage, and disposal facility
U.S.	United States
U.S.C.	United States Code
UTM	universal transverse mercator
VOC	volatile organic compound

DEFINITIONS OF COMMONLY USED TERMS

Actual Emissions are the actual rate of emissions of a pollutant from an emissions unit calculated using the unit's actual operating hours, production rates, and types of materials processed, stored, or combusted during the selected time period.

Allowable Emissions are the emissions rate that represents a limit on the emissions that can occur from an emissions unit. This limit may be based on a federal, state, or local regulatory emission limit determined from state or local regulations and/or 40 Code of Federal Regulations (CFR) Parts 60, 61, and 63.

Ambient Standards limit the concentration of a given pollutant in the ambient air. Ambient standards are not emissions limitations on sources, but usually result in such limits being placed on source operation as part of a control strategy to achieve or maintain an ambient standard.

Area Sources are smaller sources that do not qualify as point sources under the relevant emissions cutoffs. Area sources encompass more widespread sources that may be abundant, but that, individually, release small amounts of a given pollutant. These are sources for which emissions are estimated as a group rather than individually. Examples typically include dry cleaners, residential wood heating, auto body painting, and consumer solvent use. Area sources generally are not required to submit individual emissions estimates.

Carbon Monoxide (CO) is a colorless, odorless gas that depletes the oxygen-carrying capacity of blood. Major sources of CO emissions include industrial boilers, incinerators, and motor vehicles.

Class I Substances as defined in Title VI of the Clean Air Act Amendments include chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and methyl chloroform. According to the CAAA, all of these compounds must be phased out of production by the year 2000 with the exception of methyl chloroform, which must be phased out of production by the year 2002. Provisions are also made that allow for acceleration of this phaseout.

Class II Substances as defined in Title VI of the Clean Air Act Amendments include hydrochlorofluorocarbons (HCFCs). These substances must be phased out of production by the year 2015.

Continuous Emissions Monitoring (CEM) is any monitoring effort that "continuously" measures (i.e., measures with very short averaging times) and records emissions. In addition to measuring and recording actual emissions during the time of monitor operation, CEM data can be used to estimate emissions for different operating periods and longer averaging times.

Criteria Pollutants are carbon monoxide (CO), lead (Pb), nitrogen oxides (NO_x), sulfur dioxide (SO_2), volatile organic compounds (VOC), and particulate matter of aerodynamic diameter less than or equal to 10 micrometers (PM_{10}). The National Ambient Air Quality Standards (NAAQS) were mandated by the Clean Air Act of 1970, and are based on criteria including adverse health or welfare effects. NAAQS are currently used to establish air pollutant concentration limits for the six air pollutants listed above that are commonly referred to as **criteria pollutants**.

Design Standards impose certain hardware requirements. For example, a design standard might require that leaks from compressors be collected and diverted to a control device. Design standards are typically used when an emissions limit is not feasible.

Data Quality Indicators (DQIs) are qualitative and quantitative descriptors used to interpret the degree of acceptability or utility of data to the user. The principal data quality indicators are accuracy, comparability, completeness, and representativeness.

Data Quality Objectives (DQOs) are qualitative and quantitative statements developed to ensure that data of known and appropriate quality are obtained to support decisions or actions. DQOs encompass all aspects of data collection, analysis, validation, and evaluation.

Emission Concentration Standards limit the mass emissions of a pollutant per volume of air. Emission concentration standards are expressed in terms such as grams per dry standard cubic meter (g/dscm) or other similar units.

Emission Factors are ratios that relate emissions of a pollutant to an activity level at a plant that can be easily measured, such as an amount of material processed, or an amount of fuel used. Given an emission factor and a known activity level, a simple multiplication yields an estimate of the emissions. Emission factors are developed from separate facilities within an industry category, so they represent typical values for an industry, but do not necessarily represent a specific source. Published emission factors are available in numerous sources.

Emissions Reduction Standards limit the amount of current emissions relative to the amount of emissions before application of a pollution control measure. For example, an emission reduction standard may require a source to reduce, within a specified time, its emissions to 50 percent of the present value.

Emission Standards are a general type of standard that limit the mass of a pollutant that may be emitted by a source. The most straightforward emissions standard is a simple limitation on mass of pollutant per unit time (e.g., pounds of pollutant per hour).

Engineering Estimate is a term commonly applied to the best approximation that can be made when the specific emission estimation techniques such as stack testing, material balance, or emission factor age are not possible. This estimation is usually made by an engineer familiar with the specific process, and is based on whatever knowledge may be available.

Equipment Standards require a specific type of equipment to be used in certain processes. Equipment standards are typically used when an emissions limit is not feasible.

Fugitive Emissions are emissions from sources that are technically infeasible to collect and control (e.g., storage piles, wastewater retention ponds).

Hazardous Air Pollutants (HAPs) are listed in Section 112(b) of the 1990 Clean Air Act Amendments (CAAA). These pollutants are generally emitted in smaller quantities than criteria pollutants but may be reasonably anticipated to cause cancer, developmental effects, reproductive dysfunctions, neurological disorders, inheritable gene mutations, or other chronically or acutely toxic effects in humans. The CAAA specifies an initial list of 189 HAPs to be subject to further regulation. The list of HAPs includes relatively common pollutants such as formaldehyde, chlorine, methanol, and asbestos, as well as numerous less-common substances. Pollutants may, under certain circumstances, be added to or deleted from the list.

Lead (Pb) is an element that causes several types of developmental effects in children including anemia, neurobehavioral alterations, and metabolic alterations. Lead is emitted from industries such as battery manufacturing, lead smelters, and incineration. Although regulated in highway fuels, lead may also be emitted from unregulated off-highway mobile sources.

Material Balance or ***Mass Balance*** is a method for estimating emissions that attempts to account for all the inputs and outputs of a given pollutant. If inputs of a material to a given process are known and all outputs except for air emissions can be reasonably well quantified, then the remainder can be assumed to be an estimate of the amount lost to the atmosphere for the process.

Maximum Achievable Control Technology (MACT) Standards in addition to National Emissions Standards for Hazardous Air Pollutants (NESHAP), are promulgated under Section 112 of the Clean Air Act Amendments (CAAA). Technically NESHAP and MACT standards are separate programs. MACT standards differ from older NESHAPs because MACT standards are mandated by law to require the maximum achievable control technology. MACT standards are source category-specific, and each standard covers all the pollutants listed in Section 112 of the CAAA that are emitted by that source category. The first MACT standard promulgated (for the Synthetic Organic Chemical Manufacturing Industries) was originally developed as a NESHAP and is still referred to as the Hazardous Organic NESHAP (HON).

Means of Release to the Atmosphere is the mechanism by which emissions enter the atmosphere. Environmental agencies usually classify release mechanisms into three categories: process emissions, fugitive emissions, and process fugitive emissions. This characteristic of an emission source is important because emission factors and other estimation methods are specific to the type of release.

Mobile Sources include all nonstationary sources, such as automobiles, trucks, aircraft, trains, construction and farm equipment, and others. Mobile sources are a subcategory of area sources, and are generally not required to submit individual emissions estimates.

National Ambient Air Quality Standards (NAAQS) are the main ambient standards for the following six criteria pollutants: carbon monoxide (CO), lead (Pb), nitrogen oxides (NO_x), sulfur oxides (SO_x), ozone (O_3), and particulate matter of aerodynamic diameter less than or equal to 10 micrometers (PM_{10}).

National Emissions Standards for Hazardous Air Pollutants (NESHAP) are a class of standards limiting emissions of HAPs. The common usage of NESHAP actually refers to two different sets of standards. First, there are 22 emissions standards promulgated prior to the 1990 Clean Air Act Amendments (CAAA). Some of these standards are pollutant-specific (e.g., the NESHAP for vinyl chloride), others are source-category specific (e.g., the NESHAP for benzene waste operations), and still others are both pollutant- and source-category specific (e.g., the NESHAP for inorganic arsenic emissions from glass manufacturing plants).

New Source Performance Standards (NSPS) are promulgated for criteria, hazardous, and other pollutant emissions from new, modified, or reconstructed sources that the U.S. Environmental Protection Agency (EPA) determines contribute significantly to air pollution. These are typically emission standards, but may be expressed in other forms such as concentration and opacity. The NSPS are published in 40 Code of Federal Regulations (CFR) Part 60.

Nitrogen Oxides (NO_x) are a class of compounds that are respiratory irritants and that react with volatile organic compounds (VOCs) to form ozone (O_3). The primary combustion product of nitrogen is nitrogen dioxide (NO_2). However, several other nitrogen compounds are usually emitted at the same time (nitric oxide [NO], nitrous oxide [N_2O], etc.), and these may or may not be distinguishable in available test data. They are usually in a rapid state of flux, with NO_2 being, in the short term, the ultimate product emitted or formed shortly downstream of the stack. The convention followed in emission factor documents is to report the distinctions wherever possible, but to report total NO_x on the basis of the molecular weight of NO_2. NO_x compounds are also precursors to acid rain. Motor vehicles, power plants, and other stationary combustion facilities emit large quantities of $_{Nox}$.

North American Information Classification System (NAICS) is the newest U.S. Department of Commerce's categorization of business by their products or services.

Opacity Standards limit the opacity (in units of percent opacity) of the pollutant discharge rather than the mass of pollutant.

Operational Standards impose some requirements on the routine operation of the unit. Such standards include maintenance requirements or operator training certification requirements. Operational standards are typically used when an emission limit is not feasible.

Ozone (O_3) is a colorless gas that damages lungs and can damage materials and vegetation. It is the primary constituent of smog, and is formed primarily when nitrogen oxides (NO_x) and volatile organic compounds (VOCs) react in the presence of sunlight. It is also emitted in insignificant quantities from motor vehicles, industrial boilers, and other minor sources.

Particulate Matter of aerodynamic diameter less than or equal to 10 micrometers (PM_{10}) is a measure of small solid matter suspended in the atmosphere. Small particles can penetrate deeply into the lung where they can cause respiratory problems. Emissions of PM_{10} are significant from fugitive dust, power plants, commercial boilers, metallurgical industries, mineral industries, forest and residential fires, and motor vehicles.

Particulate Matter of aerodynamic diameter less than or equal to 2.5 micrometers ($PM_{2.5}$) is a measure of fine particles of particulate matter that come from fuel combustion, agricultural burning, woodstoves, etc. On November 27, 1996 the U.S. Environmental Protection Agency proposed to revise the current primary (health-based) PM standards by adding a new annual $PM_{2.5}$ standard.

Plant Level Emissions are consolidated for an entire plant or facility. A plant may contain one or many pollutant-emitting sources.

Plant Level Reporting is generally required if total emissions from a plant (which may be composed of numerous individual emission points) meet the point source cutoff. These data can be used by the state to conduct a detailed estimate of emissions from that plant. The plant level reporting used by most air pollution control agencies generally requires that the facility provide data that apply to the facility as a whole. Such data include number of employees and the Standard Industrial Classification (SIC) code designation for the plant. A plant usually has only one SIC code denoting the principal economic activity of the facility. For the purpose of clearly identifying and tracking emissions data, each plant is generally assigned a plant (alternatively, "facility") name and number. The plant is also identified by geographic or jurisdictional descriptors such as air quality control region, county, address, and universal transverse mercator (UTM) grid coordinates (or latitude/longitude) that identify a coterminous location. An owner or operator engaged in one or more related activities is also identified. In some cases, plantwide emissions may be reported at the plant level.

Point Level Emissions typically represent single stacks or vents individually large enough to be considered point sources.

Point Level Reporting includes specific data for individual emission points (typically stacks). These data are more detailed than that submitted in Plant Level Reporting and may include emission-related and modeling information such as stack height of the release point, diameter of the stack, emission rate, method of determination, fugitive emissions, gas exit velocity from a stack, gas temperature, and operating schedule. Source identification information, as previously described under Plant Level Reporting, is usually also required at the point level to ensure that emission data for a single plant remain clearly identified. Regulatory agencies generally maintain individual emission-related records at the point level.

Point Sources are large, stationary, identifiable sources of emissions that release pollutants into the atmosphere. Sources are often defined by state or local air regulatory agencies as point sources when they annually emit more than a specified amount of a given pollutant, and how state and local agencies define point sources can vary. Point sources are typically large manufacturing or production plants. They typically include both confined "stack" emission points as well as individual unconfined "fugitive" emission sources.

Within a given point source, there may be several **emission points** that make up the point source. Emissions point refers to a specific stack, vent, or other discrete point of pollution release. This term should not be confused with point source, which is a regulatory distinction from area and mobile sources. The characterization of point sources into multiple emissions points is useful for allowing more detailed reporting of emissions information.

For point sources, the emission estimate reporting system used by most state and local air regulatory agencies groups emission sources into one of three categories and maintains emission-related data in a different format for each. The three categories are plant level, point level, and process or segment level.

Potential Emissions are the potential rate of emissions of a pollutant from an emissions unit calculated using the unit's maximum design capacity. Potential emissions are a function of the unit's physical size and operational capabilities.

It is important to note that annual potential emissions from a unit are not necessarily the product of 8760 hours per year times the hourly potential emissions. For most processes, the operation of one piece of equipment is limited in some way by the operation of another piece of equipment upstream or downstream. For example, consider a batch process involving vessels X, Y, and Z in series (i.e., the output from Vessel X is the feed to Vessel Y, and the output from Vessel Y is the feed to Vessel Z) where the residence time for each vessel is different. In this process, Vessel Y may not operate 8760 hours per year because either the output from Vessel X is not feeding Vessel Y at all times or Vessel Z may not always be available to accept the output from Vessel Y.

It is also possible for the emission rate to vary over time. For instance, if a reaction requires 6 hours to reach completion, the emissions from the reaction vessel during the first hour will be different than those during the last hour. Thus, the highest hourly emission rate is not sustained during the entire cycle or for the entire year.

Process-based Emission Standards limit the mass emissions per unit of production. These standards may limit mass emissions per unit of material processed or mass emissions per unit of energy used. As process rate increases (e.g., an increase in tons of ore processed per hour), the allowable emissions increase (e.g., an increase in pounds of pollutant per hour).

Process Emissions are emissions from sources where an enclosure, collection system, ducting system, and/or stack (with or without an emission control device) is in place for a process. Process emissions represent emissions from process equipment (other than leaks) where the emissions can be captured and directed through a controlled or uncontrolled stack for release into the atmosphere.

Process Fugitive Emissions occur as leaks from process equipment including compressors, pump seals, valves, flanges, product sampling systems, pressure relief devices, and open-ended lines. Emissions from the process that are not caught by the capture system are also classified as process fugitive emissions.

Process or Segment Level Emissions usually represent a single process or unit of operation.

Process or Segment Level Reporting involves each process within a plant being identified by a U.S. Environmental Protection Agency (EPA) source classification code (SCC). For point sources, reporting guidelines may require that a plant identify, for each process or operation (designated by SCC), the periods of process operation (daily, weekly, monthly, annually); operating rate data including actual, maximum, and design operating rate or capacity; fuel use and fuel property data (ash, sulfur, trace elements, heat content, etc.); identification of all pollution control equipment and their associated control efficiencies (measured or design); and emissions rates. Source identification information, as previously described under Plant Level Reporting, is usually also required at the process level to ensure that emissions data for a single plant are clearly identified.

Process-specific Empirical Relationships are similar to emission factors in that they relate emissions to easily identifiable process parameters. However, these relationships are represented by more detailed equations that relate emissions to several variables at once, rather than a simple ratio. An example is the estimate for volatile organic compound (VOC) emissions from storage tanks that is based on tank size and throughput, air temperature, vapor pressure, and other variables.

Quality Assurance (QA) is a planned system of activities designed to provide assurance that the quality control program is actually effective. QA is a process that involves both the inventory team and external reviewers to insure the overall quality of the inventory.

Quality Control (QC) comprises the activities undertaken by all members of the inventory team during the inventory preparation that will result in the correction of specific problems such as mistaken assumptions, lost or uncollected data, and calculation and data entry errors.

Reported Emissions are those emission estimates that are submitted to a regulatory agency. Emissions inventories can be used for a variety of purposes such as State Implementation Plan (SIP) base year inventories, environmental compliance audits, air quality rule applicability, and reporting information in an air quality permit application. Emissions can be reported on an actual, potential, or maximum basis. Many state and local air pollution control agencies have rules and regulations that define an allowable emission value for a particular piece of equipment. Because of this, a facility should first define the purpose of the inventory and then choose the appropriate means of reporting emissions to the regulatory agency. For example, SIP base year inventories for point sources would contain actual emissions. However, regulatory applicability and air quality permit applications can require that actual, allowable, and potential emissions be reported.

Rule Effectiveness (RE) is the measure of a regulatory program to achieve all of the emission reductions possible, which reflects the assumption that controls are typically not 100 percent effective, because of equipment downtime, upsets, decreases in control efficiencies, and other deficiencies in emission estimates.

Rule Penetration (RP) is the percentage of an area source category that is covered by an applicable regulation.

Source Classification Code (SCC) is a process-level code that describes the equipment or operation emitting pollutants. These codes were developed by EFIG. There are four level descriptions within each 8-digit code.

Source Tests are short-term tests used to collect emissions data that can then be extrapolated to estimate long-term emissions from the same or similar sources. Uncertainties arise when source test results are used to estimate emissions under process conditions that differ from those under which the test was performed.

Standard Industrial Classification (SIC) is the U.S. Department of Commerce's initial categorization of business by their products or services;

Stratospheric Ozone-depleting Compounds are chlorofluorocarbons (CFCs), halons, carbon tetrachloride, methyl chloroform, and hydrochlorofluorocarbons (HCFCs). These pollutants are regulated by Title VI of the Clean Air Act Amendments (CAAA) because they may destroy stratospheric ozone. Title VI is primarily designed to limit the manufacture of these materials, not their use. The pollutants are divided into two classes (Class I and Class II) based on the dates by which their manufacture must be discontinued. Methods to estimate emissions of ozone-depleting compounds are not discussed in Emission Inventory Improvement Program (EIIP) documents.

Information on emissions of ozone-depleting compounds can be obtained from the U.S. Environmental Protection Agency (EPA) Office of Atmospheric and Indoor Air Programs, Global Climate Change Division, located at EPA Headquarters in Washington, D.C.

Sulfur Oxides (SO_x) are a class of colorless, pungent gases that are respiratory irritants and precursors to acid rain. Sulfur oxides are emitted from various combustion or incineration sources, particularly from coal combustion.

Volatile Organic Compounds (VOCs) react with nitrogen oxides (NO_x) in the atmosphere to form ozone (O_3). Although not criteria pollutants, VOC emissions are regulated under criteria pollutant programs because they are ozone precursors. Large amounts of VOCs are emitted from motor vehicle fuel distribution, chemical manufacturing, and a wide variety of industrial, commercial, and consumer solvent uses.

The use of certain photochemical models requires estimation of methane, ethane, and several other less photochemically reactive compounds and particulates. While not regulated as VOCs, these compounds may need to be estimated for certain modeling inventories or to meet certain state inventory requirements. For this reason, the term **total organic compounds** (TOCs) is used to refer to this broader class of chemicals.

Work Practice Standards require some action during the routine operation of the unit. For example, volatile organic compound (VOC) monitoring of a compressor might be required on a quarterly basis to ensure no leaks are occurring. Work practice standards are typically used when an emission limit is not practical.

1

INTRODUCTION

1.1 BACKGROUND

The Clean Air Act, as amended in 1990 (hereafter referred to as the CAA), has expanded the continuing role of the U.S. Environmental Protection Agency (EPA) in its effort to improve air quality in the United States. Among the mandates set forth in the CAA is the requirement that the EPA improve the quality of emission estimates of air pollutants.

Over the last two decades, the CAA and numerous other federal, state, and local programs have required industry to report the amount of air pollutants emitted. With the CAA in place, it is useful for industry to understand the methods used to estimate emissions in order to comply with regulations.

The Emission Inventory Improvement Program (EIIP) is a joint program of the EPA, Standing Air Emissions Work Group (SAEWG), and the State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials (STAPPA/ALAPCO). The ultimate goal of the EIIP is to provide cost-effective, reliable inventories by improving the quality of emissions data collected and provide for uniform reporting of this information. These emissions-related data will be made available to state and local agencies, the regulated community, the public, and EPA. The EIIP has been designed to increase the likelihood that acceptable quality emission inventory data will be available. The use of these procedures will promote consistency in these activities among the emission inventory reporting groups.

Using standardized approaches enables federal, state, and local agencies to generate data of known quality at acceptable or reasonable costs. The EIIP has implemented this concept by selecting preferred and alternative methods for use in determining emissions for various source categories of interest. Their findings are reported in the following series of guidance documents, which can also be located on the Internet www.epa.gov/ttn/chief/eiip:

- Volume I: *Introduction and Use of EIIP Guidance for Emissions Inventory Development*
- Volume II: *Point Sources Preferred and Alternative Methods*
- Volume III: *Area Sources Preferred and Alternative Methods*
- Volume IV: *Mobile Sources Preferred and Alternative Methods*
- Volume V: *Biogenic Sources Preferred and Alternative Methods*
- Volume VI: *Quality Assurance Procedures*

- Volume VII: *Data Management Procedures*
- Volume VIII: *Estimating Greenhouse Gas Emissions*
- Volume IX: *Particulate Emissions*
- Volume X: *Emission Projections*

Volume II in the series of EIIP guidance documents is intended to familiarize the private and government sectors with the basic concepts and procedures involved in estimating air pollutant emissions from point sources. Volume II should also be used to provide state agencies with instructional guidance on preferred methods for developing emission inventories for point sources.

Point sources are those facilities/plants/activities for which individual source records are maintained in the inventory. Under ideal circumstances, all sources would be considered point sources. However, in practical applications, only sources that emit (or have the potential to emit) more than some specified cutoff level of emissions are considered point sources.

Area sources, in contrast, are those activities for which aggregated source and emissions information is maintained for entire source categories rather than for an individual source. Sources not treated as point sources should be included in an area source inventory. Area sources are addressed in Volume III of the EIIP series of guidance documents.

Volume II consists of various combustion, manufacturing, and production activities that comprise point sources. The major chapters within Volume II at various stages of production are as follows:

Chapter 1: *Introduction to Stationary Point Source Emission Inventory Development*

Chapter 2: *Preferred and Alternative Methods for Estimating Air Emissions from Boilers*

Chapter 3: *Preferred and Alternative Methods for Estimating Air Emissions from Hot-Mix Asphalt Plants*

Chapter 4: *Preferred and Alternative Methods for Estimating Fugitive Air Emissions from Equipment Leaks*

Chapter 5: *Preferred and Alternative Methods for Estimating Air Emissions from Wastewater Collection and Treatment*

Chapter 6: *Preferred and Alternative Methods for Estimating Air Emissions from Semiconductor Manufacturing Facilities*

Chapter 7: *Preferred and Alternative Methods for Estimating Air Emissions from Surface Coating Operations*

Chapter 8: *Preferred and Alternative Methods for Estimating Air Emissions from Paint and Ink Manufacturing Facilities*

Chapter 9: *Preferred and Alternative Methods for Estimating Air Emissions from Metal Production Facilities*

Chapter 10: *Preferred and Alternative Methods for Estimating Air Emissions from Oil and Gas Field Production and Processes Operations*

Chapter 11: *Preferred and Alternative Methods for Estimating Air Emissions from Plastic Products Manufacturing*

Chapter 12: *How to Incorporate the Effects of Air Pollution Control Device Efficiences and Malfunctions into Emissions Inventory Estimates*

Chapter 13: *Preferred and Alternative Methods for Estimating Emissions from Stone Mining and Quarrying Operations*

Chapter 14: *Uncontrolled Emission Factor Listing for Criteria Air Pollutants*

Each industry- or source-specific document contains a brief process description; identification of emission points; an overview of methods available for estimating emissions; example calculations for each technique presented; a brief discussion on quality assurance and quality control; and the source classification codes (SCCs) needed for entry of the data into a database management system. The SCCs included in each volume apply to the process emission points, in-process fuel use, storage tank emissions, fugitive emissions, and control device fuel (if applicable).

1.2 Purpose of Chapter 1

This introductory chapter of Volume II is intended to introduce the information applicable to all stationary point sources as well as identify basic concepts of emission estimation techniques. Chapter 1 provides an introduction to air pollutant emission assessment, the basic procedures involved in estimating emissions, and industry-specific techniques for estimating emissions. Practical, detailed calculations and procedures applicable to a specific category are found within subsequent chapters (documents). These later chapters present several different estimation scenarios and provide example calculations to aid in actual emission estimation. Figure 1.1-1 is included to assist readers tasked with inventory preparation in decision making and to refer them to the applicable chapters within this volume and other volumes in the EIIP series.

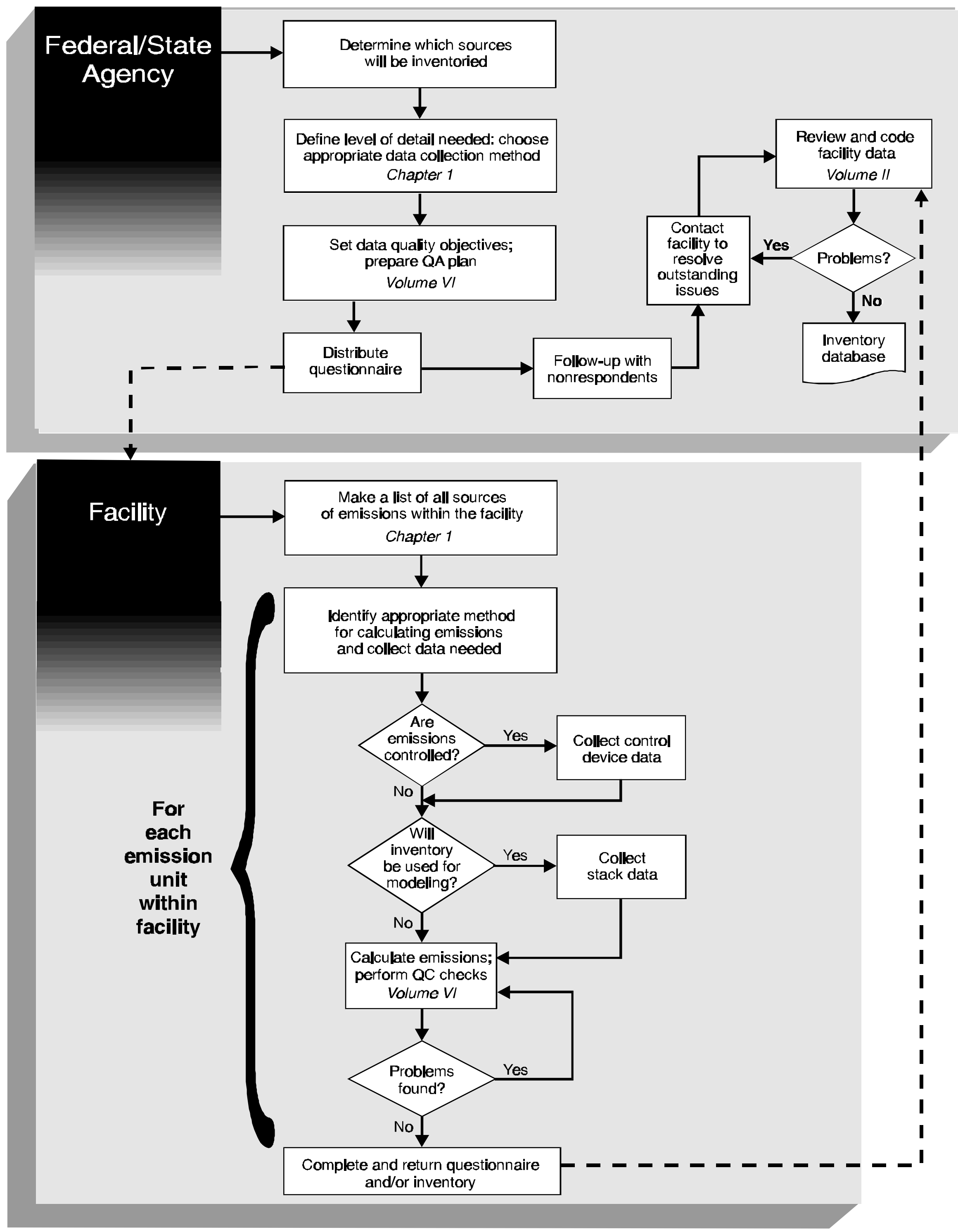

FIGURE 1.1-1. POINT SOURCE INVENTORY DEVELOPMENT PROCESS

Cumulatively, the chapters of Volume II provide a comprehensive series of manuals which should successfully serve the user in generating a point source emissions inventory.

This chapter is organized into 8 text sections and 14 appendices. Table 1.1-1 highlights the contents of each section.

TABLE 1.1-1

OVERVIEW OF DOCUMENT CONTENTS

Section Title	Overview of Contents
1. Introduction	Introduces purpose and content of the chapter
2. Purposes for Assessing Emissions	Identifies several purposes for industries to generate emissions estimates including federal and state regulations, and plant initiatives
3. Emissions Inventory Planning	Discusses the emission inventory planning effort, including data handling and documentation requirements
4. Emission Estimation Procedures	Describes basic techniques employed to estimate emissions, including emission factors, source tests, models, and material balances.
5. Data Collection	Describes the basic procedures for data collection and the types of data available for estimating emissions
6. Inventory Documentation and Reporting	Outlines guidelines and procedures for documentation of the emission estimation process and preparation of a summary report
7. Quality Assurance/Quality Control	Describes QA/QC procedures relevant to the emissions estimation process
8. References	Presents complete references for all documents cited in the report text
Appendices	Contain additional, detailed information to support the discussions provided in the document text

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2

PURPOSES FOR ASSESSING EMISSIONS

In order to comply with various federal and state regulations, sources must initiate an emissions estimation effort. This section primarily focuses on the federal requirements for reporting emissions, while typical state requirements are also briefly discussed. Figure 1.2-1 provides an overview of some of the key emissions estimation relationships among industry, and state and federal agencies (EPA, 1993a, 2000a)

2.1 FEDERAL REQUIREMENTS

Various federal requirements are linked to emissions estimation requirements. The major federal requirements for both sources and states, with emphasis on those requirements that are likely to lead to emissions estimation requirements for industry, are discussed in this section. Requirements discussed stem mainly from the Clean Air Act, and from other legislation such as the National Environmental Policy Act (NEPA), the Comprehensive Environmental Recovery and Comprehensive Liability Act (CERCLA), the Superfund Amendments and Reauthorization Act (SARA), the Resource Conservation and Recovery Act (RCRA), and the Pollution Prevention Act. Additional requirements stem from policy issued by the EPA, the Department of Energy (DOE), and the Department of Defense (DoD). The form and content of the specific emissions information varies with each requirement. A useful source for identifying which specific data elements are necessary under each requirement is the document entitled *Integrated Reporting Issues: Preliminary Findings* (EPA, 1992e). Table 1.2-1 provides an overview of the key federal emissions estimation requirements. In addition, Table 1.2-2, taken from the *Integrated Reporting Issues* document, provides an overview of the data elements for permit programs and emission statements contained in the major emissions reporting programs described in this section.

Table 1.2-3, taken from the Federal Register Proposed Rule, May 23, 2000 (EPA, 2000d) provides a listing of the program reporting elements specific to the annual and triennial National Emission Inventory (NEI).

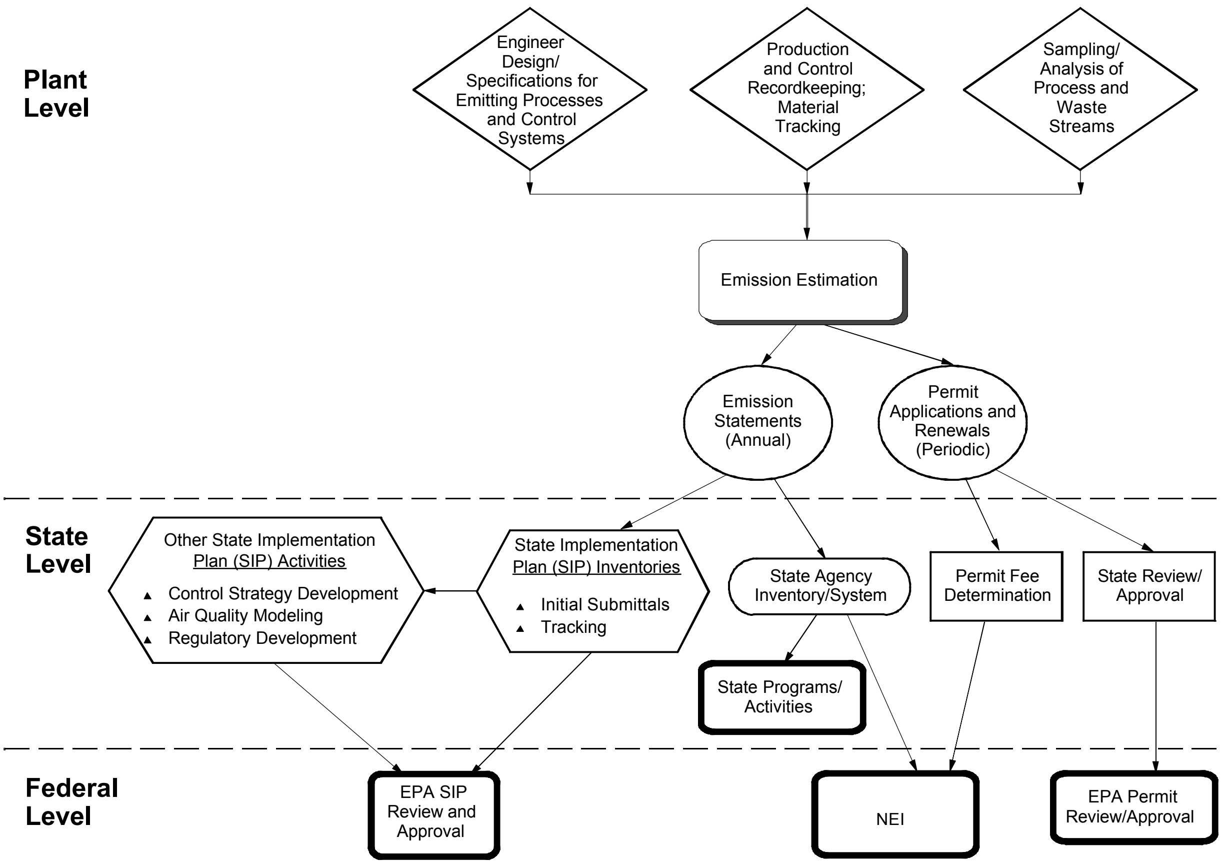

FIGURE 1.2-1. KEY RELATIONSHIPS FOR INDUSTRY AIR POLLUTANT EMISSION ESTIMATION

TABLE 1.2-1

OVERVIEW OF KEY FEDERAL EMISSION ESTIMATION REQUIREMENTS

Statutory Requirement and Agency	Pollutant	Due Date	Size Cutoff	Data Requirements
NEI/NIF				
40 CFR 51(Proposed) Agency: State to EPA	PM_{10}, sulfur oxides, VOC, NO_X, CO, and lead	June 1, annually	Facility-100 tpy PM_{10}, sulfur oxides, VOC, and NO_X, PM_{25} and NH_3; 1,000 tpy CO; 5 tpy lead. Point-25 tpy $PM_{10,}$ sulfur oxides, VOC, and NO_X; 250 tpy CO; and 5 tpy lead	General plant information, year of inventory, general operating parameters, emissions data, and control equipment data
Emission Inventory (base year and periodic)				
Clean Air Act Section 172(c)(3) Section 182(a)(1)[a] Section 182(a)(3)(A)[a] Section 187(a)(1)[b] Agency: State to EPA	All criteria pollutants	November 15, 1992 and every 3 years thereafter	Point sources-10 tpy VOC; 100 tpy PM_{10} moderate; 70 tpy PM_{10} serious; 100 tpy PM_{25}	General plant information, year of inventory, source operating data, physical data (i.e., stack height, process rate data, source emissions data, and emission limitation data)
Emission Statement				
Clean Air Act Section 182(a)(3)(B)[c] Agency: Source to state	VOC, NO_X	April 15, annually;	25 tpy VOC or NO_X; in nonattainment area; 50 tpy VOC or 100 tpy NO_X in attainment portion of transport region	Source identification, source emissions data (annual and typical summer day), control equipment data, process rate data and a certification that the data are accurate

TABLE 1.2-1

(CONTINUED)

Statutory Requirement and Agency	Pollutant	Due Date	Size Cutoff	Data Requirements
Title V Operating Permits				
Clean Air Act Title V Agency: Source to state	All criteria pollutants, all HAPs, CFCs, HCFCs	At time of initial Title V permit application submittal, which is generally one year after EPA approval of state permit program. Annual submission according to state schedule to determine fee basis.	Potential to emit "major" amounts of regulated air pollutants[d,e]	General company information, plant description, emissions information, regulatory requirements and compliance information
New Source Review				
Clean Air Act Section 172(c)(5) Agency: Source to state	Criteria pollutants, fluorides, sulfuric acid mist, hydrogen sulfide, total reduced sulfur, reduced sulfur compounds, MWC organics, metals and gases, ozone-depleting substances[f]	Prior to construction or operation of a new or modified major source	Potential to emit "major" amounts for new sources, significant net emissions increase for modified sources	Legal authority, technical specifications, potential emissions, emission compliance demonstration, definition of excess emissions, administrative and other conditions
Economic Incentive Programs (EIP)				
40 CFR Part 51 (some required, some optional) Agency: Source to state	All criteria pollutants	Specific to individual EIP	Major[d]	Specific to individual EIP. Emissions must be "quantifiable."

TABLE 1.2-1

(CONTINUED)

Statutory Requirement and Agency	Pollutant	Due Date	Size Cutoff	Data Requirements
Early Reductions Program				
Clean Air Act Section 112(i)(5) Agency: Source to state	All HAPs as defined in Section 112(b)	Reduction must be achieved before January 1, 1994, therefore demonstration must come before then	Any stationary source	Same as permit with the early reduction demonstration
Urban Air Toxics Program				
Clean Air Act Section 112(k) Agency: EPA to Congress	All HAPs as defined in Section 112(b) or (k)	EPA must report by November 15, 1993	Any source of HAPs contributing to urban concentrations, with emphasis on area sources	Data as necessary to characterize emissions of HAPs and prioritize threats to public health in urban areas
Great Lakes and Coastal Waters Program				
Clean Air Act Section 112(m) Agency: EPA to Congress	All HAPs as defined in Section 112(b)	EPA must report by November 15, 1993, and biennially thereafter	Any source contributing to deposition of HAPs	Data as necessary to determine sources and deposition rates of HAPs
Accidental Release Program				
Clean Air Act Section 112(r)	All extremely hazardous substances as defined in regulation developed under Section 112(r)	As specified in Section 112(r) regulations to be published	Sources emitting amounts above threshold quantities as specified in Section 112(r) regulations to be published	Risk management plan including estimate of potential release quantities, determination of downwind effects, previous release history, and an evaluation of the worst case accidental release

TABLE 1.2-1

(CONTINUED)

Statutory Requirement and Agency	Pollutant	Due Date	Size Cutoff	Data Requirements
New Source Performance Standards (NSPS)				
40 CFR Part 60 Agency: Source to state agency or EPA	SO_2, NO_x, total reduced sulfur, hydrogen sulfide, CO, opacity, VOC, PM	30 days after reporting period ends	As specified in standard	Pollutant, reporting period, general company information, emission limitation, monitor manufacturer and model number, data of last CMS certification or audit, process units description, total source operating time, emissions data, CMS performance data
Acid Rain Allowance Trading (Title IV)				
Title IV Clean Air Act	SO_2, NO_x	30 days after end of quarter (beginning January 30, 1994 for Phase I and April 30, 1995 for Phase II)	Any facility listed in Table A or B of Title IV or any facility that opts-in (Phase I approx. 110 sources, Phase II approx. 800 sources). Also applies to any new fossil-fuel combustion device that supplies electricity for sale or serves an electricity-generating device that supplies electricity for sale.	General plant information, emissions data, fuel use data
Section 114 General Requirements (i.e., "Section 114 letter")				
Clean Air Act Section 114 Agency: Source to EPA	As specified by EPA	As specified by EPA	Determined case-by-case by EPA	General company information, pollutant, compliance information, operating information

TABLE 1.2-1

(CONTINUED)

Statutory Requirement and Agency	Pollutant	Due Date	Size Cutoff	Data Requirements
Section 114 Compliance Certification				
Clean Air Act Section 114(a)(3) Agency: source to EPA	All criteria pollutants and all hazardous air pollutant as defined in Section 112(a)(1)	30 days after quarter ends, on a quarterly or annual basis	Major[d]	General company information, pollutant, emission information, description of enhanced monitoring system, summary of compliance demonstration, deviation description, violation information, and operation data
National Air Toxics Information Clearinghouse (NATICH)				
Clean Air Act Section 112(1)(3) Agency: State/local agency to EPA	Any hazardous air pollutant (i.e., any noncriteria air pollutant)	Voluntary	Voluntary	Agency name, general plant information, year permit issued, control equipment data, pollutant names, emission limit data, actual emission rate data, source testing data
Best Available Control Technology (BACT)/Lowest Achievable Emission Rate (LAER) Clearinghouse				
N.A. Agency: State/local agency to EPA	Criteria pollutants	Voluntary - after issuance of a BACT or LAER determination	Voluntary	General company information, plant description, year permit issued, emissions data, control technology data, compliance data
National Environmental Policy Act (NEPA)				
PL 91-190 Agency: EPA	Anything that may result in a "significant environmental impact"	Prior to implementation of any federal agency action	NA	Description of the proposed action, alternatives to the action, and environmental, social, and economic impacts of the proposed action and alternatives. May lead to specific requests from EPA to industry

TABLE 1.2-1

(CONTINUED)

Statutory Requirement and Agency	Pollutant	Due Date	Size Cutoff	Data Requirements
Comprehensive Environmental Recovery and Comprehensive Liability Act (CERCLA)				
PL 96-510, amended SARA 42 U.S.C. Section 9601 Agency: Source to state	Chemicals listed in Sections 307, 311 of Clean Water Act, Section 3001 of RCRA, Section 112 of CAA, Section 7 of Toxic Substances Control Act, others designated by EPA under Superfund	Upon release	Releases to the environment that exceed the reportable quantity for that material	Report on release of the toxic substance, including substance and quantity released. (See SARA Section 304.)
Superfund Amendments and Reauthorization Act (SARA)				
SARA Title III Section 313 ("right to know") Agency: EPA and states	EPA designated "toxic chemicals" (329 on original list; 284 added 1995)	July 1, annually	Chemicals used $10,000 lb/yr, chemical manufactured or processed $25,000 lb/yr	Chemical identify, name, location and principal business identity, certification by senior officials of business, use of each listed chemical, maximum on-site quantity at any time, amount (lb/yr) released to the environment of each chemical, amount (lb/yr) transferred offsite, method of waste treatment and disposal including treatment efficiency, release data (fugitive air emissions in lb/yr, stack/point air emissions in lb/hr, wastewater discharges, releases to land, transfers to off-site locations, underground injection)
SARA Section 304 (hazardous releases) Agency: Source to public	Hazardous substances as defined by CERCLA, extremely hazardous substances as defined by EPA	Immediately upon release	Any episode that releases more than published reportable quantity	Chemical name or identity, quantity released, time and duration of release, media into which released, anticipated health risks, medical attention requirements, precautions, evacuation information, name of person to contact for more information

TABLE 1.2-1

(CONTINUED)

Statutory Requirement and Agency	Pollutant	Due Date	Size Cutoff	Data Requirements
Resource Conservation and Recovery Act (RCRA)				
40 CFR Subtitle C Agency: Source to EPA	Hazardous waste as defined by 40 CFR 261.31, acutely defined by 40 CFR 261.33	Biennially	Small generators: 100-1000 kg non-acutely hazardous waste/month; large generators >1 kg acutely hazardous waste, >1000 kg non-acutely hazardous waste/month	EPA ID number, record of hazardous waste transfers (manifests), records of any test results, waste analyses, etc., waste minimization plan
Pollution Prevention Act				
PL 101-508 Section 6607 Agency: Source to EPA	EPA designated "toxic chemicals"	Annually	Chemicals used $10,000 lb/yr, chemical manufactured or processed $25,000 lb/yr	Toxic chemical source reduction and recycling report

Source: EPA, 1993a, 2000a.

[a] For ozone.
[b] For CO.
[c] The periodic inventory requirement is only for ozone nonattainment areas.
[d] Definition of major and significant net emissions increase depends on pollutant (e.g., for ozone it depends on an area's classification).
[e] Additional nonmajor sources may be added by EPA rule expected in 2001.
[f] Applicability determination is based on emissions of all pollutants regulated under the Act. However, emission inventory submitted to the state is generally on pollutants listed to determine control technology requirements.

CMS = Continuous Monitoring System.
NA = Not applicable.

TABLE 1.2-2

COMPARISON OF EMISSIONS REPORTING PROGRAM DATA ELEMENTS

Data Element	Permit Program[a] (Source to State)	Emission Statement (Source to State)
Plant - General Level		
FIP State Code	T	T
FIP County Code	T	T
Year of Record	T	T
Plant AFS/NEDS ID	T	T
Plant Name		T
Plant Address	T	T
FIP City Code	T	T
Plant Zip Code	T	T
UTM Zone, Easting, and Northing or Latitude and Longitude		T
Primary SIC Code	T	T
Type of Inventory		
Annual Nonbanked Emissions (Estimated Actual)	T	
Point - General Level		
FIP State Code		T
FIP County Code		T
Plant AFS ID		T
Point AFS ID		T
Operating hours/day		T
Operating days/week		T

TABLE 1.2-2

(CONTINUED)

Data Element	Permit Program[a] (Source to State)	Emission Statement (Source to State)
Operating hours/year		T
Percent throughput: Dec-Feb		T
Percent throughput: Mar-May		T
Percent throughput: Jun-Aug		T
Percent throughput: Sep-Nov		T
Stack Level		
FIP State Code		
FIP County Code		
Plant AFS ID		
Stack AFS ID		
Stack Height		
Stack Diameter		
Plume Height		
Segment - General Level		
FIP State Code		T
FIP County Code		T
Plant AFS ID		T
Point AFS ID		T
Segment AFS ID		T
SCC Number		T
Process Rate Units		T
Actual Annual Process Rate		T

TABLE 1.2-2

(CONTINUED)

Data Element	Permit Program[a] (Source to State)	Emission Statement (Source to State)
Ozone Season Daily Process Rate		T
CO Season Daily Process Rate		
Stack ID for Segment		
Segment - Pollutant Level		
FIP State Code	T	T
FIP County ID	T	T
Plant ID	T	T
Point ID		T
Segment ID (Process)		T
Pollutant/CAS Number	T	T
Primary Control Device Code		T
Secondary Control Device Code		T
Control Efficiency		T
SIP Regulation in Place		
Compliance Year for Segment		
Emission Limitation Description		
Emission Limitation Value		
Emission Limitation Units		
Emission Estimation Method		T

TABLE 1.2-2

(CONTINUED)

Data Element	Permit Program[a] (Source to State)	Emission Statement (Source to State)
Emission Factor		T
Annual Nonbanked Emissions (Estimated Actual)		T
Rule Effectiveness		T
Ozone Season Daily Emissions		T
CO Season Daily Emissions		

Source: EPA, 1992e.

[a] Proposed AFS permit enhancements.

TABLE 1.2-3

EMISSION REPORTING DATA ELEMENTS
FOR THE NATIONAL EMISSION INVENTORY

Data Element	NEI Annual Update (State to EPA)	NEI Triennial Update (State to EPA)-Attainment	NEI Triennial Update (State to EPA)-Nonattainment
Inventory Year	T	T	T
Inventory Start Date	T	T	T
Inventory End Date	T	T	T
Inventory Type	T	T	T
State FIPS Code	T	T	T
County FIPS Code	T	T	T
Federal ID Code (plant)	T	T	T
Federal ID Code (point)	T	T	T
Federal ID Code (process)	T	T	T
Site Name	T	T	T
Physical Address	T	T	T
SCC	T	T	T
Heat Content (fuel) (annual)	T	T	T
Ash Content (fuel) (annual)	T	T	T
Sulfur Content (fuel) (annual)	T	T	T
Pollutant code	T	T	T
Activity/Throughput (annual)	T	T	T
Activity/Throughput (daily)	T	T	T
Work weekday emissions	T	T	T

Table 1.2-3

(Continued)

Data Element	NEI Annual Update (State to EPA)	NEI Triennial Update (State to EPA)-Attainment	NEI Triennial Update (State to EPA)-Nonattainment
Annual Emissions	T	T	T
Emission Factor	T	T	T
Winter Throughput (%)	T	T	T
Spring Throughput (%)	T	T	T
Summer Throughput (%)	T	T	T
Fall Throughput (%)	T	T	T
Hr/day in operation	T	T	T
Start Time (hr)	T	T	T
Day/wk in operation	T	T	T
Wk/yr in operation	T	T	T
Federal ID Code (stack number)		T	T
X stack coordinate (latitude)		T	T
Y stack coordinate (longitude)		T	T
Stack height			T
Stack diameter			T
Exit gas temperature			T
Exit gas velocity			T
Exit gas flow rate			T
SIC/NAICS		T	T
Design capacity		T	T

TABLE 1.2-3

(CONTINUED)

Data Element	NEI Annual Update (State to EPA)	NEI Triennial Update (State to EPA)-Attainment	NEI Triennial Update (State to EPA)-Nonattainment
Maximum nameplate capacity		T	T
Primary control efficiency (%)		T	T
Secondary control efficiency (%)		T	T
Control device type		T	T
Rule Effectiveness (%)		T	T

Sources: EPA.

2.1.1 Clean Air Act Requirements

The Clean Air Act is the major legislation addressing air pollution in the United States. It mandates a wide variety of programs to manage air quality. The federal air quality management effort begins with the national ambient air quality standards (NAAQS). The NAAQS set nationwide minimum air quality goals. Each state must assess all areas' air quality relative to the NAAQS. For those areas meeting the standard, the state is required to submit plans showing prevention of significant deterioration (PSD).

For nonattainment areas, the state must develop and submit to EPA a detailed, comprehensive and legally binding plan to meet the NAAQS by a specified date and to continue to meet the NAAQS beyond that date. This legally binding plan is called a state implementation plan (SIP). In the SIP, each state has the responsibility for selecting a control strategy that determines which sources must control emissions and the degree of control needed to achieve and/or maintain the NAAQS. States that have been totally or partially designated as nonattainment areas must develop emissions inventories as part of their SIP to reduce emissions. If the state fails to submit an adequate plan, the EPA will impose its own plan, called a federal implementation plan (FIP).

In addition to those requirements related to maintenance of the NAAQS, other federal-state programs addressing emissions of various air pollutants have also been established to improve air quality. These include emissions standards for hazardous air pollutants (HAPs), emission and fuel standards for motor vehicles, provisions for control of acid deposition, requirements for operating permit programs, and stratospheric ozone protection. The following sections briefly describe these programs.

SIP Requirements (CAA Amendments, Title I)

The CAA requires that the base year SIP inventories be prepared according to a set of minimum standards. The requirements for ozone, CO, and PM SIP inventories are listed in Table 1.2-4.

Operating Permits Program (CAA Amendments, Title V)

Title V of the Clean Air Act mandates that states establish operating permits programs requiring the owners or operators of major and other sources to obtain permits addressing all applicable pollution control obligations under the CAA. These obligations include emissions limitations and standards, and monitoring, recordkeeping, and reporting requirements. Such requirements are to be contained in an operating permit which is issued to the source for a period of no more than five years, before renewal. EPA published its final regulations on operating permits in Part 70 of Title 40 of the *Code of Federal Regulations*.

TABLE 1.2-4

INVENTORY REQUIREMENTS OF THE CLEAN AIR ACT AMENDMENTS FOR OZONE, CO, PM_{10} AND $PM_{2.5}$

Activity	Requirement	Date
Ozone Base Year Inventory--Basis For All Other Inventories	C Comprehensive, accurate inventory for 1990 C Include VOC, NO_X, and CO from point, area, and mobile sources C Include anthropogenic and biogenic sources C Same requirements for all nonattainment classifications	11/15/92
Adjusted Ozone Base Year Inventory	C Needed to demonstrate 15 % VOC reduction by 1996 C Excludes biogenic emissions and emissions reductions required before CAAA	11/15/93
CO Base Year Inventory	C Comprehensive, accurate inventory for 1990 C Include CO emissions from point, area, and mobile sources for a 24-hour period C For moderate and serious areas	11/15/92
PM_{10}	C Comprehensive, accurate inventory due with the attainment plan C Most significant inventory will be for serious areas--due later	11/15/92
Inventory Work Plan	C The EPA requires states to submit plans to explain how they will develop, document, and submit their inventories	10/01/91

TABLE 1.2-4

(CONTINUED)

Activity	Requirement	Date
Periodic Inventories for Ozone and CO	C Same information as base year C 1993 base for first year C Purpose is to track emissions reductions for all nonattainment classifications	Ozone - 11/15/96 CO-09/30/95 Update every 3 years until attainment
Ozone Modeling Inventory	C Required for all areas using photochemical grid model and other moderate areas making an attainment demonstration C Requires base year and projected inventory C Photochemical grid model requires allocated, speciated, and spatially gridded inventory	Areas using a photochemical grid model--inventory due 11/15/94. Other modeling approaches--inventory due 11/15/93.
CO Modeling	C Needed for nonattainment areas with design values exceeding 12.7 ppm C Requires base year and projected inventory C Detail will reflect model used (proportional rollback or gridded dispersion model) C Used for determining whether proposed SIP control strategies are adequate to reach attainment by specified date. C Moderate areas demonstration plan for attainment. C Serious areas demonstration plan for attainment.	11/15/93 12/31/95 12/31/00

TABLE 1.2-4

(CONTINUED)

Activity	Requirement	Date
RFP Projection Inventory for 3% per year VOC Reduction	C Serious and above areas show 3 % per year VOC reduction after 1996 C Continue until attainment C Base year will be final year of demonstration (i.e., 1999, 2002, 2005, 2008, 2010) C Based on allowable emissions reflecting regulatory limits	11/15/94
Emission Statements	C For all nonattainment classifications C Annual statements from owners of stationary sources showing actual emissions of NO_x or VOCs C Certify information is accurate C Sources less than 25 tpy can be waived if included in inventory and the EPA emission factors used	11/15/93
$PM_{2.5}$	C Comprehensive, accurate inventory due with the attainment plan C Most significant inventory will be for serious areas-due later	11/15/92

The Part 70 regulations specify the requirements under Title V of the CAA for permitees, as well as the administrative duties required of state air permitting agencies. The minimum requirements for information to be submitted by subject sources in the permit application, which include certain emissions-related information, are listed in 40 CFR 70.5(c). Emissions-related information required to be in the application includes the following:

- All emissions of pollutants for which the source is major [including unregulated Section 112(b) pollutants], and all emissions of regulated air pollutants from all emissions units;
- Identification and description of all emissions points;
- Emissions rate in tpy and in any other units necessary to establish compliance with standards;
- Fuels, fuel use, raw materials, production rates, and operating conditions used to determine emissions, fees, or compliance;
- Pollution control and compliance monitoring activities;
- Limitations on source operation affecting emissions;
- Other relevant information, including stack height limitations; and
- Calculations on which any of the above are based.

A state's permit program may also require additional information under its own laws.

New Source Review (CAA Amendments, Title I)

Section 172(c)(5) of the CAA states that SIPs for nonattainment areas will require preconstruction permits for the construction and operation of new or modified major stationary sources anywhere within the nonattainment area. Likewise, Section 165(a)(1) of the CAA requires that new or modified sources in attainment areas must also secure preconstruction permits. These permits must contain certain basic elements, including legal authority, technical specifications (including an estimate of emissions of each pollutant that the source would have the potential to emit in significant amounts), emission compliance methods, a definition of excess emissions, and other administrative and miscellaneous conditions (EPA, 1992e). Once the source begins operation it will be necessary to determine source emissions under design operating conditions in order to demonstrate compliance or noncompliance with the allowable levels of emissions. Sources obtaining permits for new sources often use trading transactions, which also require emissions estimations.

Emissions Statements (CAA Amendments, Title I)

Section 182(a)(3)(B) of the CAA requires that states with areas designated as nonattainment for ozone obtain emissions statement data from VOC and NO_x sources in the nonattainment areas. Emissions statements are derived from point source data through plant contacts. A revision to a state's SIP to include emissions statements should have been submitted within 2 years of the CAA Amendments enactment date.

The emissions statement requirement applies to all ozone nonattainment areas, regardless of their classification, and to stationary sources that emit, or have the potential to emit, 50 tons per year (tpy) or more of VOC or 100 tpy or more of NO_x in attainment areas within ozone transport regions. A state may, with the EPA's approval, waive the requirement for emissions statements for classes or categories of sources with less than 25 tpy of actual plantwide NO_x or VOC emissions in nonattainment areas if the class or category is included in the base year and periodic inventories and emissions are calculated using emission factors established by the EPA (such as those found in *AP-42*) or other methods acceptable to the EPA. Whatever minimum reporting level is established, if either VOC or NO_x is emitted at or above this level, the other pollutant should be included in the emissions statement, even if it is emitted at levels below the specified cutoffs.

At a minimum, emissions statements should include: (1) certification of data accuracy, (2) operating schedule, (3) emissions information (to include annual and typical ozone season day emissions), (4) control equipment information, and (5) process data. Agencies are responsible for reviewing the consistency of the emissions statement data with other available data sources and resolving any inconsistencies (EPA, 1992c).

The emissions statement reporting format provides for two data collection mechanisms. Traditional sources should review and/or correct their NEI data. Nontraditional sources (i.e., those that do not have emissions data in NEI) should submit an "Emissions Statement Initial Reporting Form." In both cases, an explanatory letter and detailed instructions should be included. Agencies have the option of developing their own emissions statement reporting format, in which case care should be taken to ensure that the minimum emissions statement data elements are requested and that the emissions statement data are provided to the EPA via the NEI system..

Facilities must submit their first emissions statement within three years of the CAA Amendments enactment date, and annually thereafter. The first emissions statement will be based on 1992 emissions. The EPA strongly recommends that agencies require a submittal date of April 15 to allow use of the emissions statement data in the preparation of the annual point source inventory. Adequate records of emissions statement data and source certifications of emissions should be maintained by an agency for at least three years to allow for review or verification of the information, as needed.

Agencies should provide the EPA with a status report that outlines the degree of compliance with the emissions statement program. Since July 1, 1993, agencies are required to report the total number of sources affected by the emissions statement provisions, the number that have complied with the emissions statement provisions, and the number that have not. This report is a quarterly submittal until all the regulated sources have complied for the reporting year. The status report also includes the total annual and typical ozone season day emissions from all reporting sources, both corrected and non-corrected for rule effectiveness. Agencies should include in their status report a list of sources that emit 500 tpy or more of VOC or 2,500 tpy or more of NO_x and that are delinquent in submitting their emissions statements.

Your state must report data for the point source inventory and the three-year cycle inventory 17 months (June 1) after the end of the calendar emission year. For example, your calendar year 1999 emission inventory is due to EPA by June 1, 2001.

The emissions statement data elements were developed to be consistent with other source and agency reporting requirements. This consistency is essential to assist agencies with an avenue to check emissions estimates and to facilitate consolidation of all EPA reporting requirements. Thus, emissions statement data will provide information useful for the development, quality assurance, and completion of several emissions reporting requirements, including tracking of RFP, periodic inventories, annual AFS submittals, the operating permit program of the CAA, emissions trends, and compliance certifications. The goal of emissions statement reporting in the future is to consolidate all these reporting requirements into one annual effort.

Hazardous Air Pollutants (CAA Amendments, Title III)

Section 112 of the CAA requires EPA to promulgate regulations for reducing the emissions of HAPs. Section 112(b) contains a list of 188 pollutants which are regulate as HAPs.

Section 112 may lead to additional emission estimation or inventory requirements for sources. All sources subject to Section 112 are also subject to the Title V requirements. As such, sources of HAPs must include emissions estimates in their operating permits. In addition, four special programs under Section 112 may lead to additional requirements for emissions estimates:

- The early reductions program under Section 112(i)(5);
- The Urban Air Toxics Study under Section 112(k);
- The Great Lakes and Coastal Waters program under Section 112(m), and
- The accidental releases program under Section 112(r).

Under Section 112(s), EPA is required to maintain a database on pollutants and sources subject to Section 112. This database will be required to contain information from all of the programs described above, as well as information from standard development projects under Section 112(d).

Early Reduction Program. Under the early reduction program, existing sources may opt to apply for a 6-year extension of the regular 3-year MACT compliance deadline if such sources can demonstrate a 90 percent reduction (or 95 percent reduction for particulate emissions) or more of HAPs prior to the proposal of the applicable MACT standard. As a condition of the compliance extension, states may require additional emission reductions from such sources. Such reductions generally must be based on actual and verifiable emissions in a base year no earlier than 1987. The source must provide a one-time demonstration of the required reduction, which will require estimation and comparison of current emissions and emissions during the relevant base year. It should be noted that the emissions reductions used to qualify under this extension will be federally enforceable, and hence also require a Title V permit revision.

Urban Air Toxics Study. Under the Urban Air Toxics Study, EPA is required to conduct a program of research on sources of HAPs in urban areas. This program must include an analysis to characterize sources of such pollution with a focus on area sources. EPA, in implementing this program, may request specific emissions estimates and other relevant information from sources.

Great Lakes and Coastal Waters Program. Under the Great Lakes and Coastal Waters program (often referred to as the Great Waters Program), EPA is required to assess the extent of atmospheric deposition of HAPs into the Great Lakes, Chesapeake Bay, Lake Champlain, and coastal waters. In addition to numerous monitoring and sampling efforts, this assessment will include an investigation of the deposited chemicals and their precursors and sources. This investigation will likely lead to emissions estimation requirements for sources which emit HAPs that could be deposited into these waters.

Accidental Release Program. Under the accidental release program, sources which emit HAPs above certain threshold quantities must submit risk management plans designed to detect and prevent accidental releases of HAPs. The risk management plan must assess the potential effects of an accidental release, which will include an estimate of potential release quantities, determination of downwind effects, previous release history and an evaluation of the worst case accidental release. The plan must also include an accidental release prevention program and an emergency response program to be implemented in the event of such a release. Such plans must be submitted to EPA, the Chemical Safety and Hazard Investigation Board, and state and local air pollution control agencies.

Section 114 Reporting Requirements, Compliance Certifications and Compliance Monitoring. Section 114 of the CAA gives EPA the authority to require sources to, on a one-time, periodic, or continuous basis, report to EPA information which EPA deems necessary for developing standards or SIPs, determining compliance, or meeting other provisions of the Act. Under Section 114, EPA can require sources to establish recordkeeping; make reports; sample emissions; keep production, control technology, or other operations data; or provide other necessary information. The EPA may include emissions estimates as part of these information requirements.

Allowance Trading (CAA Amendments, Title IV)

In order to control sources of acid deposition, Title IV of the CAA Amendments establishes the allowance trading program. This program seeks to reduce emissions of SO_2 by 10 million tpy, relative to 1980 levels. Two databases, Emissions Tracking System (ETS) and the Allowance Tracking System (ATS), are set up under this program to track emissions, and allowance trading. Sources affected by Title IV (i.e., those listed in Table A, Title IV, of the CAA Amendments), or those that opt in will be responsible for reporting to these databases. These reports will include general plant information, hourly emissions data, and fuel use data. It should also be noted that sources subject to Title IV requirements are also subject to Title V operating permit provisions.

2.1.2 Requirements under Other EPA Regulations

A number of other EPA requirements which are not directly related to the CAA require some form of emissions estimation. These requirements are a result of the following federal laws: NEPA, CERCLA, SARA, RCRA, and the Pollution Prevention Act. This subsection briefly highlights these requirements.

National Environmental Policy Act (NEPA) of 1969

The National Environmental Policy Act (NEPA) requires that, where a federal agency action may result in a significant environmental impact, an environmental assessment be prepared before such policy can be implemented. An environmental assessment (EA) is a study that provides background information and preliminary analyses of the potential impact of a new policy. If the results of an EA indicate that significant environmental impact may result, EPA will prepare an Environmental Impact Statement (EIS). The EIS examines, in detail, the potential impact of a proposed agency action. Generally, industries are not required to prepare EISs, but EPA may require industry input, including emissions estimates, for its evaluation of the impact of proposed rulings (EPA, 1993a).

Comprehensive Environmental Recovery and Comprehensive Liability Act of 1980

Under CERCLA, facility managers are required to perform an Air Pathway Analysis (APA) in order to assess the potential for exposure of personnel to toxics in the ambient air at National Priority List (NPL) sites and to provide input to the Superfund risk assessment process. Air pathway analysis involves a combination of modeling and monitoring methods to assess actual or potential emissions from a hazardous waste site. The APA has three major components:

(1) characterization of air emission sources (e.g., estimation of contaminant emission rates) for the control and recordkeeping process; (2) determination of the effects of atmospheric processes (e.g., transport and dilution) on the personnel at a site; and (3) evaluation of receptor exposure potential (i.e., what air contaminant concentrations are expected at receptors of interest for various exposure periods) (EPA, 1989).

Superfund Amendments and Reauthorization Act (SARA) of 1986

SARA, which was passed in 1986 to amend CERCLA, contains two requirements likely to lead to emissions estimation. First, Section 313 of SARA requires that companies that process, manufacture, or otherwise use toxic compounds listed in Section 313 of the Act report to EPA the annual quantities used of those compounds and any releases to the environment (including air emissions) that result from their use. The Section 313 "Right-to-Know" requirements were enacted by Congress to increase public awareness and information on toxic emissions. The EPA has made Section 313 data publicly available. A database has been established, known as the Toxic Release Inventory System (TRIS), which contains information from SARA toxic chemical release reports (EPA, 1993a). TRIS reports are generated by the facility, and then sent to EPA for upload. Facilities under certain SIC codes are required to submit data if they meet the applicability thresholds of employment and chemical use. Therefore, there may be significant deficiencies in the data.

Second, Section 304 of SARA requires that any source which emits amounts in excess of threshold levels of any "hazardous" or "extremely hazardous" substance as defined by EPA pursuant to CERCLA must report the quantities of the substance(s) released. These reports are to be filed with the National Response Center, and are due immediately upon release of the substance (EPA, 1993a).

Resource Conservation and Recovery Act (RCRA) of 1976

RCRA was established to minimize the generation of hazardous waste, and to aid in the management of such hazardous waste. Sections 3001 and 3002 of RCRA require hazardous waste generating facilities to report and analyze their generation of certain hazardous wastes. Such an analysis could include estimation of emissions of certain substances. These facilities must report biennially to EPA.

Pollution Prevention Act of 1990

The Pollution Prevention Act is designed to facilitate the reduction of pollution at the source, rather than to mandate "end-of-pipe" controls. In general, this Act requires several EPA activities to facilitate pollution prevention, including establishing a clearinghouse for pollution prevention information, a grants program, reports to Congress, and others. It also imposes a specific reporting requirement on certain sources. Specifically, sources that are required to file an annual toxic release form under Section 313 of SARA must also file an annual toxic chemical source reduction and recycling report. Section 6607 of the Pollution Prevention Act describes the specific requirements for this report. For many sources, meeting these requirements will require some form of emissions estimation (EPA, 1991c).

2.1.3 Federal Requirements Outside of EPA

In addition to EPA, two other federal agencies have requirements that may lead to emissions estimates for certain sources. The Department of Energy (DOE) requires electric power plants to report information on fuels, cooling equipment, environmental control equipment, and other information from which air emissions may be estimated. The Department of Defense (DoD) is in the process of establishing a central air emissions database which is to be part of the Defense Corporate Information Management (DECIM) system. This database may require additional emissions reporting. It should also be noted that each facility subject to any DOE or DoD requirements is also subject to any relevant EPA requirements.

2.2 State Requirements

As previously described, the EPA places several requirements on states which may indirectly lead to reporting requirements for sources. These include the requirements that the states update emissions inventories on an annual basis for NEI, that the states submit base year and periodic inventories for SIP development, and that the states develop Title V Operating Permits programs. Although states must comply with federal requirements, states are not restricted from establishing their own, more stringent requirements. While the federal laws and regulations identify a minimum set of requirements, states may choose to develop additional estimating and reporting requirements. Individual state agencies can provide assistance to sources on identifying and complying with individual state requirements.

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3

EMISSIONS INVENTORY PLANNING

3.1 PRELIMINARY PLANNING ACTIVITIES

Prior to initiating the actual compilation of an emissions inventory, an agency or facility must plan a basic approach for collecting, handling, and reporting emissions data. An inventory preparation plan should identify the required resource allocations and specify the procedures to be used to collect, handle, review, and report emissions data. Figure 1.3-1 illustrates the activities involved in preparing an inventory. Careful consideration of the approach to be used in developing the emissions inventory program will greatly facilitate the inventory process and can prevent major revisions to the inventory during review. As part of the preliminary planning activities, the inventory preparer should consider the following:

- End use of the data;
- Scope of the inventory;
- Availability and usefulness of existing data; and
- Strategy for data collection and management.

Each of these issues is discussed in more detail below.

3.1.1 END USE OF THE DATA

A basic consideration in planning the inventory is establishing the end uses of the completed inventory. For the regulatory agency, the end uses of all inventories fall into three general categories:

- Air quality control strategy development;
- Air quality maintenance;
- Air quality research.

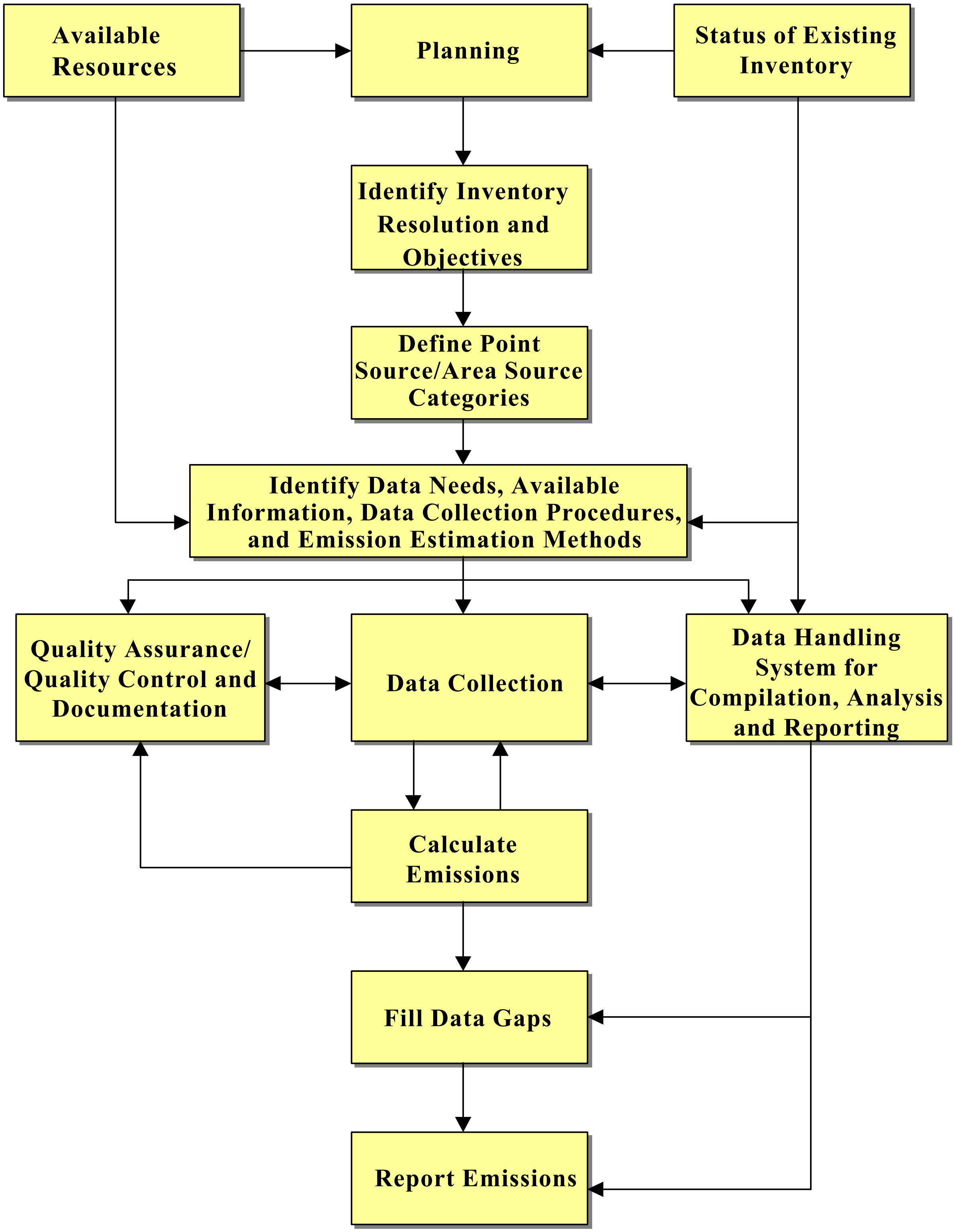

Figure 1.3-1. Activities For Preparing an Inventory

For an individual facility, the inventory may be:

- The measure of progress towards a corporate goal for emission reductions; and/or

- A means of identifying opportunities for process improvements.

Possible future use of the inventory, as well as immediate objectives, should be considered in determining inventory procedures and data needs.

3.1.2 Scope of the Inventory

In defining the scope of the inventory, the primary considerations are the desired level of detail, the desired number of sources, and the pollutant(s) of interest. Point sources can be inventoried at three levels of detail:

- The plant level, which denotes a plant or facility that could contain several pollutant-emitting activities;

- The point/stack level, where emissions to the ambient air from stacks, vents, or other points of emission are characterized; and

- The process/segment level, representing the unit operations of specific source categories. The appropriate level of detail will be a function of the intended use of the data.

Under ideal circumstances, all stationary sources would be considered point sources for purposes of emission inventories. In practical applications, however, only sources that emit more than a specified cutoff level of pollutant are considered point sources. In general, the higher the cutoff level, the fewer the facilities that are included in an inventory of point sources; a lower cutoff level would result in the inclusion of more sources. As a rule, the lower the cutoff level, the greater the cost to develop the inventory. However, a low cutoff level will increase user confidence in the source and emissions data, and the inventory will have a greater number of applications.

Identification of the pollutants to be inventoried is a major element in determining the scope of the inventory. The pollutants of interest for ozone inventories are VOCs, NO_x, and CO. For other criteria pollutants, only the criteria pollutant itself is of interest in the inventory. For HAP inventories on the federal level, the CAA list of 189 HAPs determines the pollutants to be inventoried.[a] States and local agencies may have additional toxic pollutants on their state/local toxic air pollutant (TAP) lists.

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[a] Caprolactam was delisted as a HAP (*Federal Register,* Vol. 61, page 30816, June 18, 1996).

Table 1.3-1 presents source categories that should be considered for inclusion in point source emission inventories. The table also indicates the types of pollutants emitted from these categories. In defining the scope of an inventory, the emphasis should be on those source categories that are located in the geographic area covered by the inventory and that are addressed by regulations applicable to point sources. The selected sources and source categories should be compatible with available information and be of sufficient detail to facilitate control strategy projections. Appendices A and B provide additional detail, cross-referencing HAPs and associated MACT source categories.

3.1.3 Availability and Usefulness of Existing Data

A major inventory planning consideration is whether, and to what extent, existing information can be used. Existing inventories should be examined to determine whether the appropriate sources have been included and whether the emissions data represent current conditions. Existing inventories can serve as a starting point for developing extensive data and support information, such as documentation of procedures. Information may also be drawn from other regulatory agency operations such as permitting, compliance, and source inspections and from other facility resources such as corporate reporting or compliance report submittals. For effective use of resources, an agency or facility should plan to fulfill specific emissions inventory requirements by building upon and improving the quality of regularly collected data.

For effective use of resources, an agency or facility should plan to fulfill specific emissions inventory requirements by building upon and improving the quality of regularly collected data.

3.1.4 Strategy for Data Collection

Another key decision in inventory planning regards what particular data collection procedures will be followed. Point source inventories are generally compiled using a “bottom-up” approach. This means that emissions are estimated for individual sources and summed to obtain state- or county-level estimates. Alternative data collection methods include questionnaires, plant inspections, and review of existing agency permit and compliance files. You may need to use a combination of data gathering techniques to ensure complete and accurate data are available for compilation of an inventory. Section 5 of this chapter describes data collection methods in detail.

Depending on the approach selected, the available data may be in various forms such as source tests, material balances, purchasing records, or actual emission estimates. The resources (staff and budget) required to gather the data and manipulate it into the desired inventory will vary depending on the selected approach. The inventory preparer must keep these considerations in mind during the preliminary planning phase in order to decide on the strategy that best matches the data quality needs and the available resources.

TABLE 1.3-1

POTENTIAL POINT SOURCES AND POLLUTANTS

Source Name	Description	POLLUTANTS							
		VOC	CO	NO_x	NH_3	SO_2	PM_{10}	Lead	HAP
Fuel Combustion, Electric Utilities	Coal	X	X	X	X	X	X	X	X
	Oil	X	X	X	X	X	X	X	X
	Gas	X	X	X	X	X	X	X	X
	Other	X	X	X		X	X	X	
	Internal Combustion	X	X	X	X	X	X		X
Fuel Combustion, Industrial	Coal	X	X	X	X	X	X	X	X
	Oil	X	X	X	X	X	X	X	X
	Gas	X	X	X	X	X	X		X
	Other	X	X	X	X	X	X	X	
	Internal Combustion	X	X	X	X	X			X
Fuel Combustion, Other	Commercial/Institutional Coal	X	X	X	X	X	X	X	X
	Commercial/Institutional Oil	X	X	X	X	X	X	X	X
	Commercial/Institutional Gas	X	X	X	X	X			X
	Misc. Fuel Comb. (Except Residential)	X	X	X	X	X		X	X
	Residential Wood	X	X		X	X	X		
	Residential Other			X	X	X			X
Chemical and Allied Product Mfg.	Organic Chemical Mfg.	X	X	X		X	X		X
	Inorganic Chemical Mfg.	X	X	X		X	X	X	X
	Polymer and Resin Mfg.	X		X		X	X		X
	Agricultural Chemical Mfg.	X	X	X	X	X	X		X
	Paint, Varnish, Lacquer, Enamel Mfg.	X					X		X
	Pharmaceutical Mfg.	X							X
	Other Chemical Mfg.	X	X	X		X	X		X

TABLE 1.3-1

(CONTINUED)

Source Name	Description	VOC	CO	NO_x	NH_3	SO_2	PM_{10}	Lead	HAPs
Metals Processing	Non-Ferrous Metals Processing	X	X	X	X	X	X	X	X
	Ferrous Metals Processing	X	X	X	X	X	X	X	X
	Metals Processing Not Else Classified (NEC)	X			X	X	X	X	X
Petroleum and Related Industries	Oil and Gas Production	X			X	X			X
	Petroleum Refineries and Related Industries	X	X	X	X	X	X		X
	Asphalt Manufacturing	X	X			X	X		X
Other Industrial Processes	Agriculture, Food, and Kindred Products	X			X		X		X
	Textiles, Leather, and Apparel Products	X					X		X
	Wood, Pulp and Paper, and Publishing Products	X	X			X	X		X
	Rubber and Miscellaneous Plastic Products	X							X
	Mineral Products	X	X	X	X	X	X	X	X
	Machinery Products	X					X		X
	Electronic Equipment						X		X
	Transportation Equipment						X		X
	Construction						X		X
	Miscellaneous Industrial Processes	X					X		X
Solvent Utilization	Degreasing	X							X
	Graphic Arts	X		X					X
	Dry Cleaning	X							X
	Surface Coating	X					X		X
	Other Industrial	X							X
	Nonindustrial	X				X			X

TABLE 1.3-1
(CONTINUED)

Source Name	Description	POLLUTANTS							
		VOC	CO	NO_x	NH_3	SO_2	PM_{10}	Lead	HAPs
Storage and Transport	Bulk Terminals and Plants	X				X			X
	Petroleum and Petroleum Product Storage	X							X
	Petroleum and Petroleum Product Transport	X							X
	Service Stations: Stage I	X							X
	Service Stations: Stage II	X							X
	Service Stations: Breathing and Emptying	X							X
	Organic Chemical Storage	X							X
	Organic Chemical Transport	X							X
	Inorganic Chemical Storage						X		X
	Inorganic Chemical Transport					X	X		X
	Bulk Materials Storage	X					X	X	X
	Bulk Materials Transport						X	X	X
Waste Disposal and Recycling	Incineration	X	X	X		X	X	X	X
	Open Burning	X	X	X		X	X		X
	Publicly Owned Treatment Works (POTW)	X							X
	Industrial Waste Water	X							X
	Treatment, Storage, and Disposal Facility	X					X		X
	Landfills	X	X	X			X		X
	Other	X		X			X	X	X
Miscellaneous	Agriculture and Forestry			X			X		X
	Other Combustion	X	X				X		X
	Catastrophic/Accidental Releases	X				X	X		X
	Repair Shops	X							X
	Health Services	X							X
	Cooling Towers	X					X		X
	Fugitive Dust						X		X

Source: EPA, 1999a. EIIP, Volume II, Chapter 14, Uncontrolled Emission Factor Listing for Criteria Pollutants. Revised draft, final December 2000.

Because it is not always certain whether a category will be ultimately be inventoried as a point or an area source, data collection efforts should always include as much detailed information as possible. For example, employment by standard industrial classification code may not be used in a point source inventory, but would be helpful for preparing an area source inventory.

Once the strategy for data collection is chosen, the inventory preparer needs to consider how data will be handled and managed, including QA/QC procedures. Emissions inventory data for a single point source or area source category may be minimal and can be handled using spreadsheets or by hand calculations. For large sets of data, an electronic database will be needed to organize, manipulate, and simply store the collected data. There are a wide variety of available software packages designed for tracking environmentally related emissions and release information. The system used should be able to handle the types of information being collected as well as have the ability to export information for state and federal reporting requirements.

3.2 Inventory Preparation Plan

The inventory work plan is a concise, to-the-point document that declares how an agency or plant intends to develop and present its inventory. It allows a line of communication between the inventory preparer, his/her management, and the receiving agency to ensure that the inventory is conducted effectively. The work plan should include inventory objectives and general procedures and should address all sources (regardless of size) of all the target pollutants.

Although no specific format is required by EPA, generally, the inventory preparation plan should:

- Define the geographic inventory area by attainment or nonattainment status;
- Define the scope of the inventory (i.e., identify which sources and pollutants will be covered);
- Define the data quality objectives;
- Provide the background/basis for the inventory (i.e., describe previous efforts that are related and describe purpose of this inventory);
- Specify who is responsible for preparing the inventory, with a detailed organization chart of key personnel/consultants;
- Specify each person’s responsibilities;
- Specify the QA coordinator and the technical reviewers (which are different than the technical team generating the inventory);

- Describe the approach to be used to estimate emissions (i.e., identify plans for data collection, analysis, source definition thresholds, emission estimation methods by source category type, and data reporting and storage procedures);

- Describe QA/QC procedures; and

- Describe how the agency plans to present and document the inventory for submittal to EPA and/or others.

For point sources, an agency must define how all pertinent emissions sources will be identified and located. The work plan should describe how point source activity levels and associated parameters will be developed, and how these data are used to calculate emissions estimates. It should also describe the type of source surveys that are planned and the use of existing data contained in systems such as the National Emission Inventory (NEI), state emission inventory systems, or state permitting files.

3.3 Training

Training is an important component of the facility's or agency's preliminary planning activities. The extent of training needed will depend on the staff chosen to prepare the inventory and the number of new procedures required by the inventory process.

Training courses for the critical components of an emissions inventory are provided annually by the EPA's Air Pollution Training Institute (APTI). These courses provide detailed instruction in:

- Inventory planning;

- Inventory management;

- Point source emissions;

- Emissions calculations;

- Projection techniques; and,

- Data reporting.

These courses are available to any individuals with the education, experience, or employment responsibilities involving enforcement or compliance with regulatory programs for achievement of air quality standards. Further information can be obtained by contacting the APTI (Internet address: www.epa.gov/oar/oaqps/eog/apti.htm).

3.4 Data Sources

This section introduces the various data sources available to an inventory preparer compiling an emissions inventory. The types of data needed to compile a complete emissions inventory include:

- Inventory guidance;
- Existing emission data;
- Emission factor resources;
- Models resources;
- Source characterization documents (documents that characterize an industry, including a description of processes, operating parameters, equipment used, emissions generated; and volume and type of output produced); and
- Activity data references.

Note that in many cases a single document can provide information on one or more of the types of data needed for your inventory. For example, EIIP is an excellent resource for inventory guidance as well as source characterization, and *AP-42* is an excellent resource for both emission factors and source categorization.

3.4.1 Finding Inventory Guidance

The primary guidance on emission inventory development is summarized in the EIIP volumes. These volumes present EPA's recognized standard for the development of reliable, quality-rated inventories. The EIIP documents present preferred and alternative methods for estimating emissions from point, area, mobile, and biogenic source categories. Hard copies of these manuals are available from the National Technical Information Service (NTIS). Electronic copies of the EIIP documents can be downloaded off the World Wide Web through the EIIP Web site at *http://www.epa.gov/ttn/chief/eiip/*.

Additional emissions inventory guidance, such as memoranda from OAQPS, can be downloaded off the World Wide Web through EPA's CHIEF Web site at *http://www.epa.gov/ttn/chief/index.html*.

3.4.2 EXISTING EMISSION DATA

A well-documented, existing air emissions inventory is a good source of emissions data. If an agency has previously estimated emissions based on a survey of the industry, sometimes an inventory preparer can use those data to estimate emissions for the newer inventory. This may be as simple as applying a growth factor to the emissions, or it may require further adjustments to account for other changes in the industry such as new controls. Information contained in these inventories can at least serve as a starting point for developing extensive data and support information, such as documentation of procedures.

NOTE: Existing inventories may focus on pollutants other than those needed in the inventory being prepared. Thus, certain sources that emit only one type of pollutant may not be well represented.

The most current and accessible national emission databases available for review and assessment in developing a criteria hazardous air pollutants inventory include:

- The National Emission Inventory (NEI) Database: *FTP://ftp.epa.gov/pub/emisInventory/net_96*;

- The National Toxics Inventory (NTI) Database, *FTP://ftp.epa.gov/pub/emisInventory/nti_96*;

- AIRSWeb: http://www.epa.gov/airsweb/sources.htm

Detailed descriptions of these databases are provided in Appendix C.

A less desirable but possible source of emissions data is through the extrapolation of emissions from one geographic region to another. This approach may be most appropriate when the socioeconomic conditions between two regions are comparable. In these situations, the emissions data for one region can be extrapolated to the other region based on population, employment, or other representative surrogates of the activity causing the emissions.

3.4.3 FINDING EMISSION FACTOR INFORMATION

The most commonly used emission factor resources are listed below and described in greater detail in Appendix D.

- *AP-42*: One of the most frequently cited resources for emission factor information is the EPA document, *Compilation of Air Pollutant Emission Factors* (*AP-42*). This document contains criteria pollutant emission factors for point and area sources. *AP-42* is available on the World Wide Web at *http://www.epa.gov/ttn/chief/ap42/index.html*. *AP-42* is also available on the *Air CHIEF* CD-ROM, and in hard copy from the Government Printing Office (GPO) at (202) 512-1800.

C Emission factor databases: Several emission factor databases are currently available in easy-to-access formats to state and local agencies. Two of these tools include:

- Factor Information Retrieval (FIRE) Data System (EPA, 2000c)
  < Web reference for FIRE - http://www.epa.gov/ttn/chief/software/fire/index.html#access, and

- Air Clearinghouse for Inventories and Emission Factors (Air CHIEF) CD-ROM, *http://www.epa.gov/ttn/chief/software/airchief/index.html* or (919) 541-1000.

In addition, you should conduct a search of technical papers for source test and background information for the emission source category or pollutants in question. You can conduct this search using EPA library services or through government document depositories at local universities. Examples of references and documents that you should review include:

C Miscellaneous private sector resources. For example, the National Council of the Paper Industry for Air and Stream Improvements, Inc. (NCASI) compiles, through a highly focused research program, reliable environmental data and information on the forest products industry.

C Emission factor reports published by other state and local agencies, and other states' databases and source tests. This information can be identified and acquired through direct communication with the agencies.

C Source test data used for compliance purposes and in developing operating permits for stationary sources may be readily available through state and local air permitting agencies. The use of source test data reduces the number of assumptions regarding the applicability of emission factors to a source.

C Professional societies (e.g., AWMA) symposia publications contain up-to-date information.

3.4.4 EMISSION ESTIMATION MODELS

Several emission estimation models are available for download free-of-charge.

- Landfill Gas Emissions Model: *http://www.epa.gov/ttn/catc/products.html#software*
- TANKS: *http://www.epa.gov/ttn/chief/software/tanks/index.html*
- WATER9: *http://www.epa.gov/ttn/chief/software/water/*
- CHEM9: *http://www.epa.gov/ttn/chief/software/chem9/index.html*
- PMCalc: *http://www.epa.gov/ttn/chief/software/pmcalc/index.html*

3.4.5 SOURCE CHARACTERIZATION INFORMATION

Inventory preparation requires source categorization information to identify the sources to be included in the inventory. Source categorization information includes:

- Description of the sources, facilities, or activities included in the source category. For example, the boiler source category comprises sources that combust fuels to produce hot water and/or steam. The source category definition can include the SIC code or the EPA source classification code (SCC).
- Description of emission sources within the source category. For example, the boilers category includes coal-fired boilers, oil-fired boilers, boilers using other types of fuel, cogeneration units, and auxiliary sources.
- Discussion of the factors influencing emissions such as control techniques, influences of weather conditions, or process operating factors.

Several resources are available for source characterization. Primary resources include:

- *AP-42*.
- *Locating and Estimating Air Emissions from Sources of (Source Category or Substance) (L&E) Documents.* About 30 *L&E* documents are currently available. Although *L&E* documents concentrate on hazardous air pollutants (HAPs), these documents can be useful for criteria pollutant inventories because each volume includes general descriptions of the emitting processes, and provides source characterization. *L&E* documents are available on the CHIEF Web site at

http://www.epa.gov/ttn/chief/le/index.html. A complete list of *L&E* documents is included in Appendix E.

- Industry Sector Notebooks: The EPA's Office of Compliance has developed a series of notebooks profiling selected major industrial groups. Each sector-specific notebook brings comprehensive details that include an environmental profile, industrial process information, and bibliographic references. A detailed description of the Industry Sector Notebooks project is provided in Appendix F. Industry Sector Notebooks are available on the World Wide Web at *http://es.epa.gov/oeca/sector/index.html*

Additional resources include:

- EPA reports presenting the results of engineering investigations of air emissions from various industrial processes, such as Control Techniques Guidelines (CTGs) and Available Control Techniques (ACT) documents, and Background Information Documents (BIDs) for New Source Performance Standards (NSPS) and National Emission Standards for Hazardous Air Pollutants (NESHAP) or Maximum Achievable Control Technology (MACT) standards. These reports are available through the GPO, the National Technical Information Service (NTIS), and on the World Wide Web at *http://www.epa.gov/ttn/*

- The Integrated Data for Enforcement Analysis (IDEA) system: IDEA is an interactive data retrieval and integration system developed by EPA's Office of Enforcement and Compliance Assurance (OECA). IDEA integrates facility data across EPA's various program office databases. A detailed description of IDEA is provided in Appendix F and on OECA's Web site at *http://es.epa.gov/oeca/idea/*

- Air pollution control agency files: Compliance, enforcement, permit application, or other air pollution control agency files may provide valuable information on the location and types of sources in the area of concern. For example, permit applications generally include enough information about a point source to describe the nature of the source and to estimate the magnitude of emissions that will result from its operations. A compliance file might contain a list of air pollution regulations applicable to a given source, a history of contacts made with that source on enforcement matters, and an agreed-upon schedule for the source to effect some sort of control measures.

- Annual emission statements: Most states require facilities emitting above a certain threshold to submit an annual emission statement listing various processes and their emissions. Annual emission statements should be examined to determine whether the appropriate sources have been included and that the emissions data represent current conditions.

- Other government-funded agencies, such as the Paint and Coating Resource Center (PCRC) and the National Metal Finishing Resource Center (NMFRC): The main function of these Centers is to provide regulatory compliance and pollution prevention information on their respective industries. The PCRC can be accessed on the World Wide Web at *http://www.paintcenter.org/* and the NMFRC can be accessed at *http://www.nmfrc.org/*.

3.4.6 Applicable Activity Parameters

Inventory preparers may need to use different types of activity data to estimate emissions from area and point sources - even within the same source category. Point sources may require direct measurement or direct activity (i.e., throughput) applied to an emission factor, while emissions from area sources are often estimated using surrogate activity factors, such as population or employment.

For point sources, activity parameters are generally reported as fuel consumption rates or process weight rates for fuel-burning equipment and industrial processes, respectively. You will need detailed data on process equipment, throughput, capacity, and other parameters to estimate emissions from point sources. You can obtain this information from contacts with individual facilities. The two most common types of plant contacts are surveys and questionnaires, and direct plant inspections. A type of indirect plant contact also commonly employed is the use of permit applications or compliance files. Other traditional sources of activity data for point sources include:

- State and local industrial directories;
- State Departments of Commerce and Labor statistics;
- National and state directories of manufacturers;
- Data compiled by private research and development companies such as the *Directory of Chemical Producers* compiled by SRI International; and
- Trade and professional associations.

3.5 Data Handling

Inventory data can be managed almost entirely by computer. During the inventory planning stages, the inventory preparer should anticipate the volume and types of data-handling needed in the inventory effort and should weigh the relative advantages of manual versus computerized systems. If the inventory preparer must deal with large amounts of data, maximizing the use of computerized inventory data-handling systems will allow them to spend more time gathering, analyzing, and validating the inventory data, as opposed to manipulating the data.

Computerized data handling becomes significantly more cost-effective as the database, the variety of tabular summaries, or the number of iterative tasks increases. In these cases, the computerized inventory requires less overall time and has the added advantage of forcing organization, consistency, and accuracy.

Some activities that can be performed efficiently and rapidly by computers include:

- Printing mailing lists and labels;
- Maintaining status reports and logs;
- Calculating and summarizing emissions;
- Performing error checks and other audit functions;
- Storing source, emissions, and other data;
- Sorting and selectively accessing data; and
- Generating output reports.

Additional information on data handling is presented in Volume VII of the EIIP series of guidance documents.

3.6 Documentation Requirements

Documentation is an integral part of an emissions inventory. Before submittal, internal review of the written documentation provides an opportunity to uncover and correct errors in assumptions, calculations, or methods. Following submittal of the inventory, the documentation allows the results of the inventory to be clearly understood and the quality of the inventory to be effectively judged. Complete and well-organized documentation is necessary to prepare a reliable and technically defensible inventory document. The goal of documentation is to ensure that the final written compilation of the data accurately reflects the inventory effort. Documentation requirements are discussed in detail in Section 6 of this chapter.

Although documentation requirements may evolve during the inventory data collection process, the calculation and reporting steps of the emissions inventory development process should be anticipated during planning. Planning the level of documentation required will:

- Ensure that important supporting information is properly developed and maintained;

- Allow extraneous information to be identified and discarded, thereby reducing the paperwork burden;
- Help determine data storage requirements; and
- Aid in identifying aspects of the inventory on which to concentrate the QA efforts.

3.7 Schedule

If the development and maintenance of an emissions inventory is conceptualized as a network of activities or events with a definite start and end, various techniques can be used to formulate a project schedule. One method is to graphically present the inventory tasks, their estimated completion times, major project milestones, and labor requirements. This is a useful way to visualize the activities and their relationships to one another. By identifying the "critical path" events at this early point in the schedule-planning activities, the inventory preparer can anticipate potential bottlenecks in the process and avoid delays that might affect the timely submittal of the final inventory.

It is important to remember that a schedule must be frequently compared to the actual progress of the inventory effort. By closely tracking the activities, the preparer can:

- Ensure that each task is being completed expeditiously;
- Revise labor commitments to reflect schedule and data changes; and
- Learn from experience so that this knowledge can be applied towards future inventory efforts.

3.8 Summary of Issues to Consider When Estimating Emissions from Point Sources

When compiling a point sources emissions inventory an inventory preparer should consider the issues presented in Table 1.3-2.

TABLE 1.3-2

ISSUES TO CONSIDER WHEN ESTIMATING EMISSIONS FROM POINT SOURCES

For a point source inventory, you should...	**Because...**	**Helpful references include...**
Carefully consider what source categories to include in the inventory.	Attempting to inventory all source categories may overburden an agency's resources, especially if a majority of the sources are deemed insignificant contributors to pollution by the state. A screening study will help you focus the inventory effort.	Guidance on how to conduct screening studies for the purpose of inventory development is available in Appendix F.
Consider threshold levels of emissions for sources to be included in the inventory.	If the agency does not preclude reporting of emissions below specific exemption or *de minimis* levels, the effect on agency resources may be similar to that of inventorying all source categories for all criteria pollutants.	
Consider the differences in the source definition(s) for the purposes of criteria and HAP inventories when using a HAP inventory as a starting point for the criteria pollutant inventory.	Some industrial sources with PM or VOC emissions below typical cutoff levels may be categorized as area sources for the purpose of a criteria pollutant inventory, but may qualify as major point sources for the purpose of a HAP inventory.	
Check the results of any survey for completeness.	When surveying sources directly, there may be a need to follow-up with a facility, particularly if you believe it is emitting a certain pollutant it does not report.	

TABLE 1.3-2

(CONTINUED)

For a point source inventory, you should...	**Because...**	**Helpful references include...**
Stay informed of air regulations and rule development activities and implementation information.	Some MACT standards may also contain information that addresses emission limits on criteria pollutants (e.g., a standard may use PM concentration as a surrogate to measure non-volatile metals concentration as part of total HAP reductions).	You can access comprehensive MACT rule-specific information including *Federal Register* publications and citations, compliance dates, and MACT rule contact names and phone numbers through the UATW site at *http://www.epa.gov/ttn/uatw/eparules.html*.
Keep in mind that nationally-derived emission factors may not apply directly to your area and may need to be adjusted.	Emissions calculated using national emission factors may vary considerably from actual values at a specific source or within a specific geographic area.	
Avoid double counting of sources and emissions.	Overlap can occur between point and area sources.	EIIP Volumes II and III.
Know your pollutants.	For example, several VOC are considered photochemically nonreactive by the U.S. EPA as defined in the CAA and are not included in VOC emissions inventories (63 FR 17331, April 9, 1998: Part 51 "Air Quality Revision to Definition of VOC - Exclusion of Methyl Acetate.").	

TABLE 1.3-2
(CONTINUED)

For a point source inventory, you should...	Because...	Helpful references include...
Make sure you account for fugitive emissions. Fugitive emissions are emissions that are technically infeasible to collect and control such as emissions from stockpiles, material handling and transfer operations, and process leaks.	Fugitive emissions may account for a substantial portion of actual emissions from many facilities.	
Account for factors influencing emissions such as process variability and/or equipment malfunctions and upset conditions.	Variations in emissions due to normal process variability or abnormal operating conditions can result in emissions increases which can be difficult to quantify.	Volume II, Chapter 12, of the EIIP document series addresses this topic and should be reviewed for details on how control device malfunctions affect emissions. The document also provides example calculations.

4

EMISSION ESTIMATION PROCEDURES

Air pollutant emissions may be released from numerous sources within a facility. Depending on the facility size, the nature and number of processes, and the emission control equipment in place, emission estimation may be very simple or extremely difficult. The inventory preparer should consider the types of emissions to be reported (i.e., actual, potential, or allowable), the availability of data, and the cost when selecting which method of emissions estimation is appropriate.

Selecting a method to estimate source specific emissions warrants a case-by-case analysis considering the cost and required accuracy in the specific situation. When selecting an emissions estimation method, you should consider several issues when analyzing the tradeoffs between cost and accuracy of the resulting estimates. These issues include:

- Availability of quality data needed for developing emissions estimates;

- Practicality of the method for the specific source category;

- Intended end use of the inventory (e.g., an inventory in support of significant regulatory implications such as residual risk or environmental justice issues may require that more accurate and costly emission estimation methods be used than would an inventory intended for simply a source characterization);

- Source category priority (e.g., if a source category is of relatively high priority, it may require a more accurate emission estimation method);

- Time available to prepare the inventory; and

- Resources available in terms of staff and funding.

Figure 1.4-1 (from *AP-42*) depicts various approaches to emission estimation that should be considered when analyzing the costs versus the quality of the results (EPA, 2000b). Ideally, plants needing emissions estimates would use continuous emissions monitoring (CEM) to obtain actual emissions measurements over very short time intervals. Some facilities currently do this. The CEM concentration data can be easily converted to mass emission rates provided the air volume through the monitor is also known. In cases where CEM or parametric monitoring data

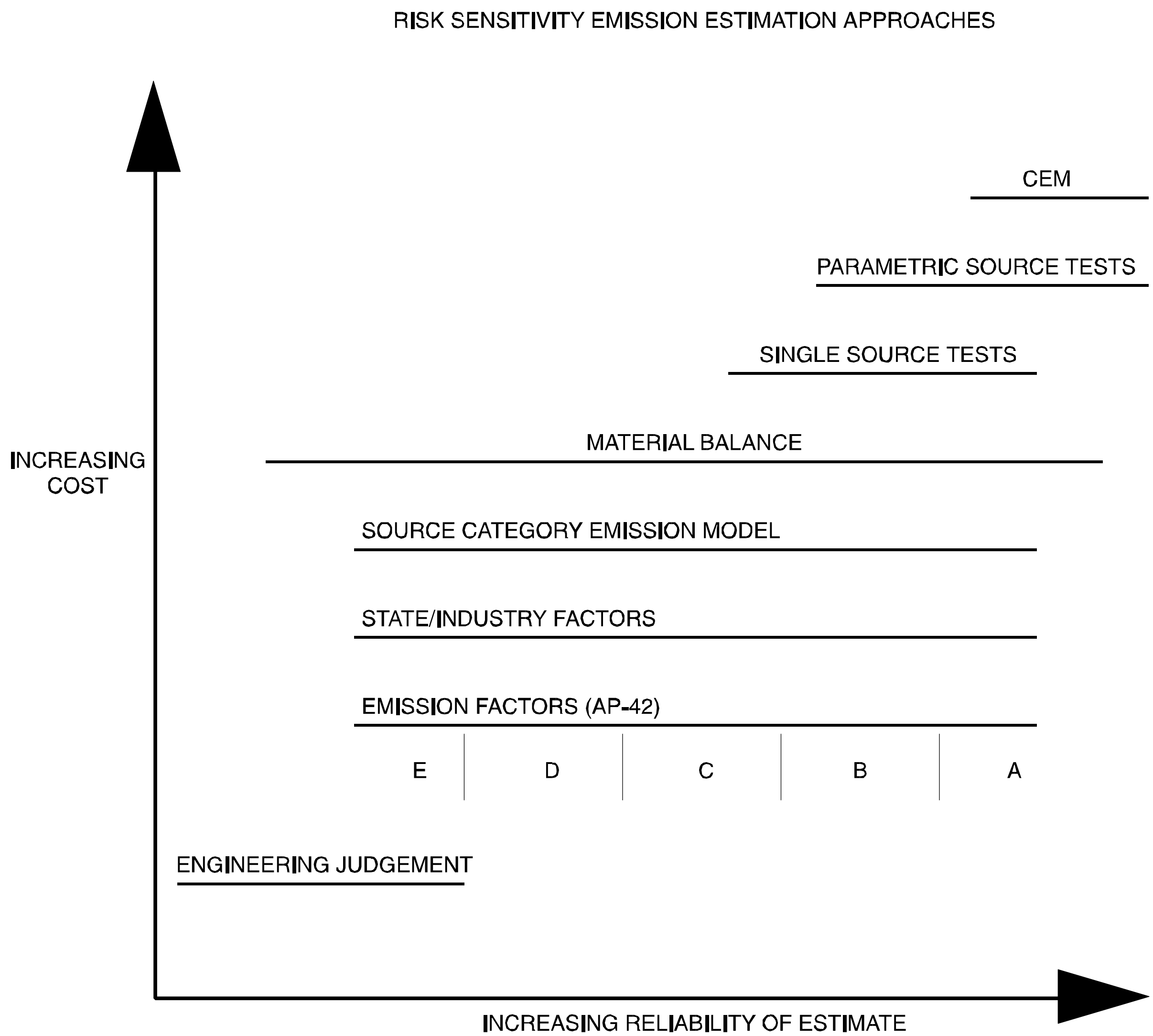

FIGURE 1.4-1. EMISSION ESTIMATION HIERARCHY

are unavailable, however, another method must be used to estimate emissions. The three principal methods for estimating emissions in such cases are source tests, material balances, and emission factors. If none of these three methods can be employed to estimate emissions for a specific process, an approximation or engineering estimate based on available process, physical, chemical, and emission knowledge may be used.

Where risks of adverse environmental or regulatory effects are high, the more sophisticated and costly emission determination methods such as CEM or source tests may be necessary. Conversely, where the risks are low, less expensive estimation methods such as the use of emission factors and emission models may be acceptable.

4.1 CEMS

Continuous emissions monitors (CEMs) measure and record actual emissions during the time period the monitor is operating and the data produced can be used to estimate emissions for different operating periods. CEMs are typically used to measure stack gas concentrations of NO_x, CO_2, CO, SO_2, and total hydrocarbons (THC). CEMs can either be permanently installed at a source to generate data 24-hours a day or they can be used for emissions monitoring during a defined source testing period (e.g., 1 to 4 hours).

4.2 Source Tests

The source test is a common method of estimating process emissions. Source tests are short-term emission measurements taken at a stack or vent. Due to the substantial time and equipment involved, a source test requires more resources than an emission factor or material balance emission estimate. Typically, a source test uses two instruments: one to collect the pollutant in the emission stream and one to measure the emission stream flow rate. The essential difference between a source test and CEM is the duration of time over which measurements are conducted. A source test is conducted over a discrete, finite period of time, while CEM is continuous.

If the use of source test data reduces the number of assumptions regarding the applicability of emissions data to a source (a common consideration when emission factors are used), as well as the control device efficiency, equipment variations, and fuel characteristics. Thus, source tests typically provide better emission estimates than emission factors or material balances, if correctly applied (Southerland, 1991). However, source test data should be used for emission estimation purposes only if the data were obtained under conditions which are representative of or related to operating conditions normally encountered at the source in question.

Two items should be noted when using source test data to calculate emissions. First, because most source tests are only conducted over several hours or days at most, adjustments may need to be made when using these data to estimate emissions over longer time intervals. Emission data from a one-time source test can be extrapolated to estimate annual emissions only if the process stream does not vary and if the process and control devices are operated uniformly.

Second, a source test may not adequately describe a given facility's annual or seasonal operating pattern. For example, there may be variations in process operation throughout the year or the efficiency of control device performance may vary due to fluctuations in ambient temperature or humidity. In such cases, multiple tests must be conducted for source testing to be useful in generating an emission estimate for extended periods that are longer than the test period. If facility operation and test methods employed during the source test cannot be adequately characterized, the source test data should not be used.

If a source test is used to estimate emissions for a process, test data gathered on-site for that process is generally preferred. The second choice is to use test data from similar equipment and processes on-site, or to use pooled source tests or test data taken from literature. The reliability of the data may be affected by factors such as the number of tests conducted and the test methodology used.

The EPA has published reference methods for measuring emissions of PM, SO_2, NO_x, CO, and VOC. The reference methods, given in Code of Federal Regulations, Title 40, Part 60, Appendix A (updated 7/1/99), define and describe the test equipment, materials, and procedures to be used in stack tests for the various criteria pollutants. Reference methods for estimating HAP emissions are published in Title 40, Code of Federal Regulations, Part 61, Appendix B (EPA, 1986; EPA, 1988). The EPA publication, *Screening Methods for the Development of Air Toxics Emission Factors*, presents an overview of the use of these reference methods for specific HAPs (EPA, 1992d). A brief description of several EPA methods is given in Appendix E. For further information, the reader can consult with the Emission Measurement Technical Information Center (EMTIC), which provides technical guidance on stationary source emission testing. Industry personnel may access EMTIC on the EPA's Technology Transfer Network bulletin board system, or by calling EMTIC staff directly. The Internet web address is http://ttnwww.epa.gov/html/emtic/em02emtic.htm#.

Most source test reports summarize emissions for each pollutant by expressing them in terms of: (1) a mass loading rate (weight of pollutant emitted per unit of time); (2) an emission factor (weight of pollutant emitted per unit of process activity); or (3) a flue gas concentration (weight or number of moles of pollutant per some weight or volume of flue gas). Generally, when a mass loading rate or flue gas concentration is provided, the resulting emission factor can easily be calculated with knowledge of equipment size or operating parameters, as in the example below (EPA, 1993a):

- <u>Example</u>. A single-line paper coating plant has been subjected to an emission test for VOC emissions. Since the coating solvent is primarily toluene, the emission concentrations were measured as toluene. The data averaged for three test runs are as follows:

Stack flow rate (Q_S)	= 10,000 scf
Emission concentration (C_e)	= 96 ppm (as toluene)

Fugitive emission capture (Eff_{cap})	= 0.90 (90 percent, as required by reasonably available control technology (RACT)

Other information needed to complete the calculations include:

Plant operation	= 16 hour/day, 312 days/year
Solvent input rate (M_i)	= 500 ton/year
Molecular weight (toluene)	= 92
Unit correction factor (f)	= 1.58×10^{-7} (lb-mole-min)/(hr-ppm-scf)

The emission calculation begins with determination of the average mass loading rate (M_o):

$$
\begin{aligned}
M_o &= (f)(MW)(C_e)(Q_s) \\
&= (1.58 \times 10^{-7})(92)(96)(10,000) \\
&= 14 \text{ lb/hr}
\end{aligned}
$$

The emission control efficiency (Eff_{con}) is calculated:

$$
\begin{aligned}
Eff_{con} &= (M_i - M_o)/M_i \\
&= [500 - ((14)(16)(312)/2,000)]/500 \\
&= 0.93 \text{ (93 percent control)}
\end{aligned}
$$

4.3 MATERIAL BALANCES

When you use material balance, you will determine emissions by knowing the amount of a certain material that enters a process, the amount that leaves the process by all routes, and the amount shipped as part of the product itself. The simplest method of material balance is to assume that all solvent consumed by a source process will evaporate during the process.

The material balance method:

- Can be used where source test data, emission factors, or other developed methods are not available;

- Is most appropriate to use in cases where accurate measurements can be made of all process parameters except the air emission component;

- Is particularly useful for processes like solvent degreasing operations, and surface coating operations.

- Is equally applicable to point and area sources.

- Should not be used for processes where material reacts to form secondary products or where the material otherwise undergoes significant chemical changes.

The basic emission estimation equation for mass balance is:

$$E_x = (Q_{in} - Q_{out}) \times C_x$$

where:

E_x	=	total emissions for pollutant x
Q_{in}	=	quantity of material entering the process
Q_{out}	=	quantity of material leaving the process as waste, recovered, or in product
C_x	=	concentration of pollutant x in the material.

The term Q_{out} could involve several different "fates" for an individual pollutant. This could include the amount recovered (or recycled) or the amount leaving the process in the product or waste stream.

If a material balance method is used to estimate emissions and if the actual emissions are a small fraction of the throughput, the throughput estimate or measurement can be even more critical. For example, applying material balances to petroleum product storage tanks is not generally feasible because the losses are too small to quantify using a metering device. In these cases, *AP-42* or equations or TANKS can be used.

Because the emissions are estimated to be the difference between the material input and the known material output, a small percentage error in estimating the input or output can result in a much larger percentage error in the emission estimate. For this reason, material balances are sometimes inappropriate for estimating relatively small losses.

4.4 Emission Factors

Emission factors allow the development of generalized estimates of typical emissions from source categories or individual sources within a category. Emission factors, used extensively in point source inventories, estimate the rate at which a pollutant is released to the atmosphere as a result of some process activity. For example, the emission factor for NO_x emissions from the combustion of anthracite coal is 9 pounds of NO_x per 1 ton of coal burned (9 lb/ton). If you know the emission factor and the corresponding activity level for a process, you can estimate the emissions. In most cases, emission factors are expressed simply as a single number, with the underlying assumption that a linear relationship exists between emissions and the specified activity level over the probable range of application. The use of emission factors is straightforward when the relationship between process data and emissions is direct and relatively uncomplicated. Note, however, that emission factors may be developed assuming no control device is in place. These are referred to as "uncontrolled emission factors." When emission factors are derived from data that was obtained from facilities with a control device in place, then emission factors are referred to as "controlled emission factors."

While the emissions calculated using emission factors may differ from actual emissions for a specific facility, emission factors nevertheless provide a reasonable estimate of pollutant emissions across an entire source category. Because emission factors are typically averages obtained from data with wide ranges and varying degrees of accuracy, emissions calculated this way for a given source are likely to indicate higher than actual emissions for some sources and lower than actual emissions for others.

When the information used to develop an emission factor is based on national data, such as a wide range of source tests or national consumption estimates, you should be aware of potential local variations. Emissions calculated using national emission factors may vary considerably from actual values at a specific source or within a specific geographic area.

National emission factors should be used when:

- No locally derived factor exists;
- The local mix of individual sources in the category is similar to the national average; and
- The source is a low priority in the inventory.

Locally derived emission factors are preferred when:

- A national level emission factor does not account for local variations; and
- The category is a high priority in the area.

Locally derived emission factors are developed based on:

- Local surveys or measurements;
- Local consumption data; and
- Adaptation of emission information in permits or another inventory.

Typically, the information gathering necessary for developing a local emission factor can be significant, but the benefits are that the emissions for the source will be well-characterized, and the emission factor or the information used to develop it can be used in subsequent inventories.

If you use factors to predict emissions from new or proposed sources, you should review the latest literature and technology to determine whether such sources would likely exhibit emission characteristics different from those sources from which the emission factors were derived.

Emission factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant. To calculate emissions using emission factors, four basic inputs to the estimation algorithm are required:

- Activity information for the process as specified by the relevant emission factor;
- An emission factor to translate activity information into uncontrolled or controlled emission estimates;
- Rule effectiveness factor; and
- When applicable, information on capture and control efficiencies of any control device when using an "uncontrolled" emission factor.

The basic emission estimation equation when using an uncontrolled emission factor is:

$$E = A \times EF \times (1 - C \times RE)$$

where:

E	=	emission estimate for the process
A	=	activity level such as throughput
EF	=	emission factor assuming no control
C	=	capture efficiency x control efficiency (expressed in percent); C equals zero if no control device is in place
RE	=	rule effectiveness, an adjustment to C to account for failures and uncertainties that affect the actual performance of control.

The basic emission estimation equation when using a controlled emission factor is:
$$E = A \times EF \times RE$$ where: E = emission estimate for the process A = activity level such as throughput EF = "controlled" emission factor RE = rule effectiveness

4.5 EMISSION MODELS

Emission models may be used to estimate emissions in cases where the calculational approach is burdensome, or in cases where a combination of parameters have been identified which affect emissions but, individually, do not provide a direct correlation. For example, the TANKS program incorporates variables such as tank color, temperature, and windspeed to obtain an emissions estimate.

Emission models may be based on measured or empirical values. The computer model may be based on theoretical equations that have been calibrated using actual data, or they may be purely empirical, in which case the equations are usually based on statistical correlations with independent variables.

Appendix F provides information on some of the more commonly used emission estimation models.

4.6 BEST APPROXIMATION OR ENGINEERING JUDGEMENT

A best approximation or engineering judgement is a final option for estimating emissions, although it is considered the least desirable method. A best approximation or engineering judgement is an emission estimate based on available information and assumptions.

4.7 OTHER CONSIDERATIONS

4.7.1 RULE EFFECTIVENESS

Inventories performed before 1987 assumed that regulatory programs would be implemented with full effectiveness, achieving all required or intended emissions reductions and maintaining the reduction level over time. However, experience has shown regulatory programs to be less than 100 percent effective for most source categories in most areas of the country.

Rule effectiveness (RE), expressed as a fraction or percent, is an adjustment which reflects the ability of a regulatory program to achieve the required emissions reductions. The intent behind the RE factor is to account for the fact that most emission control equipment does not achieve emission reductions at the designed rates at all times and under all conditions, and that some intentional noncompliance exists. Process upsets, control equipment malfunctions, operator errors, equipment maintenance, and other nonroutine operations are typical examples of times when control device performance is expected to be less than optimal.

Rule effectiveness is especially important for VOC and CO control programs because of the small size, large number, and relative complexity of most regulated sources. It is necessary to apply rule effectiveness when preparing emissions inventories because the effectiveness of existing regulations is directly related to emissions levels. Rule effectiveness must also be considered in planning for the expected effect of further regulations. Rule effectiveness should be applied for all applicable regulations: federal, state, and local.

A default fraction of 0.80 (equal to 80 percent effectiveness) has been established by the EPA to estimate rule effectiveness in the base year inventories. This fraction is a representative estimate of the average effectiveness values, based on a survey of selected state and local personnel on the perceived effectiveness of their regulatory programs for a wide range of source categories. The 80 percent default value or local category-specific rule effectiveness factor is applied if the emissions data were determined using emission factors, results of emissions tests, or estimated control efficiencies, even if the data were obtained from a survey of the source.

Although the 80-percent rule effectiveness value may generally be valid, it can vary significantly among source categories and can have a dramatic impact on sources assumed to be controlled at a high efficiency (e.g., 99.9 percent). Use of the default rule effectiveness factor should be carefully reviewed under these circumstances. A rule effectiveness of 100 percent may be applicable in some cases, but sources should be sure that no equipment downtime or emergency releases have occurred during the inventory period.

For the purpose of base year inventories under the CAA, the EPA allows the use of the 80-percent default value, but also gives agencies the option to derive local category-specific rule effectiveness factors through the use of a survey. Also, if rule effectiveness can be determined for a source category in a particular region using the protocol defined by the EPA's Office of Enforcement and Compliance Assurance, this rule effectiveness can be used. If a particular facility disagrees with the rule effectiveness factor used in an inventory, a case-by-case assessment of emissions can be performed to determine whether there is adequate data for emissions to be directly determined. If a facility can provide the explicit source data required by EPA, such as continuous source monitoring and control equipment functioning records for the inventory period, then emissions can be determined directly.

Where controls are not used, there is no need to apply rule effectiveness. The rule effectiveness factor should be applied to the estimated control efficiency in the calculation of emissions from a source. However, if emissions are estimated properly, there is no need to apply rule effectiveness. An example of the application is given below.

- Example:

  Uncontrolled emissions = 50 pounds (lb) per day

Estimated control equipment efficiency	=	0.90 (90 percent)
Rule effectiveness factor	=	0.80 (80 percent)
Emissions after control	=	50[1-(0.90)(0.80)]
	=	50(1-0.72)
	=	14 lb per day

Note: The EIIP Point Sources Committee is currently evaluating the application of the rule effectiveness policy. The committee will present their findings in an issues paper to the EIIP Steering Committee upon completion of their study.

4.7.2 Control Devices

A basic description of the techniques typically used by industry to control PM_{10}, VOCs, SO_2, NO_x, and HAPs can be found in the *Handbook*: *Control Technologies for Hazardous Air Pollutants* (EPA, 1991d). The handbook briefly describes the efficiencies commonly achieved by major types of control devices in current use and describes how to estimate emission reductions using control systems.

In order to determine removal efficiencies of HAPs from the air stream, it is necessary to know the nature of the HAPs involved, including such parameters as particle size, volatility, or combustibility. Control techniques guidelines (CTG) documents have been written for numerous VOC-emitting source categories; some of these documents contain information relevant to the control of HAPs. A list of several CTGs is presented in Table 1.4-1. Information on available CTG documents can also be obtained via the Control Technology Center (CTC) assistance line (see Appendix C). Another source of information on control devices for a particular source is a series of documents collectively referred to as alternative control techniques (ACT) documents. These documents provide background information on controls, but do not provide reasonably available control technology (RACT) analysis information as do the CTGs. A list of available ACT documents is presented in Table 1.4-2.

TABLE 1.4-1

CONTROL TECHNIQUES GUIDELINES DOCUMENTS (GROUPS I, II, III)

Source Description	EPA Report Number	NTIS Report Number	Date of Publication
Surface Coating Operations	450/2-76-028	PB-260 386	1976
Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks	450/2-77-008	PB-272 445	1977
Surface Coating of Metal Furniture	450/2-77-032	PB-278-257	1977
Surface Coating of Insulation of Magnet Wire	450/2-77-033	PB-278-258	1977
Surface Coating of Large Appliances	450/2-78-034	PB-278-259	1978
Surface Coating of Miscellaneous Metal Parts and Products	450/2-78-015	PB-286-157	1978
Factory Surface Coating of Flat Wood Paneling	450/2-78-032	PB-292-490	1978
Graphic Arts - Rotogravure and Flexography	450/2-78-033	PB-292-490	1978
Bulk Gasoline Plants	450/2-77-035	PB-276-722	1977
Storage of Petroleum Liquids in Fixed Roof Tanks	450/2-77-036	PB-276-749	1977
Refinery Vacuum Producing Systems, Wastewater Separators, and Process Unit Turnarounds	450/2-77-025	PB-275-662	1977

TABLE 1.4-1

(CONTINUED)

Source Description	EPA Report Number	NTIS Report Number	Date of Publication
Use of Cutback Asphalt	450/2-77-037	PB-278-185	1977
Tank Truck Gasoline Loading Terminals	450/2-77-026	PB-275-060	1977
Design Criteria for Stage I Vapor Control Systems-Gasoline Service Stations	--	--	1975
Control of Volatile Organic Compound Leaks from Petroleum Refinery Equipment	450/78-036	PB-286-158	1978
Petroleum Liquid Storage in External Floating Roof Tanks	450/2-78-047	PB-290-579	1978
Perchloroethylene Dry Cleaning Systems	450/2-78-050	PB-290-613	1978
Leaks from Gasoline Tank Trucks and Vapor Collection Systems	450/2-78-051	PB-290-568	1978
Volatile Organic Liquid Storage in Floating and Fixed Roof Tanks	--	--	1993
Large Petroleum Dry Cleaners	450/3-82-009	PB 83-124-875	1982
Synthetic Organic Chemical Polymer and Resin Manufacturing Equipment	450/3-83-006	PB-84-161-520	1984

TABLE 1.4-1

(CONTINUED)

Source Description	EPA Report Number	NTIS Report Number	Date of Publication
Equipment Leaks from Natural Gas/Gasoline Processing Plants	450/3-83-007	PB-84-161-520	1983
Solvent Metal Cleaning	450/2-77-022	PB-274-557	1977
Manufacture of Synthesized Pharmaceutical Products	450/2-78-029	PB-290-580	1978
Manufacture of Pneumatic Rubber Tires	450/2-78-030	PB-290-557	1978
Control Techniques for Volatile Organic Emissions from Stationary Sources	450/2-78-022	PB-284-804	1978
Air Oxidation Processes in Synthetic Organic Chemical Manufacturing Industry	450/3-84-015	PB-85-164-275	1984
Manufacture of High-Density Polyethylene, Polypropylene, and Polystyrene Resins	450/3-83-008	PB-84-134-600	1983
Fugitive Emissions Sources of Organic Compounds - Additional Information on Emissions, Emissions Reductions, and Costs	450/3-82-010	PB-82-217-126	1982

TABLE 1.4-2

ALTERNATIVE CONTROL TECHNIQUES DOCUMENTS

Source Description	EPA Report Number	NTIS Report Number	Date of Publication
Halogenated Solvent	450/3-89-030	PB 90-103268	1989
Reduction of Volatile Organic Compound Emissions from the Application of Traffic Markings	450/3-88-007	PB 89-148274	1988
Ethylene Oxide Sterilization/Fumigation Operations	450/3-89-007	PB 90-131434	1989
Reduction of Volatile Organic Compound Emissions from Automobile Refinishing	450/3-88-009	PB 89-148282	
Organic Waste Process Vents	450/3-91-007	PB 91-148270	1990
Industrial Wastewater Volatile Organic Compound Emissions-Background Information for BACT/LAER Determinations	450/3-90-004	PB 90-194754	1990
Polystyrene Foam Manufacturing	450/3-90-020	PB 91-102111	1990

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5

DATA COLLECTION

This section describes effective procedures for obtaining data for emissions inventories. Questionnaires, plant inspections, and agency air pollution files are some of the methods that are useful in collecting emissions data as well as source activity and control data. Selection of the appropriate method of data collection should include consideration of the desired level of detail of the inventory.

5.1 LEVEL OF DETAIL

Point sources can be inventoried at three levels of detail: (1) the plant level, which denotes a plant or facility that could contain several pollutant-emitting activities; (2) the point/stack level, where emissions to the ambient air from stacks, vents, or other points of emission are characterized; and (3) the process/segment level, representing the unit operations of specific source categories. A discussion of these three levels follows and includes the minimum information that will be needed for the inventory regardless of the method selected for collecting the data.

5.1.1 PLANT LEVEL

In a plant-level survey, each plant within the area should be identified and assigned a plant number. The plant should be further identified by geographic descriptors such as nonattainment area, state, county, city, street and/or mailing address, and UTM grid coordinates (or latitude/longitude). A plant contact should also be identified to facilitate communication and interaction with the plant. Additional information gathered regarding the facility should include annual fuel consumption, process throughput, hours of operation, number of employees, and the plant's standard industrial classification (SIC) code. The SIC codes are prepared and published by the U.S. Office of Management and Budget (OMB). A facility can have more than one SIC code denoting the secondary economic activities of the facility.

5.1.2 POINT/STACK LEVEL

In an inventory conducted at the point/stack level, each stack, vent, or other release point that meets or exceeds a specified minimum emission rate should be identified as an emission point. Information obtained at the point/stack level is used in application of mathematical models to correlate air pollutant emissions with ambient air quality. Thus, in addition to the facility identification, location, and plant contact, release characteristics for each emission point are necessary for establishing a comprehensive inventory and performing evaluations with modeling programs. The necessary emission point parameters include location (latitude/longitude), stack height, stack diameter, emission rate, and gas exit velocity.

It is recommended that the location of point sources be reported with a resolution of ±1 second at 30 meters. This level of resolution is consistent with existing data specifications in EPA emissions inventory databases. However, such a high degree of precision in specifying location may only be necessary in a limited number of applications

5.1.3 Process/Segment Level

A plant may include various processes or operations. Each process can usually be identified by an SCC that is used to enter emissions data into a database management system. The information necessary to establish an inventory at this level includes facility identification; facility location; plant contact; process identification information; point level data; applicable regulations; operating rate data, including actual, maximum, and design operating rate or capacity; fuel use and properties data (e.g., ash content, sulfur content, level of trace elements, heat content, etc.); and identification of all pollution control equipment and its associated control efficiency (measured or design).

5.2 Availability and Usefulness of Existing Data

A major inventory planning consideration is whether, and to what extent, existing information can be used. Existing inventories can serve as a starting point for developing extensive data and support information, such as documentation of procedures. Information may also be drawn from other regulatory agency operations such as permitting, compliance, and source inspections and from other facility resources such as corporate reporting or compliance report submittals. For effective use of resources, an agency or facility should plan to fulfill specific emissions inventory requirements by building upon and improving the quality of regularly collected data.

5.3 Data Collection Methods

For point source inventories, you can obtain information by contacting each point source in the inventory area. The two most common types of plant contacts are:

- Surveys; and
- Plant inspections

You can also use indirect plant contact techniques to gather data for point source inventories, such as examining state files (permit applications and compliance files).

You may need to use a combination of data gathering techniques to ensure complete and accurate data are available for compilation of an inventory. Appropriate method(s) are selected during the planning phase of the inventory process, based on data quality objectives and availability of resources.

5.3.1 SURVEYS

You can use the survey technique to obtain source and emissions data, sending a questionnaire to each point source in the inventory area. Figure 1.5-1 shows an example of point source surveying. To conduct a survey you will need to:

- Identify the facilities to be surveyed;
- Prepare the mailing list, including facility addresses and appropriate plant contact personnel;
- Design and assemble the questionnaire;
- Deliver the questionnaire;
- Establish tracking systems to monitor the status of each step in the survey process;
- Prepare data handling procedures; and
- Establish systems to respond to questions or concerns of survey recipients.

While paper questionnaires and return forms are still in use, it is rapidly becoming more common for these forms to be sent to sources, and responses to be returned, in an electronic format. You can send questionnaires to facilities via e-mail, or post them on the Internet. By using standardized electronic forms for data submittal, you can simplify the process for both the surveyed facilities and your agency. Electronic data systems reduce the chance of data entry errors by inventory preparers.

EIIP Volume 3, Chapter 24 provides a detailed description of how to conduct a survey.

5.3.2 PLANT INSPECTIONS

Plant inspections give you the opportunity to examine the various processes at a particular facility, interview plant personnel, and review operations and process schematics. While plant inspection is a very resource-intensive data collection technique, it has several advantages over the survey technique:

- Plant inspection provides more complete and accurate information about a facility than a questionnaire;
- Plant inspection allows you to obtain a more complete understanding of an exceptionally complex or unique process;
- Plant inspections reduce errors that can result from misinterpretation of a question by the plant contact responding to the survey; and

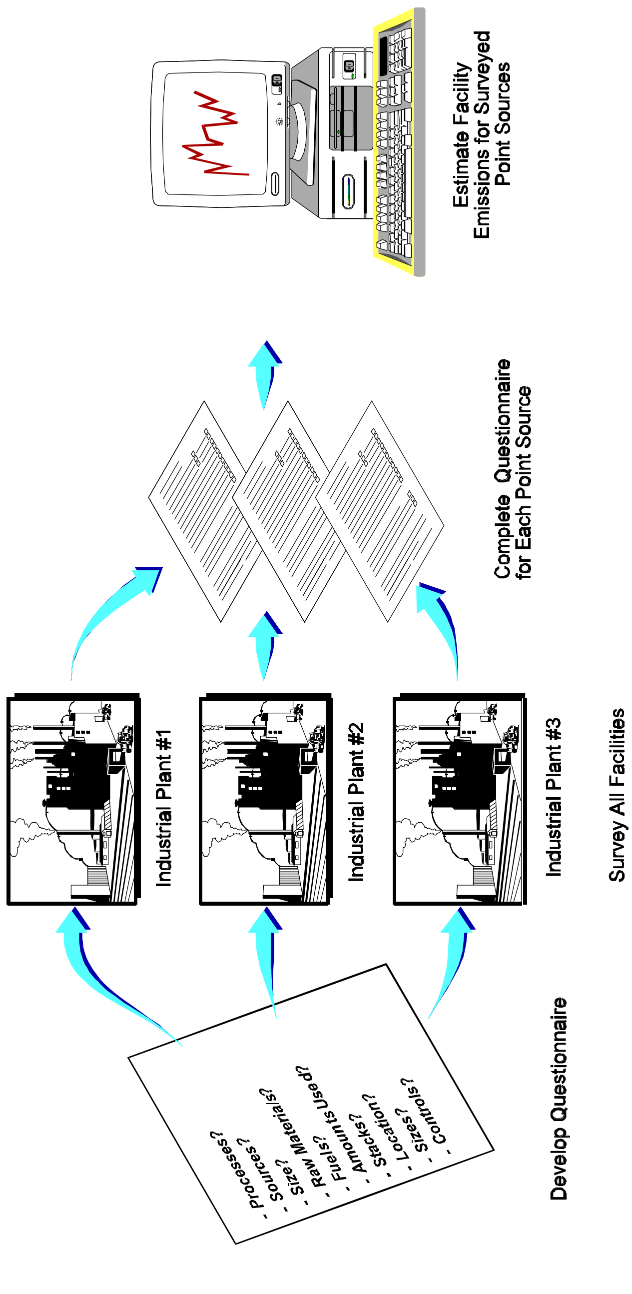

FIGURE 1.5-1. EXAMPLE OF POINT SOURCE SURVEYING

- Plant inspections reduce errors that can result from the inventory agency misinterpreting a response by the plant contact.

5.3.3 Accessing Agency Air Pollution Files

You can also use files maintained by your state/local agency as sources of information. Files that might include data relevant to emissions inventories include:

- Permit files: Permits are generally required for construction, start-up, modifications, and continuing operation of existing facilities. Permit applications include information that can be useful to describe the nature of the source and to estimate the magnitude of emissions that might result from operations.

- Compliance files: Some agencies also maintain compliance files for point sources. These files contain records of communication concerning enforcement issues, as well as a list of air pollution regulations applicable to the specific source.

5.3.4 Emissions Estimates Conducted by Plant Personnel

The number and complexity of processes within a given plant, in addition to the difficulty of accessing all the data necessary to complete emission calculations, can make emissions estimation a complex task, with significant opportunity for error. A few general guidelines for conducting overall emissions estimates for a plant are listed below:

- Identify and document the emission sources;

- Identify the types of pollutants and quantify the emissions;

- Compile the source and emissions data into a useable format;

- Design and implement a quality assurance plan; and

- Seek assistance from EPA, state, and local agencies.

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6

INVENTORY REPORTING AND DOCUMENTATION

Documentation is an integral part of an emissions inventory. The documentation of an inventory compilation process involves two phases: documentation of all data collection and emission estimation activities, and compilation of the inventory into a final written report.

Before submittal, internal review of the written documentation of an inventory's data sources and procedures may uncover errors in assumptions, calculations, or methods. Early correction of these errors will result in a more reliable and technically defensible database, which is essential in some critical aspects of the inventory such as source impact assessments and development of emissions control strategies.

Following submittal of the inventory, the documentation allows the quality of the inventory to be effectively judged. An emissions inventory that is documented according to standardized guidelines enables the receiving agency to review the inventory in a consistent manner. Because it is recognized that some variability is needed to meet the specific needs of each inventory region, standardization is emphasized for the types of data reported, but not the format in which they are reported. Inventories not meeting the minimum data reporting and documentation standards may be deemed unacceptable and returned to the preparer for modification before any further review of technical quality is performed.

The reporting steps of the emissions inventory development process should be anticipated during planning. Planning the level of documentation required will:

- Ensure that important supporting information is properly developed and maintained;

- Allow extraneous information to be identified and discarded, thereby reducing the paperwork burden;

- Help determine data storage requirements; and

- Aid in identifying aspects of the inventory on which to concentrate the QA efforts.

6.1 Documentation of Data Collection and Emission Estimation Activities

Documentation of data collection and emission estimation activities includes the daily recordkeeping that occurs during the inventory preparation process. This documentation is critical to both the integrity of the inventory process and the preparation of the final report and includes:

- Complete documentation of methods used for all data collection, including explanation of any deviations from the prescribed methods;
- Explanation of all assumptions made in the data collection or analysis;
- All raw data, including identification of the source of each data point;
- All calculations, including copies of work conducted manually and all electronic spreadsheets or databases;
- Records of all relevant communication with team members and data contacts;
- QA/QC records, including responses to issues identified by audits; and
- Identification of sources of emissions not included in the inventory.

The source and type of the raw data will determine what type of information must be placed in the project file.

If the data were collected from...	**Then you must maintain the following records...**
Surveys	Original survey forms
Site visits	Site visit notes and reports
Source test reports	Complete copies of the reports
Internet pages or electronic bulletin boards	- Hard copy printouts of the pertinent data - Electronic copies of complete original data - Complete reference citation
Published document	- Complete reference citation - When possible, copies of the pages with the data used in the inventory

If the data were collected from...	Then you must maintain the following records...
Unpublished documents or reports	- Complete reference citation - Copies of all pages with data used in the inventory - When possible, a copy of the entire document
Personal communication - written	- Complete reference citation (contact name, affiliation, address or phone number, data of communication) - Copies of all pages with data used in the inventory - When possible, a copy of the entire document
Personal communication - verbal	Standardized Contact Report Form should be completed to record information obtained by telephone or at a meeting. An example Contact Report form is presented in EIIP Volume VI, Chapter 2.

6.2 Reporting the Results of an Inventory

Written documentation should include summary tables and a report discussing the inventory development procedures and point source results. Large volumes of detailed data should be put into appendices but clearly linked to the text discussion in terms of how they were used to determine emissions.

For inventories prepared by a plant, emissions may be summarized by pollutant, equipment/source, and or stack. For larger inventories prepared by a state or local agency, the presentation maybe more broadly focused by source category and/or county. Graphics may be useful to illustrate the contribution of point sources to areawide emissions.

The appendices should contain the results of all information surveys that have been conducted. All sources inventoried should be listed according to their source category type (e.g., storage tank, process vent, petroleum refinery, graphic arts, degreasing, etc.). All references and other data sources should also be included or, if they are too voluminous, they should be clearly cited in the inventory submittal and kept in a readily accessible location on site.

EPA defined a new data transfer format in order to minimize duplication of data and to enable all users the flexibility of a relational database transfer system. This new format also allows data to be mapped into a variety of alternative database structures. Further, the end use of this system is to consolidate the National Emission Trends (NET) inventory and the National Toxics Inventory (NTI) into one National Emission Inventory (NEI). The NEI Input Format (referred to as NIF), is designed to accommodate the transfer of toxics data. Table 1.6-1 lists the data elements that

TABLE 1.6-1

DATA REPORTING ELEMENTS FOR THE NATIONAL EMISSION INVENTORY (ANNUAL AND TRIENNIAL)

Data Element	
Record type	Primary percent control efficiency
State Federal Information Processing Standards (FIPS) code	Percent capture efficiency
County FIPS code	Total capture control efficiency
Site ID	Primary device type code
Emission Unit ID	Material/Material I/O
Process ID	Process MACT code
Pollutant code	Process MACT compliance status
Emission Release Point ID	Rule effectiveness
Start Date	Stack height
End Date	Stack diameter
Annual emissions	Exit gas temperature
Emission factor	Exit gas velocity
SCC	Exit gas flow rate
SIC	Emission release point type
NAICS	XY coordinate type
Inventory year	X coordinates (longitude)
Inventory type code	Y coordinates (latitude)
Source type	UTM coordinates
Hours per day (period and average)	Transaction type
Hours per period (period and average)	Transaction creation date
Days per week (period and average)	Facility name

TABLE 1.6-1

(CONTINUED)

Data Element	
Weeks per period (period and average)	Facility location (street, city, state, zip code)
Actual throughput	Facility category
Winter throughput (%)	Address type code
Spring throughput (%)	Organization name
Summer throughput (%)	Contact (name, phone number, fax number, email)
Fall throughput (%)	Contact type code
Control status	Secondary control efficiency (triennial only)
Format version of submittal	Design capacity (triennial only)
Incremental submission number	Maximum nameplate capacity (triennial only)

Source: EPA, 2000a.

should be reported for annual and triennial National Emission Inventories for criteria pollutants. This data can be downloaded at www.epa.gov/ttn/chief/eidocs/index.html for review, or for further explanation of each data element.

Further, the Consolidated Emissions Reporting Rule (CERR) has proposed reporting requirements for Hazardous Air Pollutants (HAPs). This proposed rule requires reporting of HAP emissions for plants emitting at least 10 tons per year of any one HAP, or 25 tons per year of two or more. This rule also proposes submittal of the same data elements as that required for criteria pollutants, and would be included as part of the triennial inventory. Table 1.6-2 shows the data elements that should be reported for (HAPs) inventories.

The term data element refers to any piece of information used in the inventory compilation process. These data element requirements may be modified over time and inventory agencies should contact the EPA Regional office for the most recent list of required data elements. Reports must meet the format and content requirements specified by the regulation or the agency requiring the inventory and should include:

- Introduction describing the purpose for the inventory development;

TABLE 1.6-2

DATA REPORTING ELEMENTS FOR TOXICS FOR INCORPORATION INTO THE NATIONAL EMISSION INVENTORY

Data Element	
State FIPS	Start Date
County FIPS	End Date
Site ID	Emission Release Point ID
Process ID	Emission Numeric Value
Emission Unit ID	Emission Unit Numerator
Pollutant Code	Emission Type
Primary Device Type Code	Control Status
Primary Pct Control Efficiency	Emission Data Level
Percent Capture Efficiency	Process MACT Code
Total Capture Control Efficiency	Process MACT Compliance Status
Stack Height	X Coordinate
Stack Diameter	Y Coordinate
Exit Gas Temperature	UTM Zone
Exit Gas Velocity	XY Coordinate Type
Exit Gas Flow Rate	Record Type
SIC Primary	Facility Category
NAICS Primary	Facility Name
Organization Name	Street Line 1
Transaction Type	City
Inventory Year	State
Inventory Type Code	Zip Code
Format Version	Address Type Code
Transaction Creation Date	Contact Person Name

TABLE 1.6-2

(CONTINUED)

Data Element	
State FIPS	Start Date
Incremental Submission Number	Contact Person Phone Number
Source Type	Contact Person Email Address
Contact Type Code	

- Executive summary of the inventory results;
- Base year of the inventory;
- Geographic area;
- Summary of the emissions data, presented in a matrix format to include pollutant, source, and geographic area;
- Procedures used to collect the data;
- Sources of data, including citations for all emission factors and activity data;
- Methods used to calculate emissions, including example calculations;
- Complete explanation of all assumptions made in the estimation process;
- QA/QC checklists and all audit reports;
- Sample copies of questionnaires, and information concerning the number of questionnaires sent, the number of responses received, methods for extrapolating data to account for nonrespondents, and any assumptions made; and
- Identification of sources of emissions not included in the inventory.

Each EPA Regional Office will determine what information must be submitted as hard copy documentation. Data must be submitted to EPA in an electronic form. Inventory preparers can submit data to EPA using one of several data transfer options. The appropriate data transfer method is identified during the planning stage of the inventory process, based on the end use of the inventory and availability of resources.

Keep in mind that information technology is a rapidly changing field, and electronic reporting of inventory data is an evolving issue. Refer to the EPA Data Submission page at http:/www.epa.gov/ttn/chief/eidocs/index.html#net for updates on emissions reporting.

Three options are available for data reporting to EPA; refer to Appendix L for a detailed description of these methods. The reporting options are:

- NET Input Format;
- EIIP EDI X12; and
- Direct Source Reporting.

NOTE: The NET Input Format is the preferred option for submitting area source data. You should consult the AIRS/AFS Web site at *http://www.epa.gov/ttn/airs/afs/index.html* for the latest memos and information on the plans to migrate the emissions components of AIRS/AFS to the NET database.

If your agency decides not to use any of these methods, they are still required to submit their data in electronic form. Agencies can make special arrangements with EPA to submit another electronic format, but, because of limited resources, EPA may not be able to enter the data into the EPA system. If an agency does not submit data to EPA in a form it can process, EPA may generate data to represent the emissions from the area.

7

QUALITY ASSURANCE/ QUALITY CONTROL

The development of a reasonable and comprehensive emissions inventory requires the implementation of quality assurance/quality control (QA/QC) procedures throughout the entire inventory process. The main objective of the QA and QC for emissions inventories is the development of accurate, useful, and reliable data. These procedures should be applied consistently by the state or local agency in preparing or reviewing inventories.

Prior to establishing a quality program or plan, the meaning of quality as it relates to the inventory should be clarified. Quality control is the overall system of routine technical activities that are designed to measure and control the quality of the inventory as it is being developed. Quality assurance is an integrated system or program of activities involving planning, QC, quality assessment, reporting, and quality improvements which are designed to help ensure that the inventory meets the data quality goals or objectives established prior to developing the inventory.

DQI

DQIs, data quality indicators, are qualitative and quantitative descriptors used to interpret the degree of acceptability or utility of the data. The principal DQIs are:

- Accuracy: The closeness of a measurement to the true value, or the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of error (precision) and systematic error (bias) that are due to sampling and analytical operations;

- Comparability: The degree to which different methods, data sets, or decisions agree or can be represented as similar;

- Completeness: The amount of valid data obtained compared to the planned amount; and

- Representativeness: Degree to which an inventory is representative of the region and sources it is meant to cover.

Refer to EIIP Volume VI for additional information about DQIs.

DQO

DQOs, data quality objectives, are qualitative and quantitative statements to identify the level of uncertainty that a decision-maker is willing to accept. The purpose of DQOs is to ensure that the final data will be sufficient for the intended use.

DQOs are identified as part of the inventory planning process. They are determined based on the end use of the inventory, but should realistically reflect the limitations resulting from time constraints, resource (staff and funding) limitations, and lack of data. A statement of DQOs should be prepared as part of the inventory preparation plan.

NOTE: Your task manager is responsible for defining the DQOs for the inventory. Your responsibility as the inventory preparer is to make sure your results meet the agreed upon DQOs.

The development of a DQO statement is an iterative process. The managers must work together to balance the quality objectives and the available resources. It is important to acknowledge the constraints that limit the ultimate quality of the inventory, especially if the achievable DQOs fall short of the desired DQOs.

Refer to EIIP Volume VI for additional information about DQOs.

7.1 QUALITY CONTROL

Quality control is the performance of standardized activities during the course of inventory preparation to ensure data quality. Quality control activities include technical reviews, accuracy checks, and the use of approved standardized procedures for emissions calculations. These internal activities are designed to provide the first level of quality checking and should be included in inventory development planning, data collection, data analysis, emissions calculation, and reporting. Quality control is best implemented through the use of standardized checklists that assess the adequacy of the data and procedures at various intervals in the inventory process. Specifically, QC checklists are used to monitor the following procedures and tasks:

- Data collection;
- Data calculation;
- Emission estimates;
- Data validity;
- Data reasonableness;
- Data completeness;
- Data coding and recording; and

- Data tracking.

The checklist can aid the preparer in finalizing the inventory prior to submittal to a reviewing agency. An example QC checklist for stationary point sources is included in Appendix N. This checklist includes questions concerning completeness (e.g., questions whether all the VOC point sources $\geq$ 10 tpy have been accounted for); use of approved procedures (e.g., questions as to which model was used to estimate wastewater treatment emissions); and reasonableness (e.g., questions whether all stack heights are greater than 50 feet and all stack diameters between 0.5 and 30 feet). For additional information and guidance on applying reasonableness or reality checks to an inventory, please refer to Chapter 3, Volume VI of the EIIP series.

7.2 Quality Assurance

The keys to the success of a QA/QC program are proper planning and the involvement of QA personnel to help design the QC program. An essential part of proper planning is the specification of the data quality objectives. Much of the data used for inventories are not sufficient to establish quantitative goals. Therefore, qualitative goals must be specified.

Quality assurance activities include helping inventory preparers identify critical phases of the inventory development process that will affect the technical soundness, accuracy, and completeness of the inventory. After identifying these phases of the process, QC procedures are developed to monitor the quality of the data and work to help ensure the generation of an accurate and complete inventory. Other QA activities include the evaluation of the effectiveness of these QC procedures by conducting data and procedural audits at critical phases of the inventory development process.

If quality concerns are found during QA audits, they should be discussed with the personnel involved so that actions can be taken immediately to resolve the issues. The quality concerns, recommendations for corrective actions, and satisfactory aspects of the QC program should be summarized in an audit report. Inventory development personnel are responsible for the resolution of the quality concerns in a timely fashion so that the work progresses as planned and the quality of the data is always being optimized.

Table 1.7-1 lists six important quality goals for inventories and gives general methods for achieving those goals.

7.3 QA/QC Procedures for Specific Emission Estimation Methods

7.3.1 Source Tests and Continuous Emissions Monitoring (CEM)

The main objective of any QA/QC effort for any program is to independently assess and document the precision, accuracy, and adequacy of data. In an emissions inventory developed from source tests and CEM, the data of interest will be that generated during sampling and analysis. As a first step, a QA Plan should be developed by the team conducting the test prior to

TABLE 1.7-1

METHODS FOR ACHIEVING EMISSION INVENTORY DATA QUALITY OBJECTIVES

Data Quality Objectives	Methods
Ensure correct implementation of EPA guidance.	C Review inventory documentation, comparing actual procedures used to those required.
Where EPA guidance was not used or unavailable, assess bias by evaluating the reasonableness of the approach used.	C Technical review of approach used. C Compare with results from other methods.
Ensure accuracy of input data.	C Check accuracy of transcription of data. C Check any conversion factors used. C Assess validity of assumptions used to calculate input data. C Verify that the data source was current and the best available.
Ensure accuracy of calculations.	C Reconstruct a representative sample (or all) by hand.
Assess comparability and representativeness of inventory.	C Compare emissions to those from similar inventories. C Cross-check activity data by comparing it to surrogates.
Assess completeness of inventory.	C Compare list of source categories or emission points to those listed in EPA guidance. C Cross-check against other published inventories, business directories, etc.

each specific field test. Next, it is essential to the production of valid test data that the emissions measurement program be performed by qualified personnel using appropriate and properly functioning test equipment. Sampling equipment, such as flow meters and gauges, must be properly calibrated and maintained. Emphasis is placed upon these standard practices as means of ensuring the validity of results. Deviations from standard procedures must be kept to a minimum and applied only when absolutely necessary to obtain representative samples. For compliance testing, deviations from standard procedures may be used only with approval of the regulatory agency. Any changes in methodology must be based on sound engineering judgement and must be thoroughly documented.

Thorough descriptions of stack sampling procedures, source sampling tools and equipment, identification and handling of samples, laboratory analysis, use of the sampling data, and preparation of reports are available in several references, such as the *Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III. Stationary Source Specific Methods* (EPA, 1984). This document also contains a detailed discussion of interpretations of CEM data, required accuracy calculations, specific criteria for unacceptable CEM data, and indications that a CEM is out of control.

A systems audit should be conducted on-site as a qualitative review of the various aspects of a total sampling and/or analytical system to assess its overall effectiveness. The systems audit should represent an objective evaluation of each system with respect to strengths, weaknesses, and potential problem areas. The audit provides an evaluation of the adequacy of the overall measurement system(s) to provide data of known quality which are sufficient, in terms of quantity and quality, to meet the program objectives.

Quality control procedures for all instruments used to continuously collect emissions data are identical. The primary control check for precision of the continuous monitors is daily analysis of control standards.

The emission rates of a particular pollutant are a function of a number of stack gas parameters such as concentration and flow rate which are measured during testing. Sensitivity and error analyses illustrate the extent to which the emission estimate may be affected by variability in the measured values. See Volume VI of the EIIP series of guidance documents for additional information on evaluating how the quality of the calculated emission rates are affected by the accuracy of the measurements.

7.3.2 Material Balances

The accuracy and reliability of emission values calculated using the material balance approach are related to the quality of material usage and speciation data, and knowledge of the different fate pathways for the material.

The quantity of material used in an operation is often "eye-balled," a procedure that can easily result in an error of as great as 25 percent. This level of uncertainty can be reduced by using a standardized method of measuring quantities such as a gravimetric procedure (e.g., weighing a container before and after using the material) or use of a stick or gauge to measure the level of liquid in a container. For certain applications (e.g., those where very small quantities of materials are used), it may be more accurate to make these types of measurements monthly or annually, rather than after each application event. Another technique for determining usage quantities would be to use purchase and inventory records.

Uncertainty of emissions using the material balance approach is also related to the quality of material speciation data, which is typically extracted from Material Safety Data Sheets (MSDSs). If speciation data are not available on the MSDS, the material manufacturer should be contacted. Finally, a thorough knowledge of the amount of a material exiting a process through each fate pathway is needed. Typical fate pathways include product, recycle/reuse, solid waste, liquid waste, and air emissions.

7.3.3 Emission Factors

Realizing that site specific test or CEM data are not always available or the most cost effective means for estimating air emissions from a facility, emission factors are often used as an alternative method for calculating emissions. Data used to develop emission factors available in *AP-42* or the FIRE system, for example, are obtained from source tests, material balance studies, and engineering estimates. *AP-42* and FIRE identify any qualifications or limitations of the data. *AP-42* and FIRE emission factors represent the best available information on average emissions from the identified source categories as of the date of factor publication.

Each emission factor published in *AP-42* or FIRE receives a quality rating, which serves as an assessment of the confidence the generator of that value places in the quality of the emission factor. When using existing emission factors, the user should be familiar with the criteria for assigning both data quality ratings and emission factor ratings as described in the document *Technical Procedures for Developing AP-42 Emission Factors and Preparing AP-42 Sections* (EPA, 1993b).

The data quality ratings for source tests are as follows:

- A-Rated Test - Excellent - The test(s) was performed by a sound methodology and reported in enough detail for adequate validation. These tests are not necessarily EPA reference test methods, although such reference methods are certainly to be used as a guide.

- B-Rated Test - Above Average - The test(s) was performed by a generally sound methodology but lacked enough detail for adequate validation.

- C-Rated Test - Average - The test(s) was based on a nonvalidated or draft methodology or lacked a significant amount of background data.

- D-Rated Test - Below Average - Test(s) was based on a generally unacceptable method but may provide an order-of-magnitude value for the source.

Once the data quality ratings for the source tests are assigned, these ratings along with the number of source tests available for a given emission point are evaluated. Because of the almost impossible task of assigning a meaningful confidence limit to industry-specific variables (e.g., sample size versus sample population, industry and facility variability, method of measurement), the use of a statistical confidence interval for establishing a representative emission factor for each source category is usually not practical. Therefore, some subjective quality rating is necessary. The following factor quality ratings are used for the emission factors found in *AP-42*, FIRE, or any EPA published document:

- A - Excellent - The emission factor was developed only from A-rated test data taken from many randomly chosen facilities in the industry population. The source category is specific enough to minimize variability within the source category population.

- B - Above Average - The emission factor was developed only from A-rated test data from a reasonable number of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. As with the A-rating, the source category is specific enough to minimize variability within the source category population.

- C - Average - The emission factor was developed only from A- and B-rated test data from a reasonable number of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. As with the A-rating, the source category is specific enough to minimize variability within the source category population.

- D - Below Average - The emission factor was developed only from A- and B-rated test data from a small number of facilities, and there may be reason to suspect that these facilities do not represent a random sample of the industry. There also may be evidence of variability within the source category population.

- E - Poor - The emission factor was developed from C- and D-rated test data, and there may be reason to suspect that the facilities tested do not represent a random sample of the industry. There also may be evidence of variability within the source category population.

- U - Unrated or Unratable - The emission factor was developed from suspect data with no supporting documentation to accurately apply an "A" through "E" rating. A "U" rating may be applied in the following circumstances (FIRE):

  U1 - Mass Balance (for example, estimating air emissions based on raw material input, product recovery efficiency, and percent control).

  U2 - Source test deficiencies (such as inadequate quality assurance/quality control, questionable source test methods, only one source test).

  U3 - Technology transfer.

  U4 - Engineering judgement.

U5 - Lack of supporting documentation.

7.3.4 MODELING

When a model or other software program is used to calculate emissions, manual verification (by hand) of each type of calculation should be performed. If the calculations are complex and can not be easily reconstructed, an alternative approach is to try to duplicate the results using another calculation method. The input data should also be verified for accuracy. For additional guidance on QA/QC procedures for using models, refer to Chapter 3, *General QA/QC Methods* (EIIP, 1996).

7.4 DATA ATTRIBUTE RATING SYSTEM (DARS)

The EPA has developed a Data Attribute Rating System (DARS) to assist in evaluating data associated with emission inventories (Beck, et al., 1994). The system disaggregates emission inventories into emission factors and activity data, then assigns a numerical score to each of these two components. Each score is based on what is known about the factor and activity parameters, such as the specificity to the source category and the measurement or estimation techniques employed. The resulting emission factor and activity data scores are combined to arrive at an overall confidence rating for the inventory.

The DARS defines certain classifying attributes that are believed to influence the accuracy, appropriateness, and reliability of an emission factor or activity and derived emission estimates. This approach is semiquantitative in that it uses numeric scores; however, scoring is based on qualitative and often subjective assessments. The proposed approach, when applied systematically by inventory analysts, can be used to provide a measure of the merits of one emission estimate relative to another.

The DARS provides the means for determining the comparability and transparency of rated inventories. The inventory with the higher overall rating is likely to be a better estimate given the techniques and methodologies employed in its development. Several methods of combining the values are discussed and compared in the paper entitled *A Data Attribute Rating System* (Beck, et al., 1994).

8

REFERENCES

Appendix A, Instructions and Conventions for Using NEI Input Format, Version 2.0. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina (Internet address: http://www.epa.gov/ttn/chief/eidocs/index.html#pack2).

ASTM, *Annual Book of ASTM Standards*, Volumes 06.01 and 15.05. September 1992. Washington, D.C.

Beck, L. L., R. L. Peer, L. A. Bravo, and Y. Yan. November 3, 1994. *A Data Attribute Rating System.* Presented at the Air and Waste Management Association Specialty Conference on Emission Inventory Issues. Raleigh, North Carolina.

Chem9 Modeling Program. U.S. Environmental Protection Agency, Research Triangle Park, NC, November 1998.

Clean Air Report. June 15, 1995. *Status of EPA's Enhanced Monitoring Rule--Results of the First Stakeholders' Meeting.* Washington, DC.

Code of Federal Regulations, Title 40, Part 60, Appendix A, updated 7/1/99.

Code of Federal Regulations, Title 40, Part 61, Appendix B.

Dobie, N. 1992. *Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources* (Revised). EPA-450/4-81026d. U.S. Environmental Protection Agency. Research Triangle Park, North Carolina.

EIIP. 1996. *General QA/QC Methods, Final Report, Volume VI, Chapter 3*, Quality Assurance Committee, Emission Inventory Improvement Program, Research Triangle Park, North Carolina.

EPA. 1978. *Technology Transfer Handbook--Industrial Guide for Air Pollution Control*. EPA-625/6-78-004. U.S. Environmental Protection Agency, Environmental Research Information Center. Cincinnati, Ohio.

EPA. 1984. *Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III. Stationary Source Specific Methods.* EPA-600/4-77-027b. U.S. Environmental Agency. Cincinnati, Ohio.

EPA. 1986. *Test Methods for Evaluating Solid Waste*, SW-846, Third Edition. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. Washington, DC.

EPA. 1988. *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*, EPA-600/4-89-017, [Supplements: 600/4-87-006 and 600/4-87-013] U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC.

EPA. 1989. *Air/Superfund National Technical Guidance Study Series, Volume I: - Application of Air Pathway Analyses for Superfund Activities; Interim Final*, EPA-450/1-89-001. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina.

EPA. 1991a. *Emission Inventory Requirements for Carbon Monoxide State Implementation Plans*. EPA-450/4-91-011. Office of Air Quality Planning and Standards. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.

EPA. 1991b. *Emission Inventory Requirements for Ozone State Implementation Plans*. EPA - 450/4-91-010. U.S. Environmental Protection Agency. Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina.

EPA. 1991c. *Pollution Prevention Grants Program*. U.S. Environmental Protection Agency, Office of Pollution Prevention. Washington, DC.

EPA. 1991d. *Handbook: Control Technologies for Hazardous Air Pollutants*. EPA-625/6-91-014. U.S. Environmental Protection Agency, Office of Research and Development, Center for Environmental Research Information. Cincinnati, Ohio.

EPA. 1992a. *AIRS User's Guide Volume XI: AFS Data Dictionary*. U.S. Environmental Agency, Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina.

EPA. 1992c. *Guidance on the Implementation of an Emission Statement Program*. (Draft) U.S. Environmental Protection Agency. Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina.

EPA. 1992d. *Screening Methods for the Development of Air Toxics Emission Factors*. EPA-450/4-91-021. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina.

EPA. 1992e. *Integrated Reporting Issues: Preliminary Findings*. EPA-454/R-92-022. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina.

EPA. 1993a. *Introduction to Air Pollutant Emission Estimation Techniques For Industry*, final report. Office of Air Quality Planning and Standards, EPA Contract No. 68-D9-0173, Work Assignment No. 3/316. Research Triangle Park, North Carolina.

EPA. 1993b. *Technical Procedures for Developing AP-42 Emission Factors and Preparing AP-42 Sections.* EPA-454/B-93-050. U.S. Environmental Agency, Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina.

EPA. 1993c. *VOC/PM Speciation Data System Documentation and User's Guide, Version 1.5.* EPA-450/4-92-027. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina.

EPA. 1998. *Handbook for Air Toxics Emission Inventory Development, Volume I: Stationary Sources.* EPA-454/R-98-002. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, November 1998.

EPA. 1999a. *Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations*. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, EPA-454/R-99-006. Research Triangle Park, North Carolina.

EPA. 1999b. *Handbook for Criteria Pollutant Inventory Development, A Beginner's Guide for Point and Area Sources.* Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina.

EPA. 2000a. *1999 National Emission Inventory Data Incorporation Plan, (Draft).* U.S. Environmental Protection Agency. Research Triangle Park, North Carolina.

EPA. 2000b. *Compilation of Air Pollutant Emission Factors - Volume I: Stationary Point and Area Sources, Fifth Edition and Supplements A-B,* AP-42, U.S. Environmental Protection Agency. Research Triangle Park, North Carolina.

EPA. 2000c. *Factor Information Retrieval System (FIRE), Version 6.23*. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina.

EPA. 2000d. Federal Register, Proposed Rule, Volume 65, No. 100. May 23, 2000.

Federal Register, Vol. 39, p. 37119. *Procedures for Voluntary Preparation of Environmental Impact Statements.* October 21, 1974.

Federal Register, Volume 58, No. 203, Friday, October 22, 1993.

Fink, A. and J. Kosecoff, 1998. *How to Conduct Surveys: A Step-by-Step Guide.* Sage Publications, Thousand Oaks, CA.

Hunt, W.F., Jr. May 17, 1995. Telefax Letter from William F. Hunt, Jr., Director, Emissions, Monitoring, and Analysis Division, U.S. Environmental Protection Agency, To Stakeholders. Research Triangle Park, North Carolina.

McLean, Brian. June 26-30, 2000. *The U.S. Acid Rain Program: Overview and Lessons Learned*. Cap and Trade Program Design Training, Washington D.C.

Procedures for Preparing Emission Factor Documents. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Office of Air and Radiation, Research Triangle Park, North Carolina, November 1997.

Radian Corporation. 1996. *Emissions Inventory Development: Point Sources, Draft*. Prepared for the Mexico Emissions Inventory Development Program under Contract to the Western Governors Association. Radian Corporation. Sacramento, California.

Russell, John J., Managing Editor. 1992. *National Trade and Professional Associations of the United States*. 27th Annual Edition. Columbia Books, Inc., Washington, D.C.

Southerland, J., September 9, 1991. *Air Emissions Inventory and Estimation Fundamentals*. Presented at the Air and Waste Management Association Specialty Conference on Emission Inventory Issues in the 1990s. Durham, North Carolina.

Speciate. VOC/PM Speciation Database Management System, Version 3.1. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, 2000.

TANKS: Storage Tank Emissions Estimation Software, Version 4.0x. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

APPENDIX A

LIST OF HAZARDOUS AIR POLLUTANTS AND ASSOCIATED MACT SOURCE CATEGORIES

[NOTE: These tables include only MACT source categories for which national-level HAP emission estimates have been developed under EPA's National Toxic Inventory Development Program; they do not include all HAP emissions from all MACT sources. Source: U.S. Environmental Protection Agency, 1998. *Baseline Emissions Inventory of HAP Emissions from MACT Sources*. Prepared by the Emission Factor and Inventory Group, Research Triangle Park, North Carolina.]

Source: *Handbook for Air Toxics Emission Inventory Development, Volume I: Stationary Sources, Appendix I,* EPA-454-/B-98-002, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, November 1998.

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Hazardous Air Pollutants and Their Associated MACT Source Categories

1,1,2,2-Tetrachloroethane (79345)	
Chlorine Production	Portland Cement Manufacturing: Hazardous Waste-fired
Hazardous Waste Incineration	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Medical Waste Incinerators	Secondary Lead Smelting
MON	Sewage Sludge Incineration
Municipal Landfills	Tire Production
Polymers & Resins (Excluding P&R III)	
1,1,2-Trichloroethane (79005)	
Chlorine Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Hazardous Waste Incineration	Pulp and Paper Production (non-combustion) MACT I
MON	Steel Foundries
Paper and Other Webs (Surface Coating)	Tire Production
Pharmaceuticals Production	Utilities - Coal
Portland Cement Manufacturing: Hazardous Waste-fired	
1,1-Dimethylhydrazine (57147)	
Chlorine Production	MON
	Polymers & Resins (Excluding P&R III)
1,2,4-Trichlorobenzene (120821)	
Agricultural Chemicals Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Chlorine Production	Pulp and Paper Production (non-combustion) MACT I
MON	Semiconductor Manufacturing
Portland Cement Manufacturing: Hazardous Waste-fired	Tire Production
1,2-Dibromo-3-chloropropane (96128)	
Tire Production	
1,2-Epoxybutane (106887)	
Chlorine Production	Polymers & Resins (Excluding P&R III)
Pharmaceuticals Production	
1,2-Propylenimine (2-Methylaziridine) (75558)	
MON	Polymers & Resins (Excluding P&R III)
Pharmaceuticals Production	
1,3-Butadiene (106990)	
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
Chlorine Production	Secondary Lead Smelting
Coke By-Product Plants	Stationary Internal Combustion Engines
MON	Tire Production
1,3-Dichloropropene (542756)	
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)

Hazardous Air Pollutants and Their Associated MACT Source Categories (Continued)

Chlorine Production	Secondary Lead Smelting
MON	Utilities - Coal
1,4-Dichlorobenzene (p) (106467)	
Agricultural Chemicals Production	MON
Chlorine Production	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Friction Products Manufacturing	Sewage Sludge Incineration
Industrial Boilers	Tire Production
1,4-Dioxane (1,4-Diethyleneoxide) (123911)	
Aerospace Industries	Paper and Other Webs (Surface Coating)
Agricultural Chemicals Production	Pharmaceuticals Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
Iron Foundries	Printing/Publishing (Surface Coating)
MON	Tire Production
2,2,4-trimethylpentane (540841)	
Gasoline Distribution (Stage 1)	Petroleum Refineries: Other Sources Not Distinctly Listed
Oil and Natural Gas Production	Tire Production
2,4,5-Trichlorophenol	
Tire Production	
2,4,6-Trichlorophenol (95954)	
Polymers & Resins (Excluding P&R III)	Tire Production
2,4-D (2,4-Dichlorophenoxyacetic Acid) (94757)	
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
MON	
2,4-Dinitrophenol (51285)	
Agricultural Chemicals Production	MON
Coke By-Product Plants	Polymers & Resins (Excluding P&R III)
Industrial Boilers	Steel Foundries
Institutional/Commercial Boilers	Tire Production
2,4-Dinitrotoluene (121142)	
Industrial Boilers	MON
Institutional/Commercial Boilers	Tire Production
	Utilities - Coal
2,4-Toluene Diisocyanate (584849)	
Clay Products Manufacturing	Polymers & Resins (Excluding P&R III)
Flexible Polyurethane Foam Production	Spandex Production
MON	Vegetable Oil Production

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Paper and Other Webs (Surface Coating)	
2-Chloroacetophenone (532274)	
Industrial Boilers	Tire Production
Institutional/Commercial Boilers	Utilities - Coal
2-Nitropropane	
MON	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Portland Cement Manufacturing: Hazardous Waste-fired	Printing/Publishing (Surface Coating)
3,3-Dichlorobenzidene (91941)	
MON	Tire Production
3,3-Dimethoxybenzidine (119904)	
Tire Production	
3,3'-Dimethylbenzidine (119934)	
Tire Production	
4,4-Methylenebis(2-chloroaniline) (101144)	
Polymers & Resins (Excluding P&R III)	Tire Production
4,4'-Methylenedianiline (101779)	
Chlorine Production	Polymers & Resins (Excluding P&R III)
MON	Tire Production
4,6-Dinitro-o-cresol (including salts) (534521)	
Agricultural Chemicals Production	Tire Production
MON	
4,4'-Methylenedianiline (101779)	
Agricultural Chemicals Production	MON
Boat Manufacturing	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Flexible Polyurethane Foam Production	Printing/Publishing (Surface Coating)
Integrated Iron and Steel Manufacturing	Steel Foundries
Iron Foundries	Vegetable Oil Production
Mineral Wool Production	
4-Aminobiphenyl (92671)	
Tire Production	
Dimethylaminoazobenzene (60117)	
Tire Production	
4-Nitrobiphenyl (92933)	
Tire Production	

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

4-Nitrophenol (100027)	
Agricultural Chemicals Production	Institutional/Commercial Boilers
	MON
Industrial Boilers	Tire Production
Acetaldehyde (75070)	
Baker's Yeast Manufacturing	Pulp and Paper Production (combustion) MACT II
Chlorine Production	Pulp and Paper Production (non-combustion) MACT I
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Sewage Sludge Incineration
MON	Stationary Internal Combustion Engines
Municipal Waste Combustors	Stationary Turbines
Other Biological Incineration	Tire Production
Paper and Other Webs (Surface Coating)	Utilities - Coal
Plywood/Particle Board Manufacturing	Utilities - Oil
Polymers & Resins (Excluding P&R III)	
Acetamide (60355)	
MON	
Acetonitrile (75058)	
Agricultural Chemicals Production	Portland Cement Manufacturing: Hazardous Waste-fired
MON	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Paper and Other Webs (Surface Coating)	Sewage Sludge Incineration
Pharmaceuticals Production	Tire Production
Polymers & Resins (Excluding P&R III)	
Acetophenone (98862)	
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Tire Production
Pharmaceuticals Production	Utilities - Coal
Pulp and Paper Production (non-combustion) MACT I	
Acrolein (107028)	
Chlorine Production	Pulp and Paper Production (non-combustion) MACT I
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Stationary Internal Combustion Engines
MON	Tire Production
Polymers & Resins (Excluding P&R III)	Utilities - Coal
Acrylamide (79061)	
MON	Polymers & Resins (Excluding P&R III)

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Paper and Other Webs (Surface Coating)	

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Acrylic Acid (79107)	
Agricultural Chemicals Production	Pharmaceuticals Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
MON	Printing/Publishing (Surface Coating)
Paper and Other Webs (Surface Coating)	
Acrylonitrile (107131)	
Acrylic Fibers/Modacrylic Fibers Production	Polymers & Resins (Excluding P&R III)
Agricultural Chemicals Production	Portland Cement Manufacturing: Hazardous Waste-fired
Chlorine Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Clay Products Manufacturing	Publicly Owned Treatment Works (POTW) Emissions
MON	Secondary Lead Smelting
Municipal Landfills	Sewage Sludge Incineration
Paper and Other Webs (Surface Coating)	Tire Production
Pharmaceuticals Production	
Allyl Chloride (107051)	
Chlorine Production	Polymers & Resins (Excluding P&R III)
MON	Tire Production
Pharmaceuticals Production	
Aniline (62533)	
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
Chlorine Production	Portland Cement Manufacturing: Hazardous Waste-fired
MON	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Paper and Other Webs (Surface Coating)	Tire Production
Pharmaceuticals Production	
Antimony & Compounds	
Agricultural Chemicals Production	Primary Copper Smelting
Asphalt Roofing Manufacturing	Primary Lead Smelting
Clay Products Manufacturing	Printing/Publishing (Surface Coating)
Coke By-Product Plants	Pulp and Paper Production (combustion) MACT II
Ferroalloys Production	Secondary Aluminum Production
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Semiconductor Manufacturing
Iron Foundries	Sewage Sludge Incineration
Medical Waste Incinerators	Steel Foundries
MON	Utilities - Coal
Paper and Other Webs (Surface Coating)	Utility Turbines
Polymers & Resins (Excluding P&R III)	

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Arsenic & Compounds (inorganic including Arsine)	
Aerospace Industries	Primary Copper Smelting
Agricultural Chemicals Production	Primary Lead Smelting
Clay Products Manufacturing	Printing/Publishing (Surface Coating)
Crematories	Pulp and Paper Production (combustion) MACT II
Hazardous Waste Incineration	Secondary Aluminum Production
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Sewage Sludge Incineration
Iron Foundries	Steel Foundries
Medical Waste Incinerators	Utilities - Coal
MON	Utilities - Natural Gas
Municipal Waste Combustors	Utilities - Oil
Pharmaceuticals Production	Utility Turbines
Plywood/Particle Board Manufacturing	Wool Fiberglass Manufacturing
Asbestos (1332214)	
Asphalt Concrete Manufacturing	Chlorine Production
Asphalt Roofing Manufacturing	Paper and Other Webs (Surface Coating)
Benzene (71432)	
Aerospace Industries	Paper and Other Webs (Surface Coating)
Agricultural Chemicals Production	Petroleum Refineries: Other Sources Not Distinctly Listed
Asphalt Concrete Manufacturing	Pharmaceuticals Production
Asphalt Roofing Manufacturing	Polymers & Resins (Excluding P&R III)
Carbon Black Production	Portland Cement Manufacturing: Hazardous Waste-fired
Chlorine Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Clay Products Manufacturing	Printing/Publishing (Surface Coating)
Coke By-Product Plants	Publicly Owned Treatment Works (POTW) Emissions
Coke Ovens: Charging, Top Side, and Door Leaks	Pulp and Paper Production (combustion) MACT II
Coke Ovens: Pushing, Quenching, and Battery Stacks	Pulp and Paper Production (non-combustion) MACT I
Gasoline Distribution (Stage 1)	Secondary Lead Smelting
Hazardous Waste Incineration	Sewage Sludge Incineration
Industrial Boilers	Stationary Internal Combustion Engines
Institutional/Commercial Boilers	Stationary Turbines
Integrated Iron and Steel Manufacturing	Steel Foundries
Iron Foundries	Taconite Iron Ore Processing
Marine Vessel Loading Operations	Tire Production
Medical Waste Incinerators	Utilities - Coal

Hazardous Air Pollutants and Their Associated MACT Source Categories (Continued)

MON	Utilities - Natural Gas
Municipal Landfills	Utilities - Oil
Oil and Natural Gas Production	Utility Turbines
Benzidine (92875)	
Tire Production	
Benzotrichloride (98077)	
Chlorine Production	Pulp and Paper Production (non-combustion) MACT I
MON	Tire Production
Benzyl Chloride (100447)	
Chlorine Production	Pharmaceuticals Production
Industrial Boilers	Polymers & Resins (Excluding P&R III)
Institutional/Commercial Boilers	Tire Production
MON	Utilities - Coal
Beryllium & Compounds	
Clay Products Manufacturing	Pulp and Paper Production (combustion) MACT II
Crematories	Sewage Sludge Incineration
Industrial Boilers	Steel Foundries
Institutional/Commercial Boilers	Utilities - Coal
Medical Waste Incinerators	Utilities - Oil
MON	Utility Boilers - Coke
Municipal Waste Combustors	Utility Turbines
Primary Copper Smelting	
Biphenyl (92524)	
Agricultural Chemicals Production	Pharmaceuticals Production
Carbon Black Production	Polymers & Resins (Excluding P&R III)
Chlorine Production	Rayon Production
Coke By-Product Plants	Secondary Lead Smelting
MON	Steel Foundries
Paper and Other Webs (Surface Coating)	Tire Production
Petroleum Refineries: Other Sources Not Distinctly Listed	Vegetable Oil Production
Bis(2-ethylhexyl)phthalate (117817)	
Agricultural Chemicals Production	Plywood/Particle Board Manufacturing
Asphalt Concrete Manufacturing	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Printing/Publishing (Surface Coating)
Friction Products Manufacturing	Secondary Lead Smelting
Industrial Boilers	Sewage Sludge Incineration

Hazardous Air Pollutants and Their Associated MACT Source Categories (Continued)

Institutional/Commercial Boilers	Tire Production
Paper and Other Webs (Surface Coating)	Utilities - Coal
Pharmaceuticals Production	
Bis(chloromethyl) Ether (542881)	
MON	Polymers & Resins (Excluding P&R III)
Bromoform (75252)	
Industrial Boilers	Tire Production
Institutional/Commercial Boilers	Utilities - Coal
Cadmium & Compounds	
Aerospace Industries	Primary Lead Smelting
Carbon Black Production	Printing/Publishing (Surface Coating)
Clay Products Manufacturing	Pulp and Paper Production (combustion) MACT II
Crematories	Secondary Aluminum Production
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Sewage Sludge Incineration
Iron Foundries	Stationary Turbines
Medical Waste Incinerators	Steel Foundries
MON	Tire Production
Municipal Waste Combustors	Utilities - Coal
Other Biological Incineration	Utilities - Natural Gas
Paper and Other Webs (Surface Coating)	Utilities - Oil
Polymers & Resins (Excluding P&R III)	Utility Boilers - Coke
Primary Copper Smelting	Utility Turbines
Calcium Cyanamide (156627)	
MON	
Captan (133062)	
Agricultural Chemicals Production	MON
Carbaryl (63252)	
Agricultural Chemicals Production	MON
Carbon Disulfide (75150)	
Agricultural Chemicals Production	Municipal Landfills
Carbon Black Production	Pharmaceuticals Production
Cellophane Production	Polymers & Resins (Excluding P&R III)
Cellulose Food Casing Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Chlorine Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Clay Products Manufacturing	Publicly Owned Treatment Works (POTW) Emissions
Coke By-Product Plants	Pulp and Paper Production (non-combustion) MACT I

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Coke Ovens: Pushing, Quenching, and Battery Stacks	Rayon Production
Friction Products Manufacturing	Secondary Lead Smelting
Industrial Boilers	Steel Foundries
Institutional/Commercial Boilers	Tire Production
MON	Utilities - Coal
Carbon Tetrachloride (56235)	
Agricultural Chemicals Production	Pharmaceuticals Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Pulp and Paper Production (non-combustion) MACT I
Hazardous Waste Incineration	Sewage Sludge Incineration
Medical Waste Incinerators	Tire Production
MON	Utilities - Coal
Municipal Landfills	
Carbonyl Sulfide (463581)	
Carbon Black Production	Municipal Landfills
Chlorine Production	Polymers & Resins (Excluding P&R III)
Coke By-Product Plants	Primary Aluminum Production
Coke Ovens: Pushing, Quenching, and Battery Stacks	Steel Foundries
MON	Tire Production
Catechol (120809)	
MON	Semiconductor Manufacturing
Paper and Other Webs (Surface Coating)	
Chloramben (133904)	
Agricultural Chemicals Production	
Chlordane (57749)	
MON	
Chlorine (7782505)	
Agricultural Chemicals Production	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Coke By-Product Plants	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Ferroalloys Production	Primary Aluminum Production
Industrial Boilers	Primary Copper Smelting
Institutional/Commercial Boilers	Primary Magnesium Refining
Iron Foundries	Printing/Publishing (Surface Coating)
Leather Tanning and Finishing Operations	Pulp and Paper Production (non-combustion) MACT I

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Medical Waste Incinerators	Rayon Production
MON	Semiconductor Manufacturing
Paper and Other Webs (Surface Coating)	Steel Foundries
Pharmaceuticals Production	Steel Pickling HCl Process
Phosphate Fertilizers Production	
Chloroacetic Acid (79118)	
MON	Polymers & Resins (Excluding P&R III)
Pharmaceuticals Production	
Chlorobenzene (108907)	
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
Chlorine Production	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Industrial Boilers	Pulp and Paper Production (non-combustion) MACT I
Institutional/Commercial Boilers	Secondary Lead Smelting
MON	Sewage Sludge Incineration
Municipal Landfills	Steel Foundries
Paper and Other Webs (Surface Coating)	Tire Production
Pharmaceuticals Production	Utilities - Coal
Chloroform (67663)	
Agricultural Chemicals Production	Pharmaceuticals Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Hazardous Waste Incineration	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Industrial Boilers	Publicly Owned Treatment Works (POTW) Emissions
Institutional/Commercial Boilers	Pulp and Paper Production (non-combustion) MACT I
Medical Waste Incinerators	Secondary Lead Smelting
MON	Sewage Sludge Incineration
Municipal Landfills	Tire Production
Paper and Other Webs (Surface Coating)	Utilities - Coal
Chloromethyl Methyl Ether (107302)	
MON	Polymers & Resins (Excluding P&R III)
Pharmaceuticals Production	
Chloroprene	
Chlorine Production	Polymers & Resins (Excluding P&R III)
MON	Tire Production
Chromium & Compounds	
Aerospace Industries	Municipal Waste Combustors

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Asphalt Roofing Manufacturing	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Chromic Acid Anodizing	Portland Cement Manufacturing: Hazardous Waste-fired
Chromium Refractories Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Clay Products Manufacturing	Primary Aluminum Production
Coke By-Product Plants	Primary Copper Smelting
Crematories	Printing/Publishing (Surface Coating)
Decorative Chromium Electroplating	Pulp and Paper Production (combustion) MACT II
Ferroalloys Production	Secondary Aluminum Production
Friction Products Manufacturing	Secondary Lead Smelting
Hard Chromium Electroplating	Sewage Sludge Incineration
Industrial Boilers	Stationary Turbines
Industrial Process Cooling Towers	Steel Foundries
Institutional/Commercial Boilers	Tire Production
Integrated Iron and Steel Manufacturing	Utilities - Coal
Iron Foundries	Utilities - Natural Gas
Leather Tanning and Finishing Operations	Utilities - Oil
Lime Manufacturing	Utility Boilers - Coke
Medical Waste Incinerators	Utility Turbines
Mineral Wool Production	Wool Fiberglass Manufacturing
MON	
Cobalt Compounds	
Aerospace Industries	Primary Copper Smelting
Clay Products Manufacturing	Printing/Publishing (Surface Coating)
Ferroalloys Production	Pulp and Paper Production (combustion) MACT II
Industrial Boilers	Sewage Sludge Incineration
Institutional/Commercial Boilers	Steel Foundries
Integrated Iron and Steel Manufacturing	Utilities - Coal
Iron Foundries	Utilities - Natural Gas
MON	Utilities - Oil
Paper and Other Webs (Surface Coating)	Utility Turbines
Polymers & Resins (Excluding P&R III)	
Coke Oven Emissions	
Coke Ovens: Charging, Top Side, and Door Leaks	
Cresols (1319773) (includes o [95487], m [108394], and p [106445])	

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Agricultural Chemicals Production	Portland Cement Manufacturing: Hazardous Waste-fired
Chlorine Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Coke By-Product Plants	Primary Copper Smelting
MON	Pulp and Paper Production (non-combustion) MACT I
Paper and Other Webs (Surface Coating)	Steel Foundries
Petroleum Refineries: Other Sources Not Distinctly Listed	Tire Production
Polymers & Resins (Excluding P&R III)	Utilities - Coal
Cumene (98828)	
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
Asphalt Concrete Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Chlorine Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Gasoline Distribution (Stage 1)	Primary Aluminum Production
Industrial Boilers	Printing/Publishing (Surface Coating)
Institutional/Commercial Boilers	Pulp and Paper Production (non-combustion) MACT I
Iron Foundries	Secondary Lead Smelting
MON	Steel Foundries
Paper and Other Webs (Surface Coating)	Tire Production
Petroleum Refineries: Other Sources Not Distinctly Listed	Utilities - Coal
Pharmaceuticals Production	
Cyanide Compounds	
Agricultural Chemicals Production	MON
Carbon Black Production	Paper and Other Webs (Surface Coating)
Coke By-Product Plants	Pharmaceuticals Production
Ferroalloys Production	Primary Aluminum Production
Industrial Boilers	Printing/Publishing (Surface Coating)
Institutional/Commercial Boilers	Steel Foundries
Dibutyl Phthalate (84742)	
Asphalt Concrete Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Friction Products Manufacturing	Printing/Publishing (Surface Coating)
MON	Secondary Lead Smelting
Paper and Other Webs (Surface Coating)	Tire Production
Plywood/Particle Board Manufacturing	Utilities - Coal
Polymers & Resins (Excluding P&R III)	
Dichlorethyl Ether (111444)	
Chlorine Production	Tire Production

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

MON	

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Dichlorvos (62737)	
Agricultural Chemicals Production	Pharmaceuticals Production
MON	
Diethanolamine (111422)	
Agricultural Chemicals Production	Pharmaceuticals Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
Iron Foundries	Portland Cement Manufacturing: Hazardous Waste-fired
MON	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Paper and Other Webs (Surface Coating)	Steel Foundries
Diethyl Sulfate (64675)	
MON	Pharmaceuticals Production
Paper and Other Webs (Surface Coating)	Polymers & Resins (Excluding P&R III)
Dimethyl Phthalate (131113)	
Boat Manufacturing	Pharmaceuticals Production
Clay Products Manufacturing	Polymers & Resins (Excluding P&R III)
MON	Tire Production
Dimethyl Sulfate (77781)	
Agricultural Chemicals Production	MON
Industrial Boilers	Paper and Other Webs (Surface Coating)
Institutional/Commercial Boilers	Pharmaceuticals Production
Dimethylformamide (68122)	
Pharmaceuticals Production	
Dioxin/Furans as 2,3,7,8-TCDD TEQ (1746016)	
Crematories	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Hazardous Waste Incineration	Pulp and Paper Production (combustion) MACT II
Industrial Boilers	Scrap or Waste Tire Incineration
Integrated Iron and Steel Manufacturing	Secondary Aluminum Production
Medical Waste Incinerators	Secondary Lead Smelting
Municipal Waste Combustors	Sewage Sludge Incineration
Other Biological Incineration	Utilities - Coal
Portland Cement Manufacturing: Hazardous Waste-fired	Utilities - Oil
Epichlorohydrin (l-Chloro-2,3-epoxypropane) (106898)	
Asphalt Concrete Manufacturing	Polymers & Resins (Excluding P&R III)
Chlorine Production	Portland Cement Manufacturing: Hazardous Waste-fired
MON	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Pharmaceuticals Production	Tire Production

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Ethyl Acrylate (140885)	
Chlorine Production	Pharmaceuticals Production
MON	Polymers & Resins (Excluding P&R III)
Paper and Other Webs (Surface Coating)	
Ethyl Carbamate (51796)	
Secondary Lead Smelting	
Ethyl Chloride (75003)	
Chlorine Production	Pharmaceuticals Production
Industrial Boilers	Polycarbonates Production
Institutional/Commercial Boilers	Polymers & Resins (Excluding P&R III)
MON	Tire Production
Municipal Landfills	Utilities - Coal
Ethylbenzene (100414)	
Aerospace Industries	Petroleum Refineries: Other Sources Not Distinctly Listed
Agricultural Chemicals Production	Pharmaceuticals Production
Asphalt Concrete Manufacturing	Plywood/Particle Board Manufacturing
Asphalt Roofing Manufacturing	Polymers & Resins (Excluding P&R III)
Chlorine Production	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Coke By-Product Plants	Printing/Publishing (Surface Coating)
Friction Products Manufacturing	Publicly Owned Treatment Works (POTW) Emissions
Gasoline Distribution (Stage 1)	Pulp and Paper Production (non-combustion) MACT I
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Semiconductor Manufacturing
Iron Foundries	Sewage Sludge Incineration
Mineral Wool Production	Steel Foundries
MON	Tire Production
Municipal Landfills	Utilities - Coal
Oil and Natural Gas Production	Utilities - Oil
Paper and Other Webs (Surface Coating)	
Ethylene Dibromide (106934)	
Industrial Boilers	Pharmaceuticals Production
Institutional/Commercial Boilers	Polymers & Resins (Excluding P&R III)
MON	Tire Production
Ethylene Dichloride (75343)	
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Chlorine Production	Pharmaceuticals Production

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Gasoline Distribution (Stage 1)	Polymers & Resins (Excluding P&R III)
Industrial Boilers	Portland Cement Manufacturing: Hazardous Waste-fired
Institutional/Commercial Boilers	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Medical Waste Incinerators	Pulp and Paper Production (non-combustion) MACT I
MON	Sewage Sludge Incineration
Municipal Landfills	Tire Production
Other Biological Incineration	Utilities - Coal
Ethylene Glycol (107211)	
Agricultural Chemicals Production	Metal Coil (Surface Coating)
Asphalt Concrete Manufacturing	Metal Furniture (Surface Coating)
Asphalt Roofing Manufacturing	Mineral Wool Production
Auto and Light Duty Truck (Surface Coating)	Miscellaneous Metal Parts and Products (Surface Coating)
Carbon Black Production	MON
Chlorine Production	Paper and Other Webs (Surface Coating)
Chromium Refractories Production	Pharmaceuticals Production
Clay Products Manufacturing	Plywood/Particle Board Manufacturing
Coke By-Product Plants	Polymers & Resins (Excluding P&R III)
Ferroalloys Production	Portland Cement Manufacturing: Hazardous Waste-fired
Flat Wood Paneling (Surface Coating)	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Friction Products Manufacturing	Primary Aluminum Production
Integrated Iron and Steel Manufacturing	Printing/Publishing (Surface Coating)
Iron Foundries	Rayon Production
Large Appliance (Surface Coating)	Semiconductor Manufacturing
Metal Can (Surface Coating)	Steel Foundries
Ethylene Oxide (75218)	
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Chlorine Production	Pharmaceuticals Production
Commercial Sterilization Facilities	Polyether Polyols Production
MON	Polymers & Resins (Excluding P&R III)
Ethylidene Dichloride (75343)	
Municipal Landfills	Tire Production
Formaldehyde (50000)	
Aerospace Industries	Polymers and Resins III
Agricultural Chemicals Production	Portland Cement Manufacturing: Hazardous Waste-fired
Asphalt Roofing Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Chlorine Production	Printing/Publishing (Surface Coating)
Chromium Refractories Production	Pulp and Paper Production (combustion) MACT II

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Crematories	Pulp and Paper Production (non-combustion) MACT I
Friction Products Manufacturing	Secondary Aluminum Production
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Sewage Sludge Incineration
Iron Foundries	Stationary Internal Combustion Engines
Leather Tanning and Finishing Operations	Stationary Turbines
Medical Waste Incinerators	Steel Foundries
Mineral Wool Production	Taconite Iron Ore Processing
MON	Utilities - Coal
Municipal Waste Combustors	Utilities - Natural Gas
Paper and Other Webs (Surface Coating)	Utilities - Oil
Pharmaceuticals Production	Utility Turbines
Plywood/Particle Board Manufacturing	Wool Fiberglass Manufacturing
Polymers & Resins (Excluding P&R III)	
Glycol Ethers	
Aerospace Industries	MON
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Asphalt Roofing Manufacturing	Pharmaceuticals Production
Auto and Light Duty Truck (Surface Coating)	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Coke By-Product Plants	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Flat Wood Paneling (Surface Coating)	Primary Aluminum Production
Friction Products Manufacturing	Printing/Publishing (Surface Coating)
Iron Foundries	Publicly Owned Treatment Works (POTW) Emissions
Large Appliance (Surface Coating)	Rayon Production
Leather Tanning and Finishing Operations	Semiconductor Manufacturing
Metal Can (Surface Coating)	Shipbuilding and Ship Repair (Surface Coating)
Metal Coil (Surface Coating)	Steel Foundries
Metal Furniture (Surface Coating)	Wood Furniture (Surface Coating)
Miscellaneous Metal Parts and Products (Surface Coating)	
Heptachlor (76448)	
MON	
Hexachlorobenzene (118741)	
Agricultural Chemicals Production	Tire Production
MON	Utilities - Coal

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Hexachlorobutadiene (87683)	
Chlorine Production	Tire Production
MON	
Hexachlorocyclopentadiene (77474)	
Agricultural Chemicals Production	MON
Chlorine Production	Tire Production
Hexachloroethane (67721)	
Agricultural Chemicals Production	MON
Chlorine Production	Tire Production
Hexane (110543)	
Aerospace Industries	Petroleum Refineries: Other Sources Not Distinctly Listed
Gasoline Distribution (Stage 1)	Pharmaceuticals Production
Industrial Boilers	Polyether Polyols Production
Institutional/Commercial Boilers	Pulp and Paper Production (non-combustion) MACT I
Marine Vessel Loading Operations	Secondary Lead Smelting
Municipal Landfills	Tire Production
Oil and Natural Gas Production	Utilities - Coal
Hydrazine (302012)	
Agricultural Chemicals Production	Pharmaceuticals Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
MON	
Hydrochloric Acid (Hydrogen Chloride [gas only]) (7647010)	
Agricultural Chemicals Production	Phosphate Fertilizers Production
Asphalt Concrete Manufacturing	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Chromium Refractories Production	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Coke By-Product Plants	Primary Aluminum Production
Ferroalloys Production	Primary Copper Smelting
Friction Products Manufacturing	Primary Magnesium Refining
Hazardous Waste Incineration	Printing/Publishing (Surface Coating)
Industrial Boilers	Pulp and Paper Production (combustion) MACT II
Integrated Iron and Steel Manufacturing	Pulp and Paper Production (non-combustion) MACT I
Iron Foundries	Secondary Aluminum Production
Leather Tanning and Finishing Operations	Semiconductor Manufacturing
Lime Manufacturing	Sewage Sludge Incineration
Medical Waste Incinerators	Steel Foundries

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

MON	Steel Pickling HCl Process
Municipal Waste Combustors	Utilities - Coal
Paper and Other Webs (Surface Coating)	Utilities - Oil
Pharmaceuticals Production	Vegetable Oil Production
Hydrogen Fluoride (Hydrofluoric Acid) (7664393)	
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Chlorine Production	Phosphate Fertilizers Production
Chromium Refractories Production	Phosphoric Acid Manufacturing
Clay Products Manufacturing	Polymers & Resins (Excluding P&R III)
Ferroalloys Production	Primary Aluminum Production
Friction Products Manufacturing	Secondary Aluminum Production
Hydrogen Fluoride Production	Semiconductor Manufacturing
Integrated Iron and Steel Manufacturing	Steel Foundries
Iron Foundries	Utilities - Coal
Medical Waste Incinerators	Utilities - Oil
MON	
Hydroquinone (123319)	
Chlorine Production	Polymers & Resins (Excluding P&R III)
MON	Semiconductor Manufacturing
Paper and Other Webs (Surface Coating)	Tire Production
Isophorone (78591)	
Clay Products Manufacturing	Tire Production
Industrial Boilers	Utilities - Coal
Institutional/Commercial Boilers	
Lead & Compounds	
Aerospace Industries	Polymers & Resins (Excluding P&R III)
Agricultural Chemicals Production	Portland Cement Manufacturing: Hazardous Waste-fired
Asphalt Concrete Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Auto and Light Duty Truck (Surface Coating)	Primary Aluminum Production
Boat Manufacturing	Primary Copper Smelting
Clay Products Manufacturing	Primary Lead Smelting
Coke By-Product Plants	Printing/Publishing (Surface Coating)
Ferroalloys Production	Pulp and Paper Production (combustion) MACT II
Friction Products Manufacturing	Secondary Aluminum Production
Gasoline Distribution (Stage 1)	Secondary Lead Smelting
Industrial Boilers	Semiconductor Manufacturing

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Institutional/Commercial Boilers	Sewage Sludge Incineration
Integrated Iron and Steel Manufacturing	Steel Foundries
Iron Foundries	Taconite Iron Ore Processing
Lime Manufacturing	Tire Production
Medical Waste Incinerators	Utilities - Coal
MON	Utilities - Natural Gas
Municipal Waste Combustors	Utilities - Oil
Paper and Other Webs (Surface Coating)	Utility Turbines
Phosphate Fertilizers Production	Wool Fiberglass Manufacturing
Lindane (58899)	
Agricultural Chemicals Production	
Maleic Anhydride (108316)	
Agricultural Chemicals Production	Portland Cement Manufacturing: Hazardous Waste-fired
MON	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Paper and Other Webs (Surface Coating)	Printing/Publishing (Surface Coating)
Pharmaceuticals Production	Vegetable Oil Production
Polymers & Resins (Excluding P&R III)	
Manganese & Compounds	
Agricultural Chemicals Production	Phosphate Fertilizers Production
Boat Manufacturing	Polymers & Resins (Excluding P&R III)
Chlorine Production	Primary Aluminum Production
Clay Products Manufacturing	Primary Copper Smelting
Coke By-Product Plants	Primary Lead Smelting
Ferroalloys Production	Pulp and Paper Production (combustion) MACT II
Friction Products Manufacturing	Secondary Aluminum Production
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Semiconductor Manufacturing
Integrated Iron and Steel Manufacturing	Sewage Sludge Incineration
Iron Foundries	Stationary Turbines
Medical Waste Incinerators	Steel Foundries
MON	Utilities - Coal
Municipal Waste Combustors	Utilities - Natural Gas
Paper and Other Webs (Surface Coating)	Utilities - Oil
Pharmaceuticals Production	Utility Turbines
Mercury & Compounds	
Aerospace Industries	Portland Cement Manufacturing: Hazardous Waste-fired
Carbon Black Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Chlorine Production	Primary Copper Smelting
Chromic Acid Anodizing	Primary Lead Smelting
Clay Products Manufacturing	Pulp and Paper Production (combustion) MACT II
Crematories	Secondary Aluminum Production
Hazardous Waste Incineration	Secondary Lead Smelting
Industrial Boilers	Sewage Sludge Incineration
Institutional/Commercial Boilers	Stationary Internal Combustion Engines
Lime Manufacturing	Stationary Turbines
Medical Waste Incinerators	Steel Foundries
MON	Utilities - Coal
Municipal Waste Combustors	Utilities - Natural Gas
Polymers & Resins (Excluding P&R III)	Utilities - Oil
	Utility Turbines
Methanol (67561)	
Aerospace Industries	Plywood/Particle Board Manufacturing
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
Chlorine Production	Polymers and Resins III
Chromium Refractories Production	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Coke By-Product Plants	Printing/Publishing (Surface Coating)
Friction Products Manufacturing	Publicly Owned Treatment Works (POTW) Emissions
Integrated Iron and Steel Manufacturing	Pulp and Paper Production (combustion) MACT II
Iron Foundries	Pulp and Paper Production (non-combustion) MACT I
Leather Tanning and Finishing Operations	Rayon Production
Mineral Wool Production	Semiconductor Manufacturing
MON	Steel Foundries
Paper and Other Webs (Surface Coating)	Vegetable Oil Production
Pharmaceuticals Production	Wool Fiberglass Manufacturing
Phosphate Fertilizers Production	
Methoxychlor (72435)	
Agricultural Chemicals Production	
Methyl Bromide (Bromomethane) (74839)	
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Clay Products Manufacturing	Polymers & Resins (Excluding P&R III)
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Tire Production
MON	Utilities - Coal

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Methyl Chloride (74873)	
Aerospace Industries	Pharmaceuticals Production
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
Chlorine Production	Pulp and Paper Production (non-combustion) MACT I
Clay Products Manufacturing	Secondary Lead Smelting
Industrial Boilers	Tire Production
MON	Utilities - Coal
Methyl Chloroform (1,1,1-Trichloroethane) (71556)	
Aerospace Industries	Municipal Landfills
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Asphalt Concrete Manufacturing	Pharmaceuticals Production
Asphalt Roofing Manufacturing	Phosphate Fertilizers Production
Boat Manufacturing	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Chromium Refractories Production	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Ferroalloys Production	Primary Aluminum Production
Friction Products Manufacturing	Primary Copper Smelting
Halogenated Solvent Cleaners	Printing/Publishing (Surface Coating)
Hazardous Waste Incineration	Publicly Owned Treatment Works (POTW) Emissions
Industrial Boilers	Pulp and Paper Production (non-combustion) MACT I
Institutional/Commercial Boilers	Semiconductor Manufacturing
Integrated Iron and Steel Manufacturing	Sewage Sludge Incineration
Iron Foundries	Steel Foundries
Medical Waste Incinerators	Tire Production
Mineral Wool Production	Utilities - Coal
MON	Utilities - Oil
Methyl Ethyl Ketone (2-Butanone) (78933)	
Aerospace Industries	Paper and Other Webs (Surface Coating)
Auto and Light Duty Truck (Surface Coating)	Pharmaceuticals Production
Boat Manufacturing	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Chromium Refractories Production	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Flat Wood Paneling (Surface Coating)	Primary Aluminum Production
Friction Products Manufacturing	Printing/Publishing (Surface Coating)
Industrial Boilers	Publicly Owned Treatment Works (POTW) Emissions

Hazardous Air Pollutants and Their Associated MACT Source Categories (Continued)

Institutional/Commercial Boilers	Pulp and Paper Production (combustion) MACT II
Integrated Iron and Steel Manufacturing	Pulp and Paper Production (non-combustion) MACT I
Iron Foundries	Secondary Lead Smelting
Large Appliance (Surface Coating)	Semiconductor Manufacturing
Leather Tanning and Finishing Operations	Sewage Sludge Incineration
Magnetic Tape (Surface Coating)	Shipbuilding and Ship Repair (Surface Coating)
Metal Can (Surface Coating)	Steel Foundries
Metal Coil (Surface Coating)	Tire Production
Metal Furniture (Surface Coating)	Utilities - Coal
Miscellaneous Metal Parts and Products (Surface Coating)	Vegetable Oil Production
MON	Wood Furniture (Surface Coating)
Municipal Landfills	
Methyl Iodide (Iodomethane) (74884)	
Clay Products Manufacturing	Secondary Lead Smelting
MON	Utilities - Coal
Pharmaceuticals Production	
Methyl Isobutyl Ketone (Hexone) (108101)	
Aerospace Industries	Paper and Other Webs (Surface Coating)
Agricultural Chemicals Production	Pharmaceuticals Production
Asphalt Roofing Manufacturing	Phosphate Fertilizers Production
Auto and Light Duty Truck (Surface Coating)	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Coke By-Product Plants	Portland Cement Manufacturing: Hazardous Waste-fired
Flat Wood Paneling (Surface Coating)	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Friction Products Manufacturing	Primary Aluminum Production
Integrated Iron and Steel Manufacturing	Printing/Publishing (Surface Coating)
Iron Foundries	Publicly Owned Treatment Works (POTW) Emissions
Leather Tanning and Finishing Operations	Pulp and Paper Production (combustion) MACT II
Magnetic Tape (Surface Coating)	Pulp and Paper Production (non-combustion) MACT I
Metal Can (Surface Coating)	Semiconductor Manufacturing
Metal Coil (Surface Coating)	Shipbuilding and Ship Repair (Surface Coating)
Metal Furniture (Surface Coating)	Steel Foundries
Miscellaneous Metal Parts and Products (Surface Coating)	Tire Production
MON	Utilities - Coal
Municipal Landfills	Wood Furniture (Surface Coating)

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Methyl Isocyanate (624839)	
Agricultural Chemicals Production	MON
Iron Foundries	Plywood/Particle Board Manufacturing
Methyl Methacrylate (80626)	
Agricultural Chemicals Production	Plywood/Particle Board Manufacturing
Boat Manufacturing	Polymers & Resins (Excluding P&R III)
Industrial Boilers	Portland Cement Manufacturing: Hazardous Waste-fired
Institutional/Commercial Boilers	Portland Cement Manufacturing: Non-Hazardous Waste-fired
MON	Utilities - Coal
Paper and Other Webs (Surface Coating)	
Methyl tert-Butyl Ether (1634044)	
Gasoline Distribution (Stage 1)	Pharmaceuticals Production
Industrial Boilers	Polymers & Resins (Excluding P&R III)
Institutional/Commercial Boilers	Tire Production
MON	Utilities - Coal
Petroleum Refineries: Other Sources Not Distinctly Listed	
Methylene Chloride (75092)	
Agricultural Chemicals Production	Plywood/Particle Board Manufacturing
Boat Manufacturing	Polycarbonates Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Flexible Polyurethane Foam Fabrication Operations	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Flexible Polyurethane Foam Production	Printing/Publishing (Surface Coating)
Friction Products Manufacturing	Publicly Owned Treatment Works (POTW) Emissions
Halogenated Solvent Cleaners	Pulp and Paper Production (non-combustion) MACT I
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Semiconductor Manufacturing
Iron Foundries	Sewage Sludge Incineration
Medical Waste Incinerators	Spandex Production
MON	Steel Foundries
Municipal Landfills	Tire Production
Paper and Other Webs (Surface Coating)	Utilities - Coal
Pharmaceuticals Production	Utilities - Oil
Methylhydrazine (60344)	
Industrial Boilers	MON
Institutional/Commercial Boilers	

Hazardous Air Pollutants and Their Associated MACT Source Categories (Continued)

N,N-Dimethylaniline (121697)	
MON	Polymers & Resins (Excluding P&R III)
Paper and Other Webs (Surface Coating)	Tire Production
Pharmaceuticals Production	
N-Nitrosodimethylamine (62759)	
Pharmaceuticals Production	Utilities - Coal
Tire Production	
N-Nitrosomorpholine (59892)	
Tire Production	
Nickel & Compounds	
Aerospace Industries	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Chromium Refractories Production	Primary Aluminum Production
Clay Products Manufacturing	Primary Copper Smelting
Coke By-Product Plants	Primary Lead Smelting
Crematories	Printing/Publishing (Surface Coating)
Ferroalloys Production	Pulp and Paper Production (combustion) MACT II
Friction Products Manufacturing	Secondary Aluminum Production
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Sewage Sludge Incineration
Integrated Iron and Steel Manufacturing	Stationary Turbines
Iron Foundries	Steel Foundries
Medical Waste Incinerators	Tire Production
MON	Utilities - Coal
Municipal Waste Combustors	Utilities - Natural Gas
Paper and Other Webs (Surface Coating)	Utilities - Oil
Pharmaceuticals Production	Utility Boilers - Coke
Polymers & Resins (Excluding P&R III)	Utility Turbines
Portland Cement Manufacturing: Hazardous Waste-fired	Vegetable Oil Production
Nitrobenzene (98953)	
MON	Portland Cement Manufacturing: Hazardous Waste-fired
Pharmaceuticals Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Polymers & Resins (Excluding P&R III)	Tire Production
o-Anisidine (90040)	
MON	Tire Production
o-Toluidine (95534)	
Polymers & Resins (Excluding P&R III)	Tire Production

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

p-Phenylenediamine (106503)	
MON	Tire Production
Polymers & Resins (Excluding P&R III)	
Parathion (56382)	
Agricultural Chemicals Production	
Pentachloronitrobenzene (Quintobenzene) (82688)	
Agricultural Chemicals Production	Tire Production
MON	
Pentachlorophenol (87865)	
Agricultural Chemicals Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Plywood/Particle Board Manufacturing	Tire Production
Portland Cement Manufacturing: Hazardous Waste-fired	Utilities - Coal
Phenol (108952)	
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
Chlorine Production	Polymers and Resins III
Chromium Refractories Production	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Coke By-Product Plants	Printing/Publishing (Surface Coating)
Friction Products Manufacturing	Pulp and Paper Production (combustion) MACT II
Industrial Boilers	Pulp and Paper Production (non-combustion) MACT I
Institutional/Commercial Boilers	Secondary Lead Smelting
Integrated Iron and Steel Manufacturing	Semiconductor Manufacturing
Iron Foundries	Sewage Sludge Incineration
Lime Manufacturing	Stationary Turbines
Mineral Wool Production	Steel Foundries
MON	Tire Production
Paper and Other Webs (Surface Coating)	Utilities - Coal
Petroleum Refineries: Other Sources Not Distinctly Listed	Utilities - Oil
Pharmaceuticals Production	Wool Fiberglass Manufacturing
Plywood/Particle Board Manufacturing	
Phosgene (75445)	
Agricultural Chemicals Production	Pharmaceuticals Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
MON	

Hazardous Air Pollutants and Their Associated MACT Source Categories (Continued)

Phosphorus (7723140)	
Clay Products Manufacturing	Steel Foundries
Industrial Boilers	Utilities - Coal
MON	Utilities - Natural Gas
Phosphate Fertilizers Production	Utilities - Oil
Sewage Sludge Incineration	Utility Turbines
Phthalic Anhydride (85449)	
MON	Portland Cement Manufacturing: Hazardous Waste-fired
Paper and Other Webs (Surface Coating)	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Pharmaceuticals Production	Printing/Publishing (Surface Coating)
Polymers & Resins (Excluding P&R III)	Utilities - Coal
Polychlorinated Biphenyls (Aroclors) (1336363)	
Hazardous Waste Incineration	Other Biological Incineration
Industrial Boilers	Scrap or Waste Tire Incineration
Medical Waste Incinerators	Sewage Sludge Incineration
Municipal Landfills	Utilities - Oil
Municipal Waste Combustors	
Polycyclic Organic Matter as 16-PAH	
Aerospace Industries	Municipal Waste Combustors
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Asphalt Concrete Manufacturing	Petroleum Refineries Catalytic Cracking (Fluid and other) Units, Catalytic Reforming Units, and Sulfur Plant Units
Asphalt Roofing Manufacturing	Petroleum Refineries: Other Sources Not Distinctly Listed
Carbon Black Production	Pharmaceuticals Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Coke By-Product Plants	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Coke Ovens: Charging, Top Side, and Door Leaks	Primary Aluminum Production
Coke Ovens: Pushing, Quenching, and Battery Stacks	Printing/Publishing (Surface Coating)
Crematories	Pulp and Paper Production (combustion) MACT II
Ferroalloys Production	Scrap or Waste Tire Incineration
Friction Products Manufacturing	Secondary Lead Smelting
Gasoline Distribution (Stage 1)	Sewage Sludge Incineration
Hazardous Waste Incineration	Stationary Internal Combustion Engines
Industrial Boilers	Stationary Turbines
Institutional/Commercial Boilers	Steel Foundries

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Integrated Iron and Steel Manufacturing	Tire Production
Iron Foundries	Utilities - Coal
Medical Waste Incinerators	Utilities - Natural Gas
MON	Utilities - Oil
Municipal Landfills	
Propionaldehyde (123386)	
Chlorine Production	Polymers & Resins (Excluding P&R III)
Industrial Boilers	Pulp and Paper Production (non-combustion) MACT I
Institutional/Commercial Boilers	Secondary Lead Smelting
MON	Utilities - Coal
Propoxur (Baygon) (114261)	
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
Propylene Dichloride (78875)	
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Chlorine Production	Polymers & Resins (Excluding P&R III)
MON	Tire Production
Municipal Landfills	
Propylene Oxide (75569)	
Agricultural Chemicals Production	Polyether Polyols Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
MON	Portland Cement Manufacturing: Hazardous Waste-fired
Paper and Other Webs (Surface Coating)	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Pharmaceuticals Production	Tire Production
Quinoline (91225)	
Coke By-Product Plants	Steel Foundries
MON	Utilities - Coal
Pharmaceuticals Production	
Quinone (p-Benzoquinone) (106514)	
MON	
Selenium Compounds	
Industrial Boilers	Pulp and Paper Production (combustion) MACT II
Institutional/Commercial Boilers	Sewage Sludge Incineration
MON	Steel Foundries
Paper and Other Webs (Surface Coating)	Utilities - Coal
Pharmaceuticals Production	Utilities - Oil
Primary Copper Smelting	Utility Turbines

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Styrene (100425)	
Agricultural Chemicals Production	Plywood/Particle Board Manufacturing
Asphalt Concrete Manufacturing	Polymers & Resins (Excluding P&R III)
Boat Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Chlorine Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Clay Products Manufacturing	Primary Copper Smelting
Coke By-Product Plants	Publicly Owned Treatment Works (POTW) Emissions
Industrial Boilers	Pulp and Paper Production (combustion) MACT II
Institutional/Commercial Boilers	Pulp and Paper Production (non-combustion) MACT I
Iron Foundries	Secondary Lead Smelting
Mineral Wool Production	Steel Foundries
MON	Tire Production
Paper and Other Webs (Surface Coating)	Utilities - Coal
Petroleum Refineries: Other Sources Not Distinctly Listed	
Styrene Oxide (96093)	
MON	
Tetrachloroethylene (127184)	
Aerospace Industries	Pharmaceuticals Production
Agricultural Chemicals Production	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Coke By-Product Plants	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Dry Cleaning Facilities	Printing/Publishing (Surface Coating)
Friction Products Manufacturing	Publicly Owned Treatment Works (POTW) Emissions
Halogenated Solvent Cleaners	Pulp and Paper Production (non-combustion) MACT I
Industrial Boilers	Semiconductor Manufacturing
Institutional/Commercial Boilers	Sewage Sludge Incineration
Leather Tanning and Finishing Operations	Steel Foundries
Medical Waste Incinerators	Tire Production
MON	Utilities - Coal
Municipal Landfills	Utilities - Oil
Paper and Other Webs (Surface Coating)	
Titanium Tetrachloride (7550450)	
MON	Polymers & Resins (Excluding P&R III)
Toluene (108883)	
Aerospace Industries	Oil and Natural Gas Production

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Asphalt Concrete Manufacturing	Petroleum Refineries: Other Sources Not Distinctly Listed
Asphalt Roofing Manufacturing	Pharmaceuticals Production
Auto and Light Duty Truck (Surface Coating)	Phosphate Fertilizers Production
Boat Manufacturing	Plywood/Particle Board Manufacturing
Cellophane Production	Polyether Polyols Production
Chlorine Production	Polymers & Resins (Excluding P&R III)
Chromium Refractories Production	Portland Cement Manufacturing: Hazardous Waste-fired
Clay Products Manufacturing	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Coke By-Product Plants	Primary Aluminum Production
Coke Ovens: Pushing, Quenching, and Battery Stacks	Printing/Publishing (Surface Coating)
Flat Wood Paneling (Surface Coating)	Publicly Owned Treatment Works (POTW) Emissions
Friction Products Manufacturing	Pulp and Paper Production (combustion) MACT II
Gasoline Distribution (Stage 1)	Pulp and Paper Production (non-combustion) MACT I
Industrial Boilers	Secondary Lead Smelting
Institutional/Commercial Boilers	Semiconductor Manufacturing
Integrated Iron and Steel Manufacturing	Sewage Sludge Incineration
Iron Foundries	Shipbuilding and Ship Repair (Surface Coating)
Large Appliance (Surface Coating)	Spandex Production
Leather Tanning and Finishing Operations	Stationary Internal Combustion Engines
Magnetic Tape (Surface Coating)	Stationary Turbines
Marine Vessel Loading Operations	Steel Foundries
Medical Waste Incinerators	Taconite Iron Ore Processing
Metal Can (Surface Coating)	Tire Production
Metal Coil (Surface Coating)	Utilities - Coal
Metal Furniture (Surface Coating)	Utilities - Natural Gas
Mineral Wool Production	Utilities - Oil
Miscellaneous Metal Parts and Products (Surface Coating)	Vegetable Oil Production
MON	Wood Furniture (Surface Coating)
Municipal Landfills	
Trichloroethylene (79016)	
Aerospace Industries	Plywood/Particle Board Manufacturing
Agricultural Chemicals Production	Polymers & Resins (Excluding P&R III)
Asphalt Roofing Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Chlorine Production	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Clay Products Manufacturing	Printing/Publishing (Surface Coating)

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Coke By-Product Plants	Publicly Owned Treatment Works (POTW) Emissions
Halogenated Solvent Cleaners	Pulp and Paper Production (non-combustion) MACT I
Integrated Iron and Steel Manufacturing	Secondary Lead Smelting
Iron Foundries	Semiconductor Manufacturing
Medical Waste Incinerators	Sewage Sludge Incineration
MON	Steel Foundries
Municipal Landfills	Tire Production
Paper and Other Webs (Surface Coating)	Utilities - Coal
Pharmaceuticals Production	
Triethylamine (121448)	
Pharmaceuticals Production	
Trifluralin (1582098)	
Agricultural Chemicals Production	Pharmaceuticals Production
MON	Tire Production
Vinyl Acetate (108054)	
Chlorine Production	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Portland Cement Manufacturing: Hazardous Waste-fired
Industrial Boilers	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Institutional/Commercial Boilers	Printing/Publishing (Surface Coating)
Mineral Wool Production	Tire Production
MON	Utilities - Coal
Paper and Other Webs (Surface Coating)	Utilities - Oil
Pharmaceuticals Production	
Vinyl Bromide (593602)	
MON	Polymers & Resins (Excluding P&R III)
Vinyl Chloride (75014)	
Agricultural Chemicals Production	Paper and Other Webs (Surface Coating)
Chlorine Production	Polymers & Resins (Excluding P&R III)
Hazardous Waste Incineration	Sewage Sludge Incineration
MON	Tire Production
Municipal Landfills	
Vinylidene Chloride (75354)	
Chlorine Production	Pharmaceuticals Production
MON	Polymers & Resins (Excluding P&R III)
Municipal Landfills	Tire Production
Paper and Other Webs (Surface Coating)	Utilities - Coal

Hazardous Air Pollutants and Their Associated MACT Source Categories
(Continued)

Xylenes (1330207) (includes o [95476], m [108383], and p [106423])	
Aerospace Industries	Municipal Landfills
Agricultural Chemicals Production	Oil and Natural Gas Production
Asphalt Concrete Manufacturing	Paper and Other Webs (Surface Coating)
Asphalt Roofing Manufacturing	Petroleum Refineries: Other Sources Not Distinctly Listed
Auto and Light Duty Truck (Surface Coating)	Pharmaceuticals Production
Boat Manufacturing	Plywood/Particle Board Manufacturing
Chlorine Production	Polymers & Resins (Excluding P&R III)
Clay Products Manufacturing	Polymers and Resins III
Coke By-Product Plants	Portland Cement Manufacturing: Hazardous Waste-fired
Flat Wood Paneling (Surface Coating)	Portland Cement Manufacturing: Non-Hazardous Waste-fired
Friction Products Manufacturing	Primary Aluminum Production
Gasoline Distribution (Stage 1)	Printing/Publishing (Surface Coating)
Industrial Boilers	Publicly Owned Treatment Works (POTW) Emissions
Institutional/Commercial Boilers	Pulp and Paper Production (combustion) MACT II
Integrated Iron and Steel Manufacturing	Pulp and Paper Production (non-combustion) MACT I
Iron Foundries	Secondary Lead Smelting
Large Appliance (Surface Coating)	Semiconductor Manufacturing
Leather Tanning and Finishing Operations	Sewage Sludge Incineration
Marine Vessel Loading Operations	Shipbuilding and Ship Repair (Surface Coating)
Medical Waste Incinerators	Stationary Internal Combustion Engines
Metal Can (Surface Coating)	Stationary Turbines
Metal Coil (Surface Coating)	Steel Foundries
Metal Furniture (Surface Coating)	Tire Production
Mineral Wool Production	Utilities - Oil
Miscellaneous Metal Parts and Products (Surface Coating)	Vegetable Oil Production
MON	Wood Furniture (Surface Coating)

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APPENDIX B

LIST OF MACT SOURCE CATEGORIES AND ASSOCIATED HAZARDOUS AIR POLLUTANTS

[NOTE: These tables include only MACT source categories for which National-level HAP emission estimates have been developed under EPA's National Toxic Inventory Development Program; these do not include all HAP emissions from all MACT sources. Source: U.S. Environmental Protection Agency, 1998. *Baseline Emissions Inventory of HAP Emissions from MACT Sources*. Prepared by the Emission Factor and Inventory Group, Research Triangle Park, North Carolina.]

Source: *Handbook for Air Toxics Emission Inventory Development, Volume I: Stationary Sources, Appendix J,* EPA-454-/B-98-002, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, November 1998.

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List of MACT Source Categories and Associated Hazardous Air Pollutants

MACT SOURCE CATEGORY

Acrylic Fibers/Modacrylic Fibers Production

Acrylonitrile

Aerospace Industries

1,4-Dioxane (1,4-Diethyleneoxide)
Arsenic & Compounds (inorganic including Arsine)
Benzene
Cadmium & Compounds
Chromium & Compounds
Cobalt Compounds
Ethylbenzene
Formaldehyde
Glycol Ethers
Hexane
Lead & Compounds
Mercury & Compounds
Methanol
Methyl Chloride
Methyl Chloroform (1,1,1-Trichloroethane)
Methyl Ethyl Ketone (2-Butanone)
Methyl Isobutyl Ketone (Hexone)
Nickel & Compounds
Polycyclic Organic Matter as 16-PAH
Tetrachloroethylene
Toluene
Trichloroethylene
Xylenes (includes o, m, and p)

Agricultural Chemicals Production

1,2,4-Trichlorobenzene
1,3-Butadiene
1,3-Dichloropropene
1,4-Dichlorobenzene
1,4-Dioxane (1,4-Diethyleneoxide)
2,4-D (2,4-Dichlorophenoxyacetic Acid)
2,4-Dinitrophenol
4,6-Dinitro-o-cresol (including salts)
4-4'-Methylenediphenyl Diisocyanate
4-Nitrophenol
Acetonitrile
Acrylic Acid
Acrylonitrile
Aniline
Antimony & Compounds
Arsenic & Compounds (inorganic including Arsine)
Benzene
Biphenyl
Bis(2-ethylhexyl)phthalate
Captan
Carbaryl
Carbon Disulfide
Chlorobenzene
Chloroform
Chromium & Compounds
Cresols (includes o,m,p)
Cumene
Cyanide Compounds
Dichlorvos
Diethanolamine
Dimethyl Sulfate
Ethylbenzene
Ethylene Dichloride
Ethylene Glycol
Ethylene Oxide
Formaldehyde
Glycol Ethers
Hexachlorobenzene
Hexachlorocyclopentadiene
Hexachloroethane
Hydrazine
Hydrochloric Acid (Hydrogen Chloride [gas only])
Hydrogen Fluoride (Hydrofluoric Acid)
Lead & Compounds
Methanol
Methoxychlor
Methyl Bromide (Bromomethane)
Methyl Chloride
Methyl Chloroform (1,1,1-Trichloroethane)
Methyl Isobutyl Ketone (Hexone)
Methyl Isocyanate
Methyl Methacrylate
Methylene Chloride
Parathion
Pentachloronitrobenzene (Quintobenzene)
Pentachlorophenol
Phenol
Phosgene
Polycyclic Organic Matter as 16-PAH
Propoxur (Baygon)
Propylene Dichloride
Propylene Oxide
Styrene
Tetrachloroethylene
Toluene
Trichloroethylene

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Carbon Tetrachloride	Lindane	Trifluralin
Chloramben	Maleic Anhydride	Vinyl Chloride
Chlorine	Manganese & Compounds	Xylenes (includes o, m, and p)

Asphalt Concrete Manufacturing

Asbestos	Epichlorohydrin (l-Chloro-2,3-epoxypropane)	Methyl Chloroform (1,1,1-Trichloroethane)
Benzene	Ethylbenzene	Polycyclic Organic Matter as 16-PAH
Bis(2-ethylhexyl)phthalate	Ethylene Glycol	Styrene
Cumene	Hydrochloric Acid (Hydrogen Chloride [gas only])	Toluene
Dibutyl Phthalate	Lead & Compounds	Xylenes (includes o, m, and p)

Asphalt Roofing Manufacturing

Antimony & Compounds	Ethylene Glycol	Polycyclic Organic Matter as 16-PAH
Asbestos	Formaldehyde	Toluene
Benzene	Glycol Ethers	Trichloroethylene
Chromium & Compounds	Methyl Chloroform (1,1,1-Trichloroethane)	Xylenes (includes o, m, and p)
Ethylbenzene	Methyl Isobutyl Ketone (Hexone)	

Auto and Light Duty Truck (Surface Coating)

Ethylene Glycol	Methyl Ethyl Ketone (2-Butanone)	Xylenes (includes o, m, and p)
Glycol Ethers	Methyl Isobutyl Ketone (Hexone)	
Lead & Compounds	Toluene	

Baker's Yeast Manufacturing

Acetaldehyde

Boat Manufacturing

4-4'-Methylenediphenyl Diisocyanate	Methyl Chloroform (1,1,1-Trichloroethane)	Styrene
Dimethyl Phthalate	Methyl Ethyl Ketone (2-Butanone)	Toluene
Lead & Compounds	Methyl Methacrylate	Xylenes (includes o, m, and p)
Manganese & Compounds	Methylene Chloride	

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Carbon Black Production

Benzene	Carbon Disulfide	Ethylene Glycol
Biphenyl	Carbonyl Sulfide	Mercury & Compounds
Cadmium & Compounds	Cyanide Compounds	Polycyclic Organic Matter as 16-PAH

Cellophane Production

Carbon Disulfide	Toluene

Cellulose Food Casing Manufacturing

Carbon Disulfide

Chlorine Production

1,1,2,2-Tetrachloroethane	Carbonyl Sulfide	Hydrogen Fluoride (Hydrofluoric Acid)
1,1,2-Trichloroethane	Chlorine	Hydroquinone
1,1-Dimethylhydrazine	Chlorobenzene	Manganese & Compounds
1,2,4-Trichlorobenzene	Chloroform	Mercury & Compounds
1,2-Epoxybutane	Chloroprene	Methanol
1,3-Butadiene	Chromium & Compounds	Methyl Chloride
1,3-Dichloropropene	Cresols (includes o,m,p)	Methyl Chloroform (1,1,1-Trichloroethane)
1,4-Dichlorobenzene	Cumene	Methyl Ethyl Ketone (2-Butanone)
1,4-Dioxane (1,4-Diethyleneoxide)	Dichlorethyl Ether	Methyl Isobutyl Ketone (Hexone)
4,4'-Methylenedianiline	Diethanolamine	Methylene Chloride
4-4'-Methylenediphenyl Diisocyanate	Epichlorohydrin (l-Chloro-2,3-epoxypropane)	Phenol
Acetaldehyde	Ethyl Acrylate	Phosgene
Acrolein	Ethyl Chloride	Polycyclic Organic Matter as 16-PAH
Acrylic Acid	Ethylbenzene	Propionaldehyde
Acrylonitrile	Ethylene Dichloride	Propylene Dichloride
Allyl Chloride	Ethylene Glycol	Propylene Oxide
Aniline	Ethylene Oxide	Styrene
Asbestos	Formaldehyde	Tetrachloroethylene
Benzene	Glycol Ethers	Toluene
Benzotrichloride	Hexachlorobutadiene	Trichloroethylene
Benzyl Chloride	Hexachlorocyclopentadiene	Vinyl Acetate
Biphenyl	Hexachloroethane	Vinyl Chloride
Carbon Disulfide	Hydrazine	Vinylidene Chloride
Carbon Tetrachloride	Hydrochloric Acid (Hydrogen Chloride [gas only])	Xylenes (includes o, m, and p)

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Chromic Acid Anodizing

Chromium & Compounds	Mercury & Compounds	

Chromium Refractories Production

Chromium & Compounds	Hydrogen Fluoride (Hydrofluoric Acid)	Nickel & Compounds
Ethylene Glycol	Methanol	Phenol
Formaldehyde	Methyl Chloroform (1,1,1-Trichloroethane)	Toluene
Hydrochloric Acid (Hydrogen Chloride [gas only])	Methyl Ethyl Ketone (2-Butanone)	

Clay Products Manufacturing

1,4-Dichlorobenzene	Cobalt Compounds	Methyl Chloroform (1,1,1-Trichloroethane)
2,4-Toluene Diisocyanate	Dibutyl Phthalate	Methyl Ethyl Ketone (2-Butanone)
Acrylonitrile	Dimethyl Phthalate	Methyl Iodide (Iodomethane)
Antimony & Compounds	Ethylbenzene	Methylene Chloride
Arsenic & Compounds (inorganic including Arsine)	Ethylene Glycol	Nickel & Compounds
Benzene	Glycol Ethers	Phenol
Beryllium & Compounds	Hydrochloric Acid (Hydrogen Chloride [gas only])	Phosphorus
Bis(2-ethylhexyl)phthalate	Hydrogen Fluoride (Hydrofluoric Acid)	Polycyclic Organic Matter as 16-PAH
Cadmium & Compounds	Isophorone	Styrene
Carbon Disulfide	Lead & Compounds	Tetrachloroethylene
Carbon Tetrachloride	Manganese & Compounds	Toluene
Chlorine	Mercury & Compounds	Trichloroethylene
Chlorobenzene	Methanol	Vinyl Acetate
Chloroform	Methyl Bromide (Bromomethane)	Xylenes (includes o, m, and p)
Chromium & Compounds	Methyl Chloride	

Coke By-Product Plants

1,3-Butadiene	Cyanide Compounds	Phenol
2,4-Dinitrophenol	Ethylbenzene	Polycyclic Organic Matter as 16-PAH
Antimony & Compounds	Ethylene Glycol	Quinoline
Benzene	Glycol Ethers	Styrene
Biphenyl	Hydrochloric Acid (Hydrogen Chloride [gas only])	Tetrachloroethylene
Carbon Disulfide	Lead & Compounds	Toluene

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Carbonyl Sulfide	Manganese & Compounds	Trichloroethylene
Chlorine	Methanol	Xylenes (includes o, m, and p)

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Chromium & Compounds	Methyl Isobutyl Ketone (Hexone)	
Cresols (includes o,m,p)	Nickel & Compounds	

Coke Ovens: Charging, Top Side, and Door Leaks

Benzene	Coke Oven Emissions	Polycyclic Organic Matter as 16-PAH

Coke Ovens: Pushing, Quenching, and Battery Stacks

Benzene	Carbonyl Sulfide	Toluene
Carbon Disulfide	Polycyclic Organic Matter as 16-PAH	

Commercial Sterilization Facilities

Ethylene Oxide

Crematories

Arsenic & Compounds (inorganic including Arsine)	Chromium & Compounds	Mercury & Compounds
Beryllium & Compounds	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Nickel & Compounds
Cadmium & Compounds	Formaldehyde	Polycyclic Organic Matter as 16-PAH

Decorative Chromium Electroplating

Chromium & Compounds

Dry Cleaning Facilities

Tetrachloroethylene

Ferroalloys Production

Antimony & Compounds	Ethylene Glycol	Methyl Chloroform (1,1,1-Trichloroethane)
Chlorine	Hydrochloric Acid (Hydrogen Chloride [gas only])	Nickel & Compounds
Chromium & Compounds	Hydrogen Fluoride (Hydrofluoric Acid)	Polycyclic Organic Matter as 16-PAH
Cobalt Compounds	Lead & Compounds	
Cyanide Compounds	Manganese & Compounds	

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Flat Wood Paneling (Surface Coating)

Ethylene Glycol	Methyl Ethyl Ketone (2-Butanone)	Toluene
Glycol Ethers	Methyl Isobutyl Ketone (Hexone)	Xylenes (includes o, m, and p)

Flexible Polyurethane Foam Fabrication Operations

Methylene Chloride

Flexible Polyurethane Foam Production

2,4-Toluene Diisocyanate	4-4'-Methylenediphenyl Diisocyanate	Methylene Chloride

Friction Products Manufacturing

1,4-Dichlorobenzene	Glycol Ethers	Methyl Isobutyl Ketone (Hexone)
Bis(2-ethylhexyl)phthalate	Hydrochloric Acid (Hydrogen Chloride [gas only])	Methylene Chloride
Carbon Disulfide	Hydrogen Fluoride (Hydrofluoric Acid)	Nickel & Compounds
Chromium & Compounds	Lead & Compounds	Phenol
Dibutyl Phthalate	Manganese & Compounds	Polycyclic Organic Matter as 16-PAH
Ethylbenzene	Methanol	Tetrachloroethylene
Ethylene Glycol	Methyl Chloroform (1,1,1-Trichloroethane)	Toluene
Formaldehyde	Methyl Ethyl Ketone (2-Butanone)	Xylenes (includes o, m, and p)

Gasoline Distribution (Stage 1)

2,2,4-Trimethylpentane	Ethylene Dichloride	Polycyclic Organic Matter as 16-PAH
Benzene	Hexane	Toluene
Cumene	Lead & Compounds	Xylenes (includes o, m, and p)
Ethylbenzene	Methyl tert-Butyl Ether	

Halogenated Solvent Cleaners

Methyl Chloroform (1,1,1-Trichloroethane)	Tetrachloroethylene
Methylene Chloride	Trichloroethylene

Hard Chromium Electroplating

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Chromium & Compounds

Hazardous Waste Incineration

1,1,2,2-Tetrachloroethane	Chloroform	Polychlorinated Biphenyls (Aroclors)
1,1,2-Trichloroethane	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Polycyclic Organic Matter as 16-PAH
Arsenic & Compounds (inorganic including Arsine)	Hydrochloric Acid (Hydrogen Chloride [gas only])	Vinyl Chloride

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Benzene	Mercury & Compounds
Carbon Tetrachloride	Methyl Chloroform (1,1,1-Trichloroethane)

Hydrogen Fluoride Production

Hydrogen Fluoride (Hydrofluoric Acid)

Industrial Boilers

1,4-Dichlorobenzene	Chloroform	Methyl Chloride
2,4-Dinitrophenol	Chromium & Compounds	Methyl Chloroform (1,1,1-Trichloroethane)
2,4-Dinitrotoluene	Cobalt Compounds	Methyl Ethyl Ketone (2-Butanone)
2-Chloroacetophenone	Cumene	Methyl Methacrylate
4-Nitrophenol	Cyanide Compounds	Methyl tert-Butyl Ether
Acetaldehyde	Dimethyl Sulfate	Methylene Chloride
Acetophenone	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Methylhydrazine
Acrolein	Ethyl Chloride	Nickel & Compounds
Antimony & Compounds	Ethylbenzene	Phenol
Arsenic & Compounds (inorganic including Arsine)	Ethylene Dibromide	Phosphorus
Benzene	Ethylene Dichloride	Polychlorinated Biphenyls (Aroclors)
Benzyl Chloride	Formaldehyde	Polycyclic Organic Matter as 16-PAH
Beryllium & Compounds	Hexane	Propionaldehyde
Bis(2-ethylhexyl)phthalate	Hydrochloric Acid (Hydrogen Chloride [gas only])	Selenium Compounds
Bromoform	Isophorone	Styrene
Cadmium & Compounds	Lead & Compounds	Tetrachloroethylene
Carbon Disulfide	Manganese & Compounds	Toluene
Chlorine	Mercury & Compounds	Vinyl Acetate
Chlorobenzene	Methyl Bromide (Bromomethane)	Xylenes (includes o, m, and p)

Industrial Process Cooling Towers

Chromium & Compounds

Institutional/Commercial Boilers

2,4-Dinitrophenol	Chloroform	Methyl Ethyl Ketone (2-Butanone)
2,4-Dinitrotoluene	Chromium & Compounds	Methyl Methacrylate
2-Chloroacetophenone	Cobalt Compounds	Methyl tert-Butyl Ether
4-Nitrophenol	Cumene	Methylene Chloride

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Acetaldehyde
Acetophenone
Acrolein
Antimony & Compounds
Arsenic & Compounds (inorganic including Arsine)
Benzene
Benzyl Chloride
Beryllium & Compounds
Bis(2-ethylhexyl)phthalate
Bromoform
Cadmium & Compounds
Carbon Disulfide
Chlorine
Chlorobenzene
Cyanide Compounds
Dimethyl Sulfate
Ethyl Chloride
Ethylbenzene
Ethylene Dibromide
Ethylene Dichloride
Formaldehyde
Hexane
Isophorone
Lead & Compounds
Manganese & Compounds
Mercury & Compounds
Methyl Bromide (Bromomethane)
Methyl Chloroform (1,1,1-Trichloroethane)
Methylhydrazine
Nickel & Compounds
Phenol
Polycyclic Organic Matter as 16-PAH
Propionaldehyde
Selenium Compounds
Styrene
Tetrachloroethylene
Toluene
Vinyl Acetate
Xylenes (includes o, m, and p)

Integrated Iron and Steel Manufacturing

4-4'-Methylenediphenyl Diisocyanate
Benzene
Chromium & Compounds
Cobalt Compounds
Dioxin/Furans as 2,3,7,8-TCDD TEQ
Ethylene Glycol
Hydrochloric Acid (Hydrogen Chloride [gas only])
Hydrogen Fluoride (Hydrofluoric Acid)
Lead & Compounds
Manganese & Compounds
Methanol
Methyl Chloroform (1,1,1-Trichloroethane)
Methyl Ethyl Ketone (2-Butanone)
Methyl Isobutyl Ketone (Hexone)
Nickel & Compounds
Phenol
Polycyclic Organic Matter as 16-PAH
Toluene
Trichloroethylene
Xylenes (includes o, m, and p)

Iron Foundries

1,4-Dioxane (1,4-Diethyleneoxide)
4-4'-Methylenediphenyl Diisocyanate
Antimony & Compounds
Arsenic & Compounds (inorganic including Arsine)
Benzene
Cadmium & Compounds
Chlorine
Chromium & Compounds
Cobalt Compounds
Cumene
Diethanolamine
Ethylbenzene
Ethylene Glycol
Formaldehyde
Glycol Ethers
Hydrochloric Acid (Hydrogen Chloride [gas only])
Hydrogen Fluoride (Hydrofluoric Acid)
Lead & Compounds
Manganese & Compounds
Methanol
Methyl Chloroform (1,1,1-Trichloroethane)
Methyl Ethyl Ketone (2-Butanone)
Methyl Isobutyl Ketone (Hexone)
Methyl Isocyanate
Methylene Chloride
Nickel & Compounds
Phenol
Polycyclic Organic Matter as 16-PAH
Styrene
Toluene
Trichloroethylene
Xylenes (includes o, m, and p)

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Large Appliance (Surface Coating)

Ethylene Glycol	Methyl Ethyl Ketone (2-Butanone)	Xylenes (includes o, m, and p)
Glycol Ethers	Toluene	

Leather Tanning and Finishing Operations

Chlorine	Hydrochloric Acid (Hydrogen Chloride [gas only])	Tetrachloroethylene
Chromium & Compounds	Methanol	Toluene
Formaldehyde	Methyl Ethyl Ketone (2-Butanone)	Xylenes (includes o, m, and p)
Glycol Ethers	Methyl Isobutyl Ketone (Hexone)	

Lime Manufacturing

Chromium & Compounds	Lead & Compounds	Phenol
Hydrochloric Acid (Hydrogen Chloride [gas only])	Mercury & Compounds	

Magnetic Tape (Surface Coating)

Methyl Ethyl Ketone (2-Butanone)	Methyl Isobutyl Ketone (Hexone)	Toluene

Marine Vessel Loading Operations

Benzene	Toluene
Hexane	Xylenes (includes o, m, and p)

Medical Waste Incinerators

1,1,2,2-Tetrachloroethane	Chromium & Compounds	Methyl Chloroform (1,1,1-Trichloroethane)
Antimony & Compounds	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Methylene Chloride
Arsenic & Compounds (inorganic including Arsine)	Ethylene Dichloride	Nickel & Compounds
Benzene	Formaldehyde	Polychlorinated Biphenyls (Aroclors)
Beryllium & Compounds	Hydrochloric Acid (Hydrogen Chloride [gas only])	Polycyclic Organic Matter as 16-PAH
Cadmium & Compounds	Hydrogen Fluoride (Hydrofluoric Acid)	Tetrachloroethylene
Carbon Tetrachloride	Lead & Compounds	Toluene
Chlorine	Manganese & Compounds	Trichloroethylene
Chloroform	Mercury & Compounds	Xylenes (includes o, m, and p)

Metal Can (Surface Coating)

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Ethylene Glycol	Methyl Ethyl Ketone (2-Butanone)	Toluene
Glycol Ethers	Methyl Isobutyl Ketone (Hexone)	Xylenes (includes o, m, and p)

Metal Coil (Surface Coating)

Ethylene Glycol	Methyl Ethyl Ketone (2-Butanone)	Toluene
Glycol Ethers	Methyl Isobutyl Ketone (Hexone)	Xylenes (includes o, m, and p)

Metal Furniture (Surface Coating)

Ethylene Glycol	Methyl Ethyl Ketone (2-Butanone)	Toluene
Glycol Ethers	Methyl Isobutyl Ketone (Hexone)	Xylenes (includes o, m, and p)

Mineral Wool Production

4-4'-Methylenediphenyl Diisocyanate	Formaldehyde	Styrene
Chromium & Compounds	Methanol	Toluene
Ethylbenzene	Methyl Chloroform (1,1,1-Trichloroethane)	Vinyl Acetate
Ethylene Glycol	Phenol	Xylenes (includes o, m, and p)

Miscellaneous Metal Parts and Products (Surface Coating)

Ethylene Glycol	Methyl Ethyl Ketone (2-Butanone)	Toluene
Glycol Ethers	Methyl Isobutyl Ketone (Hexone)	Xylenes (includes o, m, and p)

MON

1,1,2,2-Tetrachloroethane	Catechol	Methanol
1,1,2-Trichloroethane	Chlordane	Methyl Bromide (Bromomethane)
1,1-Dimethylhydrazine	Chlorine	Methyl Chloride
1,2,4-Trichlorobenzene	Chloroacetic Acid	Methyl Chloroform (1,1,1-Trichloroethane)
1,2-Propylenimine (2-Methylaziridine)	Chlorobenzene	Methyl Ethyl Ketone (2-Butanone)
1,3-Butadiene	Chloroform	Methyl Iodide (Iodomethane)
1,3-Dichloropropene	Chloromethyl Methyl Ether	Methyl Isobutyl Ketone (Hexone)
1,4-Dichlorobenzene	Chloroprene	Methyl Isocyanate
1,4-Dioxane (1,4-Diethyleneoxide)	Chromium & Compounds	Methyl Methacrylate
2,4-D (2,4-Dichlorophenoxyacetic Acid)	Cobalt Compounds	Methyl tert-Butyl Ether
2,4-Dinitrophenol	Cresols (includes o,m,p)	Methylene Chloride
2,4-Dinitrotoluene	Cumene	Methylhydrazine

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

2,4-Toluene Diisocyanate	Cyanide Compounds	N,N-Dimethylaniline
2-Nitropropane	Dibutyl Phthalate	Nickel & Compounds
3,3'-Dichlorobenzidene	Dichlorethyl Ether	Nitrobenzene
4,4'-Methylenedianiline	Dichlorvos	o-Anisidine
4,6-Dinitro-o-cresol (including salts)	Diethanolamine	p-Phenylenediamine
4-4'-Methylenediphenyl Diisocyanate	Diethyl Sulfate	Pentachloronitrobenzene (Quintobenzene)
4-Nitrophenol	Dimethyl Phthalate	Phenol

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Acetaldehyde
Acetamide
Acetonitrile
Acrolein
Acrylamide
Acrylic Acid
Acrylonitrile
Allyl Chloride
Aniline
Antimony & Compounds
Arsenic & Compounds (inorganic including Arsine)
Benzene
Benzotrichloride
Benzyl Chloride
Beryllium & Compounds
Biphenyl
Bis(chloromethyl) Ether
Cadmium & Compounds
Calcium Cyanamide
Captan
Carbaryl
Carbon Disulfide
Carbon Tetrachloride
Carbonyl Sulfide
Dimethyl Sulfate
Epichlorohydrin (l-Chloro-2,3-epoxypropane)
Ethyl Acrylate
Ethyl Chloride
Ethylbenzene
Ethylene Dibromide
Ethylene Dichloride
Ethylene Glycol
Ethylene Oxide
Formaldehyde
Glycol Ethers
Heptachlor
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Hydrazine
Hydrochloric Acid (Hydrogen Chloride [gas only])
Hydrogen Fluoride (Hydrofluoric Acid)
Hydroquinone
Lead & Compounds
Maleic Anhydride
Manganese & Compounds
Mercury & Compounds
Phosgene
Phosphorus
Phthalic Anhydride
Polycyclic Organic Matter as 16-PAH
Propionaldehyde
Propylene Dichloride
Propylene Oxide
Quinoline
Quinone (p-Benzoquinone)
Selenium Compounds
Styrene
Styrene Oxide
Tetrachloroethylene
Titanium Tetrachloride
Toluene
Trichloroethylene
Trifluralin
Vinyl Acetate
Vinyl Bromide
Vinyl Chloride
Vinylidene Chloride
Xylenes (includes o, m, and p)

Municipal Landfills

1,1,2,2-Tetrachloroethane
Acrylonitrile
Benzene
Carbon Disulfide
Carbon Tetrachloride
Carbonyl Sulfide
Chlorobenzene
Chloroform
Ethyl Chloride
Ethylbenzene
Ethylene Dichloride
Ethylidene Dichloride
Hexane
Methyl Chloroform (1,1,1-Trichloroethane)
Methyl Ethyl Ketone (2-Butanone)
Methyl Isobutyl Ketone (Hexone)
Methylene Chloride
Polychlorinated Biphenyls (Aroclors)
Polycyclic Organic Matter as 16-PAH
Propylene Dichloride
Tetrachloroethylene
Toluene
Trichloroethylene
Vinyl Chloride
Vinylidene Chloride
Xylenes (includes o, m, and p)

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Municipal Waste Combustors

Acetaldehyde	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Mercury & Compounds
Arsenic & Compounds (inorganic including Arsine)	Formaldehyde	Nickel & Compounds
Beryllium & Compounds	Hydrochloric Acid (Hydrogen Chloride [gas only])	Polychlorinated Biphenyls (Aroclors)
Cadmium & Compounds	Lead & Compounds	Polycyclic Organic Matter as 16-PAH
Chromium & Compounds	Manganese & Compounds	

Oil and Natural Gas Production

2,2,4-Trimethylpentane	Ethylbenzene	Toluene
Benzene	Hexane	Xylenes (includes o, m, and p)

Other Biological Incineration

Acetaldehyde	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Polychlorinated Biphenyls (Aroclors)
Cadmium & Compounds	Ethylene Dichloride	

Paper and Other Webs (Surface Coating)

1,1,2-Trichloroethane	Cumene	Methyl Ethyl Ketone (2-Butanone)
1,4-Dioxane (1,4-Diethyleneoxide)	Cyanide Compounds	Methyl Isobutyl Ketone (Hexone)
2,4-Toluene Diisocyanate	Dibutyl Phthalate	Methyl Methacrylate
Acetaldehyde	Diethanolamine	Methylene Chloride
Acetonitrile	Diethyl Sulfate	N,N-Dimethylaniline
Acrylamide	Dimethyl Sulfate	Nickel & Compounds
Acrylic Acid	Ethyl Acrylate	Phenol
Acrylonitrile	Ethylbenzene	Phthalic Anhydride
Aniline	Ethylene Dichloride	Polycyclic Organic Matter as 16-PAH
Antimony & Compounds	Ethylene Glycol	Propylene Dichloride
Asbestos	Ethylene Oxide	Propylene Oxide
Benzene	Formaldehyde	Selenium Compounds
Biphenyl	Glycol Ethers	Styrene
Bis(2-ethylhexyl)phthalate	Hydrochloric Acid (Hydrogen Chloride [gas only])	Tetrachloroethylene
Cadmium & Compounds	Hydrogen Fluoride (Hydrofluoric Acid)	Toluene
Catechol	Hydroquinone	Trichloroethylene
Chlorine	Lead & Compounds	Vinyl Acetate
Chlorobenzene	Maleic Anhydride	Vinyl Chloride
Chloroform	Manganese & Compounds	Vinylidene Chloride
Chromium & Compounds	Methanol	Xylenes (includes o, m, and p)

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Cobalt Compounds
Cresols (includes o,m,p)
Methyl Bromide (Bromomethane)
Methyl Chloroform (1,1,1-Trichloroethane)

Petroleum Refineries Catalytic Cracking (Fluid and other) Units, Catalytic Reforming Units, and Sulfur Plant Units

Polycyclic Organic Matter as 16-PAH

Petroleum Refineries: Other Sources Not Distinctly Listed

2,2,4-Trimethylpentane
Benzene
Biphenyl
Cresols (includes o,m,p)
Cumene
Ethylbenzene
Hexane
Methyl tert-Butyl Ether
Phenol
Polycyclic Organic Matter as 16-PAH
Styrene
Toluene
Xylenes (includes o, m, and p)

Pharmaceuticals Production

1,1,2-Trichloroethane
1,2-Epoxybutane
1,2-Propylenimine (2-Methylaziridine)
1,4-Dioxane (1,4-Diethyleneoxide)
Acetonitrile
Acetophenone
Acrylic Acid
Acrylonitrile
Allyl Chloride
Aniline
Arsenic & Compounds (inorganic including Arsine)
Benzene
Benzyl Chloride
Biphenyl
Bis(2-ethylhexyl)phthalate
Carbon Disulfide
Carbon Tetrachloride
Chlorine
Chloroacetic Acid
Chlorobenzene
Chloroform
Chloromethyl Methyl Ether
Dichlorvos
Diethanolamine
Diethyl Sulfate
Dimethyl Phthalate
Dimethyl Sulfate
Dimethylformamide
Epichlorohydrin (l-Chloro-2,3-epoxypropane)
Ethyl Acrylate
Ethyl Chloride
Ethylbenzene
Ethylene Dibromide
Ethylene Dichloride
Ethylene Glycol
Ethylene Oxide
Formaldehyde
Glycol Ethers
Hexane
Hydrazine
Hydrochloric Acid (Hydrogen Chloride [gas only])
Maleic Anhydride
Manganese & Compounds
Methanol
Methyl Ethyl Ketone (2-Butanone)
Methyl Iodide (Iodomethane)
Methyl Isobutyl Ketone (Hexone)
Methyl tert-Butyl Ether
Methylene Chloride
N,N-Dimethylaniline
N-Nitrosodimethylamine
Nickel & Compounds
Nitrobenzene
Phenol
Phosgene
Phthalic Anhydride
Polycyclic Organic Matter as 16-PAH
Propylene Oxide
Quinoline
Selenium Compounds
Tetrachloroethylene
Toluene
Trichloroethylene
Triethylamine
Trifluralin
Vinyl Acetate

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Cumene	**Methyl Chloride**	**Vinylidene Chloride**
Cyanide Compounds	**Methyl Chloroform (1,1,1-Trichloroethane)**	**Xylenes (includes o, m, and p)**

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Phosphate Fertilizers Production

Chlorine
Hydrochloric Acid (Hydrogen Chloride [gas only])
Hydrogen Fluoride (Hydrofluoric Acid)
Lead & Compounds
Manganese & Compounds
Methanol
Methyl Chloroform (1,1,1-Trichloroethane)
Methyl Isobutyl Ketone (Hexone)
Phosphorus
Toluene

Phosphoric Acid Manufacturing

Hydrogen Fluoride (Hydrofluoric Acid)

Plywood/Particle Board Manufacturing

4-4'-Methylenediphenyl Diisocyanate
Acetaldehyde
Arsenic & Compounds (inorganic including Arsine)
Bis(2-ethylhexyl)phthalate
Chlorine
Chromium & Compounds
Dibutyl Phthalate
Ethylbenzene
Ethylene Glycol
Formaldehyde
Glycol Ethers
Hydrochloric Acid (Hydrogen Chloride [gas only])
Methanol
Methyl Chloroform (1,1,1-Trichloroethane)
Methyl Ethyl Ketone (2-Butanone)
Methyl Isobutyl Ketone (Hexone)
Methyl Isocyanate
Methyl Methacrylate
Methylene Chloride
Pentachlorophenol
Phenol
Styrene
Tetrachloroethylene
Toluene
Trichloroethylene
Xylenes (includes o, m, and p)

Polycarbonates Production

Ethyl Chloride
Methylene Chloride

Polyether Polyols Production

Ethylene Oxide
Hexane
Propylene Oxide
Toluene

Polymers & Resins (Excluding P&R III)

1,1,2,2-Tetrachloroethane
1,1-Dimethylhydrazine
1,2-Epoxybutane
1,2-Propylenimine (2-Methylaziridine)
Chlorine
Chloroacetic Acid
Chlorobenzene
Chloroform
Methanol
Methyl Bromide (Bromomethane)
Methyl Chloride
Methyl Chloroform (1,1,1-Trichloroethane)

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

1,3-Butadiene	Chloromethyl Methyl Ether	Methyl Ethyl Ketone (2-Butanone)
1,3-Dichloropropene	Chloroprene	Methyl Isobutyl Ketone (Hexone)
1,4-Dioxane (1,4-Diethyleneoxide)	Chromium & Compounds	Methyl Methacrylate
2,4,6-Trichlorophenol	Cobalt Compounds	Methyl tert-Butyl Ether
2,4-D (2,4-Dichlorophenoxyacetic Acid)	Cresols (includes o,m,p)	Methylene Chloride

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

2,4-Dinitrophenol	Cumene	N,N-Dimethylaniline
2,4-Toluene Diisocyanate	Dibutyl Phthalate	Nickel & Compounds
4,4'-Methylenebis(2-chloroaniline)	Diethanolamine	Nitrobenzene
4,4'-Methylenedianiline	Diethyl Sulfate	o-Toluidine
4-4'-Methylenediphenyl Diisocyanate	Dimethyl Phthalate	p-Phenylenediamine
Acetaldehyde	Epichlorohydrin (l-Chloro-2,3-epoxypropane)	Phenol
Acetonitrile	Ethyl Acrylate	Phosgene
Acrolein	Ethyl Chloride	Phthalic Anhydride
Acrylamide	Ethylbenzene	Polycyclic Organic Matter as 16-PAH
Acrylic Acid	Ethylene Dibromide	Propionaldehyde
Acrylonitrile	Ethylene Dichloride	Propoxur (Baygon)
Allyl Chloride	Ethylene Glycol	Propylene Dichloride
Aniline	Ethylene Oxide	Propylene Oxide
Antimony & Compounds	Formaldehyde	Styrene
Benzene	Glycol Ethers	Tetrachloroethylene
Benzyl Chloride	Hydrazine	Titanium Tetrachloride
Biphenyl	Hydrochloric Acid (Hydrogen Chloride [gas only])	Toluene
Bis(2-ethylhexyl)phthalate	Hydrogen Fluoride (Hydrofluoric Acid)	Trichloroethylene
Bis(chloromethyl) Ether	Hydroquinone	Vinyl Acetate
Cadmium & Compounds	Lead & Compounds	Vinyl Bromide
Carbon Disulfide	Maleic Anhydride	Vinyl Chloride
Carbon Tetrachloride	Manganese & Compounds	Vinylidene Chloride
Carbonyl Sulfide	Mercury & Compounds	Xylenes (includes o, m, and p)

Polymers and Resins III

Formaldehyde	Phenol
Methanol	Xylenes (includes o, m, and p)

Portland Cement Manufacturing: Hazardous Waste-fired

1,1,2,2-Tetrachloroethane	Dibutyl Phthalate	Methyl Isobutyl Ketone (Hexone)
1,1,2-Trichloroethane	Diethanolamine	Methyl Methacrylate
1,2,4-Trichlorobenzene	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Methylene Chloride
1,4-Dichlorobenzene	Epichlorohydrin (l-Chloro-2,3-epoxypropane)	Nickel & Compounds
2-Nitropropane	Ethylbenzene	Nitrobenzene
Acetonitrile	Ethylene Dichloride	Pentachlorophenol
Acrylonitrile	Ethylene Glycol	Phenol
Aniline	Formaldehyde	Phthalic Anhydride
Benzene	Glycol Ethers	Polycyclic Organic Matter as 16-PAH
Carbon Disulfide	Hydrochloric Acid (Hydrogen Chloride [gas only])	Propylene Oxide
Chlorine	Lead & Compounds	Styrene

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Chlorobenzene
Chloroform
Chromium & Compounds
Cresols (includes o,m,p)
Cumene
Maleic Anhydride
Mercury & Compounds
Methanol
Methyl Chloroform (1,1,1-Trichloroethane)
Methyl Ethyl Ketone (2-Butanone)
Tetrachloroethylene
Toluene
Trichloroethylene
Vinyl Acetate
Xylenes (includes o, m, and p)

Portland Cement Manufacturing: Non-Hazardous Waste-fired

1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane
1,2,4-Trichlorobenzene
1,4-Dichlorobenzene
2-Nitropropane
Acetonitrile
Acrylonitrile
Aniline
Benzene
Carbon Disulfide
Chlorine
Chlorobenzene
Chloroform
Chromium & Compounds
Cresols (includes o,m,p)
Cumene
Dibutyl Phthalate
Diethanolamine
Dioxin/Furans as 2,3,7,8-TCDD TEQ
Epichlorohydrin (l-Chloro-2,3-epoxypropane)
Ethylbenzene
Ethylene Dichloride
Ethylene Glycol
Formaldehyde
Glycol Ethers
Hydrochloric Acid (Hydrogen Chloride [gas only])
Lead & Compounds
Maleic Anhydride
Mercury & Compounds
Methanol
Methyl Chloroform (1,1,1-Trichloroethane)
Methyl Ethyl Ketone (2-Butanone)
Methyl Isobutyl Ketone (Hexone)
Methyl Methacrylate
Methylene Chloride
Nickel & Compounds
Nitrobenzene
Pentachlorophenol
Phenol
Phthalic Anhydride
Polycyclic Organic Matter as 16-PAH
Propylene Oxide
Styrene
Tetrachloroethylene
Toluene
Trichloroethylene
Vinyl Acetate
Xylenes (includes o, m, and p)

Primary Aluminum Production

Carbonyl Sulfide
Chlorine
Chromium & Compounds
Cumene
Glycol Ethers
Hydrochloric Acid (Hydrogen Chloride [gas only])
Hydrogen Fluoride (Hydrofluoric Acid)
Lead & Compounds
Methyl Ethyl Ketone (2-Butanone)
Methyl Isobutyl Ketone (Hexone)
Nickel & Compounds
Polycyclic Organic Matter as 16-PAH

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Cyanide Compounds	Manganese & Compounds	Toluene
Ethylene Glycol	Methyl Chloroform (1,1,1-Trichloroethane)	Xylenes (includes o, m, and p)

Primary Copper Smelting

Antimony & Compounds	Cobalt Compounds	Methyl Chloroform (1,1,1-Trichloroethane)
Arsenic & Compounds (inorganic including Arsine)	Cresols (includes o,m,p)	Nickel & Compounds
Beryllium & Compounds	Hydrochloric Acid (Hydrogen Chloride [gas only])	Selenium Compounds
Cadmium & Compounds	Lead & Compounds	Styrene
Chlorine	Manganese & Compounds	
Chromium & Compounds	Mercury & Compounds	

Primary Lead Smelting

Antimony & Compounds	Lead & Compounds	Nickel & Compounds
Arsenic & Compounds (inorganic including Arsine)	Manganese & Compounds	
Cadmium & Compounds	Mercury & Compounds	

Primary Magnesium Refining

Chlorine	Hydrochloric Acid (Hydrogen Chloride [gas only])	

Printing/Publishing (Surface Coating)

1,4-Dioxane (1,4-Diethyleneoxide)	Cumene	Methyl Ethyl Ketone (2-Butanone)
2-Nitropropane	Cyanide Compounds	Methyl Isobutyl Ketone (Hexone)
4-4'-Methylenediphenyl Diisocyanate	Dibutyl Phthalate	Methylene Chloride
Acrylic Acid	Ethylbenzene	Nickel & Compounds
Antimony & Compounds	Ethylene Glycol	Phenol
Arsenic & Compounds (inorganic including Arsine)	Formaldehyde	Phthalic Anhydride
Benzene	Glycol Ethers	Polycyclic Organic Matter as 16-PAH
Bis(2-ethylhexyl)phthalate	Hydrochloric Acid (Hydrogen Chloride [gas only])	Tetrachloroethylene
Cadmium & Compounds	Lead & Compounds	Toluene
Chlorine	Maleic Anhydride	Trichloroethylene
Chromium & Compounds	Methanol	Vinyl Acetate
Cobalt Compounds	Methyl Chloroform (1,1,1-Trichloroethane)	Xylenes (includes o, m, and p)

Publicly Owned Treatment Works (POTW) Emissions

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Acrylonitrile	Methanol	Tetrachloroethylene
Benzene	Methyl Chloroform (1,1,1-Trichloroethane)	Toluene
Carbon Disulfide	Methyl Ethyl Ketone (2-Butanone)	Trichloroethylene

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Chloroform	Methyl Isobutyl Ketone (Hexone)	Xylenes (includes o, m, and p)
Ethylbenzene	Methylene Chloride	
Glycol Ethers	Styrene	

Pulp and Paper Production (combustion) MACT II

Acetaldehyde	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Methyl Isobutyl Ketone (Hexone)
Antimony & Compounds	Formaldehyde	Nickel & Compounds
Arsenic & Compounds (inorganic including Arsine)	Hydrochloric Acid (Hydrogen Chloride [gas only])	Phenol
Benzene	Lead & Compounds	Polycyclic Organic Matter as 16-PAH
Beryllium & Compounds	Manganese & Compounds	Selenium Compounds
Cadmium & Compounds	Mercury & Compounds	Styrene
Chromium & Compounds	Methanol	Toluene
Cobalt Compounds	Methyl Ethyl Ketone (2-Butanone)	Xylenes (includes o, m, and p)

Pulp and Paper Production (non-combustion) MACT I

1,1,2-Trichloroethane	Chloroform	Methyl Ethyl Ketone (2-Butanone)
1,2,4-Trichlorobenzene	Cresols (includes o,m,p)	Methyl Isobutyl Ketone (Hexone)
Acetaldehyde	Cumene	Methylene Chloride
Acetophenone	Ethylbenzene	Phenol
Acrolein	Ethylene Dichloride	Propionaldehyde
Benzene	Formaldehyde	Styrene
Benzotrichloride	Hexane	Tetrachloroethylene
Carbon Disulfide	Hydrochloric Acid (Hydrogen Chloride [gas only])	Toluene
Carbon Tetrachloride	Methanol	Trichloroethylene
Chlorine	Methyl Chloride	Xylenes (includes o, m, and p)
Chlorobenzene	Methyl Chloroform (1,1,1-Trichloroethane)	

Rayon Production

Biphenyl	Chlorine	Glycol Ethers
Carbon Disulfide	Ethylene Glycol	Methanol

Scrap or Waste Tire Incineration

Dioxin/Furans as 2,3,7,8-TCDD TEQ	Polychlorinated Biphenyls (Aroclors)	Polycyclic Organic Matter as 16-PAH

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Secondary Aluminum Production

Antimony & Compounds
Arsenic & Compounds (inorganic including Arsine)
Cadmium & Compounds
Chromium & Compounds
Dioxin/Furans as 2,3,7,8-TCDD TEQ
Formaldehyde
Hydrochloric Acid (Hydrogen Chloride [gas only])
Hydrogen Fluoride (Hydrofluoric Acid)
Lead & Compounds
Manganese & Compounds
Mercury & Compounds
Nickel & Compounds

Secondary Lead Smelting

1,1,2,2-Tetrachloroethane
1,3-Butadiene
1,3-Dichloropropene
Acetaldehyde
Acetophenone
Acrolein
Acrylonitrile
Antimony & Compounds
Arsenic & Compounds (inorganic including Arsine)
Benzene
Biphenyl
Bis(2-ethylhexyl)phthalate
Cadmium & Compounds
Carbon Disulfide
Chlorobenzene
Chloroform
Chromium & Compounds
Cumene
Dibutyl Phthalate
Dioxin/Furans as 2,3,7,8-TCDD TEQ
Ethyl Carbamate (Urethane)
Ethylbenzene
Formaldehyde
Hexane
Lead & Compounds
Manganese & Compounds
Mercury & Compounds
Methyl Bromide (Bromomethane)
Methyl Chloride
Methyl Ethyl Ketone (2-Butanone)
Methyl Iodide (Iodomethane)
Methylene Chloride
Nickel & Compounds
Phenol
Polycyclic Organic Matter as 16-PAH
Propionaldehyde
Styrene
Toluene
Trichloroethylene
Xylenes (includes o, m, and p)

Semiconductor Manufacturing

1,2,4-Trichlorobenzene
Antimony & Compounds
Catechol
Chlorine
Ethylbenzene
Ethylene Glycol
Glycol Ethers
Hydrochloric Acid (Hydrogen Chloride [gas only])
Hydrogen Fluoride (Hydrofluoric Acid)
Hydroquinone
Lead & Compounds
Manganese & Compounds
Methanol
Methyl Chloroform (1,1,1-Trichloroethane)
Methyl Ethyl Ketone (2-Butanone)
Methyl Isobutyl Ketone (Hexone)
Methylene Chloride
Phenol
Tetrachloroethylene
Toluene
Trichloroethylene
Xylenes (includes o, m, and p)

Sewage Sludge Incineration

1,1,2,2-Tetrachloroethane
1,4-Dichlorobenzene
Acetaldehyde
Chloroform
Chromium & Compounds
Cobalt Compounds
Methylene Chloride
Nickel & Compounds
Phenol

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Acetonitrile	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Phosphorus
Acrylonitrile	Ethylbenzene	Polychlorinated Biphenyls (Aroclors)

Antimony & Compounds	Ethylene Dichloride	Polycyclic Organic Matter as 16-PAH
Arsenic & Compounds (inorganic including Arsine)	Formaldehyde	Selenium Compounds
Benzene	Hydrochloric Acid (Hydrogen Chloride [gas only])	Tetrachloroethylene
Beryllium & Compounds	Lead & Compounds	Toluene
Bis(2-ethylhexyl)phthalate	Manganese & Compounds	Trichloroethylene
Cadmium & Compounds	Mercury & Compounds	Vinyl Chloride
Carbon Tetrachloride	Methyl Chloroform (1,1,1-Trichloroethane)	Xylenes (includes o, m, and p)
Chlorobenzene	Methyl Ethyl Ketone (2-Butanone)	

Shipbuilding and Ship Repair (Surface Coating)

Glycol Ethers	Methyl Isobutyl Ketone (Hexone)	Xylenes (includes o, m, and p)
Methyl Ethyl Ketone (2-Butanone)	Toluene	

Spandex Production

2,4-Toluene Diisocyanate	Methylene Chloride	Toluene

Stationary Internal Combustion Engines

1,3-Butadiene	Benzene	Polycyclic Organic Matter as 16-PAH
Acetaldehyde	Formaldehyde	Toluene
Acrolein	Mercury & Compounds	Xylenes (includes o, m, and p)

Stationary Turbines

Acetaldehyde	Formaldehyde	Phenol
Benzene	Manganese & Compounds	Polycyclic Organic Matter as 16-PAH
Cadmium & Compounds	Mercury & Compounds	Toluene
Chromium & Compounds	Nickel & Compounds	Xylenes (includes o, m, and p)

Steel Foundries

1,1,2-Trichloroethane	Cresols (includes o,m,p)	Methyl Ethyl Ketone (2-Butanone)
2,4-Dinitrophenol	Cumene	Methyl Isobutyl Ketone (Hexone)
4-4'-Methylenediphenyl Diisocyanate	Cyanide Compounds	Methylene Chloride
Antimony & Compounds	Diethanolamine	Nickel & Compounds

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Arsenic & Compounds (inorganic including Arsine)	Ethylbenzene	Phenol
Benzene	Ethylene Glycol	Phosphorus
Beryllium & Compounds	Formaldehyde	Polycyclic Organic Matter as 16-PAH
Biphenyl	Glycol Ethers	Quinoline
Cadmium & Compounds	Hydrochloric Acid (Hydrogen Chloride [gas only])	Selenium Compounds
Carbon Disulfide	Hydrogen Fluoride (Hydrofluoric Acid)	Styrene
Carbonyl Sulfide	Lead & Compounds	Tetrachloroethylene
Chlorine	Manganese & Compounds	Toluene
Chlorobenzene	Mercury & Compounds	Trichloroethylene
Chromium & Compounds	Methanol	Xylenes (includes o, m, and p)
Cobalt Compounds	Methyl Chloroform (1,1,1-Trichloroethane)	

Steel Pickling HCl Process

Chlorine	Hydrochloric Acid (Hydrogen Chloride [gas only])

Taconite Iron Ore Processing

Benzene	Lead & Compounds
Formaldehyde	Toluene

Tire Production

1,1,2,2-Tetrachloroethane	Benzotrichloride	Methyl Bromide (Bromomethane)
1,1,2-Trichloroethane	Benzyl Chloride	Methyl Chloride
1,2,4-Trichlorobenzene	Biphenyl	Methyl Chloroform (1,1,1-Trichloroethane)
1,2-Dibromo-3-chloropropane	Bis(2-ethylhexyl)phthalate	Methyl Ethyl Ketone (2-Butanone)
1,3-Butadiene	Bromoform	Methyl Isobutyl Ketone (Hexone)
1,4-Dichlorobenzene	Cadmium & Compounds	Methyl tert-Butyl Ether
1,4-Dioxane (1,4-Diethyleneoxide)	Carbon Disulfide	Methylene Chloride
2,2,4-Trimethylpentane	Carbon Tetrachloride	N,N-Dimethylaniline
2,4,5-Trichlorophenol	Carbonyl Sulfide	N-Nitrosodimethylamine
2,4,6-Trichlorophenol	Chlorobenzene	N-Nitrosomorpholine
2,4-Dinitrophenol	Chloroform	Nickel & Compounds
2,4-Dinitrotoluene	Chloroprene	Nitrobenzene
2-Chloroacetophenone	Chromium & Compounds	o-Anisidine
3,3'-Dichlorobenzidene	Cresols (includes o,m,p)	o-Toluidine
3,3'-Dimethoxybenzidine	Cumene	p-Phenylenediamine
3,3'-Dimethylbenzidine	Dibutyl Phthalate	Pentachloronitrobenzene (Quintobenzene)
4,4'-Methylenebis(2-chloroaniline)	Dichlorethyl Ether	Pentachlorophenol

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

4,4'-Methylenedianiline	Dimethyl Phthalate	Phenol
4,6-Dinitro-o-cresol (including salts)	Epichlorohydrin (l-Chloro-2,3-epoxypropane)	Polycyclic Organic Matter as 16-PAH
4-Aminobiphenyl	Ethyl Chloride	Propylene Dichloride
4-Dimethylaminoazobenzene	Ethylbenzene	Propylene Oxide
4-Nitrobiphenyl	Ethylene Dibromide	Styrene
4-Nitrophenol	Ethylene Dichloride	Tetrachloroethylene
Acetaldehyde	Ethylidene Dichloride	Toluene

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Acetonitrile	Hexachlorobenzene	Trichloroethylene
Acetophenone	Hexachlorobutadiene	Trifluralin
Acrolein	Hexachlorocyclopentadiene	Vinyl Acetate
Acrylonitrile	Hexachloroethane	Vinyl Chloride
Allyl Chloride	Hexane	Vinylidene Chloride
Aniline	Hydroquinone	Xylenes (includes o, m, and p)
Benzene	Isophorone	
Benzidine	Lead & Compounds	

Utilities - Coal

1,1,2-Trichloroethane	Cresols (includes o,m,p)	Methyl Isobutyl Ketone (Hexone)
1,3-Dichloropropene	Cumene	Methyl Methacrylate
2,4-Dinitrotoluene	Dibutyl Phthalate	Methyl tert-Butyl Ether
2-Chloroacetophenone	Dioxin/Furans as 2,3,7,8-TCDD TEQ	Methylene Chloride
Acetaldehyde	Ethyl Chloride	N-Nitrosodimethylamine
Acetophenone	Ethylbenzene	Nickel & Compounds
Acrolein	Ethylene Dichloride	Pentachlorophenol
Antimony & Compounds	Formaldehyde	Phenol
Arsenic & Compounds (inorganic including Arsine)	Hexachlorobenzene	Phosphorus
Benzene	Hexane	Phthalic Anhydride
Benzyl Chloride	Hydrochloric Acid (Hydrogen Chloride [gas only])	Polycyclic Organic Matter as 16-PAH
Beryllium & Compounds	Hydrogen Fluoride (Hydrofluoric Acid)	Propionaldehyde
Bis(2-ethylhexyl)phthalate	Isophorone	Quinoline
Bromoform	Lead & Compounds	Selenium Compounds
Cadmium & Compounds	Manganese & Compounds	Styrene
Carbon Disulfide	Mercury & Compounds	Tetrachloroethylene
Carbon Tetrachloride	Methyl Bromide (Bromomethane)	Toluene
Chlorobenzene	Methyl Chloride	Trichloroethylene
Chloroform	Methyl Chloroform (1,1,1-Trichloroethane)	Vinyl Acetate
Chromium & Compounds	Methyl Ethyl Ketone (2-Butanone)	Vinylidene Chloride
Cobalt Compounds	Methyl Iodide (Iodomethane)	

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Utilities - Natural Gas

Arsenic & Compounds (inorganic including Arsine)	Formaldehyde	Phosphorus
Benzene	Lead & Compounds	Polycyclic Organic Matter as 16-PAH
Cadmium & Compounds	Manganese & Compounds	Toluene
Chromium & Compounds	Mercury & Compounds	
Cobalt Compounds	Nickel & Compounds	

Utilities - Oil

Acetaldehyde	Formaldehyde	Phenol
Arsenic & Compounds (inorganic including Arsine)	Hydrochloric Acid (Hydrogen Chloride [gas only])	Phosphorus
Benzene	Hydrogen Fluoride (Hydrofluoric Acid)	Polychlorinated Biphenyls (Aroclors)
Beryllium & Compounds	Lead & Compounds	Polycyclic Organic Matter as 16-PAH
Cadmium & Compounds	Manganese & Compounds	Selenium Compounds
Chromium & Compounds	Mercury & Compounds	Tetrachloroethylene
Cobalt Compounds	Methyl Chloroform (1,1,1-Trichloroethane)	Toluene
Dioxin/Furans as 2,3,7,8-TCDD TEQ	Methylene Chloride	Vinyl Acetate
Ethylbenzene	Nickel & Compounds	Xylenes (includes o, m, and p)

Utility Boilers - Coke

Beryllium & Compounds	Chromium & Compounds
Cadmium & Compounds	Nickel & Compounds

Utility Turbines

Antimony & Compounds	Chromium & Compounds	Mercury & Compounds
Arsenic & Compounds (inorganic including Arsine)	Cobalt Compounds	Nickel & Compounds
Benzene	Formaldehyde	Phosphorus
Beryllium & Compounds	Lead & Compounds	Selenium Compounds
Cadmium & Compounds	Manganese & Compounds	

Vegetable Oil Production

2,4-Toluene Diisocyanate	Maleic Anhydride	Toluene
4-4'-Methylenediphenyl Diisocyanate	Methanol	Xylenes (includes o, m, and p)
Biphenyl	Methyl Ethyl Ketone (2-Butanone)	

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Hydrochloric Acid (Hydrogen Chloride [gas only])	Nickel & Compounds

List of MACT Source Categories and Associated Hazardous Air Pollutants (Continued)

Wood Furniture (Surface Coating)

Glycol Ethers	Methyl Isobutyl Ketone (Hexone)	Xylenes (includes o, m, and p)
Methyl Ethyl Ketone (2-Butanone)	Toluene	

Wool Fiberglass Manufacturing

Arsenic & Compounds (inorganic including Arsine)	Formaldehyde	Methanol
Chromium & Compounds	Lead & Compounds	Phenol

APPENDIX C

OVERVIEW OF REFERENCE MATERIALS

Source: *Handbook for Criteria Pollutant Inventory Development: A Beginner's Guide for Point and Area Sources, Appendix F*. EPA-454-/R-99-037, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, September 1999.

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OVERVIEW OF REFERENCE MATERIALS

Aerometric Information Retrieval System (AIRS)

The Aerometric Information Retrieval System (AIRS) is a computer-based repository of information about airborne pollution. The Airs Facility Subsystem (AFS) contains emissions, compliance data, and permit data for stationary sources. AFS data is used primarily by states in preparation of State Implementation Plans (SIPs) and SIP inventories. Types of data stored in AFS include:

- Facility name, location, and SIC code;
- Stack parameters;
- Process-specific operating schedule;
- SCC codes;
- Annual process rate, and fuel parameters; and
- Annual emissions estimates for criteria pollutants.

AFS is used by some states as a repository of HAP emissions and facility specific data. Some states update HAP information in AFS regularly on an annual basis or whenever changes occur to a facility or its operation. Currently there is **NO** mandatory requirement by EPA for states to report HAP emissions in AFS.

If data in AFS are going to be used for HAP inventory preparation purposes, it is important to understand the appropriate applications and limitations of the data. The completeness of the data in AIRS for a given state can be evaluated by determining the extent of HAP and source category coverage. For example, states may elect to report HAP emissions in AFS only for certain regions or nonattainment areas in the state; thus, not reporting a complete inventory of HAP emissions for the entire state.

In regard to HAP coverage, it is important to consider the reporting thresholds that states have for HAP emissions. Some states require facilities to quantify and report speciated HAP emissions for any HAP emitted beyond a certain threshold. However, some states only require facilities to simply identify, but not quantify, those HAPs that are emitted beyond the requirement threshold.

It is important to know the basis of the HAP emissions in AFS--whether they are reported as actual, potential (controlled or uncontrolled), permitted, or measured emissions. Depending on the emission type, emissions may be entered in AFS on a plant or segment level. Knowing the emission type and level that a state uses for reporting data will assist in downloading data from AFS. Manuals may be downloaded from the Internet at *http://ttnwww.rtpnc.epa.gov/html/airs/airs.htm#ASIR*.

AFS can also be used to identify facilities that are subject to a MACT standard; however, this can only be done for states that designate facilities that are subject to a MACT standard. AFS allows states to report information pertaining to MACT standards, such as indicating the MACT category that applies to a facility and the MACT compliance status (whether the facility is in compliance with the MACT standard). Although reporting MACT standard information in AFS is voluntary, this information may be used to assist in MACT floor determination. If MACT information is not available in AFS, SCC codes can be used to determine the MACT that may apply to a facility.

The AIRS database resides on EPA's mainframe computer system and is not a publicly available database that can be accessed from the web. In order to retrieve information directly from AIRS, you need to obtain an account on the EPA mainframe computer system and pay the applicable computer usage charges. Information about obtaining a computer account is available by calling 1-800-334-2405 (toll free) or 919-541-7862.

AIRSWeb

The AIRSWeb gives access to air pollution data for the entire United States. AIRSWeb is a collection of the most significant AIRS data elements. AIRSWeb "Source Reports" display estimates of annual emissions of criteria pollutants from individual point sources, and number of sources and total pollutant emissions by industry. Specifically, there are six Source Reports that can be generated from AIRSWeb:

- Ranking: Lists each source in order of its pollutant emissions, ranking them from largest to smallest;

- Compliance: Indicates whether each source is complying with regulations governing air pollutant emissions;

- Address: The name and address of each source plus additional descriptive information;

- Count: The number of sources and total air pollutant emissions for each geographic area (county, state, or EPA region);

- SIC: The number of sources and total air pollutant emissions for each SIC; and

- Year: The number of sources that submitted emissions estimates for each calendar year (indicates how recent are the data).

AIRSWeb data collection is refreshed monthly, usually on the first Tuesday. AIRSWeb reports can be accessed on the World Wide Web at *http://www.epa.gov/airsweb/sources.htm.*

National Toxics Inventory

The 1993 National Toxics Inventory (NTI) database contains county-level air toxics data for the 188 HAPs for hundreds of major, area, and mobile source categories. Source categories included in the NTI are classified by SIC codes, SCC codes, AMS codes, or hybrid NTI category codes.

Specifically, the data contained in the NTI includes annual emissions at the state and county levels. The NTI air toxics data are compiled from a variety of sources including:

- CAA-mandated studies including Section 112(c)(6) and Section 112(k);
- State air toxics programs;
- TRI data;
- Data generated in support of the MACT standards program; and
- Industry and trade group data.

Data elements included in the NTI database are:

- FIPS state code;
- FIPS county code;
- Source category code and description;
- Pollutant code and description; and
- Total state and county-level emissions.

Some of the limitations of the 1993 NTI are that the inventory does not directly contain facility-specific data. Most of the emissions estimates were developed using a top-down approach. However, some of the raw data used to compile the inventory such as TRI and MACT data, and some state and local inventory data were facility-specific.

While the NTI does not provide direct procedural guidance, the emissions data and background documentation for emission calculations used in preparing it can be helpful to you in preparing your own air toxics inventory. The *1996 Periodic Inventory Guidance* document includes this information and can be downloaded from OAQPS' web page at *http://www.epa.gov/oar/oaqps/efig/ei/*.

NTI is a work-in-progress and is currently being updated to a 1996 base year, and efforts are underway to incorporate facility-specific, major source inventory data for the 1996 base year. NTI data can be downloaded off the World Wide Web through EPA's Web site at *http://www.epa.gov/ttn/chief/nti/index.html*.

The NET Database

The National Emissions Trends (NET) system is a national repository database compiled by EPA and includes EPA's latest estimates of national emissions for criteria pollutants. Non-criteria pollutants included in the inventory are HAPs, PM2.5, and ammonia. Estimates are contained in the inventory for the years 1900 to 1996, with increasing levels of detail in the more recent years.

The 1996 NET inventory includes state-submitted inventory data generated for the Ozone Transport Assessment Group (OTAG) and Grand Canyon Visibility Transport Commissions (GCVTC) and other inventory services. The NET inventory, does not necessarily include state data for any particular source or pollutant. However, EPA intends to provide statewide 1996 emissions inventory data on a county level basis to every state in the country.

The NET inventory can be used as a starting point in compiling a statewide air toxics inventory because the inventory includes some HAP emissions. Moreover, the NET inventory can be used to compile an initial list of emission sources in the state. Additional information on the NET inventory can be obtained through the EFIG's Emissions Inventory Web site at *http://www.epa.gov/ttn/chief/net/index.html* or from the Info CHIEF Help Desk at: (919) 541-1000.

Dun and Bradstreet Million Dollar Database

D&B Million Dollar Database provides information on over 1,000,000 U.S. leading public and private businesses. Company information includes name, address (including county), and industry information with up to 24 individual 8-digit SICs. The database also allows you to search for specific companies, or find companies within a specific industry group. Access to these databases is available on a subscription basis. Company data is updated every 60 days. The database can be accessed on the World Wide Web at *http://www.dnb.com/*.

Toxic Release Inventory

The EPA's Toxic Release Inventory (TRI) is a compilation of information about toxic chemicals used, manufactured, stored, treated, transported, or released into the environment. EPA stores TRI data in the Toxics Release Inventory System (TRIS). The TRI chemical list currently includes 579 individually-listed chemicals and 28 chemical categories. Some of the information included in the TRI database includes:

- Type of chemicals released into the local environment during the preceding year; and

- Quantity of each chemical that went into the air, water, and land in a particular year.

TRI data are best used when combined with information from other sources because of the following limitations associated with the TRI data:

- TRI covers only a subset of industrial sources. Non-industrial sources such as dry cleaners or automobile service stations are not covered in TRI;

- Only provides facility estimates reported as either stack or fugitive emissions; no breakout at the process level;

- Many point sources may not be required to report data to TRIS. Facilities must meet <u>all</u> of the following criteria in order to report data to TRIS;

  - Facilities that conduct manufacturing operations with SIC codes 20 through 39;
  - Facilities that have 10 or more full-time employees or their equivalent;
  - Facilities that manufacture, process, or otherwise use EPCRA Section 313 chemicals at the following thresholds: 25,000 lb/yr for manufacturing and processing, or 100,000 lb/yr otherwise used.

- TRI data are self-reported by the emitting facilities and reported releases may have been based upon estimation techniques rather than direct monitoring or testing, and therefore may not represent an accurate amount of release;

- TRI does not require a listing of all chemicals released, and thus, many releases go unreported. Moreover, chemicals may be added or deleted from the list. The EPCRA Information Hotline at (800) 535-0202 will provide up-to-date information on the status of the changes; and

- Five of the 188 HAPs are currently not required to be reported in TRI. These HAPs are: 2,2,4-trimethylpentane (540-84-1); 2,3,7,8-tetrachlorodibenzo-p-dioxin (1746-01-6); DDE (3547-04-4); coke oven emissions; and radionuclides.

TRI can be searched by pollutant, SIC, facility name, or location. Updated TRI lists of chemicals can be downloaded off the World Wide Web through EPA's Office of Pollution Prevention and Toxics Web site at *http://www.epa.gov/opptintr/tri/chemical.htm.* TRI reports are available in public libraries or can be downloaded off the World Wide Web at *http://www.epa.gov/tri/*. The TRI database can also be searched online through the Right-To-Know Network (RTK NET) at *http://www.rtk.net/trisearch.html.*

Toxic Release Inventory Reporting Form R Guidance

Title III, Section 313 Release Reporting Guidance documents contain information to help industries comply with the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 and Section 6607 of the Pollution Prevention Act of 1990. These manuals are intended to supplement the *Toxic Chemical Release Inventory Reporting Form R and Instruction*.

EPCRA Section 313 reporting requirements are discussed and the information needed to determine if an EPCRA 313 report must be prepared for a specific facility is presented. This discussion includes the definitions and lists required to make this decision. Threshold determination is explained in detail, including the step-by-step procedure with examples to clarify the process.

Detailed instructions for estimating releases are presented in each document. Again, a step-by-step approach is presented and illustrated with examples of the concepts presented and the calculations required. Industry-specific information includes a list of the commonly used EPCRA Section 313 chemicals; an overview of the industry processes; identification of appropriate chemical activities and reporting thresholds; methods for estimating quantities of chemicals released or otherwise managed; and discussion of common reporting errors.

The list of current TRI documents can be found in the reporting instructions that are sent to the facilities every year. Or, they can be obtained by calling EPA's Toxic Release Inventory Branch at (202) 260-3943.

The guidance documents that have been produced include:

- Monofilament fiber manufacture;
- Printing operations;
- Electrodeposition of organic coatings;
- Spray application of organic coatings;

- Semiconductor manufacture;
- Formulation of aqueous solutions;
- Electroplating operations;
- Textile dyeing;
- Presswood and laminated wood products manufacturing;
- Roller, knife, and gravure coating operations;
- Paper and paperboard production;
- Leather tanning and finishing processes;
- Wood preserving;
- Rubber production and compounding;
- Estimating releases and waste treatment efficiencies;
- Metal fabrication industry; and
- Food processors.

The following documents were updated in 1997 and can be obtained from the TRI Web site at *www.epa.gov/tri/*:

- Metal mining;
- Coal mining;
- RCRA Subtitle CTSD facilities and solvent recovery;
- Petroleum distribution;
- Electric generation; and
- Chemical distribution.

The following documents are being updated:

- Food processing;
- Metal fabrication;
- Electroplating;
- Semiconductors;
- Paper and paperboard;
- Printing operations;
- Spray application of organic coatings;
- Textiles;
- Rubber production;
- Electrodeposition;
- Presswood;
- Monofilament mfg;
- Roller, knife and gravure;
- Leather; and
- Wood preservation.

In addition, the following documents are being written:

- Smelting operations;
- Welding operations; and
- Incidental manufacture/byproducts.

APPENDIX D

LIST OF EMISSION ESTIMATION MODELS AND EMISSION FACTOR RESOURCES (Current as of March 2001)

Source: *Handbook for Criteria Pollutant Inventory Development: A Beginner's Guide for Point and Area Sources, Appendix G.* EPA-454-/R-99-037, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, September 1999.

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List of Emission Factor Resources

Landfill Gas Emissions Model (Version 2.01)

The Landfill Gas Emissions Model was developed by the Clean Air Technology Center (CATC). The model can be used to estimate emission rates for methane, carbon dioxide, nonmethane organic compounds, and individual toxic air pollutants from landfills. The system allows the user to enter specific information regarding the characteristics and capacity of an individual landfill and to project the emissions of methane, CO, nonmethane organic compounds, and individual HAPs over time using the Scholl Canyon decay model for landfill gas production estimation. The Scholl Canyon Model is a first-order decay equation that uses site-specific characteristics for estimating the gas generation rate. In the absence of site-specific data, the program provides conservative default values. The user also may tailor decay rate characteristics on an individual basis. An integrated decay rate constant calculator is provided for landfills that may be operating a gas recovery system to allow more accurate assessments of decay attributes. Outputs may be reviewed in either tabular or graphical forms. A help system is also provided with information on the model operation as well as details on assumptions and defaults used by the system. For additional information contact the EPA's Air Pollution Prevention and Control Division at (919) 541-2709. The model can be downloaded from the World Wide Web through EPA's TTN Web site at *http://www.epa.gov/ttn/catc/products.html#software*.

TANKS

TANKS is a Windows-based computer software program that computes estimates of VOC emissions from fixed- and floating-roof storage tanks based on the emission estimation procedures from Chapter 7 of *AP-42*, plus recent updates from the American Petroleum Institute. The TANKS program employs a chemical database of over 100 organic liquids and meteorology data from over 250 cities in the United States. The user may add new chemicals and cities to their version of the database. The tank types addressed in the program include vertical and horizontal fixed roof tanks, and internal and external floating roof tanks. The tank contents can consist of single-component liquid or a multicomponent mixture. TANKS is available through the EPA's TTN Web site at *http://www.epa.gov/ttn/chief/software/tanks/index.html*.

WATER9

WATER9 is a Windows based computer program and consists of analytical expressions for estimating air emissions of individual waste constituents in wastewater collection, storage, treatment, and disposal facilities; a database listing many of the organic compounds; and procedures for obtaining reports of constituent fates, including air emissions and treatment effectiveness. WATER9 is available through the EPA's TTN Web site at *http://www.epa.gov/ttn/chief/software/water/*.

CHEMDAT8

CHEMDAT8 is a Lotus 1-2-3 spreadsheet that includes analytical models for estimating emissions from treatment, storage and disposal facility (TSDF) processes. The original models include disposal impoundments, closed landfills, land treatment facilities, and aeration and nonaeration impoundment processes.

The models in CHEMDAT8 can be applied to other types of TSDF processes besides those contained in the original design. The nonaerated impoundment model in CHEMDAT8 can estimate emissions from storage surface impoundments and open-top wastewater treatment tanks. The CHEMDAT8 aerated impoundment model may be used for predicting emissions from surface treatment impoundments and aerated wastewater treatment tanks. The land treatment model in CHEMDAT8 can estimate emissions from land treatment soil, open landfills, and wastepiles. Emissions from an oil film surface in a land treatment facility or an oil film on surface impoundments can be predicted via the oil film model in CHEMDAT8. When a CHEMDAT8 model is not available to predict emissions, the equations shown in the reports that provide the background to the model can be used to perform hand calculations of emissions.

This eighth version of the CHEMDAT spreadsheet contains several major operational modifications. In CHEMDAT8, the user can select a subset of target compounds for investigation. The user can also specify which TSDF processes are to be considered during a session. These two selections improve the efficiency of CHEMDAT8 relative to some of the earlier versions by minimizing storage requirements as well as actual loading and execution time.

Default input parameters in the CHEMDAT8 diskette demonstrate example calculations. However, the input parameters can be changed to reflect different TSDF characteristics and then recalculate emissions under these modified conditions. The list of 60 compounds currently in CHEMDAT8 can be augmented by an additional 700 chemicals. Procedures for introducing data for additional compounds into CHEMDAT8 are described in the supporting documentation report. CHEMDAT8 is available through the EPA's TTN Web site at *http://www.epa.gov/ttn/chief/software/water/water8.html*

PM Calc

PM Calc is a computer software developed by EPA to estimate PM2.5 emissions. PM Calc is applicable to point sources and requires the user to input uncontrolled emissions (either total particulate or PM10) for each source, the source category classification (SCC) and the type of control device, if any. The program will then calculate controlled emissions for PM2.5 and PM10 for each point source. PM Calc is available through the EPA's TTN Web site at *http://www.epa.gov/ttn/chief/software/pmcalc/*

Compilation of Air Pollutant Emission Factors (*AP-42*)

The primary reference for criteria pollutant emission factors for industrial sources is *AP-42* (EPA, 2000b). EPA is continuously updating *AP-42* to include available emission factors for the most common emission source categories.

The extent of completeness and detail of the emission information in *AP-42* is determined by the information available from published references. Emissions from some processes are better documented than others. For example, several emission factors may be listed for the production of one substance: one factor for each of a number of steps in the production process such as neutralization, drying, distillation, and other operations. However, because of less extensive information, only one emission factor may be given for production facility releases for another substance, though emissions are probably produced during several intermediate steps. There may be more than one emission factor for the production of a certain substance because differing production processes may exist, or because different control devices may be used. Therefore, it is necessary to look at more than just the emission factor for a particular application and to observe details in the text and in table footnotes of *AP-42*.

Each *AP-42* emission factor is given a rating from A through E, with A being the best. A factor's rating is a general indication of the reliability, or robustness, of that factor. This rating is assigned based on the estimated reliability of the tests used to develop the factor and on both the amount and the representative characteristics of those data. Because ratings are subjective and only indirectly consider the inherent scatter among the data used to calculate factors, the ratings should be seen only as approximations. A rating should be considered an <u>indicator</u> of the accuracy and precision of a given factor being used to estimate emissions from a large number of sources. This indicator is largely a reflection of the professional judgment of *AP-42* authors and reviewers concerning the reliability of any estimates derived with these factors.

The fact that an emission factor for a pollutant or process is not available from EPA does not imply that the Agency believes the source does not emit that pollutant or that the source should not be inventoried, but it is only that EPA does not have enough data to provide any advice. *AP-42* must be considered work-in-progress. Up-to-date sections of *AP-42* can be downloaded off the World Wide Web through OAQPS' TTN Web site at *http://www.epa.gov/ttn/chief/ap42/index.html*. *AP-42* is also available through *Fax CHIEF* automated fax document delivery service, through the *Air CHIEF* CD-ROM, and in hard copy from the Government Printing Office (202) 512-1800.

Factor Information Retrieval (FIRE) Data System

FIRE is a database management system containing:

- EPA's recommended emission estimation factors for criteria pollutants and HAPs;
- Information about industries, their emitting processes, and chemicals emitted;

- All EPA point and area SCCs through September 2000;

- Easy access to emission factors obtained from *AP-42, L&E* series documents, factors derived from state-reported test data, and factors taken from literature searches;

- Each emission factor entry includes comments about its development, in terms of the calculation methods and/or source conditions, as well as the references where the data were obtained. The emission factor entry also includes a data quality rating;

- Capability for users to browse through records in the database or to select specific emission factors by source category name or source classification code (SCC), by pollutant name or CAS number, or by control device type or code.

FIRE Version 6.23 (released November 2000) is a user-friendly, menu-driven Windows® program that can run under Windows® Version 3.1, 95 or Windows® NT. FIRE can be downloaded off the World Wide Web through OAQPS' TTN Web site at *http://www.epa.gov/ttn/chief/software/fire/*. FIRE is also available on the Air CHIEF, a compact disc read-only memory (CD- ROM) and can be obtained by calling the Info CHIEF Help Desk at (919) 541-1000.

Air Clearinghouse for Inventories and Emission Factors (Air CHIEF) CD-ROM

Air CHIEF CD-ROM format, gives access to air emission data specific to estimating the types and quantities of pollutants that may be emitted from a wide variety of sources. Updated annually, Air CHIEF offers thousands of pages contained in some of EPA's most widely used documents. This most recent version of Air CHIEF contains many enhancements, such as linking between related documents, Web links directly to the CHIEF Web site for easy access to the most recent updates, and enhanced full-CD searching. The Adobe Acrobat® software included on the CD allows for easy browsing of all information or locating specific information by conducting keyword searches by pollutant, source category, SCC, or SIC code. Some of the databases included on Air CHIEF version 8.0 are: (1) *AP-42*; (2) *L&E* documents; (3) *EIIP* documents; (4) *AP-42* background files; and (5) FIRE version 6.23. Also included on Air CHIEF are the installable copies of these software programs: BEIS, WATER8, CHEMDAT8, CHEM9, Landfill Model, and SPECIATE.

Air CHIEF version 8.0 is available for distribution for free from the Info CHIEF Help Desk. Call the Help Desk at (919)541-1000, or send an email to info.chief@epa.gov.

APPENDIX E

LIST OF L&E DOCUMENTS

(http://www.epa.gov/ttn/chief/le/index.html)

(Current as of March 2001)

Source: *Handbook for Criteria Pollutant Inventory Development: A Beginner's Guide for Point and Area Sources, Appendix H.* EPA-454-/R-99-037, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, September 1999.

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List of *L&E* Documents

Substance	EPA Publication Number	Available On Line?
Acrylonitrile	EPA-450/4-84-007a	YES
Arsenic	EPA-454/R-98-013	YES
Benzene	EPA-454/R-98-011	YES
Butadiene	EPA-454/R-96-008	YES
Cadmium	EPA-454/R-93-040	YES
Carbon Tetrachloride	EPA-450/4-84-007b	YES
Chlorobenzene (update)	EPA-454/R-93-044	YES
Chloroform	EPA-450/4-84-007c	YES
Chromium (supplement)	EPA-450/2-89-002	YES
Chromium	EPA-450/4-84-007g	YES
Cyanide Compounds	EPA-454/R-93-041	YES
Dioxins and Furans	EPA-454/R-97-003	YES
Epichlorohydrin	EPA-450/4-84-007j	YES
Ethylene Dichloride	EPA-450/4-84-007d	YES
Ethylene Oxide	EPA-450/4-84-007l	YES
Formaldehyde	EPA-450/4-91-012	YES
Lead	EPA-454/R-98-006	YES
Manganese	EPA-450/4-84-007h	NO
Mercury	EPA-453/R-97-012	YES
Methyl Chloroform	EPA-454/R-93-045	YES
Methyl Ethyl Ketone	EPA-454/R-93-046	YES
Methylene Chloride	EPA-454/R-93-006	YES
Nickel	EPA-450/4-84-007f	YES
Organic Liquid Storage Tanks	EPA-450/4-88-004	NO
Perchloroethylene and Trichloroethylene	EPA-450/2-89-013	YES
Phosgene	EPA-450/4-84-007i	YES
Polychlorinated Biphenyls (PCBs)	EPA-450/4-84-007n	NO
Polycyclic Organic Matter (POM)	EPA-454/R-98-014	YES
Styrene	EPA-454/R-93-011	YES
Toluene	EPA-454/R-93-047	YES

List of *L&E* Documents (Continued)

Substance	EPA Publication Number	Available On Line?
Vinylidene Chloride	EPA-450/4-84-007k	YES
Xylenes	EPA-454/R-93-048	YES

APPENDIX F

GUIDANCE ON HOW TO CONDUCT SCREENING STUDIES

Source: *Handbook for Criteria Pollutant Inventory Development: A Beginner's Guide for Point and Area Sources, Appendix M*. EPA-454-/R-99-037, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, September 1999.

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Contents

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ELEMENTS

An emission inventory questionnaire mail-out has three basic elements: the cover letter, the questionnaire instructions, and the questionnaire itself. The questionnaire format and content depends on the detail of the inventory and the ultimate use of the data. All of these components, when considered together, make up the questionnaire package.

Cover Letter

The cover letter is a key to the emission inventory, because it introduces the purpose of the questionnaire and is the initial contact with the recipient. If the cover letter does not command attention, the attached questionnaire may be discarded or filed away and not considered a top priority. This could make the number of companies requiring recontact by agency personnel increase dramatically.

The cover letter should include the following:

- Applicable regulations, if any, that require the recipient to respond;
- Confidentiality provisions, if applicable;
- The purpose of the questionnaire;
- A respectful request for cooperation in filling out the questionnaire;
- Due date for the return of completed questionnaires;
- A state or local agency contact name and telephone number to answer questions; and
- Rationale for asking for what may appear to the source to be redundant information.

The cover letter should be as short and direct as possible. The most successful return rates for questionnaires have been the ones having the strongest legal statements. Therefore, states/local agencies requiring source registration to obtain construction or operating permits may obtain better source cooperation.

A strong statement about existing and applicable regulations which require a recipient to respond to the questionnaire is the agency's most powerful tool for maximizing the return rate. The statement should be placed prominently in the beginning or at the top of the cover letter. It should cite any applicable regulations or proposed regulations and specify penalties for noncompliance.

Another important item to include in a cover letter to ensure a high return rate is the due date. The final due date should be included in the cover letter to that it will not be overlooked by those who do not read instructions. The due date may be specified either as a stated date or as a period of time after the recipient receives the questionnaire. The first approach is more specific, and gives the recipient a definite deadline. With the latter approach however, the questionnaire mailing can be staggered without having to reprint the due dates listed on the cover letter. The agency should record each due date so it will be clear when follow-up letters or phone calls may need to begin for tardy respondents.

Questionnaire Instructions

General information that affects the whole questionnaire may be included first on the instruction page. For example, if the questionnaire is “open-ended” (i.e., asks the recipient to list every toxic compound from every emission source) , it should be clear that the respondent should use chemical compound names or preferably CAS numbers and not just industrial trade names. Also, it may be helpful to point out that not all questions, sections, or pages may apply to every industry, as in a source category specific directed questionnaire. If the questions are designed for direct coding to computer input, the general instructions should explain how to enter numbers properly. In addition to explaining how to complete the questionnaire, the general instructions should indicate the specific year, or other appropriate period of time, for which all data are required.

Some agencies have utilized production/use questionnaires which basically just ask sources to identify whether each substance is purchased, used, or produced, followed by a more detailed questionnaire targeted to specific industries. Some agencies include minimum usage or emissions levels specified on an attached list as part of the instructions.

Questionnaire Design

There are several ways to design a questionnaire. Of utmost importance when designing a questionnaire is that the format suits the needs of the agency and attains correct responses and maintains a good agency-industry working relationship.

Several approaches can be taken in designing the questionnaire which, in turn, will effect the format of the questionnaire. The approaches that can be used include: open vs. closed-ended, emission-based vs. chemical use, permit related, and general vs. industry-specific. In order for an agency to decide which approach to use, it needs to be familiar with some of the impacts of each approach.

Each agency should tailor their inventory package according to their agency’s individual needs. Many times, the examples are a combination of approaches. For instance, in one case a general design questionnaire was sent to various manufacturers and process industries, and later, industry specific questionnaires were sent to a small subset of the original recipients. In still another case a screening study was first done to narrow down the number of sources to be inventoried and indicated the design needs of the final questionnaire to be sent out. Later, a second questionnaire was sent.

The following sections explain the advantages and disadvantages of various type questionnaire designs. These are not necessarily mutually exclusive.

Open-Ended Approach

The open-ended approach does not target specific source types or a limited group of compounds. The open-ended approach asks the respondent to list any compound that they emit. It does not provide a checklist of compounds. Therefore, with an open-minded approach a much larger number of contacts will be necessary. This approach has several similarities to a screening study:

- Less time and effort in questionnaire design;
- Responses may be less detailed;
- More responses may be inaccurate or trade names (not chemical compound names) may be listed; and
- Some sources may report no air toxic emissions.

Closed-Ended Approach

The closed-ended approach is a more direct approach, which usually provides a limited list of compounds with the questionnaire. Some agencies' list lists of toxic compounds are becoming rather extensive and use of CAS numbers is widespread. This approach requires more design time up from (e.g. screening studies, modeling analyses). However, the benefits are that the resulting number of sources contacted can be greatly reduced and the quality and detail of the data received are usually better.

Emissions-Based Approach

Emissions-based questionnaires request information often included in annual volatile organic compound (VOC) or particulate matter emissions inventories.

The agency may request permitted or potential emissions per source and/or actual emissions, average emissions, or emissions per day. They may also specify emissions per hour (or time interval) for specific compounds. In many cases some of this information can be collected for the majority of sources from the established criteria emission inventory records. The agency may also ask for emergency episode emissions, fugitive emissions, and information from excluded criteria emission inventory sources.

Chemical Use Approach

Chemical use questionnaires are directed toward lists of specific compounds and ask for process input information and Material Safety Data Sheets (MSDS). The Material Safety Data Sheets include the needed species composition data and should be requested where available, for any approach used. The agency can require the source to contact the suppliers of chemicals they use, if MSDS are not available. The agency can use these data to make emissions estimates if information is also provided on daily use, process operating parameters, and efficiency of the control equipment.

General Approach

This type of questionnaire may be used as input to simple screening models to determine if a particular source is a potential problem and if further, more detailed source, emissions, and modeling data are required. A list of chemicals is provided and the sources must access it if it emits any of the listed compounds. These questionnaires may list minimum levels for each compound addressed. Such questionnaires may also be used in conjunction with several source specific questionnaires. The general questionnaire may also be sent to a variety of manufacturing or industrial process facilities not covered by the source specific questionnaires.

Industry-Specific Approach

These are very detailed questionnaires that may include emissions information from process vents, fugitive equipment leaks, equipment openings, raw material/product storage and handling, secondary waste treatment, and liquid spills. Questionnaires of this type are usually focused on a handful of very large, singularly important point sources. A great deal of pre-screening effort would be required for industry-specific questionnaires, and a great deal of effort would also be required of the recipient in filling out the questionnaire. More effort would be required per source for the agency to properly interpret the response. However, this level of detail is probably the next best thing to actual source testing in estimating emissions. This technique may also prove useful in targeting particular sources the agency determines may or may not need to conduct source tests.

Tiered Approach

In the tiered or staggered mail-out approach, a cover letter and screening study type questionnaire are used, followed later by more detailed questionnaires sent to a select number or type of sources. A phone survey may be conducted by the agency prior to the screening study to narrow the number of facilities to send the screening study questionnaire or the detailed questionnaire. Whether the phone survey is conducted before or after the screening study questionnaire is sent depends on the number and type of facilities in the inventory area.

A good example would be dry cleaning establishments. The state manufacturing guide may list 100 dry cleaners in a certain city. However, after a phone survey the agency found that 75 percent of these locations are only drop-off and pick service centers. By conducting the phone screening, it was obvious that no questionnaires were necessary for those service centers. A more detailed questionnaire was sent to the remaining 25 dry cleaners. This benefitted both the agency by not having to review unnecessary forms, and the excluded service centers by not wasting their time completing unnecessary forms. Phone screening may not always be an efficient use of agency time, depending on the individual agency needs or types of industries included.

Another approach is to first send an open-ended questionnaire or general questionnaire, followed by later designed industry specific (by source type) questionnaire, followed-up by phone calls to clarify data and/or source tests or inspections.

OTHER CONSIDERATIONS

Other considerations when developing a questionnaire are more related to strategy for maximizing accuracy and minimizing cost and time involved to conduct an inventory. These include discussions of the importance of the following:

- Asking the right questions;
- Maximizing return rates;
- Providing for facility confidentiality of trade secrets;
- Outlining what questions are applicable for particular source categories;
- Designing question/answer style and format to decrease confusion or misrepresentation;
- Providing written instructions for answers (especially units of measurement) with computer coding format instructions if necessary; and
- Developing a data quality assurance procedure.

Some of these considerations are clearly technical in nature, but they need to be incorporated with administrative and procedural considerations for the whole effort to be the most efficient.

The Right Questions

A successful questionnaire obtains the right answers to the right questions for the particular agency while maintaining a good working relationship with the recipients. Duplication of information already available through permit files may not be needed if the number of sources included in the survey is few and the information is easily extracted from other sources. However, for large survey efforts, it may be too time consuming for agency personnel to extract needed available information and thus, some duplication of effort on the part of the sources cannot be avoided. If the sources being sent questionnaires are the same as included in the criteria pollutant inventory, all information which the agency already has about the recipient's facility, such as mailing address, SIC number, UTM coordinates, emission point numbers, etc., should be preprinted on the questionnaire. The agency could use a window envelope to expose the facility name and address and avoid making additional mailing labels.

The Return Rate

The return rate of a questionnaire depends on several factors. The first impression of the recipient, the simplicity of the questionnaire, and conveying the importance of returning the questionnaire are all important factors affecting the return rate.

<u>Minimize Questionnaire Length</u>

The recipient's first impression will be based on the size of the questionnaire. It should be as brief as possible. Unfortunately, it may be impossible for the forms and accompanying instructions for a large listing of toxic compounds or source categories to be brief. So, the next best approach may be to design the forms in such a way to make the pages as uncluttered and readable as possible leaving ample room for answers.

<u>Maximizing Return Rates</u>

Staggered mailing is particularly important for very large inventories, because 1000 or more questionnaires returned simultaneously may be too difficult to process at one time. Staggered return uses the agency's limited manpower and resources more economically. Questionnaires can easily become lost or damaged if they are not processed expediently by the agency, and this may be less likely to occur if the staggered mailing approach is used.

Each respondent should have an equal amount of time to respond to questionnaires when using the same format and approach especially if there is a penalty for late responses. But this must depend on equal complexity of the information required by questionnaires. Obviously more time will be needed for a large source to complete a source specific questionnaire than a simple screening survey or a general information questionnaire with, for example 20 compounds versus 200 compounds. Therefore, the time period allowed for completion of emission inventories require more planning than criteria pollutant inventories. The time period should be long enough so that the respondent is not overly rushed and short enough that the respondent does not procrastinate in responding.

Another good approach for a large inventory is to classify the mailings according to priority chemicals, source type, source size, county locations, or simply a source name (alphabetical) staggered approach. In this way, all of the questionnaires will not be returned as the same time. Each questionnaire should be reviewed as soon as possible after it is received. When this approach is used for a selected small number of sources at the beginning of the update, the agency can predict the manpower and resources it will take to complete the full-blown inventory effort. They may find they do not in fact have the manpower to conduct the type of inventory they want. They can instead rethink and replan their approach or request additional manpower to complete the inventory.

Confidentiality

Confidentiality can be established in one of several ways. The simplest is a box to be checked to request confidentiality for all information other than emissions data given in the questionnaire. Justification for the request would be given by the recipient on a separate sheet. In this way each piece of confidential information can be keyed as such.

Another approach would be for the industry to submit one full questionnaire and one "sanitized" questionnaire that would be available for public review.

The main advantage to this approach is that it clearly indicates the request to the agency. It also alerts the agency to look for supplementary supporting information. If the questionnaire is converted to computer input, a check in the confidentiality box can be programmed as a command to store all information in a limited access data file.

The disadvantages of this approach are that it does not provide confidentiality for only specific pieces of information and that it may be too easy to use. It should be used only for recipients who are anticipated to be deeply concerned about confidentiality. This judgment is best handled by the appropriate agency officials. A better method may be to require the industry to highlight each and every answer it deems confidential.

A more complex method for establishing confidentiality involves the assignment of a survey number to each questionnaire; this number would also be printed on the general information page. The agency director would detach the general information page from the returned questionnaire and store it in a locked file. Since all identification is presented on the general information page, no one would be able to associate the information on the question pages with a specific facility. If necessary, a facility could be identified by locating the survey number in the locked file of general information pages. This consideration is especially important if the agency subcontracts to a private consultant for the interpretation and transcription of the information. If the information is computerized, the identification information could be entered into a separate limited access file.

Each agency should be versed in their local laws to ascertain that the concealment of identification is not forbidden (the public access to records varies among states).

A system which allows for partial confidentiality could be established in the cover letter using a paragraph similar to the following:

Any proprietary information, which you believe is of a confidential nature, should be identified in a supplementary letter with applicable data in the questionnaire marked with the word CONFIDENTIAL. A brief explanation in your letter for the desired confidentiality should be included.

This system indicates clearly to the agency which information is confidential and which is not. It also alerts the agency to look for supplementary supporting information with each returned questionnaire that is marked anywhere with the word "CONFIDENTIAL." However, unless the marking is very clear, this system can become tedious and inefficient.

Applicability and Clarity of Questions

Several factors in the design of the question section can determine the efficiency of the mailing and affect the return rate as well. First, there should be a clear statement from which the respondent can determine whether the questionnaire is applicable to his facility. Second, the questions should be well-arranged and easy to answer.

A clear statement of applicability serves several purposes. If the questionnaire is applicable, the statement reinforces the necessity of compliance. If the questionnaire is not applicable and recipient can easily determine it as such, he may be more cooperative in the future when the questionnaire does apply to him. A maximum return rate for non-applicable respondents is important because the agency will not have to waste time and money for follow-up and know up front which facilities are not being inventoried.

The use of a check box for applicability will help the agency distinguish between questionnaires that are not applicable and the ones that are returned without any response. Examples of statements of applicability are provided below.

- C If this equipment was used at least five (5) days last year, check this box and complete the questionnaire.
- C If this equipment was not used at least five (5) days last year, check this box and return this form.
- C If this equipment has been removed, check this box and return this form.
- C If any compound used on the attached table is less than the minimum level listed, check this box and return this form.

Statements of non-applicability at the beginning of each page or section can be used as an alternative or supplement to a general statement of applicability. Colored pages may be used to designate different sections of the questionnaire. By supplying a check box, the agency can discriminate between pages that were forgotten and pages that were not applicable.

Complexity and Questionnaire Format

As mentioned earlier, the questions must be well-arranged and easy to answer. Brevity enhances the rate of return. The agency can usually reduce the bulk of the question section by designing industry-specific questionnaires instead of general questionnaires. Industry-specific questionnaires are designed specifically for one particular type of industry, as opposed to general questionnaires applicable to a whole group of industries. For example, it may be better to send an industry-specific questionnaire to a dry cleaning establishment and a multipage, general questionnaire to an organic solvent user.

The consideration of questionnaire format, however, must be balanced against the level of resources available to the agency conducting the inventory. It takes more money and manpower to design, mail out, and interpret industry-specific questionnaires than it does general questionnaires. Processing of industry-specific questionnaires is also more complex because the format of each questionnaire will vary. Furthermore, it is possible to send an inappropriate industry-specific questionnaire to a facility. On the other hand, general questions may be preferable if the agency's resources are limited or if the agency is unfamiliar with many of the sources. Inventories for specific pollutants may be most advantageously conducted with general questionnaires. Furthermore, general questionnaires may be more appropriate for large or complex facilities that are difficult to characterize. Most of these facilities will have engineers available to translate their process and emission information onto the forms.

If a general questionnaire must be used, it is important to provide a statement of applicability for each page. In addition, questionnaires that are organized so that all information about each emission point can be provided on one page are usually easier to fill out than questionnaires that have separate pages for process, emissions, control equipment, and stack information (subject-by-subject). For this reason, source-by-source questionnaires are usually considered the better format. However, if the questions are arranged by subject, industry-specific questionnaires can be designed by simply selecting the subject pages that apply to each industry. Then only a few supplementary pages of questions that are unique to an industry must then be formulated.

Another method that can minimize the level of effort required from the recipient, and therefore enhance the return rate, concerns the format of the questions. Multiple choice questions are the easiest type for recipients to answer. Many questions can easily be formatted as multiple choice. For example, a question that asks the recipient to describe or name the type of control device used can be improved by supplying a list of conceivable control devices and asking the recipient to put a check next to the appropriate answer. When needed, multiple choice questions can include the choice "other" with a blank beside it for entering out-of-the-ordinary controls. Other questions, such as those that require exact numerical answers, can only be answered appropriately with a written response. If there are repetitive questions, the recipient could be asked to make a copy of a questionnaire for each point source or substance being inventoried.

Clarity of Instructions

To be considered accurate, questionnaire responses must provide both the descriptive information desired and the correct numerical data. Every effort must be made not to confuse the recipient. Therefore, it is important to provide clear, complete instructions to decrease the chances of error in the responses. Instructions should be as concise as necessary. Units of measurement, method of calculations and conversions, and code number instructions should be put on the questionnaire itself and not explained in the instructions. This enables the recipient to read through instructions expediently without becoming caught up in too much detail.

In conclusion, general instructions should be as precise as possible. Some of the most effective questionnaire instructions are those which explain in detail how to answer each question. If a particular question requires special clarification, it is best to note special instructions on the same page as the question rather than print them on a separate instruction page.

The following types of information should be included when asking detailed questions:

- Specific Responses--printing the type of units wanted for an answer right next to the answer space. Using the multiple choice format;

- Samples--providing completed samples with the instructions for process flow, schematic and plant layout diagrams. Sample diagrams help the recipient to visualize what is expected; they are easiest to interpret if they are adjacent to the instructions;

- Standardized Forms--providing standardized forms when periodic inventory updates are performed. Regular recipients will eventually learn how to provide the correct responses. This is one condition under which a single generalized form for all facilities is efficient;

- Emissions Estimates--instructions for the inclusion of estimation methods used. Examples of estimation methods include: material balance, emission factors, source test results, models, and engineering judgments.

Final Considerations

After a questionnaire is designed, it is good quality assurance procedure to check its effectiveness. This can be accomplished using a limited pilot mailing followed by site visits. This procedure provides a check on the effectiveness of the particular questionnaire package and its applicability to different sources. A final possibility that may improve industry-agency relations would be to include a few questions at the end of the questionnaire or on a separate page for industry suggestions for future questionnaires or questions such as the following:

- Were the questions clear?
- Approximately how long did it take to complete the form?
- Were the questions applicable to your company?
- If you called for help and/or agency clarification, did we adequately respond?
- Was the time allowed after receiving the questionnaire adequate? If not, why?
- Please provide additional comments, if any.

This type of addition may indicate to the recipients a true concern to minimize industry paperwork, or at least the desire to work with industry to improve future questionnaires.

FOLLOW-UP PROCEDURES

Follow-up can be as important or more important than the planning and effort expended in questionnaire design. The accuracy and completeness of responses must be checked and tabulated, and entered into a computer. Depending on how thorough the questionnaire instructions were explained with the mail-out, and whether deadlines were identified in the cover letter, a second major effort may be required to contact recipients who are delinquent in responding or to clarify items such as emissions units or estimates of control efficiencies. Some second effort can be expected, either for clarification of answers or for non-response. The following sections discuss the importance of such follow-up procedures such as data quality checks, the use of on-site inspections, and recontacting sources. Questionnaire revisions are also discussed.

Quality Control of Data

All the questionnaires should be checked by engineers, chemists, or experienced environmental scientists to determine if the data provided are reasonable. It is helpful to ask for process flow and plant layout diagrams to aid in the interpretation of data. In addition, the best quality check would be performed by engineers or scientists who have worked in or are familiar with the industry. Finally, for similar processes and chemicals, total emissions can be compared against each other or checked against appropriate emissions factors to determine reasonableness. The extent that detailed checks can be done depends on the resources available to the agency, the number of sources included in the inventory, and the use of the data. It is suggested to recontact a higher percentage of respondents that considered their usage lower than specified yearly amount, or as having no toxic emissions when their SIC code would suggest otherwise. Perhaps they only misunderstood the way the instructions were worded, or know their chemicals by a trade name instead of chemical composition. In any event, a follow-up call may increase the accuracy of the inventory.

On-Site Inspections

For certain sources, it may be appropriate to consider plant visits if more specific information needs to be obtained for a particular program purpose, although this approach can become resource intensive and time consuming. Another approach is to do a preliminary screening and visit a very small percentage of facilities as part of a data quality control procedure. Also, it may be wise to visit a representative sample of respondents that checked the “not applicable” box, especially if the agency determines from cross referencing SIC codes, that the source has a potential to emit air toxic compounds.

Another less resource intensive approach may be to inspect the facility to check emission responses during the next regularly scheduled air compliance inspection. Most agencies periodically inspect major facilities within their jurisdiction. The problems that can be encountered using this approach is that air inspectors may need additional training before such inspections, because most regular air inspections involve criteria pollutants, or at the most select pollutants associated with NESHAPs or NSPS.

Recontacting Sources

The return rate for the questionnaires can be increased by recontacting recipients that are delinquent in responding either by letter or by phone. This recontact reminds them that they will not be forgotten and may be subject to fine, and that a response is necessary. For other companies that may be confused by some of the questions, recontact provides them with a less embarrassing way to ask questions. This interaction is the most effective while the questionnaire is being initially completed, rather than having to return questionnaires to the industries for corrections. Using a pilot mailing will help get an idea of the average time recipients take to respond and how many recipients will need to be recontacted. In addition, a pilot mailing can provide an overview of the effectiveness of the questionnaire before the final mailing is done. Unnecessary recontacts should be minimized to avoid the possibility of some firms becoming uncooperative. Inventory efforts, after all, are not a one-time need. Yearly updates may be necessary.

Revising the Questionnaire

The process of revising the questionnaire should be an evolving process. With each mail-out or updating of the inventory, the questionnaire or instructions for completing the questionnaire can be fine tuned or redirected to meet the developing program needs. But, as mentioned before, industry will become familiar with questionnaire format that is not changed drastically from mailing to mailing. So, a carefully considered initial design is the best approach, and will reduce time needed for follow-up.

Some changes can be expected, such as:

- Promulgation of new regulations, stricter source registration requirements, or changes in reporting requirements;
- More EPA approved emission factors or more available stack test data;
- Increases in the number and types of compounds included;
- Changes in format of questions when agency installs or changes its data handling system; and
- Changes in control technology and/or control equipment efficiency.

Other changes may be made because of the widespread occurrence of wrong responses to a particular question. Still another kind of revision, but one that has much impact, are changes in various aspects of the inventory process, such as:

- Addition or deletion of the use of screening questionnaires;
- Changes in the cover letter, instructions or confidentiality provisions;
- Changes in the type of questionnaire, such as a change from open-ended to industry-specific questionnaires;
- Changes in the ways that the agency intends to use the data; and
- Changes in agency budgets and/or resources and manpower available for inventory efforts.

Perhaps the best way to proceed is not to plan in terms of needed emission inventory questionnaire <u>revisions</u>, but to continually focus on needed <u>improvements</u>, whatever the reasons turn out to be.

Sample Survey Forms for the Dry Cleaning Industry

Name of Facility:____

Street Address:____

City/State:____

Contact Person:____

Telephone Number:____
_

Please check the appropriate box describing your operation.

1. Solvent Used	Amount Purchased Annually (gallons)
☐ PERC (Perchloroethylene)	____________
☐ Petroleum (Stoddard Solvent)	____________
☐ Other Petroleum Solvents	____________
☐ CFC-113 (Trichlorofluoroethane)	____________
☐ TCA (1,1,1-Trichloroethane)	____________
☐ Other	____________

Sample Survey Forms for the Dry Cleaning Industry (Continued)

For each machine at your facility, please provide the following information:

Machine Type	Load Capacity (pounds of garments)	Estimated Solvent Use Per Load (gallons of solvent)	Controls in Place
____________	____________	____________	____________
____________	____________	____________	____________
____________	____________	____________	____________
____________	____________	____________	____________
____________	____________	____________	____________
____________	____________	____________	____________

For your entire facility, please estimate the amount of solvent sent for off-site disposal or recycling:

Solvent Type		Estimated (gallons/year)
PERC (Perchloroethylene)		____________
Petroleum Solvents:	____________	____________
	____________	____________
	____________	____________
TCA (1,1,1 -Trichloroethane		____________
CFC-113 (Trichlorofluoroethane)		____________
Other (please specify):	____________	____________
	____________	____________
	____________	____________

For your facility, please estimate the average days per week and hours per day that dry cleaning equipment is operating:

______________ days per week _______________ hours per day

Please list the number of employees at this facility:

______________ employees

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APPENDIX G

LIST OF EIIP PREFERRED AND ALTERNATIVE METHODS BY SOURCE CATEGORY (Current as of March 2001)

Source: *Handbook for Criteria Pollutant Inventory Development: A Beginner's Guide for Point and Area Sources, Appendix C.* EPA-454-/R-99-037, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, September 1999.

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Contents

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Table 1. List of EIIP Preferred and Alternative Methods by Source Category (Point Sources)

Source Category	Estimation Methods, Preferred (P) or Alternative (A)						
	Material Balance	Emission Factors	Source Testing	CEM Data	Emission Models/ Predictive Monitoring[a]	Fuel Analysis	Engineering Calculations
Aircraft Manufacturing, Surface Coating	P, A	A	P, A		A		
Appliances, Surface Coating	P, A	A	P, A		A		
Automobiles and Light-duty Trucks, Surface Coating	P, A	A	P, A		A		
Automobile Refinishing, Surface Coating	P, A	A	P, A		A		
Equipment Leaks		A	A		P		
Flat Wood Product Manufacturing, Surface Coating	P, A	A	P, A		A		
Heavy-duty Truck Manufacturing, Surface Coating	P, A	A	P, A		A		
Hot-Mix Asphalt Plants		P	P	A	A	P	
Magnet Wire, Surface Coating	P, A	A	P, A		A		
Metal Cans, Surface Coating	P, A	A	P, A		A		
Metal Coil, Surface Coating	P, A	A	P, A		A		

Table 1. List of EIIP Preferred and Alternative Methods by Source Category (Point Sources) (Continued)

Source Category	Estimation Methods, Preferred (P) or Alternative (A)						
	Material Balance	Emission Factors	Source Testing	CEM Data	Emission Models/ Predictive Monitoring[a]	Fuel Analysis	Engineering Calculations
Metal Furniture, Surface Coating	P, A	A	P, A		A		
Miscellaneous Metal Parts, Surface Coating	P, A	A	P, A		A		
Oil & Gas Field Production & Processing		P, A	A	A	P		
Paint and Ink Manufacturing	A	P, A	A		P		
Paper Coating, Surface Coating	P, A	A	P, A		A		
Plastic Products Manufacturing	P, A	A	P, A		A		
Plastic Parts, Surface Coating	P, A	A	P, A		A		
Secondary Metal Processing		P, A	P, A	P, A			
Semiconductor Manufacturing	P	A	P, A				A
Ships, Surface Coating	P, A	A	P, A		A		
Wastewater Collection and Treatment	A	A	A		P		A

Table 1. List of EIIP Preferred and Alternative Methods by Source Category (Point Sources) (Continued)

Source Category	Estimation Methods, Preferred (P) or Alternative (A)						
	Material Balance	Emission Factors	Source Testing	CEM Data	Emission Models/ Predictive Monitoring[a]	Fuel Analysis	Engineering Calculations
Wood Furniture, Surface Coating	P, A	A	P, A		A		

[a] Predictive emission monitoring is an estimation method where emissions are correlated to process parameters based on demonstrated correlations.

Reference: *Emission Inventory Improvement Program Preferred and Alternative Methods*. Volume I, Introduction to the EIIP, and Volume II, Point Sources.

Table 2. List of EIIP Preferred and Alternative Methods by Source Category (Area Sources)

Source Category	Estimation Methods, Preferred (P) or Alternative (A)					
				Top-Down Approach		
	Survey	Material Balance	Emission Factors	Per-employee or Per-capita Emission Factors	Allocation of National Level Activity	Emission Estimation Models
Architectural Surface Coating	P	P		A	A	
Asphalt Paving	P, A	P	A			
Autobody Refinishing	P	P		A	A	
Consumer Solvents	A			P, A		
Dry Cleaning	P	P	P	A		
Gasoline Distribution, Stage I	P, A		P, A		A	
Gasoline Distribution, Stage II	P		P, A		A	P, A
Graphic Arts	P			A	A	
Industrial Surface Coating				P, A		
Landfills	P			A		P, A
Marine Vessel Loading, Ballasting and Transit	P		P			
Open Burning	P	A	P			

Table 2. List of EIIP Preferred and Alternative Methods by Source Category (Area Sources) (Continued)

Source Category	Estimation Methods, Preferred (P) or Alternative (A)					
				Top-Down Approach		
	Survey	Material Balance	Emission Factors	Per-employee or Per-capita Emission Factors	Allocation of National Level Activity	Emission Estimation Models
Pesticide Use, Agriculture	P, A	A	P, A			
Pesticide Use, NonAgriculture (Municipal, Commercial and Consumer)	P			A		
Residential Wood Combustion	P		P, A		A	
Solvent Cleaning	P, A		P	A	A	
Traffic Paints	P	P	P, A	A	A	

Reference: *Emission Inventory Improvement Program Preferred and Alternative Methods*. Volume III, Area Sources.

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APPENDIX H

POINT SOURCES EXAMPLE CALCULATIONS

Source: *Handbook for Criteria Pollutant Inventory Development: A Beginner's Guide for Point and Area Sources, Appendix D*. EPA-454-/R-99-037, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, September 1999.

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Contents

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Example 1-- Coal-fired Industrial Boiler (Emission Factors and Temporal Allocation)

This example illustrates the procedures to calculate emissions from an industrial boiler firing anthracite coal.

Assumed Operating Parameters

Coal type: Anthracite
Annual coal consumption: 928,000 tons per year (tpy)
Ash content of coal: 7 percent
Sulfur content of coal: 1.87 percent

Seasonal throughput fractions: Winter = 50%;
Spring = 20%;
Summer = 10%;
Fall = 20%

Particulate emissions are controlled with a 75 percent efficient cyclone
Sulfur oxides emissions are controlled with a 93 percent efficient limestone injection system.

Boiler Type: Traveling grate stoker

AP-42 Emission Factors

Section 1.2 of *AP-42* provides emission factors for pollutants from anthracite coal combustion in stoker fired boilers:

Total organic compounds (TOC): = 0.3 lb/ton (Table 1.2-6)
Particulate matter (PM): = 0.8A lb/ton for PM-filterable and 0.08A lb/ton for PM-condensible where A is the ash content of coal in weight percent (Table 1.2-3)
Lead (Pb): = 8.9E-03 lb/ton (Table 1.2-3)
Nitrogen oxides (NO_x): = 9 lb/ton (Table 1.2-1)
Sulfur dioxide (SO_2): = 39S lb/ton where S is the weight percent of sulfur in the coal (Table 1.2-1)
Carbon monoxide (CO): = 0.6 lb/ton (Table 1.2-2)

Example 1-- Coal-fired Industrial Boiler (Emission Factors and Temporal Allocation) (Continued)

Estimating Uncontrolled Emissions

The general equation for estimating uncontrolled emissions of TOC, Pb, NO_x, CO, and CO_2 from anthracite coal combustion in boilers is as follows:

Boiler Emissions = Annual Coal Consumption x Emission Factor

TOC = 928,000 tons/year x 0.3 lb/ton = 278,400 lb/year = 139.2 tpy
Pb = 928,000 tons/year x 8.9E-03 lb/ton = 8,259 lb/year = 4.1 tpy
NO_x = 928,000 tons/year x 9 lb/ton = 8,352,000 lb/year = 4,176 tpy
CO = 928,000 tons/year x 0.6 lb/ton = 556,800 lb/year = 278 tpy

The general equation for estimating uncontrolled emissions of PM from anthracite coal combustion in boilers is as follows:

PM Emissions	=	Annual Coal Consumption x (Emission Factor x Coal Ash Content)
PM-Filterable	=	928,000 tons/year x (0.8 lb/ton x 7) = 51,968 lb/year
	=	25.98 tpy
PM-Condensible	=	928,000 tons/year x (0.08 lb/ton x 7) = 5196.80 lb/year
	=	2.598 tpy
Total PM	=	25.98 tpy + 2.598 tpy = 28.58 tpy

The general equation for estimating uncontrolled emissions of SO_2 from anthracite coal combustion in boilers is as follows:

SO_2 Emissions	=	Annual Coal Consumption x (Emission Factor x Coal Sulfur Content)
SO_2	=	928,000 tons/year x (39 lb/ton x 1.87) = 676,790.4 lb/year
	=	338.4 tpy

Example 1-- Coal-fired Industrial Boiler (Emission Factors and Temporal Allocation) (Continued)

Estimating Controlled Emissions

Particulate emissions are controlled with a 75 percent efficient cyclone and SO_2 emissions are controlled with a 93 percent efficient limestone injection system. The general equation for estimating controlled emissions of PM and SO_2 is as follows:

Controlled Emissions = Uncontrolled Emissions x (1 - Efficiency/100)

Total PM = 28.58 tpy x (1-75/100) = 28.58 tpy x (0.25) = 7.15 tpy
SO_2 = 338.4 tpy x (1-93/100) = 338.4 tpy x (0.07) = 23.7 tpy

Temporal Allocation of PM Emissions

The general equation for estimating seasonal emissions is as follows:

Seasonal emissions = Seasonal throughput fraction x annual emissions

Therefore:

Winter emissions of PM = 0.5 x 7.15 tpy = 3.575 tons
Spring emissions of PM = 0.2 x 7.15 tpy = 1.43 tons
Summer emissions of PM = 0.1 x 7.15 tpy = 0.715 tons
Fall emissions of PM = 0.2 x 7.15 tpy = 1.43 tons

Example 2--Natural Gas And Number 6 Fuel Oil Fired Industrial Boiler Emissions (Emission Factors)

This example illustrates the use of *AP-42* emissions factors to estimate emissions from a small industrial boiler firing natural gas and Number 6 fuel oil.

Assumed Operating Parameters

Natural Gas
Annual Consumption: 99,885 MMBtu/year
Heating Value: 1,032 Btu/scf
Usage: 81% of the time

#6 Oil
Annual Consumption: 147,983 gal/year
Heating Value: 150,000 Btu/gal
Sulfur Content: 1 percent
Nitrogen Content: 0.4 percent
Usage: 19% of the time

AP-42 Emission Factors

Sections 1.3 and 1.4 of *AP-42* provide emission factors for pollutants from industrial boilers firing Number 6 fuel oil and natural gas, respectively.

Natural Gas
PM-Filterable: 1.9 lb/10^6 scf (Table 1.4-2)
PM-Condensible: 5.7 lb/10^6 scf (Table 1.4-2)
SO_x: 0.6 lb/10^6 scf as SO_2 (Table 1.4-2)
NO_x as NO_2: 100 lb/10^6 scf as NO_2 (Table 1.4-1)
CO: 84 lb/10^6 scf (Table 1.4-1)
TOC: 11 lb/10^6 scf (Table 1.4-2)

Number 6 Fuel Oil
All emission factors for Number 6 fuel oil are obtained from Table 1.3-1 in *AP-42* (except as noted) for boilers with firing rate less than 100 million Btu/hr:

CO: 5 lb/10^3 gal
Nonmethane Volatile Organics: 0.28 lb/10^3 gal [Table 1.3-3]
Methane Volatile Organics: 1 lb/10^3 gal [Table 1.3-3]
NO_x as NO_2: [20.54 + (104.39 x N)] lb/10^3 where N is the weight percent of nitrogen in the oil
NO_2 emission factor = 20.54 + (104.39 x 0.4) = 62.3 lb/10^3 gal

Example 2--Natural Gas And Number 6 Fuel Oil Fired Industrial Boiler Emissions (Emission Factors) Continued

Particulate Matter (PM): [9.19(S) + 3.22] lb/10^3 gal where S is the weight percent of sulfur in the oil
PM emission factor = [9.19(1) + 3.22] lb/10^3 gal = 12.41 lb/10^3 gal

Sulfur Oxides as SO_2: 157(S) lb/10^3 gal where S is the weight percent of sulfur in the oil
SO_2 emission factor = 157(1) = 157 lb/10^3 gal

Sulfur Oxides as SO_3: 2(S) lb/10^3 gal where S is the weight percent of sulfur in the oil
SO_3 emission factor = 2(1) = 2 lb/10^3 gal

<u>Estimating Uncontrolled Emissions by Fuel Type</u>

Natural Gas
The general equation for estimating natural gas consumption in scf/year is as follows:

$$\text{Annual Consumption} = \frac{\text{Annual Heat Input}}{\text{Natural Gas Heating Value}}$$

$$= \frac{99{,}885 \times 10^6 \text{ Btu/year}}{1{,}032 \text{ Btu/scf}} \;'\; 96.8 \times 10^6 \text{ scf/year}$$

The general equation for estimating uncontrolled emissions from natural gas combustion is as follows:

Natural Gas Emissions = Annual Gas Consumption x Emission Factor

PM-Filterable	=	96.8x10^6 scf/year x 1.9 lb/10^6 scf = 184 lb/year = 0.09 tpy
PM-Condensible	=	96.8x10^6 scf/year x 5.7 lb/10^6 scf = 552 lb/year = 0.28 tpy
SO_x	=	96.8x10^6 scf/year x 0.6 lb/10^6 scf = 58 lb/year = 0.03 tpy
NO_x	=	96.8x10^6 scf/year x 100 lb/10^6 scf = 9,680 lb/year = 4.8 tpy
CO	=	96.8x10^6 scf/year x 84 lb/10^6 scf = 8,132 lb/year = 4.07 tpy
TOC	=	96.8x10^6 scf/year x 11 lb/10^6 scf = 1,064.8 lb/year = 0.53 tpy

Total PM emissions from the combustion of natural gas is given by the following equation:

Total PM Emissions = PM-Filterable + PM-Condensible
= 0.09 tpy + 0.28 tpy = 0.37 tpy

Example 2--Natural Gas And Number 6 Fuel Oil Fired Industrial Boiler Emissions (Emission Factors) (Continued)

Number 6 Fuel Oil

The general equation for estimating uncontrolled emissions from Number 6 fuel oil combustion in an industrial boiler is as follows:

Number 6 Fuel Oil Emissions = Annual Fuel Oil Consumption x Emission Factor

PM	=	147,983 gal/year x 12.41 lb/10^3 gal = 1,836 lb/year = 0.92 tpy
SO_x as SO_2	=	147,983 gal/year x 157 lb/10^3 gal = 23,233 lb/year = 11.6 tpy
SO_x as SO_3	=	147,983 gal/year x 2 lb/10^3 gal = 296 lb/year = 0.15 tpy
NO_x as NO_2	=	147,983 gal/year x 62.3 lb/10^3 gal = 9,219 lb/year = 4.6 tpy
CO	=	147,983 gal/year x 5 lb/10^3 gal = 740 lb/year = 0.37 tpy
Nonmethane Volatile Organics	=	147,983 gal/year x 0.28 lb/10^3 gal = 41.44 lb/year = 0.021 tpy
Methane Volatile Organics	=	147,983 gal/year x 1 lb/10^3 gal = 148 lb/year = 0.074 tpy

Total SO_x emissions from the combustion of Number 6 fuel oil is given by the following equation:

$$SO_x \text{ Emissions} = SO_2 \text{ emissions} + SO_3 \text{ emissions} = 11.6 + 0.15 = 11.75 \text{ tpy}$$

Total Volatile Organic emissions from the combustion of Number 6 fuel oil is given by the following equation:

Total Organic Emissions	=	Nonmethane Volatile Organics + Methane Volatile Organics
	=	0.021 tpy + 0.074 tpy = 0.095 tpy

<u>Estimating Total Uncontrolled Emissions</u>

Total Emissions = Natural Gas Emissions + Number 6 Fuel Oil Emissions

Total PM	=	0.37 tpy + 0.92 tpy = 1.29 tpy
Total SO_x	=	0.03 tpy + 11.75 tpy = 11.78 tpy
Total NO_x	=	4.8 tpy + 4.6 tpy = 9.4 tpy
Total CO	=	4.07 tpy + 0.37 tpy = 4.44 tpy
Total TOC	=	0.53 tpy + 0.095 tpy = 0.625 tpy

Example 3--Copper Coil Manufacturing (Mass Balance)

This example illustrates the use of material (mass) balances as a method for estimating emissions from a metal rolling unit that processes copper coil. Prior to a rolling step, copper coil is sprayed with oil for lubrication and heat dispersion. After rolling, the copper coil is sent to an annealer which has been shown to destroy 85 percent of the oil during the heat treatment of the copper coil. Negligible amounts of oil remain on the copper coil after annealing. The oil is assumed to be 100 percent VOC. The VOC emissions associated with this process occur from volatilization of lubricating oil during its application prior to rolling as well as the undestructed oil exhausted from the annealer.

<u>Assumed Operating Parameters</u>

Mass of copper coil processed:	5,000 kg
Mass of copper coil and oil sent to annealer:	5,075 kg
Mass of lubricating oil sprayed onto the copper:	3,000 kg
Mass of lubricating oil recovered:	2,800 kg

<u>Estimating Emissions</u>

The general formula to complete a material balance is represented by:

Input + Generation - Output - Consumption = Accumulation

where:

Input:	mass entering the process
Generation:	mass produced in the process
Output:	mass exiting the process
Consumption:	mass consumed in the process
Accumulation:	mass that builds up within the process

For this example, the parameters listed above are described as:

Input:	mass of lubricating oil applied (3,000 kg)
Generation:	not applicable/no material generation (0 kg)
Output:	mass of oil lost as an emission
Consumption:	mass of oil destroyed in the annealer
Accumulation:	mass of lubricating oil recovered (2,800 kg)

The estimate for the Consumption parameter is calculated from the mass of copper coil processed, the mass of copper coil and oil sent to the annealer, and the oil destruction efficiency as it is exposed to high temperatures in the annealer.

Example 3--Copper Coil Manufacturing (Mass Balance) (Continued)

Consumption = (mass of coil/oil to annealer - mass of coil processed) x 85 percent
= (5,075 kg - 5,000 kg) x 0.85
= 64 kg oil destroyed in the annealer

After simplifying the material balance formula, the estimate of the Output (emissions) from this process is:

Input - Output - Consumption = Accumulation

Or:

Output = Input - Consumption - Accumulation

Output = 3,000 kg - 64 kg - 2,800 kg

Output = 136 kg

The VOC emissions associated with this process are thus 136 kg oil per 5,000 kg of copper coil processed, or 0.027 kg oil per kg of copper coil processed.

Example 4-- Paint Manufacturing (Source Test Data)

This example illustrates the use of source test data to estimate process emissions from a spray booth at a paint manufacturing facility. The materials emitted from the spray booth stack are assumed to be 100 percent VOC.

Assumed Operating Parameters

Stack flow rate:	50,000 scm/hr
Average measured VOC concentration from stack:	0.005 kg VOC/scm
Spray booth annual operation:	2,080 hr/year

Estimating Emissions

Since the source testing provided a VOC concentration and the average stack exhaust flow rate, the concentration can be converted to a mass flow rate:

Mass Flow rate = volumetric flow rate x concentration
= 50,000 scm/hr x 0.005 kg VOC/scm
= 250 kg VOC/hr

The annual VOC emissions can then be estimated using the mass flow rate and the annual hours of operation for the paint spray booth:

Emissions = mass flow rate x annual hours operation
= 250 kg VOC/hr x 2,080 hr/yr
= 520,000 kg VOC/yr or 520 metric tons

Example 5 -- Boiler Emissions (Source Testing)

This example illustrates the procedure to estimate lead emissions from a boiler using stack testing results.

Assumed Operating Parameters

The results of these stack sampling test runs show that the average concentration of lead (Pb) in the stack gas is 0.0005 pound per dry standard cubic feet (lb/dscf) and the average stack gas volumetric flow rate is 51,700 dry standard cubic feet per minute (dscf/min). The boiler operates 5,840 hours per year, and is equipped with a multicyclone.

Calculating Pb Emissions

The Pb emission rate is calculated as follows:

Pb Emission Rate	=	Pb concentration x stack gas flow rate
	=	0.0005 lb/dscf x 51,700 dscf/min x 60 min/hr
	=	1,551 lb/hr
Annual Pb Emissions	=	1,551 lb/hr x 5,840 hr/yr x 1 ton/2,000 lb = 4,528 tpy

Example 6--Boiler Emissions (CEM Data)

This example illustrates how average SO_2 emissions can be calculated based on raw CEM data.

<u>Assumed Operating Parameters</u>

Example CEM output for a boiler burning fuel oil is provided in the following table:

Period	O_2 (%V)	SO_2 (ppmv)	Stack Gas Flow Rate (dscfm)
11:00	2.1	1,004.0	155,087
11:15	2.0	1,100.0	155,943
11:30	2.1	1,050.0	155,087
11:45	1.9	1,070.0	154,122
12:00	1.9	1,070.0	156,123
Average	2.0	1,058.8	155,272

HHV: Fuel heating value: 18,000 Btu/lb
SO_2: Molecular weight: 64 lb/lb-mole
V: Molar volume: 385.5 ft^3/lb-mole at 68EF and 1 atm
Q_f: Mass fuel throughput: 46,000 lb/hr
OpHrs: Total annual hours of operation: 5,400 hours

<u>Calculating Hourly Emissions of SO_2</u>

$$E_{SO_2} = \frac{(C \text{ x } MW \text{ x } Q \text{ x } 60)}{(V \text{ x } 10^6)}$$

Where:

C: Parts per million by volume dry air (ppmvd)
MW: Molecular weight in lb/lb-mole
Q: Flow rate in dry standard cubic feet per minute (dscfm)
V: molar volume in cubic feet (ft^3)/lb-mole

Example 6--Boiler Emissions (CEM Data) (Continued)

$$E_{SO_2} = \frac{1{,}058.8 \times 64 \times 155{,}272 \times 60}{385.5 \times 10^6} = 1{,}637 \text{ lb/hr}$$

Calculating Heat Input

$$H_{in} = \frac{(Q_f \times HHV)}{(10^6)}$$

$$H_{in} = \frac{46{,}000 \times 18{,}000}{10^6} = 828 \text{ MMBtu/hr}$$

Developing SO_2 Emission factors

An SO_2 emission factor expressed as lb/MMBtu is calculated as follows:

$$EF_{SO_2} = \frac{E_{SO_2}}{H_{in}} = \frac{1{,}637 \text{ lb/hr}}{828 \text{ MMBtu/hr}} = 1.98 \text{ lb/MMBtu}$$

Calculating Annual SO_2 Emissions

$$\text{Annual } SO_2 \text{ Emissions} = \text{hourly } SO_2 \text{emissions} \times O_P\text{Hrs}$$

$$= \frac{(1{,}637 \text{ lb/hr} \times 5{,}400 \text{ hrs})}{(2{,}000 \text{ lb/ton})} = 4{,}419 \text{ tons per year}$$

Example 7--Boiler Emissions (Fuel Analysis)

This example illustrates how SO_2 emissions from fuel combustion can be calculated using fuel analysis results.

Assumed Operating Parameters

Sulfur content of fuel:	1% by weight
Fuel throughput:	5,000 lb/hr
Hours of operation:	8,760 hours/year

Calculating SO_2 emissions:

The basic equation in fuel analysis emission calculation is:

$$E = Q_f \text{ x pollutant concentration in fuel x } (Mw_p/MW_f)$$

Where:

Q_f = Throughput of fuel in lb/hr
MW_p = Molecular weight of pollutant emitted (lb/lb-mole)
MW_f = Molecular weight of pollutant in fuel (lb/lb-mole)

In this example, $MW_p = 32 + (16 \text{ x } 2) = 64$ lb/lb-mole
$MW_f = 32$ lb/lb-mole

Therefore,

$$E_{SO_2} = 5{,}000 \text{ lb/hr x } 0.01 \text{ x } (64/32)$$

$$= 100 \text{ lb/hr}$$

$$= 100 \text{ lb/hr x } 8{,}760 \text{ hr/yr x } \frac{1 \text{ ton}}{2{,}000 \text{ lbs}}$$

$$= 438 \text{ tons/year of } SO_2$$

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APPENDIX I

CONTACTS

Source: *Handbook for Criteria Pollutant Inventory Development: A Beginner's Guide for Point and Area Sources, Appendix P.* EPA-454-/R-99-037, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, September 1999.

EIIP, Volume I, Chapter 1, Appendix C, *Introduction to Stationary Point Source Emission Inventory Development.* July 1997.

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APPENDIX I1

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APPENDIX J

CLEARING UP THE RULE EFFECTIVENESS CONFUSION

Source: *Handbook for Criteria Pollutant Inventory Development: A Beginner's Guide for Point and Area Sources, Appendix B*. EPA-454-/R-99-037, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, September 1999.

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Clearing Up the Rule Effectiveness Confusion

Introduction

Since its formation, EPA has been implementing rules and regulations that require states to reduce the amount of pollution being emitted into the atmosphere. Achieving the air quality anticipated by implementing a particular rule has not always been successful despite imposition of numerous emission controls. In 1987 EPA acknowledged that existing air quality regulations were not resulting in sufficient emission reductions to reach acceptable levels of air quality. The November 24, 1987 Federal Register said "The EPA believes that one reason ozone levels have not declined as much as expected is that reductions from national and local control measures have not been as high as expected."[1] This Federal Register further stated that "the effectiveness (i.e., the ratio of actual reductions to expected reductions expressed as a percentage) of some rules is much lower than 100 percent." To correct or compensate for the lower than anticipated amount of reductions, the Federal Register notice stated that "for both new and existing rules, EPA proposes to allow States to assume not more than 80 percent of full effectiveness unless adequate higher levels are adequately demonstrated." Said another way, "we don't believe your rule will get as much reduction as you think it will." This under-performance can result from:

- Some sources not implementing (or not implementing all the time) controls required by the rule;
- Some sources not installing sufficient control equipment to achieve required emission rate;
- Some sources operating installed control equipment at less than rated control efficiency;
- New source being introduced into the local area covered by the rule.

Any of these situations could result in attainment year emissions being higher than anticipated. Even though an individual source's emission rate is reduced to that specified in a state rule, the overall reduction within the state may not be as great because of the above considerations.

The 1987 Federal Register[1] defines "effectiveness" as:

$$\text{Effectiveness} = \frac{\text{Actual Reductions}}{\text{Expected Reductions}} \tag{1}$$

For complete compliance to occur, effectiveness must equal 100 percent. This Federal Register recognizes however, that effectiveness is usually not 100 percent. To adjust for non-compliance, the Federal Register limits the amount of reduction that a state can anticipate. This forces policy planners to account for less than complete compliance. For example, if an agency implemented a rule to reduce emissions by 100 tpy (expected reduction), the Federal Register suggests that the actual reduction will not be as great as the expected reduction (Equation 1). For the 100 tpy goal to be met (i.e., "effectiveness" to be 100 percent), the actual reduction in Equation 1 must be modified as follows:

$$\text{Effectiveness} = \frac{\text{Reduction Target x (Empirical Factor)}}{\text{Expected Reduction}} \tag{2}$$

Where:

Expected Reduction = Emission reduction required as estimated by modeling to meet air quality standard

In this example, Equation 2 becomes:

$$100\% = \frac{\text{Reduction Target x 0.8}}{100}$$

Solving for Reduction target: Reduction target = 125 tpy

Policy makers then develop control strategies based on this Reduction target value. If an agency implements a rule to reduce emissions by 100 tpy, the policy makers must target a 125 tpy reduction to be able to achieve the needed 100 tpy. Note that the results of equation 2 do not reflect the accuracy of the emission estimates, but only adjust for the past history of complying with a new rule.

The 1992 Federal Register[2] defines rule effectiveness as:

$$\text{Rule Effectiveness (RE)} = \frac{\text{Actual Reduction}}{\text{Expected Reduction}} \tag{3}$$

Where:

Actual reduction = (base year emissions) - (current year emission estimates)

In Equation 3, the new term "RE" is an indicator that compares the amount of actual emission reduction to the expected reduction. This metric is useful to decision makers as they evaluate how well their policies are achieving the intended goals or how effective the rule is in achieving expected reductions. For example, assume an agency modeling exercise indicated that 100 tpy reduction is needed in 10 years to be able to reach attainment status. Also assume the base year inventory is 200 tpy. If a 50 tpy reduction is achieved 5 years into the implementation period, then the RE = (200 - 150)/100 = 50 percent. At the end of 10 years, if the entire 100 tpy has been removed, then the RE = (200 - 100)/100 = 100 percent.

Introducing the factors contained in these equations acknowledges the reality that, in an imperfect world, a rule intended to reduce emissions and improve air quality does not always work as planned. Equation 2 offers, for planning purposes, an empirical solution to this problem while Equation 3 measures the effectiveness of the solution after controls are implemented. The empirical approach assumes that only 80 percent (or higher if an agency can substantiate) of the required control will be achieved. To offset this shortfall, additional controls are needed. This concept was further supported in the April 16, 1992 Federal Register.[2] Under III(A)(2)(a)(2) it is stated that “one hundred percent rule effectiveness is the ability of a regulatory program to achieve all the emission reductions at all sources at all times.” The “extra” controls in Equation 2 compensate for parts of the air quality strategy that are not completely implemented “at all of the sources all of the time”.

As the air quality control community became more sophisticated, it realized that other causes could be contributing to the inability to reach acceptable air quality levels. Two areas of concern are the accuracy of air quality model predictions (air quality modeling issues will not be addressed in this discussion) and the accuracy of the emission inventory accounting process (quantity of emissions represented in the inventory). Policy makers use emission estimates to help develop new rules that will cause the removal of a specified quantity of pollutant. They assume that removing this amount of pollutant will lead to acceptable air quality. The amount to be removed is usually selected as a result of various air quality modeling exercises. If the initial quantity of emissions used in the model calculations is incorrect, then the amount of pollutant to be reduced, as calculated by the model, may also be incorrect.

To offset an assumed underestimate of emissions, states are required to apply a compensation factor to facility control device efficiency values. This action has the effect of reducing the assumed efficiency of the control device (a reasonable assumption since control equipment may fail, be off line due to equipment maintenance, and process upsets occur) and increasing individual source emission estimates. This factor, also called Rule Effectiveness, has a default value of 80 percent.

Very few sources measure their emissions directly using continuous emission monitors (CEM). Uncontrolled emissions at sources not monitored by CEMs are estimated using the following equation:

$$\text{Emissions} = \text{Emission Factor} \times \text{Activity Data} \tag{4}$$

If RE is used, the equation to calculate emissions from a facility containing a control device becomes:

$$\text{Emissions} = \text{Emission Factor} \times \text{Activity Data} \times (1 - CE \times RE) \qquad (5)$$

Where:

CE = manufacturer stated control efficiency

The definition of RE in Equations 3 and in Equation 5 are very different. Equation 3 provides policy makers with a method to measure the amount of reduction at a point in time and judge the success of a particular rule. Equation 5 adjusts individual facility estimates to compensate for assessment techniques that do not account for all emissions. Even though the philosophy behind the emission adjustments is different in each case, the same term - RE, is used for both situations.

<u>Why Confusion Exists</u>

In 1992, EPA issued "Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO State Implementation Plan Base Year Inventories."[3] Under section 1.2 the document states "The appropriate method for determining and using RE depends upon the purpose for the determination: compliance program or inventory. RE discussed outside the particular purpose may be generically referred to as control effectiveness. The following three common uses for a control effectiveness estimate have historically been called rule effectiveness:

- Identifying and addressing weakness in control strategies and regulations related to compliance and enforcement activities (more accurately call *Compliance Effectiveness*);

- Defining or redefining the control strategy necessary to achieve the required emissions reductions designated in the CAAA (more accurately called *Program* or SIP *Design Effectiveness*); and

- Improving the accuracy or representativeness of emission estimates across a nonattainment area (hereafter called *Rule Effectiveness*)"(3)

"The inventory RE is an adjustment to estimated emissions data to account for the emissions underestimates due to compliance failures and the inability of most inventory techniques to include these failures in an emission estimate. The RE adjustment accounts for known underestimates due to noncompliance with existing rules, control equipment downtime or operating problems and process upsets. The result is a better estimate of expected emission reductions and control measure effectiveness in future years".[3]

Previous paragraphs provide definitions of Compliance effectiveness and Rule effectiveness and try to make a distinction between the two. Despite these distinctions, the second sentence of the preceding paragraph inadvisely combines concepts of both rule noncompliance and the problem of overestimating collection efficiency of control equipment. Even though there is a recognition that the two situations are different, the RE term is used interchangeably in each of these examples.

Rule Effectiveness Guidance: Integration of Inventory, Compliance, and Assessment Applications was issued in January 1994.[4] In the Introduction, the document states that "Rule Effectiveness (RE) is a generic term for identifying and estimating the uncertainty in emission estimates caused by failures and uncertainties in emission control programs. It is a measure of the extent to which a rule actually achieves its desired emission reductions." Implying a second definition, the Introduction further states that "rule effectiveness accounts for identifiable emission underestimates due to factors including noncompliance with existing rules, control equipment downtime, operating and maintenance problems, and upsets." As was previously noted, the RE term is again used in different contexts within the same section of the same document.

This Guidance document contributes further to the confusion by using apparently different definitions of rule effectiveness.[4] The Glossary defines Rule Effectiveness as "a generic term for identifying and estimating the uncertainties in emission estimates caused by failures and uncertainties in emission control programs. Literally, it is the extent to which a rule achieves the desired emission reductions."

Based on past history it is understandable that, over time, the inventory community has used RE to describe different situations and often interchanging the definitions during the same discussion. The RE definition has evolved, taking on slightly different meanings, depending on the group using the term and the program to which it is being applied. Confusion results because the inventory community often uses the term RE without indicating the context in which it is being applied. Mangat, in a paper presented at an emission inventory conference in 1992 and in a subsequent EIIP paper, recognized that dissimilar definitions were being used and tried to explain the differences.[5, 6]

<u>Solutions to the Confusion</u>

RE is currently being used to describe and solve unrelated problems. In one case it is being used to address the failure of control equipment to operate at its stated efficiency for 100 percent of the time. In the second case RE is being used to address the failure of people to implement a rule with the required vigor.

Applying an adjustment factor is a valid approach in each of these situations. Unfortunately, the same term (RE) is used to describe and address both cases. The inventory community does not need more jargon. However, a solution to the current dilemma is to abandon the RE name and replace it with two distinctive terms, each describing specifically the situation in which it applies.

Separate definitions should allow those interested in measuring how well a rule is achieving its intended reductions to determine those results. Those interested in adjusting actual emission estimates to compensate for upsets, downtime, etc could also meet their needs. Each new term is described below.

The **Practical Compliance Index (PCI)** is to be used by those in policy positions to measure how well a rule is achieving its intended results. The PCI is a measure of the extent to which a rule actually accomplishes its desired emission reductions. For example, if a new rule has a PCI of 80 percent, it has caused 80 percent of the needed emission reductions to occur. A 100 percent of the expected reductions did not (has not) occurred because not all facilities implemented controls mandated by the rule, some facilities did not control at the emission rate required by the rule, or unanticipated growth occurred in the area. Additionally, policy makers using historical PCI values can develop realistic control strategies for their area.

The **Operational Adjustment Factor (OAF)** is to be used to adjust control efficiency ratings of control devices. Adjustments are necessary due to control equipment down time, subpar control device operations, and process upsets. Current methods of estimating emissions do not account for these situations. The OAF will not be used to adjust emission factors, activity data, or direct measurement of emissions.

<u>How to Apply a PCI and an OAF</u>

PCI

Air quality modeling is performed to support new rule development. Models are run to determine how much pollutant should be removed from the air to reach an acceptable ambient air quality concentration level. When the new rule is implemented, a strategy is developed, based on model results, that describes the sources to be controlled and the acceptable emission rate of each source.

The Practical Compliance Index (PCI) provides policy makers with two tools. The Index measures how well the control strategy is progressing toward reaching the air quality goal. The PCI is calculated by:

$$\text{PCI} = \frac{(\text{Base Year Emission Estimate}) - (\text{Current Year Emission Estimate})}{\text{Expected Reduction}} \qquad (6)$$

The PCI measures progress toward meeting the new emission target in the designated attainment year. PCI can be calculated periodically to provide policy makers with information on how the policy is being implemented and the extent of compliance with new control requirements.

Past experience has shown that, even if after a new rule is fully implemented, the ambient air quality level still exceeds the standard. One reason for this failure is lack of compliance with a new rule. Policy makers can use this information to increase the likelihood that future emission targets will be met. This can be done by using an empirically derived factor is used to adjust Equation 6. Even though the air quality modeling indicates a certain number of tons of pollutant are needed to be removed to reach the standard, practical experience shows that, without additional emphasis, this target will not be reached. The compensation factor in Equation 6a offsets this lack of compliance. If the goal is to achieve a 100 percent PCI, then Equation 6 becomes:

$$PCI = \frac{\text{Reduction Target} \times \text{Compensation Factor}}{\text{Expected Reduction}} \tag{6a}$$

Where:

Compensation factor has a default value of 80 percent

The denominator is the amount of reduction necessary, as calculated by air quality modeling, to achieve acceptable ambient air pollutant levels. By setting the PCI to 1 (100 percent) and solving for the Reduction target in the numerator, policy makers will know how much pollutant reduction should be targeted for their control strategies. The compensation factor is analogous to the definition of RE in Equation 3. Guidance currently being used to calculate a RE factor can be used to estimate the compensation factor in Equation 6a.

OAF

An inventory is composed of data that are used to estimate emissions. It contains information on control efficiencies of the devices connected to the processes being inventoried. Actual emissions are estimated either from direct measurements of the source or from calculations using variables contained in the inventory. The most common approach to estimating emissions is to select an emission factor associated with a process and combine it with the activity (thruput) of the operations. This amount is adjusted by the control efficiency of the devices attached to the process. The final product is an estimate of pollutant emitted to the atmosphere. Actual emissions are calculated by:

$$\text{Actual Emissions} = (\text{Emission Factor})_{unctl} \times (\text{Activity Data}) \times (1 - \text{Control Efficiency} \times \text{OAF}) \tag{7}$$

There are several inaccuracies associated with this approach. Even though the precision of the emission factor or activity estimate may be poor, there is usually no quantifiable bias associated with these values. However, because of operational process upsets, down time of the control device, and maintenance of the control equipment, overall control efficiency of the devices attached to the process is not as great as stated by the manufacturers. This introduces a bias into the emission estimating process that is known qualitatively, but is not accounted for in the inventory.

Equation 7 assumes there is no bias in the emission factor or activity data and that the control device operates at 100 percent of its design efficiency all the time the process is running. To reflect reality, control efficiency should be adjusted for process upsets and control device downtime. Equation 7 then becomes:

$$\text{Actual Emissions} = (\text{Emission Factor})_{\text{unctl}} \times (\text{Activity Data}) \times (1 - \text{Control Efficiency} \times \text{OAF}) \qquad (8)$$

$$\text{Where:}\quad \text{OAF} = 1 - \frac{(\text{Tons by-passing control device}}{[\text{Tons Collected (tpy)}] + [\text{Tons by-passing cor}}$$

The OAF is determined by examining operating records for a control device or family of devices. The amount of time it is operating, the number of process upsets, and the quantity of pollutant that bypasses the control device during these periods can be used to create the OAF.

Recently, some emission rates are being combined with process control efficiencies to form an emission factor that consists of a process-control device combination. Equation 8a is used when the emission factor incorporates control efficiency.

$$\text{Actual Emissions} = (\text{Emission Factor})_{\text{ctl}} \times (\text{Activity Data}) \times (1/\text{CE} - \text{OAF}) \qquad (8a)$$

<u>Summary</u>

The emission inventory community has been using RE for almost a decade. Even though the term has been used interchangeably in totally different applications, the distinctions have been poorly understood. New terminology proposed in this paper should correct this problem. The PCI measures the degree to which a rule is being implemented (by measuring the amount of actual reduction and comparing it to the expected reduction). It is based on historical results from past rule implementation efforts or from recent surveys that indicate the degree of compliance to be expected. The PCI compensates for the failure of people to fully implement a rule.

The OAF is a function of control equipment efficiency, the adequacy of equipment maintenance, equipment reliability, and the stability of a process. This information is available from records maintained at each facility. The OAF compensates for the failure of equipment to perform at its stated capacity.

Next Steps

- Determine how this proposed approach affects existing data;
- Determine how existing guidance must be changed to reflect new approach;
- Decide what to do about previously reported data that has RE applied; and
- Develop new guidance explaining use of PCI and OAF.

References

1. Federal Register, Vol. 52, No. 226, Tuesday, November 24, 1987, p45059.

2. Federal Register, Vol. 57, No. 74, Part III, Thursday, April 16, 1992.

3. "Guidelines for Estimating and Applying Rule Effectiveness for ozone/CO State Implementation Plan Base year Inventories," November 1992, EPA-452/R-92-010
.

4. "Rule Effectiveness Guidance: Integration of Inventory, Compliance, and Assessment Applications," January 1994, EPA-452/4-94-001.

5. "Developing Present and Future Year Emissions Inventories Using Rule Effectiveness Factors", presented at the International Conference and course, Emission Inventory Issues, Durham, NC, October 1992.

6. "Emission Inventories and Proper Use of Rule Effectiveness," *http://www.epa.gov/ttn/chief/eiip/committee/point_sources/pointsrc.html,* draft report, October 1998.

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APPENDIX K

OPTIONS FOR DATA REPORTING

Source: *Handbook for Criteria Pollutant Inventory Development: A Beginner's Guide for Point and Area Sources, Appendix I.* EPA-454-/R-99-037, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, September 1999.

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Options for Data Reporting

You can submit your data to EPA using one of several data transfer options. The appropriate data transfer method is identified during the planning stage of the inventory process, based on the end use of the inventory and availability of resources.

At this time the NET Input Format and the AIRS/AFS are equally viable options for submitting the point source data. The NET Input Format is the preferred option for submitting area data. You should keep in mind that information technology is a rapidly changing field, and electronic reporting of inventory data is an evolving issue. Refer to the EPA Data Submission page at *http:/www.epa.gov/ttn/chief/ei/eisubmit.html* for updates on emissions reporting.

Four options are available for data reporting:

- **Aerometric Information Retrieval System/Aerometric Information Retrieval Facility Subsystem (AIRS/AFS)** - AIRS is a computer-based system for the storage and retrieval of ambient air quality monitoring data and emissions and compliance data for individual facilities. AFS contains emissions, compliance, and permit data for point sources regulated or tracked by federal, state, and local air pollution agencies.

  This is the option that has been used for transferring SIP and annual emission inventory data to EPA. This option may be used to transfer **only point source data**. State and local agencies can upload industrial facility data directly to AIRS/AFS. EPA will extract the point source data submitted to AIRS/AFS and translate it into a format compatible with storage in the EPA National Emissions Trends (NET) database. You can find more information on the use of this option on the World Wide Web at *http:/www.epa.gov/airsdata*.

  For states that submit point source data via AIRS/AFS, it is necessary to use one of the other data transfer options to submit area, mobile, and biogenic data. Note, However, that the emissions component of AIRS/AFS will be phased out by the end of September, 2000, and the data transferred to the NET format. You should consult the AIRS/AFS Web site at *http://www.epa.gov/ttn/airs/afs/index.html* for the latest memos and information on the plans to migrate the emissions component of AIRS/AFS to the NET database.

- **NET Input Format** - The NET is an Oracle database that contains emission estimates of carbon monoxide, nitrogen oxides, sulfur dioxide, volatile organic compounds, particulate matter, lead, hazardous air pollutants, and ammonia from point, area, nonroad mobile, onroad mobile, and biogenic sources. The Emission

Factor and Inventory Group is redesigning its NET database in Oracle using the EIIP Phase I Data Model as one of the primary design criteria.

The NET Input Format creates relational, normalized data sets which conform to the relational standards and structure of the NET Oracle database. The flexibility of the format design enables it to be mapped to a wide variety of alternative database structures (e.g., state/local systems, EPA systems). By avoiding duplication of data, the data set(s) created in this format are optimized in terms of the file space and the time it takes for electronic transfer to EPA.

EFIG will process and load the NET input files into its NET database system. You should note that point source data submitted to the NET will **not** be transferred to AFS. If you are interested in obtaining the EPA's new NET Oracle database structure, contact the Technical Support Center at 800-334-2405 or 919-541-7862 for additional details.

- **EIIP EDI X12** - The EIIP Data management Committee has developed a data transfer format using existing electronic data interchange (EDI) X12 standards. The EDI data exchange standard is a nonproprietary standard created and maintained by the American National Standards Institute (ANSI) X12 committee. This format is described in EIIP Volume VII, *Data Management*. The EDI data transfer procedure may be available to state/local agencies through EPA assistance. If your agency would like to use this option, contact the Technical Support Center at 800-334-2405 or 919-541-7862 to obtain advice on how to proceed.

  Agencies choosing to use this option will need to develop an application interface and procure an EDI translator, or use a translator provided by the EIIP/EDI data transfer demonstration. The standardized format generated by this approach will be loaded by EPA into the NET database system. The EIIP/EDI procedure allows an agency to submit their point, area, mobile, and biogenic information in a single file.

  While the EIIP successfully tested the use of EDI through its prototype demonstration, the EPA is determining how to best establish and support EDI data transfer procedures across the Agency. To learn more about the EDI data transfer technique and the results of the EIIP prototype demonstration, see the EIIP Data Management Committee, Procedures Documents page at *www.epa.gov/ttn/chief/eiip/*.

- **Direct Source Reporting** - Point sources may already be reporting electronic emissions inventory data to EPA as part of Title IV or regional NO_x trading programs. For example, electricity-generating units subject to Title IV Acid Rain monitoring and reporting provisions must report continuous emission monitoring (CEM) data to EPA in a specified electronic data reporting (EDR) format. Submission of this data will not fulfill reporting requirements for ozone, PM, or regional haze SIP inventory submittal, but EPA recognizes this as a viable data option where reporting requirements overlap.

To avoid duplication of efforts, EPA envisions that the emissions data submitted directly to EPA from the source will be:

- Transferred to EPA's NET database; or

- Made available to the states for incorporation into their emissions inventories, which will then entered into the NET database.

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APPENDIX L

SAMPLE QC CHECKLIST

Source: *Handbook for Criteria Pollutant Inventory Development: A Beginner's Guide for Point and Area Sources, Appendix N.* EPA-454-/R-99-037, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, September 1999.

EIIP, Volume I, Chapter 1, Appendix D, *Introduction to Stationary Point Source Emission Inventory Development.* July 1997.

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Inventory Identification ____

Assessed By ______________________ Date ______________________

Provide the information requested along with the corresponding resource document [ref] or data. After completing the checklist, indicate the actions to be taken, deadline for completion, and date the actions are completed.

SOURCE CATEGORY:

Defined before data collection? [ref] ______________________ Yes No

Were definitions adhered to during data collection? Yes No

Inclusive of all listed pollutants? [ref] ______________________ Yes No

____

POINT SOURCE CUTOFFS:

Identified during data collection? [ref] ______________________ Yes No

Documented and reported to people involved in area source inventory? Yes No

______________________ ______________________
Report ID Date

SURVEY RESULTS:

Was the response rate determined? ______________________
rate Yes No

Was the percentage of missing information per returned survey estimated? Yes No

____
percent

EMISSIONS CALCULATIONS VERIFICATIONS:

Were nonreactive VOC emissions excluded from each source category emissions estimates? [ref] ______________________ Yes No

EPA recommended estimation methodology used? Yes No

____
____
____

Emissions calculations checked? ______________ ______________ Yes No
checked by date

Are equations explicitly shown? [ref] ______________________ Yes No

REASONABLENESS CHECKS:

Were magnitudes of calculated emissions compared with other source categories? Identify second source reference or reference location of data in file. [ref] ______________________ Yes No

Were magnitudes compared with national/state ranks of source categories? Yes No

______________________ ______________________

compared by date

Were other inventories and/or national averages compared to AIRS? List other inventories or reference data in master file. Yes No

Were findings reported and documented? Yes No

SOURCE DATA:

Were area source activity data reliability verified using available data sources?

______________________ ______________________

verified by date Yes No

Are emissions factor sources documented? ______________________ Yes No

where

Are local emission factors within national range? [ref] ______________________ Yes No

Were facilities whose emissions and activity levels are known compared against generic emission factors to check emission factor reasonableness? Yes No

______________ ______________ ______________

compared by date project file no.

Are assumptions documented for scaling-up source category emissions and seasonal adjustment factor corrections? [ref] ______________________ Yes No

Were point sources subtracted from area source emissions estimates? [ref] ______________________ Yes No

Are point source corrections to area source emission estimates documented in the category calculations? [ref] ______________________ Yes No

Use the worksheet on page 3 of 3 to record the actions to be taken in response to any problems found. Set a deadline for the completion of the action and indicate when the actions are implemented.

INTERNAL SOURCE CATEGORY CONSISTENCY AND ACCURACY QUALITY CONTROL CHECKS (Continued)

Actions To Be Taken	Deadline	Completion Date

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APPENDIX M

QA/QC PROCEDURES

Source: *Handbook for Criteria Pollutant Inventory Development: A Beginner's Guide for Point and Area Sources, Section 4.4*. EPA-454-/R-99-037, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, September 1999.

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Quality Control Procedures

You should follow prescribed QC procedures while inputting and manipulating data. You should also conduct some of the technical reviews and accuracy checks listed in Table M-1. These procedures are briefly described below. Carefully review the QA/QC portion of your inventory preparation plan to identify the QC activities you are responsible for.

Quality control is best implemented through the use of standardized checklists that assess the adequacy of the data and procedures at various intervals in the inventory development process. The EIIP series of documents addresses QC procedures and provides detailed checklists to assist you.

Specifically, you should use QC checklists to monitor the following procedures and tasks:

- Data collection;
- Data calculations;
- Evaluation of data reasonableness;
- Evaluation of data completeness;
- Data coding and recording; and
- Data tracking.

Checklists can assist you in finalizing the inventory prior to submitting it to a reviewing agency (e.g., EPA). The checklist includes questions concerning completeness, use of approved procedures, and reasonableness. **An example QC checklist is included in Appendix L**.

Since most, if not all, of the emission calculations activities are performed electronically, rather than manually, it is critical that the spreadsheets used to generate the emission estimates be checked for accuracy. **Appendix N provides procedures for developing, documenting, and evaluating the data in spreadsheets**.

Reality Check

The reality check is the most commonly used QA/QC method and is used to catch large errors early in the estimation process. This check is in the form of the questions "Is this number reasonable?" or "Does this number make sense?" **You should never use the reality check as the sole criterion of quality.** Each reviewer should carefully document the results of the reality check, using standardized forms or report formats, when applicable.

Table M-1.

Primary QA/QC Functions Of General Types Of Methods

Method	Ensure Reasonableness of Emissions, Data	Ensure Validity of Assumptions, Methods	Ensure Mathematical Correctness	Ensure Valid Data Were Used	Optimize QA/QC Efforts	Ensure Proper Implementation of QA/QC Program	Assess Accuracy of Estimates
Reality checks	T						
Peer review	T	T	T	T			T
Sample calculations			T	T			T
Computerized checks	T		T	T			T
Sensitivity analysis		T			T		
Statistical checks	T		T				
Independent audits	T	T	T	T	T	T	
Emissions estimation validation	T	T					T

When using the reality check as a QC check of the data, you must keep in mind:

- In order to answer the reality check questions with confidence, the reviewer must have a sound understanding of what is reasonable for the value being estimated;
- An estimate can appear to be reasonable, and be incorrect;
- An estimate can appear to be not reasonable, and be correct; and
- This method does not yield any information about the source of the error.

Table M-2 summarizes the EIIP preferred and alternative methods for performing reality checks.

Peer Review

Peer review is an independent review of calculations, assumptions, and/or documentation by a person with a moderate to high level of technical experience. Peer review generally involves reading or reviewing documentation. Peer review is conducted to ensure that assumptions and procedures are reasonable, but might not include rigorous certification of data or references.

When using peer review as a QC check of the data, you must keep in mind:

- Peer review is a form of reality check, and therefore has the same limitations;
- For large or complex inventories, it is easy for a peer reviewer to overlook errors.

No specific tools are required to conduct a peer review, but the use of checklists or review forms is recommended. A checklist ensures that reviewers have a clear understanding of what they are expected to do. Also, checklists provide an efficient means to document the QC procedure. Each reviewer should carefully document the results of the peer review, using standardized forms or report formats, when applicable. Table M-3 summarizes the EIIP preferred and alternative methods for performing peer reviews.

Replication of Calculations

Replication of calculations is the most reliable way to detect computational errors and can be done by any team member involved in the inventory. Replication of calculations should be conducted throughout the inventory process by the author of the original calculations as a self-check, by the team member conducting QC checks, and as part of the QA audit.

When using replication of calculations as a QC check of the data, you must keep in mind:

- Replication of calculations does not check to ensure that the approach and assumptions are correct;

Table M-2.

Reality Checks: Preferred and Alternative Methods

Method	Procedure
Preferred	Compare data or estimate to a standard reference value.
Alternative 1	Compare data or estimate to a value from a previous or alternative inventory (or database) for the same region.
Alternative 2	Compare data to values used for other regions.
Alternative 3	Use expert or engineering judgment to assess the reasonableness of the values.
Alternative 4	Compare estimates for similar categories within the same inventory.

Table M-3.

Peer Review: Preferred and Alternative Methods

Method	Procedure
Preferred	Use of a checklist showing elements to be covered by the review. Provides a guide for the peer reviewer and can be tailored to fit a specific situation.
Alternative 1	Written comments by reviewer identifying issues noted.
Alternative 2	Written notes summarizing reviewer's comments identifying issues noted by reviewer as told to author of notes.

- Replication of calculations does not involve a check of the accuracy or quality of the original data; and

- This is a labor-intensive process.

No specific tools are required to conduct replication of calculations, but the use of checklists or review forms is recommended. A checklist ensures that reviewers have a clear understanding of what they are expected to do. Also, checklists provide an efficient means to document the QC procedure. Each reviewer should carefully document the results of the replication of calculations, using standardized forms or report formats when applicable.

Because replication of calculations is a labor-intensive process, you must follow procedures presented in the QA/QC portion of the inventory plan to determine the percentage of calculations to be checked. As a general rule, a minimum of ten percent of calculations is checked, but this percentage will vary depending on:

- The complexity of the calculations;
- The inventory DQOs; and
- The rate of errors encountered in the data that are checked.

Table M-4 summarizes the EIIP preferred and alternative methods for replication of calculations.

Table M-4.

Calculation Checks: Preferred and Alternative Methods

Method	Procedure
Preferred	Hand replication of one complete set of calculations.
Alternative 1	Hand replication of most complex calculations.
Alternative 2	Hand calculation using a different method, attempting to approximate the result.

Computerized

Automated data checks can be built-in functions of databases, models, or spreadsheets or can be designed as stand-alone programs. You can use automated QA/QC functions to facilitate peer review or, in some cases, replace manual reality checks. Computer-based QC checks can process large volumes of data quickly, significantly reducing the amount of time needed to compile and QA an inventory. You can use automated data checks to:

- Check for data format errors. For example, a program can be used to ensure that characters cannot be entered in a field that requires a numerical value;
- Conduct range checks to ensure that data falls within a specified minimum and maximum range; or

- Provide look-up tables to define permissible entries.

When using automated data checks as a QC check of the data, you must keep in mind:

- Human reasoning and judgment are necessary to evaluate the data for errors. Automated data checks are not a substitute for evaluation of the data by an auditor; they serve as a tool to allow an auditor to evaluate the data efficiently;

- These checks provide only the information requested. Data not subject to computerized checks must be evaluated by another means;

- Automated data checks do not check to ensure that the approach and assumptions are correct;

- Automated data checks do not involve a check of the accuracy or quality of the original data; and

- Each reviewer should carefully document the results of the review, using standardized forms or report formats when applicable.

Table M-5 presents examples of computerized data checks.

Statistical Checks

Commonly used statistical methods for QC of an emissions inventory are:

- Descriptive statistics - mean, standard deviation, frequency distributions. These are used to summarize the data set and facilitate peer review;

- Statistical procedures to identify outliers; and

- Statistical tests, such at the t-test, can be used for comparability checks, for data validation, or to evaluate the relationships between parameters used in an inventory.

Statistical procedures can be used as tools to facilitate reality checks, peer reviews, and independent audits. They can be used to compare results or to identify unusual or unlikely values. Statistical data checks can process large amounts of data and reduce the subjectivity of informal reality checks. Refer to EIIP Volume VI for additional information.

Table M-5.

Summary of Common Automated Checks

Type of Automated Check	Description	Examples	Strengths/Limitations
Variable type check	Alerts user if wrong data type or inappropriate value is entered.	Numeric value is expected, character string entered: a warning is issued immediately or field is flagged in subsequent report.	Reduces errors early in process, especially if warning issued interactively and/or if incorrect data entry prohibited. Report in which error is flagged is easily ignored.
Range (value) checks	Checks value entered to determine if it is within an expected or acceptable range.	Range of stack heights is used to flag a stack height that is too high or low.	Flags suspicious data for further review. Does not eliminate possibility that wrong value entered is within range, or that value outside range could still be correct.
Look-up table	Uses a parameter (such as user-supplied input variable) to select other appropriate parameters from a table.	User enters a source category code (SCC) and program supplies appropriate emission factor.	Eliminates some types of data entry errors; assures data consistency. If wrong value added (i.e., incorrect SCC), all dependent values will also be wrong.
Pull-down menu, pop-up window	Presents selection of possible values for a particular field.	List of possible fuel types is presented to user when entering data to calculate boiler emissions.	Eliminates transcription errors, reduces chance of using wrong value due to user not understanding what is wanted. Does not eliminate possibility that wrong choice will be made by user.
Completeness/ Consistency checks	These two terms are often used to describe similar operations; include a wide array of checks and/or comparisons.	Checks verify that some specified amount of data for certain fields has been entered; or, if a certain field has data, verifies that other required fields also have data. Assure that units, equipment types, IDs, and other parameters are consistent.	Completeness is often difficult to quantify; in practice, a minimum expected value is used to determine completeness. Does not assure that data are correct. Impossible to completely automate these types of checks, some expert judgment usually required. If too much consistency automated into process, inflexibility may result.

When using statistical methods for QC checks of the data, you must keep in mind:

- Human reasoning and judgment are necessary to evaluate the data for errors. Statistical analyses are not a substitute for evaluation of the data by an auditor; they serve as a tool to allow an auditor to evaluate the data efficiently;
- Common statistical methods are based on the assumptions of normality. Emissions data are often not normally distributed;
- Statistical data checks do not check to ensure that the approach and assumptions are correct;
- Statistical data checks do not involve a check of the accuracy or quality of the original data; and
- Each reviewer should carefully document the results of the review, using standardized forms or report formats when applicable.

Quality Assurance Audits

Independent audits (QA audits) involve a systematic evaluation of the emission inventory preparation process. They are a managerial tool to evaluate how effectively the emissions inventory team complies with predetermined specifications for developing an accurate and complete inventory. QA audits are conducted to determine whether QC procedures in place are effective, are being followed, and if additional QC is necessary to the inventory development process.

Because QA audits are conducted by personnel outside of the emissions inventory team, you will not be involved in this process. You should be prepared to fully cooperate with any auditor who requests information or documentation.

Specifically, QA audits are managerial tools used to:

- Identify staffing issues such as understaffing, or inadequate training of staff;
- Evaluate the effectiveness of the technical and quality procedures used to develop the emissions data;
- Provide confidence in the accuracy and completeness of the emissions data;
- Determine if DQOs are being met;
- Identify the need for additional QC measures; and
- Streamline the costs associated with the inventory development.

APPENDIX N

PROCEDURES FOR DEVELOPING, DOCUMENTING, AND EVALUATING THE ACCURACY OF SPREADSHEET DATA

Source: *Handbook for Criteria Pollutant Inventory Development: A Beginner's Guide for Point and Area Sources, Appendix O.* EPA-454-/R-99-037, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, September 1999.

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Procedures for Developing, Documenting, and Evaluating the Accuracy of Spreadsheet Data

Procedure

To maintain acceptable data quality, it is important to practice adequate QC measures during the development and review of spreadsheets. The information presented in a spreadsheet should be evaluated to determine if input data are transcribed correctly, calculated results are technically sound, and the final results are reported in a manner that will allow the data to be evaluated.

The procedures to follow when developing, documenting, and evaluating the accuracy of spreadsheets are described in this appendix. These procedures describe the minimum standards to be maintained to help ensure data quality and reproducibility. An example spreadsheet (with facility identification removed) is presented at the end of this appendix.

Definitions

Spreadsheet - An electronic table that is used to process or present data. A spreadsheet can be used to store and manipulate data, as well as present data in report-quality, tabular format.

Spreadsheet Developer (Developer) - The person responsible for the overall accuracy and quality of a spreadsheet. The Developer ensures that data are entered correctly and that mathematical functions are accurately executed.

Technical Reviewer - The person not associated with the development of the spreadsheet that is technically qualified and responsible for verifying the accuracy, completeness, and reasonableness of the data in the spreadsheet.

Quality Assurance Coordinator(QAC) - The person that ensures that QC checks and technical review are performed on the spreadsheet.

Summary of Responsibilities

The Spreadsheet Developer:

- Describes the development of the spreadsheet in the project notebook or in a memorandum to the project file.

- Ensures that all original data are transcribed (entered) to the spreadsheet correctly.

- Ensures that all equations used to generate results are entered correctly; ensures that all equations are used appropriately.

- Ensures that all conversion factors and constants used in equations are described.

- Ensures that all sources of original data are referenced in the spreadsheet.

- Ensures that all variables within equations are defined.

- Ensures that all supporting documentation for the information provided in the spreadsheet is obtained and submitted to the project file; ensures that memoranda summarizing procedures, activities, etc., are also maintained in the project file.

- Keeps a log of spreadsheet revisions. If different versions of a spreadsheet are created, the Developer maintains a log that describes the changes made to the different versions and maintains a historical file of the spreadsheet(s).

- Locks and protects the spreadsheet when giving the electronic file to reviewers. If the spreadsheet is being given to someone who will make revisions or enter data, data cells that should not be changed should be locked. Locking data cells in this manner will help prevent inadvertent changes to the spreadsheet.

The Team Manager or Leader:

- Determines when the use of spreadsheets (rather than database technology) are appropriate.

- Determines if a specific format must be used and specifies what information should be included in each spreadsheet.

- Reviews and approves the procedure for spreadsheet development.

- Ensures that these procedures are followed.

- Ensures that methods and technical approaches used to produce a desired result are technically sound.

- Assigns adequately trained staff to develop and review the spreadsheet.

- Specifies the level of detail to follow in reviewing the spreadsheet.

- Determines the level of QC necessary. For example, the Team Manager or Leader must decide if all data points and all calculations should be checked, or if only a percentage should be checked. It may be appropriate to initially check a percentage and, based on the number of discrepancies identified, decide if additional QC is required.

- Considers the data quality objectives of the work (how will the data be used?), the complexity of the calculations, and experience level of the data generator.
- Specifies the level of detail to be included in the spreadsheet documentation.
- Ensures that spreadsheet documentation is included in the project file.
- Assigns a project assistant to organize and maintain a project file.
- Provides guidance on how to present data in the spreadsheet.

The Technical Reviewer:

- Verifies that the Developer's technical approach is reasonable and logical.
- Verifies that documentation is complete and clear.
- Ensures that assumptions and procedures used are reasonable.
- Provides timely, constructive, and direct comments to the Developer.
- Verifies (manually recalculates) at least one result at both low and high extremes as well as a result around the mid-point of the two.
- Verifies at least one calculation for each equation or combination of equations used.
- Verifies the accuracy of total values, means, and statistical evaluations of the data.
- With the Team Manager or Leader, determines the amount of data to check; the number of errors found will dictate the amount of data evaluated for accuracy. The higher the error rate, the more data points to be checked. If numerous errors are found, the spreadsheet should be returned to the data generator with a note that includes a description of the review procedure and percentage of errors found. The error rate is a good indicator of the accuracy of all of the information in the spreadsheet. If needed, the QA Coordinator should be consulted for guidance in determining the most effective way to determine which and how many values to recalculate.

- Verifies that original data were input correctly.

- Evaluates the technical soundness of methods and approaches used.

- Ensures that equations in the spreadsheet produce the correct result and that equations were entered into the spreadsheet accurately.

- Ensures that adequate documentation is included in the spreadsheet and that the documentation supports the data in the spreadsheet.

- Verifies that the source of all original data is referenced and all equations are explained.

- Notes all discrepancies identified during their QC review.

- Discusses all discrepancies with the Developer and Team Manager or Leader, as appropriate. Actual spreadsheet errors identified by the Reviewer should be corrected by the Developer.

- Summarizes the review (provides a written summary of the data checked, the errors or problems found, and the recommendations for revisions). The summary should also include the reviewer's name, date of QC review (month/day/year), name of file, type of data reviewed, and the percentage of each type reviewed.

- Keeps a copy of the written summary along with an electronic copy of the spreadsheet that was reviewed.

The Quality Assurance Coordinator:

- Ensures that an appropriate Technical Reviewer has been assigned to review the spreadsheet.

- Reviews the Developer's quality control (QC) plan.

- Ensures that the procedures described here are followed.

Spreadsheet Identification

- Include a title in the spreadsheet, at the beginning. Make the title descriptive enough to clearly identify the data presented and the project.

- Identify the Developer and the actual date (month/day/year) the spreadsheet was developed. (Distinguish between the "print" date and the "actual" date the spreadsheet was finalized.)

- Identify the reviewer and the date (month/day/year) the spreadsheet was reviewed.

- Include headers or footers that identify the name of the electronic spreadsheet file, the page number, and total number of pages (e.g., Page 1 of 2), and the date the spreadsheet was last revised. The name of the disk or drive on which the file is stored may also be included with the file name. An exception to this procedure is a report-quality table for inclusion in a report.

- Assign a unique name and number to the revised version of the spreadsheet. Add comments as a footnote to explain what was revised, the date the revision was made, and by whom.

Spreadsheet Development

- Keep the spreadsheet as simple as possible. Clarity is important. Avoid numerous calculations in one equation.

- Identify any constants or conversion factors used.

- Identify the source of all information and data. Include as much detail as possible (e.g., table and page number along with the title of the document, where appropriate).

- Describe all equations, using footnotes or a comments field, where appropriate. (e.g., if gram/kilogram are being converted to pound/ton, the equation performing the calculation should be explained as: "Convert g/kg to lb/ton: 1 g/kg x 1 lb/453.59 g x 1 kg/1,000 g x 453.59 g/lb x 2,000 lb/ton, which is equivalent to multiplying by 2"). If detailed descriptions exist in project notebooks, then a reference to that notebook (e.g., notebook and page number) should be made in the comments field.

- Describe spreadsheet functions (e.g., average, conditional operators [IF statements]).

- Avoid using specific values in equations, except for easily recognizable conversion factors or constants.

- Enter values within a cell. Equations that use the value should reference the cell.

- When a single equation is used numerous times, it may be desirable to enter the equation in a cell and reference the cell when the equation is used. (e.g., If 20 data elements are being converted from g/kg to lb/ton, enter the conversion equation in one cell and reference the cell 20 times, rather than entering the conversion equation 20 times.)

- Hand (manually) verify equation cells.

- Protect verified equation cell regions of spreadsheets to avoid accidentally over writing.

Supporting Data Requirements

The original raw data used in the spreadsheet should be retained in the project file and in the project archive. Reference all information and published documents used for spreadsheet development. Where applicable, photocopy the cover/title page and specific pages of the reference document.

Describe the development of the spreadsheets in the project notebook or in a memorandum or calculation sheet addressed to the project file. Include the following information:

- Project name/reference number;

- Purpose/task;

- Data references;

- Problems that may have occurred during the development of the spreadsheet and how they were eliminated;

- Justification for the technical approach; and

- A description of the data review process and the written comments from the technical reviewer (signed/dated).

Project Data File Requirements

Include all of the data required to reconstruct the development of the spreadsheet and determine the accuracy of the information reported. Include the electronic version of the spreadsheet in the project data file. Maintain an electronic backup copy at an identified location and in hard copy in the project file.

Project: Identification of Emission Factors for CO_2/Coal-Fired Boilers
Developed by: JLJ 06/21/98
Reviewed by: RFD 07/02/98
File name:

TEST REPORT TITLE: RESULTS OF THE NOVEMBER 7, 1991 AIR TOXIC EMISSION STUDY ON THE NOS. 3, 4, 5 & 6 BOILERS AT THE @@@@@ PLANT

FACILITY:	@@@@
UNIT NO.:	3, 4, 5 & 6
LOCATION:	@@@@
COAL EF DATABASE REFERENCE NO	5

PROCESS DATA

	Run 1	Run 2	Run 3
Oxygen (% v/v) a	7.70	7.60	7.80
Vol. Flow Rate (dscf/m) b	804,786	788,668	815,076
Vol. Flow Rate (dscf/hr)	48,287,160	47,320,080	48,904,560
F-factor (dscf/MMBtu) c	9,780	9,780	9,780
Heat input (MMBtu/hr)	3,118	3,079	3,134
HHV Bituminous Coal (Btu/lb)	8,498	8,498	8,498
HHV Bituminous Coal (Btu/ton)	16,996,000	16,996,000	16,996,000
Coal Feed Rate (ton/hr)	183	181	184
Coal type e	Subbituminous		
Boiler configuration e	Pulverized, dry bottom		
Coal source e	Rochelle		
SCC	10100222		

Control device 1 e	ESPC
Control device 2 e	None
Data Quality	B
Process Parameters e	Watertube boilers with economizers and air preheaters
Test methods f	MM 5 metals, PM, PM10, Method 3 for CO2, Method 18 for
Number of test runs g	3

a Page 29.
b Page 37.
c 40 CFR Pt 60, App A, Meth.
d Page 42
e Page 1.
f Page 1.
g Various pages.

CO2 EMISSION FACTORS

	Run 1	Run 2	Run 3	Avg
CO2 concentration (%v/v) a	11.9	11.9	11.60	
CO2 concentration (ppm) b	0.00119	0.00119	0.00116	
CO2 molecular weight	44	44	44	
CO2 concentration (lb/dscf)	1.36E-10	1.36E-10	1.32E-10	
CO2 emission rate (lb/hr) d	0.007	0.006	0.006	
CO2 emission factor (lb/ton)	3.57E-05	3.55E-05	3.51E-05	#N/A

a Page 29
b convert 1/100 to
c (concentration,ppm * molecular weight)/385,500,000
d concentration, lb/dscf * Volumetric flow rate * 60 min/hr
e emission rate/coal feed rate

Date developed: 06/21/98
Date revised: Not applicable

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