United States
Environmental Protection
Agency

Office of
Toxic Substances

September 1988

EPA

Risk Screening Guide (Interim Final)

THE RISK SCREENING GUIDE

Prepared for:

U.S. Environmental Protection Agency
Office of Toxic Substances

Prepared by:

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September 1, 1988
Interim Final

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PESTICIDES AND TOXIC SUBSTANCES

September 1, 1988

Dear Reader.

Thank you for your interest in helping us evaluate this Interim Final Risk Screening Guide. It is an EPA document intended to provide guidance to those evaluating SARA Section 313 emissions data for the purpose of making statements about potential adverse health or ecological effects. We hope you will find it a useful tool in your efforts to respond to risk-related questions from concerned citizens and to identify and prioritize problem facility emissions.

The risk screening approaches offered in this guidance manual have been developed based upon our knowledge of the type of data and our expections of the quality of data reported to EPA and States under SARA §313 by July 1, 1988, and the public's interest in it. We recognize that actual experience may differ markedly from these expectations. As you evaluate §313 data, we fully expect that you will find some parts of this document more useful than others. In order to make it a nationally pertinent technical reference, we need feedback from you on your experiences using it.

We would like your evaluation of the Guide based upon your use of it during the next couple of months. Please complete the attached evaluation form and return it to me by November 15, 1988. Be sure to indicate on the evaluation form your interest in receiving updated versions of the guidance manual. Feel free to xerox copies of this document for other interested parties. Please encourage them to complete and return the evaluation form by November 15.

Sincerely,

David Klauder

David S. Klauder, PhD
Director, Regional
Risk Guidance Staff
TS-778
U.S. EPA
401 M Street, S.W.
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EVALUATION FORM

for

INTERIM FINAL RISK SCREENING GUIDE (the Guide)

1. Name: _____

2. Expertise (e.g., chemist, toxicologist, environmental scientist, chemical engineer, health educator): _____

2. Title: _____

3. Address: _____

_____

4. Telephone Number: _____

5. Date received the Guide: _____

6. Date completed this form: _____

7. Between these two dates how much total staff time, or Full Time Equivalents (FTE), was spent working on Section 313 issues? (For example, 0.1 FTE is a person or people working the total equivalent of 1/10 of a person's time between the dates you listed in questions 5 and 6.)

   A. 0.1 FTE B. 0.1-1 FTE C. 1.1-3 FTE D. Greater than 3 FTE

8. Approximately how many phone calls or other inquiries related to potential health or ecological impacts of 313 emissions were your staff (all FTEs recorded in question 7) involved in answering?

   A. None B. Less than 10 C. 10 to 50 D. More than 50

9. Did you attempt to use Section 313 emissions data to identify and prioritize problem facility emissions?

   A. Yes B. No

10. Did you use/consult the Guide?

    A. Never B. Seldom C. Often

11. In general, did you find the Guide (circle any of the descriptions below which are appropriate):

A. Too simple.

B. Too technical.

C. Well-organized.

D. Hard to find what I needed.

E. Consistent with screening approaches I use in other programs.

F. Inconsistent with approaches I use to screen data of similar quality and type.

G. Other (explain):

12. For each section of the Guide, indicate by a designation of high (H), medium (M) or low (L), its utility to you and how you would suggest improving it.

	Usefulness (H,M,L)	Improvements (please attach additional pages)
I - Background		
II - Elements of Risk Screening		
III - Responding to Questions		
IV - Qualitative Risk Screening: A System for Prioritizing the Data		

13. For each appendix in the Guide, indicate by a designation of high (H), medium (M) or low (L), its utility to you and how you would suggest improving it.

	Usefulness (H,M,L)	Improvements
A. Contacts		
B. Toxic Chemical Release Inventory Reporting Form		
C. Release Guidance		
D. Hazardous Substance Fact Sheet		
E. Federal Laws		
F. Reportable Quantities (RQS) and Data for 313 Chemicals that are CERCLA Hazardous		
G. Systems and Models for Evaluating Risk Assessments on Environmental Pollutants		
H. Acronyms and Glossary		

	Usefulness (H,M,L)	Improvements
I. Technical and Risk Communications Bibliographies		
ATTACHMENT A - EPA Roadmap to Information on Section 313 Chemicals		

14. Are there other individuals/organizations which you think might find the Guide useful? Who?/Which?

Name (individual, organization, etc.)	Address (street, city, state, zip code)

15. Would you like to receive updates of the Guide?

A. Yes B. No

16. Additional comments:

THANK YOU FOR YOUR HELP.
Please return this evaluation form
to David Klauder, TS-778, U.S. EPA,
401 M St., S.W., Washington, D.C. 20460
before November 15, 1988.

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TABLE OF CONTENTS

TABLE OF CONTENTS (CONT.)

TABLE OF CONTENTS (CONT.)

INTRODUCTION

In recent years, the American public has become increasingly aware of and concerned about the risks associated with exposure to toxic industrial chemicals. This awareness is reflected in the environmental legislation enacted by Congress and particularly in the Superfund Amendments and Reauthorization Act (SARA) Title III, also known as the Emergency Planning and Community Right-To-Know Act (EPCRA). Under Section 313 of Title III, businesses must submit annual reports for each toxic chemical manufactured, imported, processed, or used at the facility, as prescribed in the reporting rule.*

Under this reporting rule, facilities must account for the total aggregate releases to the environment for the calendar year of each toxic chemical listed under Section 313. Releases to the environment include:

- Releases to air.
- Discharges to surface waters.
- Releases to land and underground injection wells.

Many people will want to know the potential health and environmental significance of the chemical releases reported under Section 313. Citizens will also want to know what is being done to control these releases at the local, State, and Federal level. They may demand to know why any chemical deemed "toxic" is being released at all. As a health or environmental official, you probably are already well-versed in evaluating risk and/or in helping members of the public understand and deal with toxic chemicals. However, the Section 313 release data present new challenges for all of us. The purpose of this guide is to describe some of these challenges and to suggest ways of approaching them.

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*Final rule published in the Federal Register, Feb. 16, 1988, Vol. 53, p. 4500. This risk screening guide should not be used in lieu of Federal Register documents or the Code of Federal Registry for purposes of compliance.

A New Age in Reporting

Many industries now report release data to the U.S. Environmental Protection Agency (EPA) and the States under the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act, and other statutes. However, under Section 313, a facility must report releases of a chemical to all media (land, air, and water). Additionally, the Section 313 reporting represents a major step forward in collecting data on air releases. The Clean Air Act requires reporting on criteria pollutants* only; prior to Section 313 reporting, most air releases were not reported anywhere.

Section 313 reporting can be viewed as a new beginning in environmental awareness for both the government and the public. The reporting represents the first systematic way of gathering information about the release of toxic chemicals in or near communities and of making these data readily available to the public. Because the reporting is new for everyone - localities, States, the Federal government, manufacturers, processors, users, and the public - there will be some initial difficulties in understanding and using the data.

During the first years of reporting, the release data are expected to be limited in type and quality. Not everyone who is obligated to report will do so. The data will be summary data, reported in units of pounds per year. No information on frequency, duration, or peak release is required, and therefore this information will not be reported. Further, the data will often be estimates rather than measurements of releases, and may be inaccurate due to misunderstandings or errors in calculation. Some of the estimates may be off by as much as an order of magnitude or more.

Nevertheless, health and environmental officials like yourself will have access to an unprecedented amount of information concerning the release of toxic chemicals into the environment. The Section 313 data will be an important supplement to existing programs, and they should greatly assist in

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* See Glossary for a definition of this term.

giving you a broad picture on release of toxic chemicals into the environment since releases to all media (air, water, land) will be reported under a single Act for the first time.

A Two-Fold Purpose

The information reported under Section 313 is likely to spur many questions about its use and interpretation - both within your organization and from concerned citizens. This guide suggests steps you can take to answer two key issues of concern:

- How can you respond effectively to health and ecological inquiries from the public?
- How can the releases of greatest potential concern from a public health or environmental standpoint be identified from the thousands of forms submitted so that these critical cases can be further investigated?

Concerning the first issue, this manual offers guidance in responding to risk-related questions that the public will likely ask when the data are made available (e.g., How dangerous for my health are these specific releases?). General strategies for handling inquiries, tracking phone calls, assembling resources, and disseminating information are presented.

To address the second issue, the guide describes an approach for using Section 313 data as a supplement to your organization's current programs to set priorities for follow-up data collection. While you want to be responsive to every site that poses a potential problem and every question from a concerned citizen, it would be impossible to treat them all equally. Therefore, this guide presents an approach to prioritizing those chemicals or sites that appear to pose the most immediate or serious concerns.

A Map to the Manual

The guide is divided into five sections:

Section I presents general background information on Title III or EPCRA, and a specific discussion of Section 313, including type, quality, and availability of the release data that will be reported.

Section II defines risk-related concepts and terms relevant to Title III and Section 313, including risk screening - the subject of this guide.

Section III presents strategies for answering risk-related questions from the public. This section suggests what you can do to prepare for response, how to handle calls as they come, and how to set up a system for efficiently responding to queries.

Section IV presents a risk screening system for use in your organization. This system can help you evaluate potential risks and identify sites that may pose the greatest problems. This section discusses why this approach is suggested, what its essential elements are, and how to use it.

The appendices to this guide compose a directory of resources that should be of value to you in using and interpreting Section 313 data, and in communicating with the public about them. These appendices are referenced frequently in the guide and consist of the following:

- **Appendix A** - Contacts. A designated contact for each EPA Region and State is listed.

- **Appendix B** - Toxic Chemical Release Inventory Form. This is the reporting form industries will submit to EPA and the States. A blank reporting form and instructions for completing it are included here, as well as a description of information reported on the form relevant to risk screening.

- **Appendix C** - Release Guidance. Estimations of likely rates of release and release patterns (based on generic industry data) for certain chemical uses are provided in this guidance.

- **Appendix D** - Hazardous Substance Fact Sheet. The New Jersey Department of Health has developed fact sheets on many Section 313 chemicals. A sample fact sheet and summary description are provided here. Fact sheets are available from the Region and State Section 313 contacts listed in Appendix A.

- **Appendix E** - Federal Laws. Brief summaries of several Federal laws are provided in this appendix.

- **Appendix F** - Reportable Quantities (RQs) and Data for Section 313 Chemicals that Are CERCLA Hazardous. RQs that are available for Section 313 chemicals and chemical categories are listed here. Included are RQs for aquatic toxicity, acute mammalian toxicity, chronic toxicity, and potential carcinogenicity.

- **Appendix G** - Systems and Models for Risk Assessments on Environmental Pollutants. The risk assessment models provided here can be used as a guide to the kind of information you'll want to collect at a site to perform a risk assessment. The data input elements required for each method are listed.

- **Appendix H** - Acronyms and Glossary. Key terms and acronyms used in this guide are defined.

- **Appendix I** - Technical and Risk Communications Bibliographies. This appendix lists many important resources for additional information on risk assessment, risk communication, and risk management.

Attachment A is the hard copy version of "Roadmaps," a Section 313 chemical information directory. A Roadmaps software package has also been developed. Roadmaps can point you to a number of data bases and documents containing information on health and ecological effects of Section 313 chemicals. It also contains information on Federal and State regulatory levels for these chemicals, as well as State contacts for various media (e.g., air, water) programs.

SECTION I - BACKGROUND

What Is The Emergency Planning and Community Right-To-Know Act (Title III)?

The Emergency Planning and Community Right-To-Know Act (EPCRA) of the Superfund Amendments and Reauthorization Act (SARA) became law in 1986. Commonly known as "Title III," EPCRA establishes requirements for:

- Federal, State, and local governments and industry regarding emergency planning.
- Community right-to-know reporting on hazardous and toxic chemicals.

There are four major parts to EPCRA: emergency response planning (Sections 301 to 303); emergency notification (Section 304); on-site inventories (Sections 311, 312); and toxic chemical release reporting (Section 313). Only the toxic chemical release reporting section, the focus of this guide, is described below. Information on other parts of EPCRA are contained in the "Title III Fact Sheet - Emergency Planning and Community Right-to-Know," available through your EPA Region or State Section 313 contact (Appendix A).

What Is Meant by Release?

A release is any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment (including the abandonment or discarding of barrels, containers, and other closed receptacles) of any toxic chemical.

For the purpose of this guidance, two types of releases need to be defined:

- "Burst" releases are typically accidental, rapid releases of short duration.
- Routine releases are those occurring during the conduct of normal operation at the facility, and are typically longer in duration than "bursts."

The guidance presented in this guide is applicable to releases that are longer in term than bursts, and for which there are limited release data. A separate guide, the Technical Guide for Hazard Analysis*, has been prepared for burst releases of the extremely hazardous substances (EHSs) listed under Section 302 of Title III. Burst releases of EHSs should be addressed using the Technical Guide for Hazard Analysis. Routine releases should be addressed using this risk screening guide.

Under Section 313, the releases reported by facilities will include both routine and burst releases. A reported release may have occurred over the course of a year, or on a single day. It may be a combination of burst and routine releases. Because facilities are not required to indicate the frequency, duration, or peak release rate of the release, it will be impossible to know from the reporting form alone whether a release was accidental or routine, short- or long-term, or both. For Section 313 chemicals that are also Title III, Section 304 (emergency notification) chemicals, you could cross-check a Section 313 release with Section 304 reporting (emergency notification) to determine if any part of the release was accidental.

What Information Will Be Reported?

Under Section 313, certain manufacturers (Exhibit 1) are required to submit reports each year on the amounts of toxic chemicals their facilities store, use, and release into the environment, including publicly owned treatment works, landfills, and off-site disposal. The reports must be sent to both the EPA and the State's designated agency. A sample Toxic Chemical Release Inventory Reporting Form (Form R) is provided in Appendix B. The first annual report (for the calendar year 1987) was due to EPA and the designated State agencies on July 1, 1988.

Section 313 requires reporting of the following chemical releases:

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*See Bibliography for a complete citation.

EXHIBIT 1. WHO MUST REPORT?*

Plants, factories, or other facilities that:

- Employ 10 or more full-time individuals.
- Manufacture, import, or process any of the Section 313 listed chemicals in amounts greater than:

  - 75,000 pounds in 1987.
  - 50,000 pounds in 1988.
  - 25,000 pounds in 1989 and subsequent years.

- Use any listed chemical in any other way (other than manufacture, import or process - e.g., using trichloroethylene to degrease tools) in amounts greater than:

  - 10,000 pounds in 1987 and subsequent years.

- Are classified in the Standard Industrial Classification (SIC) codes 20 through 39:

SIC	Industry Group
20	Food
21	Tobacco
22	Textiles
23	Apparel
24	Lumber and wood
25	Furniture
26	Paper
27	Printing and publishing
28	Chemicals
29	Petroleum and coal
30	Rubber and plastics
31	Leather
32	Stone, clay, and glass
33	Primary metals
34	Fabricated metals
35	Machinery (excluding electrical)
36	Electrical and electronic equipment
37	Transportation equipment
38	Instruments
39	Miscellaneous manufacturing

*See Federal Register, Vol. 53, No. 30, Feb. 16, 1988, p. 4500. This risk screening manual should not be used in lieu of Federal Register documents or the Code of Federal Registry for purposes of compliance.

- To the air from fugitive or nonpoint sources. (Fugitive releases are those that are not released through stacks, vents, or any other confined air stream.)
- To the air from stack or point sources.
- To the water directly discharged to a receiving stream.
- In wastes that are injected underground.
- To land on site (including landfills, surface impoundments, or landspreading).
- To water discharged to a publicly owned treatment works (POTW).
- In other wastes transferred offsite for treatment or disposal.

The quantities reported reflect the amounts of chemical released after any onsite treatment and are specific to the chemical or chemical category subject to reporting. Releases of the chemical to the environment are given in pounds per year. The release quantities represent the total amount of the chemical released from all possible sources for each medium. For example, for water sources, releases estimated separately from process outfalls, pollution control devices, and washing from containers are added and entered under "Discharges to Water." Some sources of chemical wastes are listed in Exhibit 2.

Under Section 313, over 300 toxic chemicals and chemical categories are subject to reporting (a listing of these chemicals is provided in "Roadmaps," Attachment A). Section 313 also requires reporting of listed chemicals and/or chemical categories that are components of mixtures. The company may use the name of the mixture or the trade name product instead of the chemical's actual name only if the specific identity of the chemicals in the mixture are not known.

Companies can claim a chemical's identity as a trade secret, but they must substantiate such a claim. A $25,000 fine for frivolous trade secret claims has been established under Title III. If a firm claims a chemical is a trade secret, it must provide a generic name for that chemical, and that name must be descriptive of the chemical structure. Companies may withhold only the specific chemical identity of the compound - including chemical name and Chemical Abstract Services (CAS) number.

EXHIBIT 2. SOURCES OF WASTES*

When estimating releases of a chemical, industries must consider all sources of wastes. Sources of waste include, but are not limited to:

Fugitive or non-point air sources

- Equipment leaks from pumps, valves and/or flanges
- Building ventilation systems
- Evaporative losses from surface impoundments

Stack or point air sources

- Vents from reactors and other process vessels
- Storage tank vents
- Stacks or vents from pollution control equipment

Water sources

- Process outfalls
- Washings from vessels, containers, etc.
- Pollution control devices
- Stormwater runoff (if applicable)

Solids, slurries, and non-aqueous sources

- Filter cakes
- Spent catalysts
- Pollution control wastes (such as absorber sludges) and/or wastewater treatment sludges
- Spent catalysts
- Vessel or tank residues
- Spills and sweepings
- Spent solvents
- By-products

*Source: U.S. Environmental Protection Agency. 1978a. Estimating Releases and Waste Treatment Efficiencies for the Toxic Chemical Release Inventory Form, EPA 560/4-88-002. U.S. EPA, Office of Pesticides and Toxic Substances, Washington, DC.

What Is the Quality of Section 313 Data?

Much of the data provided by industries will be based on engineering estimates, not on actual measurements of release. If monitoring data are readily available, industries must use that data to calculate releases. However, no additional monitoring or measurements are required. Furthermore, no information on rates of release (such as duration, frequency of release, or peak release) is currently required. This missing information will significantly decrease the level of certainty in most risk assessments. In addition, omissions, misunderstandings, and inaccuracies may occur in reporting - especially in the first years. Some smaller companies may not even be aware they are required to report under this new law.

> **KEY POINT:** During the first years of reporting, Section 313 data when taken alone are expected to be of limited quality and type for assessing risk because of the lack of information on rates of release and uncertainties associated with release estimates.

EPA expects the quality of data to improve in subsequent years as industries become familiar with the reporting form and the reporting requirements. In addition, it is hoped that in subsequent years, the quality of the data reported will further improve through a program of outreach, technical audits, facility inspections, and enforcement. EPA plans to modify the reporting requirements in the future to obtain additional release information. Also, EPA plans to check the reports for obvious errors, and get them corrected promptly.

In the interim, it may be possible to estimate likely rates of release and release patterns based on generic industry data. Appendix C provides some guidance on this type of information. Additional information on estimation techniques is provided in EPA's Estimating Releases and Waste Treatment Efficiencies for the Toxic Chemical Release Form.*

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*A complete citation is provided in the Bibliography.

How Can the Data Be Used?

Two immediate uses of the Section 313 data are: 1) responding to health and ecological inquiries from the public; and 2) identifying and prioritizing problem releases. These uses are addressed in this guide. The Section 313 data may also be used to:

- Determine what chemicals to monitor and where to monitor. In some situations, the release data may be used to tell what chemicals should be monitored in the environment and, perhaps, where a monitoring station should be located.

- Help develop control strategies. The data may be useful in helping to develop general multimedia toxic control strategies and assessments, as well as strategies to control "hot spots."

- Verify permit information. The information provided on the release form can be cross-checked with permit applications, and discrepancies investigated.

- Enforce compliance with the law. Unpermitted facilities, illegal releases, and unauthorized disposal activities may be identified through Section 313 reporting. Enforcement activities within a geographic area or for specific industries may also be targeted.

- Reduce waste at the source. Facilities that need to employ available source reduction technologies can be identified, and priorities for developing new technologies can be set.

These applications of the Section 313 data are beyond the scope of this guide; however, the risk screening system described in Section IV for prioritizing releases may be useful as an initial step in these other applications.

How Will the Release Data Be Made Available?

EPA is mandated to establish and maintain a national toxic chemical release inventory (TRI) of Section 313 data. The EPA is required to make this inventory accessible by computer telecommunications and other means to any person on a cost-reimbursable basis. To meet this mandate:

- EPA will create the inventory by entering the submitted data into an EPA computer. States and local agencies will be able to access this computer directly.

- The inventory will be made available to the general public on the National Library of Medicine's (NLM) TOXNET System in the spring of 1989. The public data base will be easy to use, and will have complementary toxicological and health and safety data files available with it.

- "Other means" of accessing TRI data are planned for 1989. Some alternatives under consideration are microfiche and compact disk (cd-rom).

States and localities will have the option of accessing the internal EPA computer rather than the NLM computer. The internal data base will use EPA's standard data base management system, ADABAS, and the NATURAL programming language. Consequently, it will not be as "user-friendly" as the NLM computer. Specific information about accessing both these computers will be made available as the time of their availability approaches.

SECTION II - ELEMENTS OF RISK SCREENING

Each year, EPA and the States will receive thousands of Toxic Chemical Release Inventory Reporting Forms. Few organizations will have the resources to treat the reported releases equally. To make decisions about how best to apply their limited resources, organizations responsible for handling Section 313 data must develop some system, however crude, for screening and prioritizing the information. There is at least one criterion - potential risk to public health or the environment - that most organizations may wish to include as a screening criterion.

Section IV of this manual describes one approach to evaluating risk - risk screening. This section of the manual introduces this concept and compares it to two related processes: risk assessment and risk analysis. Additional risk concepts and key terms are also described to provide background for understanding the information presented in the following sections of this manual.

What Is Risk Screening?

Risk screening, in the context of Section 313 of SARA, is a type of risk assessment used when data are limited. The process results in a qualitative expression of risk (e.g., high, medium, low). Risk screening is useful for establishing risk-based priorities and information needs for follow-up chemical- or site-specific risk assessment activities. Although the risk screening process relies on general risk assessment principles, the data input requirements are less demanding than those for risk assessment.

> **KEY POINT:** Risk screening results in less definitive expressions of risk (i.e., relative risk rankings) than those derived from the risk assessment process (i.e., estimates of actual risk).

What Are the Differences Between Risk Screening, Risk Assessment, and Risk Analysis?

Risk assessment is the process of estimating the probability of occurrence of adverse health or ecological effects. A chemical- or site-specific risk assessment has two major components:* (1) the estimation of the probability of exposure(s) resulting from reported releases, and (2) the estimation of the probability that adverse effects will result from the exposure(s).

Risk analysis, in the context of Section 302 of SARA, is the third of a three-step hazards analysis process for emergency planning.** Risk analysis requires an estimation of both the likelihood of occurrence of an accidental chemical release (unique to this process) as well as the subsequent potential for exposure (with emphasis on human exposure to extremely hazardous substances). In risk analysis, the major focus of the estimation of the "consequences" of exposure (i.e., the component analagous to step (2) under risk assessment above) is on the characterization of the potential magnitude of specific adverse effects, i.e., death or irreversible toxicity, in the community bordering sites where accidental release(s) could occur.

Like risk screening under Section 313, risk analysis is a flexible, judgmental exercise that results in qualitative risk statements. In addition, the responsibility for appropriately weighting each of the components under both risk analysis and risk screening is left to the affected community and its elected, appointed, or volunteer officials.

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*Risk assessment in the Federal government is divided into four major steps: hazard identification, dose-response assessment, exposure assessment, and risk assessment. For purposes of this guidance, hazard identification and dose-response assessment have been combined.

**See Technical Guidance for Hazards Analysis. A complete citation is provided in the Bibliography.

What Is the Difference Between Qualitative and Quantitative Expressions of Risk?

Risk may be described qualitatively or quantitatively. Qualitative risk evaluations may be based on limited data and/or data estimates, and therefore lack precision. However, qualitative expressions of risk are often the best way to develop an understanding of the interrelationships among factors important to the assessment of risk. The qualitative approach describes risks in relation to other risks, i.e., in terms of relative probability of harm. Descriptive terms (e.g., high, low, or trivial) may be used to categorize the risk. Comparisons may also be used. For example, "The release of chemical A from facility X appears to pose a greater concern to local public health than most other releases reported in the area." Qualitative expressions of risk should be accompanied by a characterization of the nature of uncertainties.

Quantitative expressions of risk imply a far greater accuracy and certainty of knowledge than qualitative expressions. However, quantitative expressions of risk should be presented with caution. The results of a quantitative assessment can be misused if greater precision and/or accuracy is assigned to the result than the input data warrant. Quantitative expressions of risk can be presented if and only if the data are of sufficient quality, quantity, and type. Section 313 release data, when taken alone, should not be used in risk assessments that result in quantitative expressions of risk. The quantitative approach describes risks in numerical terms. For example, "The presence of chemical A in the environment at concentration B is expected to cause one additional case of lung cancer per 100,000 exposed individuals." A characterization of the nature and potential magnitude of uncertainties should always accompany quantitative expressions of risk.

Individual Versus Population Risks

Risks can be estimated for both individuals and populations. Individual risks are most often estimated first. Groups of individuals (subpopulations) exposed to similar concentrations of the same chemical(s) are considered to have similar risks. The risks to subpopulations considered to

be more susceptible than average (e.g., children, pregnant women, sick people, and elderly people) are determined separately.

The excess incidence of an adverse effect (e.g., cases of respiratory distress, cancer) in a population can be quantitatively estimated by multiplying the probability of effect (the individual or subpopulation risks) by the number of individuals in that subpopulation. The total aggregate population incidence of adverse effects is the sum of all these products. Qualitatively, the estimated excess incidence of adverse effects will increase as the sizes of the exposed population increases.

The risk-related level of concern for releases of toxic chemicals should be based on both individual and aggregate population risks. For example, situations with very high individual risks may be of concern even though the estimated number of exposed individuals is very low, and the aggregate risk is therefore low. Similarly, large populations exposed to relatively low individual risks may prompt concern because the aggregate impact would be significant.

The Two Key Elements of Risk

The risk screening and assessment processes involve characterizing the toxicological potency of a substance and the potential exposures to target individuals or populations. If the toxicological potency and exposures are known, the risk can be assessed.

Toxicological potency information describes the toxicity of a chemical. It is chemical-specific and, therefore, does not depend on exposure data. Evaluating the toxicological potency of a chemical involves collecting and evaluating data on:

- The nature of adverse health or ecological effects that may be produced by a chemical (Exhibits 3 and 4 list the adverse health and ecological effects identified under Section 313).

- The exposures at which those effects occur, i.e., exposure (dose)-response relationships.

Toxicological potency may be expressed as the magnitude of the adverse effect per unit of exposure.

Exposure is the amount of chemical that comes into contact with an individual or population during a given period of time. It depends on many site-specific factors (e.g., how and where the chemical was released; the transport and fate of the chemical in the environment; the behavior of the potentially exposed population). Ideally, exposure is measured at the point of contact between the chemical and the individual or population, either directly (e.g., personal monitoring) or indirectly (e.g., amounts of chemicals in body fluids or tissues). Opportunities to measure the actual exposure are rare, however. Generally, exposure must be estimated from information on the levels of a chemical in the environment. Measured environmental concentrations will result in more accurate estimates of exposure than estimated environmental concentrations derived from release data (e.g., Section 313 data) using environmental transport and fate models. Obviously, the further one must extrapolate from data on the amount or concentration of a chemical in the environment to the point of potential exposure, the greater the uncertainty in the estimate of exposure.

What Are the Differences Between Environmental Concentration, Exposure, and Dose?

The concentration of a chemical in the environment is one of two components of exposure. The second component is the amount of the environmental media in contact with the exposed individual per unit of time. In the absence of data on the behavior patterns of each exposed individual, standard assumptions are used for this second component of dose. These assumptions, called exposure constants, account for the amount of water or other environmental media (e.g., air, soil, food) a typical person takes in

EXHIBIT 3. HUMAN HEALTH EFFECTS OF CONCERN AS IDENTIFIED UNDER SECTION 313

- Carcinogenicity. The property or quality of being able to cause tumor formation in any tissue.

- Heritable gene and chromosome mutations. Events that occur in germ cells. These include deficiencies, duplications, insertions, inversions, and translocations of chromosomes, as well as gains or losses of whole chromosomes.

- Neurotoxicity. Any adverse effect on the structure or function of the central and/or peripheral nervous system related to exposure to a chemical substance.

- Reproductive and developmental toxic effects (teratogenicity). Reproductive toxic effects are adverse effects on male or female reproductive ability, while developmental toxic effects are any adverse effects on the developing organism, including death, structural abnormalities, altered growth, and functional deficits such as learning disorders. Developmental toxicity also includes teratogenic effects, which are permanent structural defects that may adversely affect development or survival of the developing organism.

- Other chronic effects. Any adverse effects other than cancer that are observed from long-term repeated exposure to a chemical.

- Adverse acute effects. Adverse effects are any deleterious effects suffered by an organism, while acute effects occur rapidly as a result of short-term exposure to a high concentration of a chemical. For TRI listing, both lethal and nonlethal effects (such as eye and respiratory irritation) may be considered significant adverse acute effects. These effects occur outside the facility as a result of continuous or frequently recurring releases.

EXHIBIT 4. ECOLOGICAL EFFECTS OF CONCERN AS IDENTIFIED UNDER SECTION 313

- Environmental toxicity. EPA has identified several indicators of toxicity. These include aquatic LC_{50}, mammalian or avian LD_{50}, and avian 5-day dietary LC_{50} for acute effects. Chronic maximum acceptable toxicant concentrations (MATCs) can be considered for aquatic organisms (or cases where some dietary concentration is involved). For avian and mammalian toxicity tests, dosing by gavage is frequently employed, and the NOEL (No-Observed-Effect Level) is used.

- Toxicity and persistence. EPA is especially concerned about chemical persistence in cases where toxicity concerns are based on chronic toxicity data.

- Toxicity and bioaccumulation. Bioaccumulation can be considered by evaluating measured bioconcentration factors (BCFs). In the absence of BCF data, the octanol-water partition coefficient (log P) may be used to estimate a BCF figure. Estimated log P data may be used in the absence of log P data.

- Any significant adverse effect on the environment. As defined under the Toxic Substances Control Act (TSCA) 8(e) policy statement, any significant adverse effect means "any ecologically significant change in species interrelationships, such as changes in species behavior, growth, or survival that in turn adversely affect the behavior, growth or survival of other species."

per day. For example, it has been determined that an average adult person drinks about 2 L of water per day. Therefore, the exposure of an individual to a concentration of 100 ug/L of Chemical X in his or her drinking water is estimated to be about 200 ug/day (100 ug/L x 2 L/day).

Dose is the amount of a chemical that is absorbed by the body. In the above example, if 10% of Chemical X were known or assumed to be absorbed, the estimated dose would be about 20 ug/day.

What Is the Difference Between Release and Exposure?

KEY POINT: The release of a toxic substance does not automatically result in exposure.

For exposure to occur, the substance must first travel from the facility to people, animals, or other organisms of concern. Many factors influence whether a chemical reaches a target organism and in what concentration. Chemicals may, for instance, rapidly break down once they are released. They may be diluted if they are discharged into air or water. They may bind to soils and may not be easily released. These factors must be evaluated before exposure can be estimated from release data.

Why Must Both Exposure and Toxicological Potency Be Known to Estimate Risk?

KEY POINT: Exposure to a toxic substance does not automatically result in toxicity.

Risk is a measure (qualitative or quantitative) of how close measured or estimated exposures are to those known to cause toxic effects. Obviously, the lower the exposure, the less the risk. Exposures to organisms of concern may be below levels required to cause toxic effects or below unacceptable risk levels. After potential risks or relative risks are assessed, a determination must be made as to the "acceptability" of the risk. Although not the subject of this manual, a few references on this subject have been included in the Technical Bibliography.

SECTION III - RESPONDING TO QUESTIONS

Responding to people's questions and concerns about the Section 313 chemical releases will not be an easy task. Communicating information on life and health issues is never simple, for these subjects evoke strong emotions. Your job is made more difficult because the data, at least in the first years of reporting, will be limited. In addition, while data may be available for each listed chemical, little or no data will be available on the impact of exposure to more than one release or to chemical mixtures. This section of the guide provides general strategies for preparation, information gathering and dissemination, and response. General references for risk communication are listed in Appendix I.

What Can You Do to Prepare for Response?

There are several steps you can take and resources you can assemble to prepare yourself for responding to Section 313 questions. Exhibit 5 is an "Action Checklist" designed to help you prepare for responding to questions. This checklist consists of three parts: 1) answering questions, 2) assembling information; and 3) disseminating information. The checklist was designed to help you test your agency's preparedness, and to identify ways to make your response efforts as efficient as possible.

The designated Section 313 State agencies will have different methods for handling queries. Some may opt to centralize all queries. Others may refer calls to various State media offices, State or local health departments, etc. Since most questions are likely to be local in scope, a system for referring these calls to the appropriate local agencies and/or officials would be valuable. The "Action Checklist" suggests some strategies for handling calls as they come in, such as establishing an intra-State/Regional or local network.

The strategy should include a system for recording information regarding calls. You might create a special form for this purpose. The information could also be computerized. In either case, you'll want to record basic

EXHIBIT 5 - ACTION CHECKLIST

ANSWERING QUESTIONS

1. How will you handle the calls as they come in? Will you:

   - Designate one or more people to answer the questions?
   - Prepare a guide instructing secretaries and others who generally answer the phones on how and where to forward Section 313 related calls.
   - Establish an intra-State/Regional or local network to handle questions you will be getting?
   - Supply written responses to inquiries? If so, what will you provide?
   - Suggest callers follow up inquiries with a letter detailing their concerns?

2. If you intend to designate people to answer questions, do you know who within the Region, State, or locality are the contact points for answering specific questions related to:

   - Health and/or environmental effects?
   - Exposure and risk assessment?
   - Air, solid waste, ambient water, and drinking water questions?
   - Standards and regulations?

3. How will you document calls as they come in? Will you:

   - Create a form that responders can use to record essential information on each call?
   - Create a system that enables you to track how many calls were received per facility?
   - Periodically review these files to ascertain the level and nature of public concern?

4. If a serious problem is apparent:

   - Do you know what action your agency can or will take?
   - Can you communicate this to the public?

EXHIBIT 5 - ACTION CHECKLIST (con't)

ASSEMBLING INFORMATION

1. Have you assembled the appropriate materials that may be needed to answer the questions?

   - Are copies of the Toxic Chemical Release Inventory Reporting Form readily accessible? A sample Form is provided in Appendix B.
   - Will you have access to the TRI data base (when it becomes available) or the data on the data base?
   - Can you access the EPA "Roadmaps" data base that has been developed? Attachment A is a hard copy version of "Roadmaps."
   - Do you have information related to the health and/or environmental effects of the TRI chemicals, e.g., EPA Hazardous Substance Fact Sheets (Appendix D); Agency for Toxic Substances Disease Registery (ATSDR) Toxicological Profiles*; printouts from EPA's Integrated Risk Information System (IRIS), and Chemical Emergency Preparedness Program (CEPP) Profiles?**
   - Do you have a listing of certified toxicologists in the area who are willing to assist in responding to citizens' health questions?
   - Do you know the status of Federal regulations on the Section 313 chemicals? See Appendix E for brief descriptions of several Federal laws.
   - Do you know how your state regulates the Section 313 chemicals?

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*Under SARA, Section 110, ATSDR and EPA are required to develop toxicological profiles on a specified number of hazardous substances commonly found at facilities on the Superfund National Priorities List (NPL) and which pose the most significant potential threat to human health. Some of these profiles have been completed on Section 313 chemicals and are available through ATSDR.

**IRIS is an on-line data base that contains the latest information about EPA health assessments and regulatory decisions on over 260 chemicals. It has been designed especially for Federal, State, and local environmental health agencies. CEPP Profiles contain information for chemicals on the EPA list of Extremely Hazardous Substances, such as acute hazard information, chemical properties, and emergency handling techniques. Descriptions of IRIS and CEPP Profiles are provided in the hard copy version of "Roadmaps" (Attachment A).

EXHIBIT 5 - ACTION CHECKLIST (con't)

- Do you have access to data from State media programs (e.g., air toxics or water releases)? These programs can provide information on regulation and compliance. They may also have monitoring data and/or environmental fate and transport information on specific chemicals. State programs may also be able to tell you if a chemical has a state air or water standard, and if a particular release is permitted. In this way, toxic chemicals released into the environment without permit restrictions or standards can be identified. State programs may also be aware of a permitted company's compliance record. Contacts for State media programs are provided in "Roadmaps" (Attachment A).

- Have you collected maps containing site-specific information, such as facility locations, meteorological, topological, hydrological, and demographic information (including sensitive population locations) in your geographic area that are important to exposure evaluations?

- Have you contacted local groups or associations, e.g., libraries, weather services, Local Emergency Planning Committees (LEPCs), in your geographic area of responsibility to determine their willingness to provide site-specific information?

- If you answered no to any of the above questions, do you know where to get the information?

2. Will you read local newspaper articles to prepare responses to anticipated questions?

3. Do you want to prepare summary data of the Toxic Chemical Release Inventory Reporting Forms? If so, will you do it by: __state __county __zip code __industry?

DISSEMINATING INFORMATION

1. Have you made plans to distribute the Toxic Chemical Release Inventory Reporting Forms to the public? Will you distribute summary data of these Forms?

2. Do you have plans to publicize your phone number?

3. Do you have summary information that you can give to the public concerning:

   - The community right-to-know program? (Title III Fact Sheets and Right-to-Know Brochures are available from the State and EPA Regional Section 313 contacts listed in Appendix A.)

EXHIBIT 5 - ACTION CHECKLIST (con't)

- Health and environmental effects? (EPA has distributed chemical fact sheets based on New Jersey fact sheets to State and EPA Regional Section 313 contacts. A sample fact sheet is provided in Appendix D; contacts are listed in Appendix A.)

- Access to the TRI data?

4. Do other programs in your State or locality know (have) what you have in terms of materials you have assembled?

5. Will you be developing communication channels for sharing call information between States and localities? If so, how will you publicize this information?

information about the caller and the request as well as your responses or action:

Call Log-in

- Caller's name (check your organization's policy regarding your abiltiy to keep callers' requests and queries confidential).
- Address.
- Telephone number.
- Date and time of call.

Nature of Call

- Facility(s) of concern.
- Chemical(s) of concern.
- Caller's specific concerns.
- Reasons for concern.
- Source of the caller's information.
- Other information about caller's problem.

Response

- Nature of verbal response provided.
- Documents sent.
- Other follow-up actions taken.
- Suggestions for further follow-up/response.

The checklist also suggests that you periodically review the call information to monitor the level and nature of public concern. This will be useful in identifying releases, facilities, and communities that may require follow-up activities (see Follow-up Activities later in this section).

Assembling information that can help you answer questions is another important part of preparation. The "Action Checklist" lists key resources, including documents and data bases. Finally, the checklist asks you to consider what information you will distribute to the public, how you will

distribute it, and what resources and information could be shared with other programs and agencies.

What Questions Will Be Asked, and Who Will Ask Them?

The questions that are likely to be asked of you will come from citizens, workers, local and national environmental groups, realtors, health professionals, lawyers, industry, and others. They will take the form of phone calls, letters, and questions at public meetings. A steering committee of Federal, State, and local government representatives that helped develop this document identified several questions likely to be asked about the Section 313 data. These questions fall into two main categories: 1) risk assessment and 2) risk management:

Risk Assessment Questions

- Am I exposed?
- To how much of Chemical X am I exposed?
- Will I/my child get sick (e.g., die, get cancer)?
- Is my present sickness (or that of my child or my community) the result of past exposures to toxic chemicals?
- How can I be sure if Chemical X caused this effect(s)?
- What if I am exposed to more than one chemical?
- Is the decline of the fish population in Lake X a result of these releases?
- Can I eat the fish from this lake?

Risk Management Questions

- What is being done to control releases?
- Is the chemical regulated? If not, why not?
- How can I get more information about these releases?
- What can I do to get the release of a particular chemical reduced?

How Can These Questions Be Answered?

The response to each question will vary depending on such factors as:

- The quality and type of data available.
- The level of knowledge of the questioner.
- The time and resources available to answer the question.

Obviously, if sufficient data have been gathered to estimate exposure, a more specific answer can be given than if only data from the Section 313 reporting form are available. Depending on what understanding the questioner has of basic risk assessment issues, the response will also vary in terms of the terminology used and the depth of the response. Finally, you may be able to answer a question more thoroughly at a community meeting, for instance, where you have an hour to speak than you could in an over-the-phone response.

Sample Question

> Hi. This is Charlie Citizen from Town of Concern, Indiana. I live two miles from the No Name Company, and I just read in the newspaper that the company is dumping 10,000 pounds of Chemical X into the air over the course of a year, and the newspaper also says it causes cancer. I want to know if this exposure is going to affect me and my family, and what you're going to do about this?

Charlie Citizen is really asking two questions: 1) Am I at risk? and 2) What is your agency doing to control/stop/regulate the release? The first question is asking for an estimate of actual risk - the goal of risk assessment; the second question is asking that a risk management decision be made (or communicated, if such a decision has already been made).

Responding to Questions Concerning Actual Risk

Attempting to answer questions that ask for estimates of actual risk will be very difficult given the limited type and quality of data that will be provided on the Toxic Chemical Release Inventory Reporting Form (Form R). You

could take the following three-step approach:

1. Determine what information is needed to answer the question.
2. Determine what information is readily available.
3. Decide what you can tell the questioner.

Step One: Determine What Information Is Needed to Answer the Question

To determine actual risk, you need to perform a risk assessment. To do a risk assessment, you need to know the toxicological potency of Chemical X. This means you need to collect and evaluate data on the adverse health or ecological effects that may be produced by Chemical X and the doses at which those effects occur.

You also need to know the exposure, or amount of chemical with which Charlie Citizen is in contact. To determine this, you need to collect and assess site-specific information - ideally personal monitoring or measurement of the amount of Chemical X in Charlie Citizen's body fluids or tissues. Alternatively, if concentrations of Chemical X in the environment are known, you could estimate exposure by using exposure models (appended to some environmental transport and fate models, e.g., GEMS, see Appendix G). If only release data are available, environmental concentrations and exposure must be estimated (see Appendix G). Quantitative estimates of exposure from Section 313 emissions data, without information on rates of release and a clear understanding of the quality of the data, will seldom be of sufficient certainty to be meaningful. At a minimum, contact with the chemical company will be necessary to obtain this type of information.

Step Two: Determine What Information Is Readily Available

Information on the toxicological potency of Chemical X is likely to be available for many Section 313 chemicals. Roadmaps (Attachment A) identifies several sources of potency information. If you have taken the preparatory

steps outlined in the Action Checklist (Exhibit 5), you will have additional resources on hand such as the EPA Hazardous Substances Fact Sheets, ATSDR Profiles, and the "Roadmaps" data base which can point you to documents and data bases with health and/or ecological effects information. The reporting company may also be an important source of information.

As for determining exposure, you know from Charlie Citizen that the amount of Chemical X being released to the air is 10,000 pounds annually. You can verify this information by consulting the Toxic Chemical Release Inventory Reporting Form submitted by the company for this release. Charlie Citizen has also told you that the exposure point is two miles from the facility. What you don't know is Charlie Citizen's actual exposure to Chemical X, or the duration of this exposure. To make these determinations, you will need to collect site-specific data. Some questions you might ask the Technical Contact designated on the Toxic Chemical Release Inventory Reporting form are listed in Exhibit 6. More information on the type of data you'll want to collect for risk screening and risk assessment is presented in Section IV.

Step Three: Decide What You Can Tell the Questioner

You should tell Charlie Citizen that you can't answer his question with the information you have. You may need to explain what risk assessment is, why you need to do this process to answer his question, and why you don't feel comfortable doing risk assessment with just the Section 313 data. You may also want to explain to Charlie Citizen that there are good reasons to question the accuracy of the reported data and what you are doing (if anything) to get better data.

Charlie Citizen can also participate in answering his own question or in taking action to reduce the perceived risks. Citizens' participation is important and should be encouraged. You can tell callers how they can help collect information to answer their own questions, especially if these questions relate to potential exposure. This can be done by referring callers to potential sources of information and carefully explaining what they might realistically attempt to do (Exhibit 7). Citizens should be encouraged

EXHIBIT 6 - QUESTIONS TO ASK A COMPANY'S TECHNICAL CONTACT

1. Does the total quantity of the release reported include any accidental releases? If so:
   - When did they happen?
   - How much of Chemical X was released?
   - How likely is it for such a release to happen again?
2. What is the frequency of any routine release(s)?
3. What is the duration of any routine release(s)?
4. When and what is the peak release?
5. How long have there been releases of Chemical X?
6. Do reported releases reflect past release levels?
7. Is the release pattern of Chemical X expected to change in the future?
8. If the Toxic Chemical Release Inventory Reporting Form lists a mixture or chemical compound, what substances might be expected to be present in the mixture or compound, and in what quantities?
9. Is the company employing best practicable technology (BPT) or best available technology (BAT)? What are they?
10. Has the company done any monitoring? If so, is this information available? What sampling and analytical methods were used?
11. Has the company attempted to model potential exposures from release or monitoring data? If so, what models and assumptions were used?
12. Is any toxicological information available on Chemical X?
13. Is any information available on potential fate and transport of Chemical X?

EXHIBIT 7 - SUGGESTIONS FOR CITIZEN ACTION

Here are some actions the public might take to voice its concerns (you might have additional ideas or contacts to which you can point concerned citizens):

- Contact the company. Most companies are concerned about their public image and may be more than happy to establish a meaningful liaison with a concerned citizen or citizens' group. Call or write the public contact designated on the Toxic Chemical Release Inventory Reporting Form.

- Obtain more information. Potential sources for information include:

  - The chemical company itself.
  - Local libraries (may be able to provide the citizen with a list of references).
  - State or local health and environmental protection departments.
  - Medical and public health schools.
  - Hotlines, clearinghouses, and support centers (such as the TSCA Assistance Office at (202) 554-1411 or for the hearing impaired, TDD (202) 554-0551).
  - The Environmental Protection Agency (Regional offices).

- Write a follow-up letter. Citizens can write to:

  - The designated Region or Section 313 State contact.
  - Local government officials such as the Mayor, town council members, or selectmen.
  - The Environmental Protection Agency (Federal, Regional, and State offices).
  - Congressmen.
  - The reporting company.
  - Local and national environmental groups.

- Investigate control technologies. Citizens can find out what the state-of-the-art control technology is for a particular industry, and compare it to what the facility is using. Citizens can contact their EPA Region or State Section 313 contact for information on state-of-the-art control technologies.

- Contact the family physician to discuss medical concerns.

- Identify other concerned citizens. Citizens may find it fruitful to work together in performing the activities listed above. The Local Emergency Planning Committee may be a good starting place for networking with other citizens.

to work in a spirit of cooperation and communication with the various groups they come in contact with in achieving their goals.

Finally, you could offer to send Charlie Citizen additional information about Title III and the potential health and environmental effects associated with the chemical(s) reported to be released from the No-Name Company. Title III Fact Sheets, Right-to-Known Brochures, and Chemical Fact Sheets are available from the State and EPA Regional Section 313 contacts listed in Appendix A. To facilitate information dissemination, you might send callers a "request for more information" form. A sample form is provided in Exhibit 8. Your State or locality may wish to modify this form or create your own materials (if you haven't already) to best suit your needs. For example, a list of the type of materials or information your agency can typically provide would be a useful adjunct to the form.

Responding to Risk Management Questions

Charlie Citizen also wants to know what is being done about regulating or controlling the release. You can find out what Federal and State regulations apply to the chemical through State and Regional contacts, Roadmaps, and other sources.

If the chemical is regulated, say so. To address why a chemical is not regulated, you need to be familiar with State and Federal regulatory programs and legal constraints, as well as factors that are considered in regulatory control and decision-making. You might review a chemical's regulatory history to determine whether regulation was considered in the past. Emphasize to Charlie Citizen that this is the first time any government agency at any level - local, State, or Federal - has had access to these data. The government is assessing data to determine the extent of possible risk and will be taking action, as appropriate, under existing legislative mandates.

If a facility is in compliance with laws and standards covering Chemical X, you should explain how the standards were set. Explain to Charlie Citizen the extent to which potential health effects of Chemical X were

EXHIBIT 8 - REQUEST FOR MORE INFORMATION*

Please send me more information on the following facility or chemical. (I have attached sheets for other facilities/chemicals that interest me.)

Facility/chemical name: _____

My Address Is: _____

City: _____

County: _____

Telephone No.: _____

I am interested in the potential uses of the hazardous substance data collected under the Emergency Planning and Community Right-To-Know law. Specifically, the reason that I am requesting information is:

- I am an elected official in my town and I want to start planning for hazardous materials emergencies.
- I am a firefighter and this information will help me take appropriate precautions when dealing with an emergency situation.
- I want to be sure that my community has an appropriate plan to handle a hazardous materials incident.
- I want to discuss possible hazardous material exposure with my physician.
- I am curious about the releases of toxic chemicals into the environment.
- Other _____.
- I want to use my RIGHT TO KNOW!

*Adapted from the New Jersey Department of Environmental Protection's Bureau of Hazardous Substances Information Community Right-to-Know Fact Sheets.

considered in setting the standards - and the extent to which the laws require such considerations. Finally, let Charlie Citizen know that States and the Federal government intend to evaluate the Section 313 data to determine the adequacy of existing regulations and standards.

Follow-up Activities

This section has described short-term response to citizens' queries. Depending on your organization's resources and priorities, you may also wish to flag certain queries for follow-up. These queries can be identified in several ways:

- Information provided by a caller may suggest that a situation deserves further follow-up.
- Periodic and systematic review of the call logs will help identify releases, facilities, or communities for which there have been unusually high levels of concern.
- The risk screening described in Section IV will help identify releases and facilities that should receive a higher priority for follow-up from a public health and environmental standpoint.

Long-term follow-up may take several forms:

- Public meetings. These will enable direct communication between your agency and concerned parties. Such communication is particularly important in communities that have voiced a high level of concern.
- Information gathering. Any information that enables you to put potential exposures into perspective will be useful in responding to citizens' concerns. For example, if you receive many calls about a particular chemical, you could obtain information about ongoing exposures to that same chemical that have not caused harm and that have been accepted by the community or nearby communities (if such information is available).
- Follow-up letters. If you do obtain more information of relevance to an original call, send it to the citizen or citizens who called.

Your organization should consider the various options and determine how and when to exercise them.

SECTION IV - QUALITITIVE RISK SCREENING: A SYSTEM FOR PRIORITIZING THE DATA

This section of the guide suggests a screening system for using the Section 313 data to set priorities for follow-up activities and to determine the additional data that would be most useful for such evaluations. The system is consistent with EPA's understanding of the type and expected quality of the Section 313 data and readily available supplementary data. Also, the system is intended to be flexible, and each organization should use judgment in applying and interpreting it.

An Overview of the System

This screening system follows the basic risk assessment steps. By considering available information on (1) toxicological potency in conjunction with general indicators of (2) exposure, you will gain useful insights into the potential public health and ecological risks of certain releases. These insights may help you determine whether releases should receive a high, medium, or low priority for further investigation.

Background on Ranking Relative Toxicological Potency

For risk assessment, the toxicological potency of a chemical is assessed by assembling original toxicological data or reviews of such data. For risk screening purposes on Section 313 data, this is unnecessary. Given the uncertainties in the data available for exposure evaluation, the relative toxicological potency of the chemicals (rather than the actual toxicological potency) is all that is needed.

Several systems are available for ranking relative toxicological potency. One such system is the Reportable Quantities (RQs) developed under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). The RQ for a substance is the level at or above which a release of

that substance must be reported to the National Response Center (NRC), the State Emergency Response Commission, and the Local Emergency Planning Committee. There are five levels of RQs: 1, 10, 100, 1,000, and 5,000 pounds. An RQ is assigned to a chemical based on a consideration of the chemical's intrinsic chemical, physical, and toxicological properties. The lower an RQ, the higher the relative toxicological potential of the chemical. Thus, RQs can be used as crude indicators of a chemical's overall relative potential to cause toxicological and/or ecological effects at a given exposure level.

In assigning an overall RQ for a substance, up to six individual RQs are calculated separately for aquatic toxicity, acute mammalian toxicity, chronic toxicity, potential carcinogenicity, reactivity, and ignitability. Four of these are based on health or ecological effects (aquatic toxicity, acute mammalian toxicity, chronic toxicity, and potential carcinogenicity) and are, therefore, appropriate as a basis for assigning relative toxicological potency to Section 313 chemicals.

RQs appear to be an appropriate hazard ranking system for Section 313 chemicals for the following reasons:

- The RQ score considers type of effects, severity of effects, and dose-response for the endpoints of concern under Section 313.
- The RQ score is based on data in primary literature sources.
- Data evaluation under the RQ system is consistent with EPA's risk assessment guidelines.*
- RQs have been peer-reviewed and endorsed by the EPA.
- RQs have been developed for more than two-thirds of the Section 313 chemicals.

Appendix F lists the aquatic toxicity, acute mammalian toxicity, chronic toxicity, and potential carcinogenicity RQS. Toxicity data (e.g., acute

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*See Bibliography for complete citations.

inhalation LC_{50}s) assigned to Section 313 chemicals that can be used to rank chemicals according to their potential to cause these effects are also presented. RQs for hazardous substances that are members of the 20 toxic chemical categories listed under Section 313 are listed as well. Additional information on assigning RQs is provided in Exhibit 9.

Factors to Consider in Evaluating Exposure Potential

Potential exposure is evaluated for each medium based on consideration of many variables. For the purposes of qualitative risk screening, several factors can be considered as general indicators of potential exposure:

- Quantity of Substance Released - The greater the quantity released, the greater the potential for exposure.

- Transport Mechanisms - The closer the proximity of the release to an available transport medium that can convey the chemical to a population, the greater the potential for exposure. For example, a release directly to air or a waterway offers greater exposure potential than a release to a lined impoundment located far from any sources of ground water. Meteorological, topological, and hydrogeological conditions will affect the transport of the chemical, and therefore must be considered.

  - For air exposures, the individuals and populations exposed to the highest concentrations will generally be located downwind and nearest to the source of the release (dependent upon emission stack height).

  - For ground water, in general, nearby wells will have higher chemical concentrations than distant wells, and wells in the direction of ground-water flow will have higher chemical concentrations.

  - For surface water, the significant exposure points depend on downstream uses of the water. Downstream use includes drinking, cooking, bathing, water contact sports, agricultural livestock watering, and industrial use. Discharges of volatile chemicals to water can also become significant sources of air pollution, and affect target populations in this way.

  - For soil, individuals and populations in nearby areas will be more likely to be exposed than those at a greater distance. A toxic chemical may also be taken up by plants or grazing animals and subsequently be ingested by humans. Soil may also be a significant exposure pathway for children with a tendency to eat dirt. In some circumstances, contaminated soil can also become airborne and be carried significant distances.

EXHIBIT 9 - USING RQS IN THE RISK SCREENING SYSTEM

Assigning the appropriate RQ to a Section 313 chemical will depend upon your understanding of the target populations/organisms of concern and the reported chemicals' likely release rates. Choosing the lowest RQ in the examples below will give you conservative results for risk screening.

- If you are concerned about health and ecological effects, select the lowest RQ value from among the four RQs for that chemical: aquatic toxicity, acute mammalian toxicity, chronic toxicity, and potential carcinogenicity.

- If you are concerned about aquatic effects only, select the aquatic toxicity RQ.

- If you are concerned about human health effects only, select the lowest RQ from among the three human health values.

- If you are concerned only about human health effects and if release data indicate a frequent or relatively continuous release that implies relatively long-term exposure, use the lower of the potential carcinogenicity and chronic toxicity RQs.

Other guidelines apply to mixtures or trade secret substances for which generic names have been given; to chemical categories; and to chemicals for which no RQ has been assigned.

- Generic names. If you can ascertain from the generic name the types of chemicals that might be components of the substance, you can select from among the most toxic of these chemicals for risk screening. If, however, you can't make such a determination, consult with the facility to collect sufficient information to put boundaries on the potential toxicity of the substance.

- Chemical categories. Some chemicals that make up the 20 categories listed under Section 313 have RQs. Select the most toxic of the chemicals listed in the category that exhibits the same properties (e.g., physical state) as the compound of concern. Absent any information on the toxicity of the reported compound, you should generally use the most toxic chemical listed in the category for conservative risk sceeening.

- No RQ. If a chemical does not have an RQ, you can assign a relatively toxic RQ (i.e., 10 or 100) to the chemical for the purposes of screening. Again, assuming relatively high toxicity will result in the most conservative screening.

- Chemical Fate - Various characteristics of the chemical will affect its duration and where it will finally reside in the environment. These characteristics include:

  - Stability - The more stable and persistent a chemical is in the environment, the greater the potential for exposure.

  - Mobility - The more mobile a substance, the more widespread the potential for exposure, but the lower the likely exposure concentrations.

  - Media affinity - Media affinity refers to the tendency of the chemical to move from the media into which it was discharged to another media. For instance, if a chemical has affinity for water and is released into water, it is unlikely to move from that media to another. On the other hand, a volatile chemical released into water, is likely to move into another medium, such as air.

- Population Characteristics - Characteristics of the target population or environment can influence exposure. These include:

  - Density. The more dense the nearby population, the greater the number of people that may be exposed.

  - Sensitive Populations or Sensitive Environments.* Certain populations or environments may be more susceptible than average to exposure. Reviewing information on the site area can indicate whether sensitive populations or environments are present.

- Individual or Population Behavior - Population behaviors (e.g., eating habits, recreational activities of humans) will affect exposure. For example, if a given pollutant concentrates in fish tissue, the amount of fish consumed by the potentially exposed population is a critical factor affecting exposure.

The potential for exposure is estimated, based on the available data, by filling out a questionnaire provided at the end of this section. The questionnaire is described in more detail below.

Using the Risk Screening System

The risk screening system presented in this guide consists of three parts:

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*See Glossary for definitions of these two terms.

- The Risk Screening Procedure.
- The Questionnaire for Qualitative Screening.
- The Facility Risk Screening Worksheet.

The risk screening procedure requires the user to address the questions in the questionnaire in the order prescribed and to record results on copies of the facility worksheet. All three items are used concurrently in performing the risk screening, and you will work back and forth among them. The three parts are described in more detail below.

Sources of information useful for risk screening are listed in Exhibit 10 at the end of this section. The more reliable information you access in responding the questions, the greater the confidence you can have in the results of the screen.

The Risk Screening Procedure

The screening procedure provides a logical process for considering the many variables associated with a determination of potential risks at a facility or site. It describes how to screen potential risks among multiple facilities each releasing several chemicals into different environmental media (air, water, and land/ground water). The same approach may be used to determine relative risks among chemicals at a specific facility.

There are essentially four steps to the procedure:

- Perform a preliminary assessment to determine plausible routes of exposure and the target organisms of concern.
- Assess toxicological potency, using the RQ system described earlier.
- Perform exposure ranking.
  - Rank release quantities for each chemical.
  - Consider further the magnitude of potential exposures for each plausible route of exposure.

- Rank facilities or geographic areas based on relative risk. Chemicals and facilities can be ranked according to potential risks to humans or ecological organisms from releases into each environmental media. At the risk screening stage, an overall risk ranking for a specific chemical or facility cannot be determined where multiple routes of exposure are likely.

The Questionnaire for Qualitative Screening

The questionnaire requires the user to draw qualitative conclusions in response to a series of questions, e.g., to judge whether releases are "high, medium, or low," or whether people are "close to or far from" the release site. The questionnaire is meant to be flexible enough to serve the interest and needs of a diversity of users in all parts of the country. Therefore, quantitative limits on these terms are not provided (with a couple of exceptions which are presented for illustrative purposes) since quantitative perceptions of "high" or "close to" will differ among site locations, areas of the country, program emphasis, etc.

Since answering the questions may involve making estimates, the risk screening procedure is best performed by two to four individuals who can reach consensus on what estimates are appropriate. Also, for consistency within your own program, you may want to consider establishing quantitative ranges or limits for each of the qualitative terms in the answers to the questions which will meet your program objectives and the community interests.

The Facility Risk Screening Worksheet

The results of the screening procedure are recorded on copies of this worksheet. A sample worksheet is provided at the end of the questionnaire. You'll want to make several copies of this worksheet since one worksheet must be filled out for each individual or population of concern for which there is a plausible exposure route.

Other Factors to Consider

The risk screening system presented in this guide is based solely on considerations of risk to public health and the environment. In your decision on the type and extent of follow-up activities of a facility or geographic area, you may wish to consider other non-risk factors, e.g., permitting, public concern, control technologies, economics, and politics.

Before applying this risk screening system, organizations may wish to determine whether the release is permitted and meets the permit requirements. Releases from permitted facilities in compliance with the permit(s) may be less likely to pose a concern than an unpermitted release or one in violation of a permit. Organizations may also want to be responsive to the level of public concern about an area, facility, or individual release. Such concern may be an important indicator of a situation requiring some follow up, both from a public health/environmental and a political standpoint. If a facility is already using best practicable technology (BPT) or best available technology (BAT), it may not be able to reduce the level of releases any further without tradeoffs. Budgetary restraints and political factors will also be important considerations.

After Prioritization - Then What?

After narrowing down specific emissions or sites that appear to require further investigation, the risk assessment models provided in Appendix G can be used as a guide to the kind of information you'll want to collect to perform risk assessment. The appendix includes a description of data input elements required in each method. These input elements, along with information on data gaps identified in completing the Questionnaire for Qualitative Screening, can help you decide what information needs to be collected and/or data generated to determine actual risk.

THE RISK SCREENING PROCEDURE

1. Preliminary Exposure Route and Target Organism Screen

   - Run a quick first pass through the "Plausible Routes of Exposure" section of the questionnaire to determine plausible routes of exposure to humans and ecological organisms. For example, if there are no drinking water intakes and no swimming or fishing in the vicinity (say, 10 Km) of a water discharge, then exposure potential to humans via surface water is low. (See note on distance in the questionnaire on page 4-13.)

   - Drop exposure routes determined to be implausible. These routes should be further evaluated during risk assessment, if determined necessary.

   - Fill out the "Site, Media, and Organisms of Concern" lines of the "Facility Risk Screening Worksheet." (NOTE: You need to fill out a separate worksheet for each media and each organism of concern.)

2. Assess Toxicological Potency

   - Look up and record the lowest RQ values of each chemical released into an environmental media for which there is a worksheet. See Exhibit 9 for guidance in assigning RQ values.

   - Complete the "Toxicological Potency" section in the Questionnaire.

   - Enter the chemicals assigned "high" and "medium" toxicological potencies in the appropriate sections on the facility worksheets under "Chemical Name." (Do not list chemicals assigned "low" toxicological potency.)

3. Determine Exposure Potential

   Release Quantities

   - Group facilities where emissions are close together (e.g., emission stacks or discharge pipes that are within perhaps 1 Km of each other)unless there are reasons not to do so (e.g., residences or recreational areas in between discharge locations). See note on distance in the questionnaire on page 4-12.

   - Add releases of chemicals in common among grouped facilities as though releases occurred from one site. Consider combining releases for any chemicals that are known to cause toxic effects by the same or similar mechanisms of action, or that have a common site of toxicity, (e.g., liver, lung). If the toxic effects of a chemical are not known, make a note to look up this information during the follow-up risk assessment, if determined necessary.

   - Complete the "Quantity of Release" portion of the questionnaire.

   - Fill in the "Release Quantity" columns in the "Facility Risk Screening Worksheet."

- Do not list "low" release quantities of "high" toxicological potency chemicals unless they are determined to be persistent.

- List "medium" release quantities of "medium" toxicological potency chemicals only if they are determined to be persistent.

- Do not list "medium" toxicological potency/"low" release chemicals.

- At this point, low and possibly some medium risk chemicals have been screened out.

Plausible Routes of Exposure

- Complete the "Plausible Routes of Exposure" section of the questionnaire for each chemical on each facility worksheet.

- For each chemical, assign and record under "Plausible Route" a "high" or "medium" ("lows" have been dropped in Step One) likelihood of exposure and level of confidence in each estimate

4. Rank Relative Risks

- Add any chemicals to the facility worksheet which were screened out using the above criteria, but for which you have reason to consider the need for further evaluation (e.g., metal compounds or other highly persistent chemicals, release points very close to exposure points, chemicals receiving public attention in your area).*

- If further ranking of chemicals on the facility worksheets is needed, the chemicals that scored "high" in all three columns ("Toxicological Potency," "Release Quantity," and "Plausible Route") should be ranked at the top of the risk list. Those that scored "high" in two of the three columns should be listed next, and those that scored "high" for only one of the three columns should be grouped at the bottom of the list.

- Compare worksheets for each organism of concern and media of interest in order to rank facilities according to their relative risks.

- Collect information necessary to increase the certainty in estimates of toxicological potency, release quantities, or plausible routes assigned a "low" or, in some cases, a "medium" level of confidence, before making a decision about the need for and focus of a chemical or site specific risk assessment. (See Exhibit 10 for useful sources of information.)

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*To conserve limited resources, keep the number of chemicals requiring follow-up risk assessment to a minimum. If a preliminary risk assessment is necessary on the chemicals you select from the facility worksheets, it should indicate the need to further expand the scope of the assessment to include additional chemicals dropped during risk screening. If, in the preliminary quantitative risk assessment, risks associated with your high chemical risk candidates are determined to be low, there is no need to further refine the risk assessment by addressing chemicals of lower risk potential.

THE QUESTIONNAIRE FOR QUALITATIVE RISK SCREENING

Instructions:

Circle the appropriate response. If you do not have enough information to answer the question, circle "insufficient data."

To the left of each question is a place to rank your confidence in your answer. To address your confidence in toxicological potency, circle H if the exact identity of chemical and its RQ are known. Circle M or L if there is doubt about the chemical's identity (e.g., chemical is identified by generic name or chemical category), or if no RQ has been assigned to the chemical. For quantity of release, your confidence will be higher if you know that actual monitoring data were used to derive the estimate given on Form R and that the monitoring data were of high quality, or if specific estimates rather than ranges of releases are reported. For exposure, circle H when your answer is based on documented evidence and/or high quality data. Circle M or L if you have some uncertainty about the available information and your response.

TOXICOLOGICAL POTENCY

1. Is the appropriate RQ for the chemical:

Confidence				
H	M	L	5,000	A. Low
			100 to 1,000	B. Medium
			1 to 10	C. High

[NOTE: These ranges are provided only for example prior to the first data submissions. You should define your own ranges of "high," "medium," and "low."]

EXPOSURE POTENTIAL - AIR

QUANTITY OF RELEASE

1. Is the total quantity of release (both fugitive and stack emissions):

Confidence				
H	M	L	Less than 5,000 lbs/year	A. Low
			5,000 - 50,000 lbs/year	B. Medium
			Greater than 50,000 lbs/year	C. High

[NOTE: The quantity figures are provided only for example prior to the first data submissions. You should define your own categories here based on an analysis of the actual quantities emitted. For example, the three categories could be defined so that each category will contain approximately one third of the emissions reported.]

PLAUSIBLE ROUTES OF EXPOSURE

1. Confidence H M L — Is the site of release known?

A. Exactly (latitude and and longitude coordinates of discharge site known)
B. Nearly (facility street address known)
C. Approximately (facility zip code known)
D. Not at all

[NOTE: If the answer is "D - not at all," there are insufficient data to screen potential risks resulting from air emissions.]

2. Confidence H M L — Is there a population center or sensitive environment (see Glossary for definitions of these terms):

A. Relatively close to the release point
B. Somewhere in between A and C
C. Very far from the release point
D. Insufficient data

3. Confidence H M L — Is the population center or sensitive environment downwind of the release:

A. Often or always
B. Sometimes
C. Never
D. Insufficient data

[NOTE: The determination of "close" or "far" depends upon consideration of site-specific factors such as meteorology, topography, and chemical release height. In general, the higher the average wind speed in the direction of target organisms, the more direct the pathway from the point of release to target organisms (e.g., no intervening mountain ranges or the target organisms are not located in a valley over which the chemical plume may pass without falling), and the higher the stack from which the chemical is discharged, the further the chemical plume is likely to travel, and, in most instances, the "closer" the population center or sensitive environment should be considered to the release point. As a general guideline, "close" may vary from meters up to a kilometer and distances in excess of 10 kilometers will almost always be "far." In addition, the physical and chemical properties of a chemical may factor into a determination of what is "close" and "far." Chemicals that are solids, liquids, or adsorbent gases under ambient environmental conditions will tend to fall to the ground closer to the point of release than inert gases.]

4. Confidence H M L — Do environmental fate data indicate that the chemical is persistent in air (i.e., not likely to be degraded or otherwise removed from the air before the chemical plume reaches population centers or sensitive environments)?

A. Yes
B. No
C. Insufficient data

5. Confidence H M L — If ambient air monitoring data are available, was the point of monitoring:

A. Very close to the point of potential exposure
B. In between the release and exposure
C. Very close to the release point
D. Insufficient data

[See NOTE above.]

6. Confidence H M L — If A or B, can the presence of the chemical at the monitoring point be reasonably linked to the release?

A. Yes
B. No
C. Insufficient data

7. Confidence H M L — If standards or other threshold limits are available for the chemical in air, do the monitoring data indicate that levels of the chemical in ambient air were generally:

A. Above or around the limit
B. Below the limit
C. Insufficient data

CONSIDERING THE ABOVE FACTORS AND THEIR RELATIVE IMPORTANCE, would you say that the potential for exposure of the individual, population, or ecosystem to the emitted chemical is:

A. Low
B. Medium
C. High
D. Insufficient data

OVERALL CONFIDENCE

Considering the quantity and the quality of the available data, is your confidence in this data:

A. Low
B. Medium
C. High

EXPOSURE POTENTIAL - GROUND WATER/LAND

QUANTITY OF RELEASE

Is the quantity of release to land (including underground injection):

Confidence H M L		
	Less than 5,000 lbs/year	A. Low
	5,000 - 50,000 lbs/year	B. Medium
	Greater than 50,000 lbs/year	C. High

[NOTE: The quantity figures are provided only for example prior to the first data submissions. You should define your own categories here based on an

analysis of the actual quantities emitted. For example, the three categories could be defined so that each category contains exactly one third of the emissions reported.]

PLAUSIBLE ROUTES OF EXPOSURE

1. Confidence H M L Is the disposal site known?

A. Exactly (latitude and and longitude coordinates of disposal site known)
B. Nearly (facility street address known)
C. Approximately (facility zip code known)
D. Not at all

[NOTE: If the answer is "D - not at all," there are insufficient data to screen potential risks resulting from ground water/land disposal.]

2. Confidence H M L How likely is it that contamination will travel to a point of actual or potential use?

A. Fairly likely
B. Somewhere in between A and C
C. Very unlikely
D. Insufficient data

3. Confidence H M L Are there streams or other surface water bodies near the area that the chemical is likely to enter - considering local weather conditions (e.g., high rainfall), topographical conditions (e.g., ground slope), and any environmental fate data available on the chemical (e.g., potential to evaporate)?

A. Yes
B. No
C. Insufficient data

[If the answer is "yes," also complete the section on surface water.]

4. Confidence H M L Is there a potable ground-water (i.e., Class I or II) aquifer (see Glossary for definitions of terms) in the release area?

A. Yes
B. No
C. Insufficient data

[If the answer is "no" or "insufficient data," skip to surface water.]

5. Confidence H M L If yes, considering the local geology (including soil porosity and depth to the aquifer) and environmental fate of the chemical in soil (e.g., hydrolysis, adsorption, water solubility), how likely is it that the chemical may reach the aquifer?

A. Fairly likely
B. Somewhere in between A and C
C. Very unlikely
D. Insufficient data

6. Confidence H M L — Are any high-priority ground waters endangered (i.e., Class I ground waters, well head protection areas, or other designated high priority areas)?

A. Yes B. No C. Insufficient data

7. Confidence H M L — Are public or private wells endangered in the immediate area or along the likely flow path?

A. Yes B. No C. Insufficient data

8. Confidence H M L — Do monitoring data show that the chemical is present in ground water or drinking water from the ground-water source:

a. Beneath the facility near the point of release?

A. Yes B. No C. Insufficient data

b. At the edge of the facility?

A. Yes B. No C. Insufficient data

c. At a currently used well?

A. Yes B. No C. Insufficient data

9. Confidence H M L — At any of the above locations, can the presence of the chemical at the monitoring point be reasonably linked to the release?

A. Yes B. No C. Insufficient data

10. Confidence H M L — If drinking water standards or similar threshold limits are available for the chemical in drinking water at any of the above locations, do the monitoring data indicate that levels of the chemical in the water were generally:

A. Above or around the limit B. Below the limit C. Insufficient data

CONSIDERING THE ABOVE FACTORS AND THEIR RELATIVE IMPORTANCE, would you say that the potential for exposure of the individual, population, or ecosystem to the emitted chemical is:

A. Low
B. Medium
C. High
D. Insufficient data

OVERALL CONFIDENCE

Considering the quantity and quality of the available data, is your confidence in this data:

A. Low
B. Medium
C. High

EXPOSURE POTENTIAL - SURFACE WATER

QUANTITY OF RELEASE

1. Is the quantity of release for discharges to surface water:

Confidence H M L		
	Less than 5,000 lbs/year	A. Low
	5,000 - 50,000 lbs/year	B. Medium
	Greater than 50,000 lbs/year	C. High

[NOTE: The quantity figures are provided only for example prior to the first data submissions. You should define your own categories here based on an analysis of the actual quantities emitted. For example, the three categories could be defined so that each category contains exactly one third of the emissions reported.]

PLAUSIBLE ROUTES OF EXPOSURE

1. Confidence H M L — Is the site of release known?

A. Exactly (latitude and longitude coordinates of discharge site known)
B. Nearly (facility street address known)
C. Approximately (facility zip code known)
D. Not at all

[NOTE: If the answer is "D - not at all," there are insufficient data to screen potential risks resulting from surface water.]

2. Confidence H M L — Is a drinking water intake located downstream of the point of entry of the chemical into the surface water?

A. Yes B. No C. Insufficient data

3. Confidence H M L — Do people swim or boat in the water body into which the chemical is emitted?

A. Yes B. No C. Insufficient data

4. Confidence H M L — Are fish harvested from the water body for human consumption?

A. Yes B. No C. Insufficient data

5. Confidence H M L — If so, does the chemical bioaccumulate in these species?

A. Yes B. No C. Insufficient data

6. Confidence H M L — Are there any ecologically valuable fish in the water body into which the chemical is emitted?

A. Yes B. No C. Insufficient data

7. Confidence H M L — If the answer is "yes" to any of questions 1 through 5 above, is the location of potential exposure:

A. Very close to the the release? B. Somewhere in between A and C? C. Far from release? D. Insufficient data

[NOTE: The determination of "close or "far" depends upon consideration of site-specific factors such as surface water volume and flow rate, and distance from the chemical release point. In general, the smaller the stream or river, the faster the flow rate, and the more direct the pathway from the point of release to target organisms (e.g., on the same side of the river as a drinking water intake or recreational area, or near spawning areas in shallow, quiet areas of the water body), the "closer" the location of potential exposure should be considered to the release point. In addition, the physical and chemical properties of a chemical may factor into a determination of what is "close" and "far." Chemicals that are soluble and persistent in water will migrate further downstream than those that are volatile or insoluble and degrade in water.]

8. Confidence H M L — Do environmental data indicate that the chemical is persistent in water (i.e., not likely to be degraded or otherwise removed from the water)?

A. Yes B. No C. Insufficient data

9. Confidence H M L — If yes, do environmental fate data (e.g., log octanol/water partition coefficient) indicate that the chemical is more likely to be associated with suspended particulates and sediments?

A. Yes B. No C. Insufficient data

[NOTE: Adsorption to particles and sediments would tend to reduce potential exposures in drinking water, and increase exposures to "bottom-feeding" aquatic organisms. Exposures during water contact recreational activities would depend upon the turbidity in the area of these activities.]

10. Confidence H M L — Are monitoring data available that record the levels of the chemical in ambient water, drinking water, or in fish?

A. Yes B. No C. Insufficient data

11. Confidence H M L If yes, can the presence of the chemical be reasonably linked to the release?

A. Yes B. No C. Insufficient data

12. Confidence H M L If standards or similar threshold limits are available for the chemical in ambient water, drinking water, or fish, do the monitoring data indicate that the levels of the chemical were generally:

A. Above or around the limit B. Below the limit C. Insufficient data

CONSIDERING THE ABOVE FACTORS AND THEIR RELATIVE IMPORTANCE, would you say that the potential for exposure of individual, population, or ecosystem to the emitted chemical is:

A. Low
B. Medium
C. High
D. Insufficient data

OVERALL CONFIDENCE

Considering the quantity and the quality of the available data, is your confidence in this data:

A. Low
B. Medium
C. High

FACILITY RISK SCREENING WORKSHEET

Site: _____

Media (Air, Surface Water, Land/Ground Water): _____

Organisms of Concern (Human, Ecological/Aquatic or Ecological/Terrestrial):

_____

HIGH TOXICOLOGICAL POTENCY CHEMICALS

Chemical Name ( )[1]	Release Quantity ( )[2]	Plausible Route ( )[3]
A.		
B.		
C.		
D.		
E.		

MEDIUM TOXICOLOGICAL POTENCY CHEMICALS

Chemical Name ( )	Release Quantity ( )[4]	Plausible Route ( )
A.		
B.		
C.		
D.		
E.		

[1]Level of confidence (H, M, or L) in the toxicological potency is indicated within the parenthesis. (Under "Chemical Name", chemicals with RQ values are given an "H". The level of confidence in the toxicological potency for chemicals without RQ values should reflect the confidence in the estimation technique).

[2]Low release quantity chemicals are listed only if determined to be persistent.

[3]If "Plausible Route" is determined to be "Low" then potential risk is low for this media and organism. Therefore, a worksheet is <u>not</u> necessary.

[4]Medium release quantity chemicals are listed only if determined to be persistent. Low release quantity chemicals are <u>not</u> listed.

EXHIBIT 10

WHERE TO GO FOR INFORMATION

INFORMATION USEFUL FOR RISK SCREENING	TOXIC CHEMICAL RELEASE INVENTORY REPORTING FORM (FORM R)	ROAD-MAPS	HAZARDOUS SUBSTANCE FACT SHEET	ATSDR TOXICOLOGICAL PROFILES; CEPP PROFILES; IRIS	ENVIRONMENTAL TRANSPORT AND FATE DATA BASES	EXPOSURE ANALYSIS SYSTEMS	GEOGRAPHIC INFORMATION SYSTEMS	THE REPORTING COMPANY	STATE AND FEDERAL MEDIA PROGRAMS	OTHER
Toxicological Potency										
Physical state of compound (i.e., solid, liquid, or gas)		X	X	X	X			X	X	
Chemical toxicity (e.g., type and nature of effects, dose-response data)		X	X	X				X	X	
Relative hazard indicators (e.g., RQs)		X								• Appendix F
Chemical interactions		X	X	X				X		
Exposure								X		
Source and quantity of release	X									

EXHIBIT 10

WHERE TO GO FOR INFORMATION

INFORMATION USEFUL FOR RISK SCREENING	TOXIC CHEMICAL RELEASE INVENTORY REPORTING FORM (FORM R)	ROAD-MAPS	HAZARDOUS SUBSTANCE FACT SHEET	ATSDR TOXICOLOGICAL PROFILES; CEPP PROFILES; IRIS	ENVIRONMENTAL TRANSPORT AND FATE DATA BASES	EXPOSURE ANALYSIS SYSTEMS	GEOGRAPHIC INFORMATION SYSTEMS	THE REPORTING COMPANY	STATE AND FEDERAL MEDIA PROGRAMS	OTHER
Quality of release data								X	X	• Appendix C • EPA's guidance on estimation techniques (see Bibliography) • EPA will be working to improve data quality through audits, inspections, etc.
Media into which chemical is released	X							X	X	
Transport mechanisms (e.g., meteorological, topological, and hydrological)						X	X	X	X	• Airport, National Weather Service, NOAA, military bases, TV/radio • Size vicinity and land use maps • Aerial photos • State university environmental studies, health sciences, and meteorological departments • Poison center • LEPCs

EXHIBIT 10

WHERE TO GO FOR INFORMATION

INFORMATION USEFUL FOR RISK SCREENING	TOXIC CHEMICAL RELEASE INVENTORY REPORTING FORM (FORM R)	ROAD-MAPS	HAZAR-DOUS SUB-STANCE FACT SHEET	ATSDR TOXICO-LOGICAL PRO-FILES; CEPP PRO-FILES; IRIS	ENVIRON-MENTAL TRANS-PORT AND FATE DATA BASES	EXPOSURE ANALYSIS SYSTEMS	GEO-GRAPHIC INFOR-MATION SYSTEMS	THE RE-PORTING COMPANY	STATE AND FEDERAL MEDIA PRO-GRAMS	OTHER
Chemical fate		X		X	X	X		X	X	• State university environmental studies departments
Potentially exposed populations (including sensitive subpopulations)						X	X		X	• Census data • Population density maps • Aerial photos • Site vicinity and land use maps • AAA maps • Sierra Club • Red Cross • LEPCs
Behavior patterns of exposed populations						X				• Individuals • Land use maps • Aerial photos • LEPCs

NOTES TO EXHIBIT 10

Toxic Chemical Release Inventory Reporting Form (Form R). This is the reporting form industries will submit to EPA and the states. A blank reporting form is provided in Appendix B.

Roadmaps. This is a Section 313 chemical information directory. Roadmaps can point you to a number of data bases and documents containing information on health and ecological effects, as well as environmental transport and fate of Section 313 chemicals. It also contains information on Federal and State regulatory levels for these chemicals, as well as State contacts for various media (i.e., air, water, etc.) programs. A hard-copy version is provided in Attachment A. An on-line version is also available.

Hazardous Substance Fact Sheet. The New Jersey Department of Health has developed fact sheets on many Section 313 chemicals. A sample fact sheet is provided in Appendix D.

Agency for Toxic Substances and Disease Registry (ATSDR) Profiles. Under SARA Section 110, ATSDR and EPA are required to develop toxicological profiles on a specified number of hazardous substances commonly found at facilities on the Superfund National Priorities List and which pose the most significant potential threat to human health. The Profiles contain varied information, including chemical and physical properties; health effects; toxicity; environmental fate and potential for human exposure; and regulatory status. Profiles have been completed for the following Section 313 chemicals: chloroform; benzene; vinyl chloride (monomer); dichloromethane (methylene chloride); N-nitrosodiphenylamine; 1,4-dichlorobenzene; di(2-ethylhexyl)phthalate (DEHP); tetrachloroethylene (perchloroethylene); lead; nickel; arsenic; cadmium; and chromium. A description of the Profiles is provided in Roadmaps (Attachment A).

CEPP Profiles. These Profiles contain information for chemicals on the EPA list of EHSs, such as acute hazard information, chemical properties, and emergency handling techniques. A description of the Profiles is provided in Roadmaps (Attachment A).

IRIS. IRIS is an on-line data base that contains the latest information about Agency conclusions on toxicological potencies, health assessments, and regulatory decisions on over 260 chemicals (about 85 Section 313 chemicals). It has been designed specifically for Federal, State, and local environmental health agencies. A description of IRIS is provided in Roadmaps (Attachment A).

Environmental Transport and Fate Data Bases. Descriptions of useful environmental transport and fate data bases are provided in Roadmaps (Attachment A). Among these are Envirofate and the Hazardous Substances Data Bank

Exposure Analysis and Systems. These systems provide access to data and models used in estimating chemical fate, exposed populations, and aggregate exposure. EPA has developed several exposure analysis systems, including the Graphical Exposure Modeling System (PC-GEMS); the Computer-Assisted Management Emergency Operations (CAMEO); and the Emergency Information System/Chemical (EIS/C). These systems run on PCs and provide access to data management and analysis tools. PC-GEMS includes data on selected environmental characteristics (primarily meteorology and streams) and population; models for predicting concentrations in air, water, soil, and ground water; and mapping and graphics capabilities. CAMEO, which currently runs on a Macintosh, was designed for first responders to chemical spills and emergency planners. A number of local governments have used CAMEO to load and manage information on chemicals in their cities' facilities, and display this information together with locally-entered data on populations, schools, and hospitals. CAMEO contains two spill-scenario models, and can display extents of estimated plumes. EIS/C, also primarily an emergency planning system, records chemical, facility, transportation, vulnerable population, and other information. Check with the contacts listed in Appendix A about the availability of these systems. See also Appendix G for a more complete description of PC-GEMS.

Geographic Information Systems (GIS). GIS are computer mapping and analysis systems that can store and combined multiple "layers" of information (e.g., meteorologic, geologic, hydrologic, demographic, land use data). Most GIS run on mainframe systems, and are used for land use planning, although others which are oriented toward environmental analysis have been recently implemented in EPA regions and several states. Check with your State and/or Regional Section 313 contacts for more information.

NOTES TO EXHIBIT 10 (cont.)

The Reporting Company. The reporting company can provide supplementary release information. It may also be able to provide monitoring, toxicological, and transport and fate data. Some facilities may also be willing to provide permitting history and files containing information on regulatory compliance. Technical and public contacts have been designated for each facility and these contacts are listed on Form R.

State and Federal Media Programs. These programs can provide information on regulation and compliance. They may also have monitoring data and/or environmental transport and fate data. State programs can tell you if there are State standards for Section 313 chemicals, and if a particular release is permitted. They may also be aware of a permitted facility's compliance record. Contacts for State media programs are provided in Roadmaps (Attachment A).

Other. Various resources are also available, as indicated. These include Local Emergency Planning Committees (LEPCs), which have been established across the country under Sections 301 to 303 of Title III. Although LEPCs are not designated to receive Section 313 data, they may have information about facilities, chemicals, and geographic areas of interest to you. Land use maps from the U.S. Geological Survey (USGS) National Cartographic Information Center (NCIC) will also be useful, and can be accessed through the National NCIC in Reston, Virginia, as well as USGS Regional offices. Aerial photos can indicate the chronology of changes in an area's land use and identify indicators of contamination (such as changes in soil conditions and vegetation), as well as patterns of dispersion, and a general idea of site environs. Aerial photos are also archived at USGS. Ask your EPA Region or State Section 313 contact how to access the appropriate LEPC or nearest USGS Regional office. The U.S. Department of Agriculture may also be able to provide photographs. Additionally, many municipalities periodically conduct aerial surveys, so consult with local authorities.

APPENDIX A

CONTACTS

STATE CONTACTS

The names in this directory were provided to the Environmental Protection Agency (EPA) by each state. This list should point you to the appropriate agency within a state that will provide information related to the Toxic Release Inventory. A limited number of states were unable to provide a contact point in time to include their names in this directory. In those cases, EPA has listed the name of the Toxic Release Inventory State Designated Agency with the notation, **"To obtain copies of the form, contact:"**.

In addition to the state listings, EPA regional contact points are provided. Any request for changes to contact list should be made to the EPA regional contact.

TOXIC RELEASE INVENTORY STATE CONTACTS

Alabama

Mr. Lloyd G. Linn, Jr.
Alabama Department of Environmental Management
1751 Federal Drive
Montgomery, AL 36109
(205) 271-7940

Alaska

To obtain copies of the form, contact:
Ms. Amy Kyle
Alaska Emergency Response Commission
Department of Environmental Conservation
P.O. Box 0
Juneau, AK 99811-1800
(907) 465-2600

American Samoa

Mr. Pati Faiai, Director,
American Samoa Environmental Protection Agency
Office of the Governor
Pago Pago, American Samoa 96799
(684) 633-2682

Arizona

Art Blech
Arizona Department of Environmental Quality
2005 North Central Avenue
Room 400
Phoenix, AZ 85004
(602) 257-2395

Arkansas

Section 313, Multi-Media, Water Pollution, Hazardous Waste and Pesticide Issues:
Mr. John Ward
Department of Pollution Control and Ecology
8001 National Drive
Little Rock, AR 72209
(501) 562-7444

Health and Toxicology Issues:
Mary Coleman, Ph.D.
Arkansas Department of Health
Division of Health Maintenance
4815 West Markum
Little Rock, AR 72205-3867
(501) 661-2665

Air Media Issues:
Mr. Mike Porta
Department of Pollution Control and Ecology
P.O. Box 9583
Little Rock, AR 72219
(501) 562-7444

California

Section 313 and Multi-Media Issues:
Mr. Charles Shulock, Assistant to the Secretary
California Environmental Affairs Agency
Sacramento, CA 95812
(916) 324-8124

Health and Toxicology Issues:[1]
Tox - Information Hotline
(800) 233-3360

[1]Will respond to requests regarding health effects of specific chemicals. Inquiries related to actual health problems should be referred to local health officers (Appendix A-1).

Air Media Issues:
Mr. Robert Barham, Chief
Toxic Air Contaminant Identification Branch
California Air Resources Board
P.O. Box 2815
Sacramento, CA 95812
(916) 322-7072

Water Pollution Issues:
Mr. Dave Cohen, Chief, Investigation Branch
Division of Water Quality
State Water Resources Control Board
901 P Street
Sacramento, CA 95814
(916) 322-8401

Hazardous Waste Issues:
Department of Health Services
Toxic Substances Control Division
P.O. Box 942732
Sacramento, CA 94232-7320
(916) 324-1781

Solid (Non-Hazardous) Waste Issues:
Mr. Bernard Vlach, Chief, Enforcement Division
California Waste Management Board
1020 Ninth Street, Suite 300
Sacramento, CA 95814
(916) 322-6172

Colorado

Pam Harley
Colorado Department of Health
Division of Hazardous Materials and Waste Management
4210 East 11th Avenue
Denver, CO 80220
(303) 331-4858

Commonwealth of the Northern Mariana Islands

Russell Meecham, III
Chief, Division of Environmental Quality
P.O. Box 1304
Saipan, Commonwealth of the
Northern Mariana Islands 96950
(670) 234-6984

Connecticut

Section 313 and Air Quality Issues:
Mr. Leonard Bruckman
Department of Environmental Protection
Air Compliance Unit
State Office Building
165 Capitol Avenue
Hartford, CT 06106
(203) 566-4030

Health and Toxicology Issues:
Laurie Gokey
Acting Chief, Toxic Hazards Section
Department of Health Services
150 Washington St.
Hartford, CT 06106
(203) 566-8167

Water Pollution Issues:
Michael Harder
Department of Environmental Protection
Water Compliance Unit
122 Washington St.
Hartford, CT 06106
(203) 566-3245

Drinking Water Issues:
Paul Schur
Water Supplies Section
Department of Health
150 Washington St.
Hartford, CT 06106
(203) 566-3186

Pesticide, Hazardous and Solid Waste Issues:
Charlie Ziemenski
Department of Environmental Protection
Oil Chemicals Spill Section
165 Capitol Avenue
Hartford, CT 06106
(203) 566-4633

Delaware

Section 313 Issues:
June MacArtor, Deputy Director
Division of Air & Waste Management
Delaware Department of Natural Resources and
Environmental Control (DNREC)
Richardson & Robbins Building
89 Kings Highway
P.O. Box 1401
Dover, DE 19903
(302) 736-5071

Health and Toxicology Issues:
Larry Krone, Ph.D.
Bureau of Environmental Health
Division of Public Health
Department of Health and Social Services
Robbins Building
802 Silver Lake Blvd.
Dover, DE 19901
(302) 736-4731

Air Media Issues:
Robert French
Division of Air & Waste Management
DNREC
Richardson & Robbins Building
89 Kings Highway
P.O. Box 1401
Dover, DE 19903
(302) 736-4791

Water Pollution Issues:
R. Wayne Ashbee, Director
Division of Water Resources
DNREC
89 Kings Highway
P.O. Box 1401
Dover, DE 19903
(302) 736-4860

Hazardous Waste Issues:
Gary Molchan
Waste Management Section
Division of Air and Waste Management
DNREC
Richardson and Robbins Building
P.O. Box 1401
89 Kings Highway
Dover, DE 19903
(302) 763-4781

Delaware (Cont)	**Pesticides Issues:** Mr. Grier Stayton DE Department of Agriculture 2320 S. Dupont Highway Dover, DE 19901 (302) 736-4817
	All Title III Issues (Emergency Information): Clarke Jester Division of Emergency Response Delaware Department of Public Safety Office of Emergency Preparedness P.O. Box 527 Dover, DE 19901 (302) 834-4531
District of Columbia	A. Padmanabha, Director Environmental Control Division Department of Consumer and Regulatory Affairs 613 G Street, N.W. Washington, DC 20009 (202) 783-3180
Florida	Ms. Lindsey Gager Florida Department of Community Affairs Division of Emergency Management 2740 Centerview Drive Tallahassee, FL 32399 (904) 487-4915
Georgia	Mr. Jimmy Kirkland Georgia Department of Natural Resources 205 Butler Street, S.E. Suite 1166 Floyd Towers East Atlanta, GA 30334 (404) 656-6905
Guam	Charles P. Crisostomo Administrator, Guam Environmental Protection Agency P.O. Box 2999 Agana, GU 96910 (617) 646-8863
Hawaii	Mark Ingoglia Emergency Response Coordinator Hawaii Department of Health Hazard Evaluation Emergency Response Program P.O. Box 3378 Honolulu, HI 96801-9984 (808) 548-2076

Idaho	Jennie Records Idaho Emergency Response Commission Division of Environment Statehouse Boise, ID 83720 (208) 334-5888
Illinois	Mr. Will Flower Public Information Officer #8 Illinois Environmental Protection Agency P.O. Box 19276 2200 Churchill Road Springfield, IL 62794-9276 (217) 782-5562
Indiana	Mr. Skip Powers, Staff Director Indiana Emergency Response Commission Indiana Department of Environmental Management Management Office of Emergency Response 5500 West Bradbury Avenue Indianapolis, IN 46241 (317) 243-5123
Iowa	**To obtain copies of the form contact.** Mr. Peter Hamlin Chief, Air Quality and Solid Waste Department of Natural Resources Des Moines, IA 50319 (515) 281-8852
Kansas	Karl Birns Right-to-Know Program Kansas Department of Health and Environment Building 728, Forbes Field Topeka, KS 66620 (913) 296-1690
Kentucky	Mr. Bill Burger Department of Environmental Protection 18 Reilly Road Frankfort, KY 40601 (502) 564-2150
Louisiana	**Section 313, Multi-Media Issues:** Mr. Bruce Hammatt Emergency Response Coordinator Department of Environmental Quality Office of Water Resources P.O. Box 44091 Baton Rouge, LA 70804-4091 (504) 342-6363

Louisiana (Cont)

Health and Toxicology Issues:
Ruddie Clarkson, Ph.D.
Department of Health
P.O. Box 60630, Room 513
New Orleans, LA 70160
(504) 568-5051

Air Media Issues:
Atly Brasher
Department of Environmental Quality
P.O. Box 44096
Baton Rouge, LA 70804-4091
(504) 342-1220

Water Pollution Issues:
Mr. Roger Hartzog
Department of Environmental Quality
Office of Water Resources
P.O. Box 44091
Baton Rouge, LA 70804-4091
(504) 342-6363

Hazardous Waste Issues:
Mr. Jim Brent
Department of Environmental Quality
Inactive and Abandoned Sites Division
P.O. Box 44307
Baton Rouge, LA 70804-4307
(504) 342-8925

Maine

Section 313 Issues:
David Brown, Director
Maine Emergency Management Agency
State Office Building
Station 72
Augusta, ME 04333
(207) 289-4080

Health, Toxicology, and Drinking Water Issues:
Donald Hoxie
Department of Health
Division of Health Engineering
State Office Building
Station 10
Augusta, ME 04333
(207) 289-3826

Air Media Issues:
Dennis Keschl
Department of Environmental Protection
Bureau of Air Quality Control
State Office Building
Station 17
Augusta, ME 04333
(207) 289-2437

Maine (Cont)

Water Pollution Issues:
Stephen Groves
Department of Environmental Protection
Bureau of Water Quality Control
State Office Building
Station 17
Augusta, ME 04333
(207) 289-3901

Hazardous and Solid Waste Issues:
Alan Prysunka
Department of Environmental Protection
Bureau of Oil and Hazardous Materials
State Office Building
Station 17
Augusta, ME 04333
(207) 289-2651

Maryland

Ms. Pam Phillips
Maryland Department of the Environment
Toxics, Environment, Science and Health
201 W. Preston Street
Baltimore, MD 21201
(301) 225-5790

Massachusetts

Section 313 Issues:
Arnold Sapenter
Department of Environmental Quality Engineering (DEQE)
One Winter Street, 9th Floor
Boston, MA 02108
(617) 556-1029

Health and Toxicology Issues:
Carol Rowan-West
Director of Research and Standards
DEQE
One Winter Street, 10th Floor
Boston, MA 02108
(617) 292-5510

Air Media Issues:
Barbara Kwetz
DEQE
One Winter Street, 8th Floor
Boston, MA 02108
(617) 292-5593

Water Pollution Issues:
Thomas McMahon, Director
Division of Water Pollution Control
DEQE
One Winter Street, 7th Floor
Boston, MA 02108
(617) 292-5646

Massachusetts (Cont)

Drinking Water Issues:
Patricia Deese
Division of Water Supply
DEQE
One Winter Street, 9th Floor
Boston, MA 02108
(617) 292-5770

Hazardous Waste Issues:
William Cass
Division of Hazardous Waste
DEQE, 5th Floor
One Winter Street
Boston, MA 02108
(617) 292-5589

Solid Waste Issues:
Jim Miller
DEQE
One Winter Street
Boston, MA 02108
(617) 292-5561

Pesticide Issues:
Jeffery Carlson
Department of Food and Agriculture
21st Floor
100 Cambridge Street
Boston, MA 02202
(617) 727-7712

Michigan

Section 313 Issues:
Mr. David Warner
Environmental Response Division
Michigan Department of Natural Resources
P.O. Box 30028
Lansing, MI 48909
(517) 373-8451

Health and Toxicology Issues:
Michigan Department of Public Health
Toxics Hotline
Lansing, MI
1-800-MI-TOXIC
or
Michigan State University
Center for Environmental Toxicology
(517) 353-0008

Michigan (Cont)

Air Media Issues:
Kathy Simon (Toxicology)
or
Robert Teoh (Standards)
Air Quality Division
Michigan Department of Natural Resources
P.O. Box 30028
Lansing, MI 48909
(517) 373-7023

Water Pollution Issues:
Gary Hurlburt (Toxicology)
or
Jim Grant (Standards)
Surface Water Quality Division
Michigan Department of Natural Resources
P.O. Box 30028
Lansing, MI 48909
(517) 373-2190

Hazardous Waste Issues:
Kim Paksi (Toxicology)
(517) 373-5895
or
Steve Sliver (Standards)
(517) 373-1976
Waste Management Division
Michigan Department of Natural Resources
P.O. Box 30028
Lansing, MI 48909
(517) 373-5895

Pesticide Issues:
Dr. David Wade
Department of Agriculture
(517) 373-1087

Minnesota

Ms. Jean Small-Johnson
Minnesota Pollution Control Agency
520 LaFayette Road
St. Paul, MN 55155
(612) 296-7287

Mississippi

Mr. Bill Austin
Mississippi Emergency Management Agency
1410 Riverside Drive
Jackson, MS 39202
(601) 352-9100

Missouri

Mr. Dean Martin
Missouri Emergency Response Commission
P.O. Box 3133
Jefferson City, MO 65102
(314) 751-7929

Montana

Tom Elleroff
Montana Department of Health and Environmental Sciences
Cogswell Building, A-107
Helena, MT 59620
(406) 444-3948

Nebraska

Mr. Craig Bagstad
Technical Services Section
Nebraska Department of Environmental Control
P.O. Box 98922
Lincoln, NE 68509-8922
(402) 471-4230

Nevada

Bob King, Director
Division of Emergency Management
2525 South Carson
Carson City, NV 89710
(702) 885-4240

New Hampshire

Section 313 Issues:
Lee Kimball
Office of Emergency Management
107 Pleasant Street
Concord, NH 03301
(603) 271-2231

Health and Toxicology Issues:
Dr. Brain Strohm
Director's Office
Division of Public Health Services
Health & Welfare Building
6 Hazen Drive
Concord, NH 03301
(603) 271-4664

Air Media Issues:
Dennis Lunderville
Air Resources Division
64 North Main Street
Concord, NH 03301
(603) 271-1370

Water Pollution and Drinking Water Issues:
Russel Nylander
Division of Environmental Services
Water Supply and Pollution Control Division
Health & Welfare Building
6 Hazen Drive
Concord, NH 03301
(603) 271-3503

New Hampshire (cont.)	**Hazardous and Solid Waste Issues:** John Minichiello Division of Environmental Services Hazardous Waste Bureau Health & Welfare Building 6 Hazen Drive Concord, NH 03301 (603) 272-2942
	Pesticide Issues: Stephen Taylor New Hampshire Department of Agriculture Caller Box 2042 Concord, NH 03302-2042 (603) 271-3550
New Jersey	Jill Lipoti, Ph.D. New Jersey Department of Environmental Protection Division of Environmental Quality--CN-405 401 East State Street Trenton, NJ 08625 (609) 292-6714
New Mexico	**Section 313, Multi-Media, Air Media, and Pesticides Issues:** Mr. Sam Larcombe State Emergency Response Commission 4491 Cerrillos Road Sante Fe, NM 97504-1628 (505) 827-9222
	Health and Toxicology Issues: Mr. Harry Hull State Department of Health and Environment Epidemiology Bureau P.O. Box 968 Sante Fe, NM 87504-0968 (505) 827-0006
	Air Media Issues: Cubia Clayton Air Quality Bureau Chief New Mexico Environmental Improvements Division P.O. Box 968 Santa Fe, NM 87504-0968 (505) 827-0042
	Water Pollution Issues: Mr. Richard Mitzelfelt, Deputy Director Department of Health and Environment Water Management Bureau P.O. Box 968 Sante Fe, NM 87504-0968 (505) 827-2919

New Mexico (cont.)	**Hazardous Waste Issues:** Mr. Jack Ellvinger Environmental Improvement Division Hazardous Waste Bureau P.O. Box 968 Sante Fe, NM 97504-0968 (505) 827-2925
New York	William Miner New York Department of Environmental Conservation Bureau of Emergency Operations 50 Wolf Road Albany, NY 12233 (518) 457-4107
North Carolina	Vance E. Kee North Carolina Division of Emergency Management 116 West Jones Street Raleigh, NC 27603-1335 (919) 733-3867
North Dakota	Dean Monteith North Dakota State Department of Health and Consolidated Laboratories P.O. Box 5520 Bismarck, ND 58502-5520 (701) 224-2374
Ohio	Ms. Cindy Sferra Ohio Environmental Protection Agency P.O. Box 1049 1800 WaterMark Drive Columbus, OH 43266-0149 (614) 644-2286
Oklahoma	**Section 313, Multi-Media, Water Pollution, Hazardous Waste and Pesticide Issues:** Mr. Jack Muse Hazardous Materials Planning Coordinator Oklahoma Civil Defense Division P.O. Box 53365 Oklahoma City, OK 73152 (405) 521-2481
	Health and Toxicology Issues: Nancy Coleman, Ph.D. Oklahoma State Department of Health Air Quality Service P.O. Box 53551 Oklahoma City, OK 73152 (405) 271-5220

Oklahoma (cont.)	**Air Media Issues:** Mr. Dennis Doughty Oklahoma State Department of Health Air Quality Service P.O. Box 53551 Oklahoma City, OK 73152 (405) 271-5220
Oregon	**To obtain copies of the form, contact:** Mr. Dennis Walthall Oregon State Fire Marshal Hazardous Materials Section 3000 N.E. Market Salem, OR 97310 (503) 378-2885
Pennsylvania	Fred Osman Bureau of Air Quality Control Division of Technical Services and Monitoring P.O. Box 2063 Harrisburg, PA 17120 (717) 787-5027
Puerto Rico	Mr. Juan Merced Mateo Puerto Rico Environmental Quality Board Emergency Response Section P.O. Box 11488 Santurce, PR 00910 (809) 725-5140
Rhode Island	Martha Delany Department of Environmental Management Division of Air and Hazardous Materials 204 Cannon Building 75 Davis Street Providence, RI 02908 (401) 277-2808
South Carolina	Mr. Ron Kinney Department of Health and Environmental Control 2600 Bull Street Columbia, SC 29201 (803) 734-5200
South Dakota	Robin Livermore South Dakota Department of Water and Natural Resources Joe Foss Building 523 East Capitol Pierre, SD 57501 (605) 773-3153

Tennessee

Department of Health and Environment
701 Broadway
Nashville, TN 37219
(615) 741-6287

Texas

Section 313 Issues:
Mr. David Barker
Emergency Response Unit
Texas Water Commission
P.O. Box 1307, Capitol Station
Austin, TX 78711
(512) 463-8527

Health and Toxicology, Multi-Media, Water Pollution, Hazardous Waste and Pesticide Issues:
Pricilla Seymour, Ph.D.
Texas Water Commission
P.O. Box 13087, Capitol Station
Austin, TX 78711
(512) 463-8527

Air Issues:
Mr. Jim Meyers
Texas Air Control Board
6330 Highway 290 East
Austin, TX 78723
(512) 451-5711

Utah

Neil Taylor
Utah Department of Health
Division of Environmental Health
P.O. Box 16690
288 North 1460 West
Salt Lake City, UT 84116-0690
(801) 538-6121

Vermont

Section 313 Issues:
Ray McCandless
Director, Occupational Health
Administration Building
10 Baldwin Street
Montpelier, VT 05602
(802) 828-2886

Health and Toxicology Issues:
William Bress
Department of Health
Laboratory
115 Colchester Avenue
P.O. Box 70
Burlington, VT 05402
(802) 863-7558

Vermont (Cont)

Air Media Issues:
Harold Garabedian
Department of Environmental Conservation
Air Pollution Control Division
103 South Main Street
Building 3 South
Waterbury, VT 05676
(802) 244-8731

Water Pollution Issues:
David Clough
Department of Environmental Conservation
Water Quality Division
103 South Main Street
Building 10 North
Waterbury, VT 05676
(802) 244-6951

Drinking Water Issues:
Kenneth Stone
Department of Health
P.O. 70
60 Main Street
Burlington, VT 05402
(802) 863-7223

Hazardous Waste Issues:
John Malter
Waste Management Division
West Building
103 South Main Street
Waterbury, VT 05676
(802) 244-8702

Solid Waste Issues:
Ed Leonard
Waste Management Division
West Building
103 South Main Street
Waterbury, VT 05676
(802) 244-8702

Pesticide Issues:
Phillip Benedict
Department of Agriculture
116 State Street
Montpelier, VT 05602
(802) 828-2420

Virginia

All Title III and Section 313 Issues:
Mr. Wayne T. Halbeleib
Department of Waste Management
James Monroe Building
101 North 14 Street
Richmond, VA 23219
(804) 225-2667

Health and Toxicology Issues:
Dr. C.M.G. Buttery, Commissioner
Virginia Department of Health
109 Governor Street
James Madison Building
Richmond, VA 23219
(804) 786-3561

Multi-Media, Hazardous Waste and Pesticide Issues:
Ms. Cynthia V. Bailey, Executive Director
Virginia Department of Waste Management
101 North 14th Street, 11th Floor
Richmond, VA 21219
(804) 225-2667

Air Media Issues:
Richard Cook, Executive Director
Virginia Air Pollution Control Board
9th Street Office Building
Richmond, VA 23219
(804) 936-9035

Water Pollution Issues:
Mr. Richard Burton, Executive Director
Virginia Water Pollution Control Board
211 North Hamilton Street
Richmond, VA 23230
(804) 367-6384

Virgin Islands

Alan D. Smith, Commissioner
Department of Planning and Natural Resources
179 Altona and Welgunst
St. Thomas, VI 00800
(809) 774-3320

Washington

Ms. Rebecca Voerman
Washington State Department of Ecology
MS PV-11
Olympia, WA 98504-8711
(800) 633-7585

West Virginia	Mr. William Pinnell Office of Environmental Health Services West Virginia Department of Health 1800 East Washington St., Room 507 Charleston, WV 25305 (304) 348-2981
Wisconsin	Bureau of Technical Services Wisconsin Department of Natural Resources P.O. Box 7865 Madison, WI 53707 (608) 266-0531
Wyoming	Ed Usui, Executive Secretary State Emergency Response Commission Wyoming Emergency Management Agency 5500 Bishop Blvd. Cheyenne, WY 82009 (307) 777-7566

EPA REGIONAL TOXIC RELEASE INVENTORY PUBLIC CONTACT POINTS

EPA Region 1
JFK Federal Building
Boston, MA 02203

Section 313 Issues:
Ann Walsh
Pesticides and Toxic Substances Branch
FTS 835-3230
(617) 565-3230

Health and Toxicology Issues:
Sally Edwards
Program, Planning and Coordination Branch
FTS 835-2993
(617) 565-3276

Air Media Issues:
Norm Anderson
Pesticides and Toxic Substances Branch
FTS 835-3232
(617) 565-3232

Water Pollution Issues:
Eric Hall
Water Quality Branch
FTS 835-3620
(617) 565-3533

Hazardous and Solid Waste Issues:
Art Wing
Connecticut Waste Management Branch
FTS 833-1655
(617) 873-9655

Drinking Water Issues:
Pi-Yun Tsai
Water Supply Branch
FTS 835-3276
(617) 565-3230

Pesticide Issues:
Harold Kazmaier
Pesticides and Toxic Substances Branch
FTS 835-3276
(617) 565-3276

EPA Region 2
26 Federal Plaza
New York, NY 10278

Section 313 Issues:
Nora Lopez
Pesticides and Toxics Branch
USEPA Region 2
Woodbridge Avenue, Building 209
Edison, NJ 08837
FTS 340-6890
(201) 906-6890

or

Kim Helper
Office of External Program
USEPA Region 2
26 Federal Plaza
New York, NY 10278
FTS 264-2515
(212) 264-2515

EPA Region 3
841 Chestnut Street
Philadelphia, PA 19107

Section 313 Issues:
Kurt Elsner
Toxics and Pesticides Branch
FTS 597-1260
(215) 597-1260

EPA Region 4
345 Courtland Street, NE
Atlanta, GA 30365

Section 313 Issues:
Melvin Russel
Toxics and Pesticides Branch
FTS 257-5053
(404) 347-5053

EPA Region 5
536 S. Clark Street
Chicago, IL 60605

Section 313 Issues:
Dennis Wesolowski
Pesticides and Toxics Branch
FTS 353-5907
(312) 353-5907

EPA Region 6
1445 Ross Avenue
Dallas, TX 75202-2733

Section 313, Health and Toxicology Issues:
Gerald Carney
Pesticides and Toxic Substances Branch
FTS 255-7244
(214) 655-7244

Air Media Issues:
Jill Lyons
Air Programs Branch
FTS 255-7208
(214) 655-7208

Water Pollution Issues:
Jack Ferguson
Permits Branch
FTS 255-7190
(214) 655-7190

Drinking Water Issues:
Ed Jeffrey, Ph.D
Water Supply Branch
FTS 255-7155
(214) 655-7155

Public Affairs:
Karen Brown
External Affairs
FTS 255-2200
(214) 655-2200

EPA Region 7
726 Minnesota Avenue
Kansas City, KS 66101

Section 313 Issues:
Ed Vest
Congressional and Intergovernmental Liaison
FTS 757-2806
(913) 236-2806

EPA Region 8
999 18th Street
Denver, CO 80202-2405

Section 313 Issues:
Dianne Groh
Gene Johnson (Alternate)
Paul Grim (Alternate)
Toxic Substances Branch
FTS 564-1730
(303) 293-1730

Health and Toxicology Issues:
Dr. Suzanne Wuerthele
Toxic Substances Branch
FTS 564-1730
(303) 293-1730

Multi-Media Issues:
Dianne Groh
Toxic Substances Branch
FTS 564-1730
(303) 293-1730

Air Media Issues:
Katie Lunsford
FTS 564-1814
(303) 293-1814

Drinking Water Issues:
Pat Crotty
FTS 564-1408
(303) 293-1408

Region 8 (cont.)

Water Pollution Issues:

Industrial Discharges:
Pat Godsil
FTS 564-1623
(303) 293-1623

Municipal discharges:
Jim Brooks
FTS 564-1549
(303) 293-1549

Surface Water Quality:
Dale Vodehnal
FTS 564-1565
(303) 293-1565
or
Toney Ott (Alternate)
FTS 564-1574
(303) 293-1574

Section 304(l) Water Toxics:
Bruch Zander
FTS 564-1580
(303) 293-1580

Ground Water Issues:
Dick Long
FTS 564-1796
(303) 293-1796

Hazardous Waste Issues:

Colorado and Montana:
Judy Wong
FTS 564-1798
(303) 293-1798
or
Marcella Devargas (Alternate)
FTS 564-1825
(303) 293-1825

Utah and North Dakota:
Larry Wapensky
FTS 564-1500
(303) 293-1500
or
Mel Poundstone (Alternate)
FTS 564-1704
(303) 293-1704

Wyoming and South Dakota:
Terry Anderson
FTS 564-1790
(303) 293-1790

Randy Lamdin (Alternate for SD)
FTS 564-1797
(303) 293-1797

Bob Stone (Alternate for WY)
FTS 382-5477
(307) 261-5477

Disposal of Small Quantities of Hazardous Waste:
Jon Minkoff
FTS 565-1676
(303) 293-1676

Underground Storage Tanks
Terry Bahrych
FTS 565-1484
(303) 293-1484

Analytical Methods and Laboratory Issues:
Marvin Frye
Building 53
Denver Federal Center
Denver, CO
(303) 236-1484

STORET/SAROAD/GIS
Larry Svoboda
(303) 236-5097

EPA Region 9
215 Fremont Street
San Francisco, CA 94105

Section 313 Issues:
Kathleen Goforth
Pesticides and Toxics Branch
FTS 454-7280
(415) 974-7280

Health and Toxicology Issues:
Gerry Hiatt
Office of Health and Emergency Planning
FTS 454-0579
(415) 974-0579

EPA Region 9 (cont.)

Air Media Issues:
Kathy Diehl
Air Toxics Office
FTS 454-8381
(415) 974-8381

Water Pollution Issues:
Bill Pierce
Permits Branch
FTS 454-8110
(415) 974-8110

Hazardous Waste Issues:
RCRA Information Line
FTS 454-7473
(415) 974-7473
Operated 1-4 PM PST

Pesticides Issues:
Nancy Frost
Pesticides Branch
FTS 454-8366
(415) 974-8366

EPA Region 10
1200 Sixth Avenue
Seattle, WA 98101

Section 313 Issues:
Phil Wong
Pesticides and Toxic Substances Branch
FTS 399-4016
(206) 442-4016

Title III Issues:
Gordon Goff
Superfund Branch
FTS 399-4349
(206) 442-4349

Health and Toxicology Issues:
Pat Cirone
Technical Support Branch
FTS 399-1597
(206) 442-1597

Multi-Media Issues:
Gill Haselberger
Pesticides and Toxic Substances Branch
FTS 399-1094
(206) 442-1094

Air Media Issues:
Elizabeth Waddell
Air Programs Branch
FTS 399-8578
(206) 442-8578

Drinking Water Issues:
Larry Worley
Drinking Water Branch
FTS 399-1893
(206) 442-1893

Water Permits Issues:
Jeannine Brown
Water Permits and Compliance Branch
FTS 399-1214
(206) 442-1214

Hazardous Waste Issues:
Mike Gearheard
Waste Management Branch
FTS 399-2777
(206) 442-2777

Pesticide Issues:
Chuck Shenk
Pesticides and Toxic Substances Branch
FTS 399-1270
(206) 442-1270

APPENDIX A-1

CALIFORNIA HEALTH OFFICERS DIRECTORY

April 1988

ALAMEDA COUNTY
Carl. L. Smith, M.D.
499 5th Street
Oakland, CA 94607
(415) 268-2727

ALPINE COUNTY
Gregory J. Hayes, M.D.
P.O. Box 306
Markleeville, CA 96120
(916) 694-2146

AMADOR COUNTY
James McClenahan, M.D.
108 Court Street
Jackson, CA 95642
(209) 223-6407

BERKELEY CITY
Carmen Nevarez, M.D.
2180 Milvia Street, 3rd Fl.
Berkeley, CA 94704
(415) 644-6421

BUTTE COUNTY
Chester L. Ward, M.D.
18 County Center Drive
Suite B
Oroville, CA 95965
(916) 538-7581

CALAVERQS COUNTY
Robert Marshall, M.D.
Government Center
San Andreas, CA 95249
(209) 754-6465

COLUSA COUNTY
John R. Heckman, M.D.
251 East Webster Street
Collusa, CA 95932
(916) 458-5177

CONTRA COSTA COUNTY
William B. Walker, M.D.
2500 Alhambra Avenue
Martinez, CA 94553-3191
(415) 646-4416

DEL NORTE COUNTY-See
Humboldt-Del Norte

EL DORADO COUNTY
Curtiss E. Weidmer, M.D.
931 Spring Street
Placerville, CA 95667
(916) 626-2131

FRESNO COUNTY
Donn R. Cobb, M.D.
P.O. Box 11867
Fresno, CA 93775
(209) 445-3200

GLENN COUNTY
Robert Zadra, M.D.
240 North Villa Avenue
Willows, CA 95988
(916) 934-5418

HUMBOLDT-DEL NORTE
Paul Anderson, M.D.
529 I Street
Eureka, CA 95501
(707) 445-6200

IMPERIAL COUNTY
L. Lee Cottrell, M.D.
El Centro, CA 92243
(619) 339-4429

INYO COUNTY
John H. Eaton, M.D.
P.O. Drawer H
Independence, CA 93526
(619) 878-2411

KERN COUNTY
Leon M. Hebertson, M.D.
1700 Flower Street
Bakerfield, CA 93305-4198
(805) 861-2231

KINGS COUNTY
Sheldon Minkin, M.D.
330 Campus Drive
Hanford, CA 93230
(209) 584-1401

LAKE COUNTY
Peter Stanley, M.D.
922 Bevins Court
Lakeport, CA 95453
(707) 263-2241

LASSEN COUNTY
Ken Korver, M.D.
555 Hospital Lane
Susanville, CA 96130
(916) 257-8311
Ext. 108

LONG BEACH CITY
Rugmini Shah, M.D.
P.O. Box 6157
Long Beach, CA 90806
(213) 427-7421
Ext. 248

LOS ANGELES COUNTY
Robert Gates
313 North Figueroa St.
Los Angeles, CA 90012
(213) 974-8101

MADERA COUNTY
C. Dean McClure, M.D.
14215 Road 28
Madera, CA 93638
(209) 675-7893
Ext. 280

MARIN COUNTY
Theodore Hiatt, M.D.
Marin County Civic
Center, Room 280
San Rafael, CA 94903
(415) 499-6879

MARIPOSA COUNTY
Avery E. Sturm, M.D.
P.O. Box 5
Marifposa, CA 95338
(209) 966-3689

MENDOCINO COUNTY
Craig McMillan, M.D.
Courthouse
Ukiah, CA 95482
(707) 463-4134

MERCED COUNTY
Richard Welch, M.D.
P.O. Box 471
Merced, CA 95341
(240 East 15th Ave)
(209) 385-7421

MODOC COUNTRY
Ed R. Richert, M.D.
139 West Henderson St.
Alturas, CA 96101
(916) 233-4517

MONO COUNTY
John Eaton, M.D.
P.O. Box 476
Bridgeport, CA 93517
(619) 932-7485

MONTEREY COUNTY
Robert J. Melton, M.D.
1270 Natividad Road
Salinas, CA 93906
(408) 755-4525

NAPA COUNTY
Robert S. Hill, M.D.
P.O. Box 749
Napa, CA 94559
(2281 Elm Street)
(707) 253-4461

NEVADA COUNTY
Jerry J. Zarriello, M.D.
HEW Complex
10433 Willow Valley Road
Nevada City, CA 95959
(916) 265-1450

ORANGE COUNTY
Rex Ehling, M.D.
P.O. Box 355
Santa Ana, CA 92702
(714) 834-3155

PASADENA CITY
Gene Stevenson, M.D.
Interim
100 North Garfield Ave.
Room 104
Pasadena, CA 91109
(818) 405-4388

APPENDIX B

TOXIC CHEMICAL RELEASE INVENTORY REPORTING FORM

APPENDIX B - TOXIC CHEMICAL RELEASE INVENTORY REPORTING FORM

A facility must submit a separate Toxic Chemical Release Inventory Reporting Form (hereafter referred to as Form R) for each chemical listed under Section 313. A copy of Form R is attached. Information on Form R that you should be aware of if you are responding to questions from the public or conducting risk screening is found in Parts I and III of the form:

PART I

3.1* Facility Name and Address. A facility's name and/or location may be used to access the TRI data base. The specific location of a facility can also be used to access geographic data bases, which may contain information useful for assessing exposure (e.g., meteorological and demographic data).

3.3 Technical Contact. This individual has been designated by the reporting company to respond to questions from EPA or State officials about information on the Form. This individual may also be able to supply additional information not reported on the Form (e.g., frequency and concentration of the release). The technical contact should not be contacted by the public.

3.4 Public Contact. This person has been designated by the reporting company to answer questions from the public. You can refer citizens who have questions regarding Form R to this person.

3.5 Standard Industrial Classification (SIC) Code.* The SIC code system established by the U.S. Commerce Department classifies business "establishments." Establishments are defined as distinct and separate economic activities that are performed at a single physical location. Businesses may report separately on the activities involving a toxic chemical at each establishment, or group of establishments, rather than submitting a single Form for that chemical for the entire facility. A box must be checked that indicates whether the report contains information about a chemical for an entire facility or for only part of a facility. Facilities that conduct manufacturing operations included in codes 20 through 39 are subject to reporting under Section 313. SIC codes may be used to access the TRI data base.

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*These numbers correspond to numbers used on Form R to categorize the information.

3.6 Latitude and Longitude. This information may be used to access geographic data bases. All facilities must provide latitude and longitude information for the calendar year 1988, and subsequent years. This information was not mandatory for 1987.

3.7 Dun and Bradstreet Number. This is a unique identifying number assigned by the Dun and Bradstreet financial firm to facilities and/or establishments within facilities. The Dun and Bradstreet number can be used to establish a facility's exact location so as to access geographic data bases.

3.8 EPA Identification Number assigned under the Resource Conservation and Recovery Act (RCRA). The EPA I.D. number is a 12-digit number assigned to facilities covered by RCRA hazardous waste regulations.

3.9 National Pollutant Discharge Elimination System (NPDES) Permit Number(s) assigned under Title IV of the Clean Water Act (CWA). NPDES permits are the key to enforcing effluent limitations and water quality standards of the Act. Every point source discharger must obtain a permit from either EPA or an authorized State. Generally, facilities and large cities are required to obtain a permit by 1991. Small cities have until February, 1992. Under these permits, dischargers are subject to both technology-based treatment requirements and, where necessary to protect a designated use, controls based on water quality standards.

3.11 Underground Injection Well Code (UIC) Identification Number assigned under the Safe Drinking Water Act (SDWA). (Brief descriptions of SDWA and other Federal laws are provided in Appendix E.)

[NOTE: The numbers provided in 3.8, 3.9, and 3.11 can help agencies investigate regulation for a particular facility. Toxic chemicals released into the environment without permit restrictions or standards can be identified. The information provided on Form R can also be cross-checked with permit applications. Additional information useful for risk screening that is not reported under Section 313 may be found on these permits.]

PART II

No information useful for risk screening.

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*For more information on SIC codes, consult Standard Industrial Classification Manual 1987, available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. Phone: (703) 487-4650.

PART III

1.2 Chemical Abstract Service (CAS) Number. This number identifies the chemical released. You can use it to access the TRI data base, the "Roadmaps" Directory (Attachment A), and many health effects data bases.

1.3 Chemical or Chemical Category Name. Like the CAS number, the chemical's name can be used to access many resources that provide information on the chemical, including the TRI data base, the Roadmaps Directory (Attachment A), the EPA Hazardous Substance Fact Sheets (Appendix D), and chemical data bases. If a chemical category name is given, you will not know exactly which chemical is being released. However, you may be able to obtain information about the potency characteristics of some chemicals included within the category.

1.4 Generic Chemical Name. If the reporting company claims the released chemical is a trade secret, the CAS number and chemical name will not be provided. Instead, the reporting company will provide a generic chemical name that is descriptive of the chemical structure. Since you do not know the chemical's exact identity, you will not be able to determine its effects and potency. However, you may be able to identify related chemicals that may have similar characteristics.

2 Mixture Component Identity.* If the chemical is part of a mixture, the reporting company is allowed to identify it using a generic chemical name. As in 1.4 above, this will hamper your ability to characterize the effects and toxicological potency of the chemical. Mixtures also present additional difficulties in assessing health or ecological risks. Unlike a single chemical, mixtures may or may not exhibit distinct toxic effects or effects characteristic of individual mixture components. Additionally, not all the components of a mixture may be known, and toxicologic data on the known components may be scarce.

3 Activities and Uses of the Chemical at the Facility. For certain chemical uses, it may be possible to estimate the likely rates of release, release patterns, and background exposures based on generic industry data (see Appendix C).

5A Releases of the Chemical to the Environment. This part of the Form tells you (1) how much of the chemical is being released each year, and (2) into what media. Releases are reported in units of pounds per year as a range or a single number, depending on the total quantity released. Five categories of releases are reported: 1) fugitive or non-point air emissions; 2) stack or point air emissions; 3) discharges to water (any surface water bodies or streams into which the chemical is directly discharged must be reported, and this information is found in Part I of the Form, 3.10); 4) underground injection; and 5) releases to land. The total release reported for each of these categories includes routine releases and any accidental releases.

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*Guidance on assessing the health and ecological risks of chemical mixtures is provided in the Federal Register, September 24, 1986, Vol. 51. pp. 34014-34025.

5B Basis of Estimate.* Most Section 313 release data will be estimates rather than measurements of releases. Facilities must consider all possible sources of release in making their calculations. This is complex if the chemical is made or used in multiple processes. Estimation techniques also vary in complexity and reliability. Accordingly, so will the accuracy of the estimates generated. In some cases, it may be possible for an estimate to be off by as much as an order of magnitude or more. There are four methods that facilities may use in calculating release estimates:

- Monitoring data. Monitoring data must be used if accurate and readily available. Section 313 does not require facilities to perform additional monitoring, but if data have been collected at a facility in accordance with other laws or as part of routine facility operations, these data must be used, to the extent possible, in estimating releases.

- Mass balance. This method can be used for estimating releases when monitoring data are not available and when input and output streams are quantified. Mass balance can be performed around entire processes or pieces of process equipment. The mass of material leaving a vessel equals the mass entering. If input and output streams are known (based on measured values), a wastestream can be calculated as the difference between input and product (any accumulation/depletion of the chemical in the equipment must also be accounted for).

- Published emission factors. Commonly used for estimating air emissions, emission factors may be based on the average measured emissions at several facilities in the same industry.

- Other approaches. Other approaches, such as engineering calculations (e.g., estimating volatilization or solubility using published mathematical formulas), can also be used.

Facilities may use more than one of these estimation techniques to obtain a single release estimate. However, Form R simply asks for the principal method used to derive an estimate. If, for example, 40% of the stack emissions of the reported substance were derived using monitoring data, 30% by mass balance, and 30% by emission factors, monitoring would be the principal method and it would be entered on the Form. Some understanding of how facilities derive releases and which approaches are most effective for each type of release (i.e., likely to yield the most accurate estimates) is useful to assessing the accuracy of the reported data.

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*For more information on estimation techniques and their relative effectiveness, see EPA's Estimating Releases and Waste Treatment Efficiencies for the Toxic Chemical Release Inventory Form (a complete citation is provided in the Bibliography.)

(Important: Type or print; read instructions before completing form.)

U.S. Environmental Protection Agency

EPA TOXIC CHEMICAL RELEASE INVENTORY REPORTING FORM

EPA FORM **R**

Section 313, Title III of The Superfund Amendments and Reauthorization Act of 1986

PART I. FACILITY IDENTIFICATION INFORMATION

(This space for EPA use only.)

1. 1.1 Does this report contain trade secret information? ☐ Yes (Answer 1.2) ☐ No (Do not answer 1.2) | 1.2 Is this a sanitized copy? ☐ Yes ☐ No | 1.3 Reporting Year

2. CERTIFICATION (Read and sign after completing all sections.)

I hereby certify that I have reviewed the attached documents and that, to the best of my knowledge and belief, the submitted information is true and complete and that the amounts and values in this report are accurate based on reasonable estimates using data available to the preparers of this report.

Name and official title of owner/operator or senior management official

Signature | Date signed

3. FACILITY IDENTIFICATION

3.1 Facility or Establishment Name
Street Address
City | County
State | Zip Code

3.2 This report contains information for: (check one)
a. ☐ An entire covered facility.
b. ☐ Part of a covered facility.

3.3 Technical Contact | Telephone Number (include area code) ( ) -

3.4 Public Contact | Telephone Number (include area code) ( ) -

3.5 a. SIC Code | b. | c.

3.6 Latitude Deg. Min. Sec. | Longitude Deg. Min. Sec.

3.7 Dun & Bradstreet Number(s) a. | b.

3.8 EPA Identification Number (RCRA I.D. No.) a. | b.

3.9 NPDES Permit Number(s) a. | b.

Where to send completed forms:

U.S. Environmental Protection Agency
P.O. Box 70266
Washington, DC 20024-0266
Attn: Toxic Chemical Release Inventory

3.10 Name of Receiving Stream(s) or Water Body(s)
a.
b.
c.

3.11 Underground Injection Well Code (UIC) Identification No.

4. PARENT COMPANY INFORMATION

4.1 Name of Parent Company

4.2 Parent Company's Dun & Bradstreet No.

(This space for EPA use only.)

EPA FORM R
PART II. OFF-SITE LOCATIONS TO WHICH TOXIC CHEMICALS ARE TRANSFERRED IN WASTES

1. PUBLICLY OWNED TREATMENT WORKS (POTW)

Facility Name

Street Address

City | County

State | Zip

2. OTHER OFF-SITE LOCATIONS - Number these locations sequentially on this and any additional page of this form you use.

☐ **Other off-site location**

EPA Identification Number (RCRA ID. No.)

Facility Name

Street Address

City | County

State | Zip

Is location under control of reporting facility or parent company? ☐ Yes ☐ No

☐ **Other off-site location**

EPA Identification Number (RCRA ID. No.)

Facility Name

Street Address

City | County

State | Zip

Is location under control of reporting facility or parent company? ☐ Yes ☐ No

☐ **Other off-site location**

EPA Identification Number (RCRA ID. No.)

Facility Name

Street Address

City | County

State | Zip

Is location under control of reporting facility or parent company? ☐ Yes ☐ No

☐ Check if additional pages of Part II are attached.

(This space for EPA use only.)

EPA FORM R

PART III. CHEMICAL SPECIFIC INFORMATION

1. CHEMICAL IDENTITY

1.1 ☐ Trade Secret (Provide a generic name in 1.4 below. Attach substantiation form to this submission.)

1.2 CAS # ☐☐☐☐☐☐ - ☐☐ - ☐ (Use leading zeros if CAS number does not fill space provided.)

1.3 Chemical or Chemical Category Name

1.4 Generic Chemical Name (Complete only if 1.1 is checked.)

2. MIXTURE COMPONENT IDENTITY (Do not complete this section if you have completed Section 1.)

Generic Chemical Name Provided by Supplier (Limit the name to a maximum of 70 characters (e.g., numbers, letters, spaces, punctuation)).

3. ACTIVITIES AND USES OF THE CHEMICAL AT THE FACILITY (Check all that apply.)

3.1 Manufacture: a. ☐ Produce b. ☐ Import c. ☐ For on-site use/processing d. ☐ For sale/ distribution e. ☐ As a byproduct f. ☐ As an impurity

3.2 Process: a. ☐ As a reactant b. ☐ As a formulation component c. ☐ As an article component d. ☐ Repackaging only

3.3 Otherwise Used: a. ☐ As a chemical processing aid b. ☐ As a manufacturing aid c. ☐ Ancillary or other use

4. MAXIMUM AMOUNT OF THE CHEMICAL ON SITE AT ANY TIME DURING THE CALENDAR YEAR

☐☐ (enter code)

5. RELEASES OF THE CHEMICAL TO THE ENVIRONMENT

You may report releases of less than 1,000 lbs. by checking ranges under A.1.		A. Total Release (lbs/yr) A.1 Reporting Ranges 0	1–499	500–999	A.2 Enter Estimate	B. Basis of Estimate (enter code)	C. % From Stormwater
5.1 Fugitive or non-point air emissions	5.1a					5.1b ☐	
5.2 Stack or point air emissions	5.2a					5.2b ☐	
5.3 Discharges to water 5.3.1 ☐ (Enter letter code from Part I Section 3.10 for streams(s).)	5.3.1a					5.3.1b ☐	5.3.1c
5.3.2 ☐	5.3.2a					5.3.2b ☐	5.3.2c
5.3.3 ☐	5.3.3a					5.3.3b ☐	5.3.3c
5.4 Underground injection	5.4a					5.4b ☐	
5.5 Releases to land 5.5.1 ☐☐☐ (enter code)	5.5.1a					5.5.1b ☐	
5.5.2 ☐☐☐ (enter code)	5.5.2a					5.5.2b ☐	
5.5.3 ☐☐☐ (enter code)	5.5.3a					5.5.3b ☐	

☐ (Check if additional information is provided on Part IV-Supplemental Information.)

6. TRANSFERS OF THE CHEMICAL IN WASTE TO OFF-SITE LOCATIONS

You may report transfers of less than 1,000 lbs. by checking ranges under A.1.	A. Total Transfers (lbs/yr)				B. Basis of Estimate (enter code)	C. Type of Treatment/ Disposal (enter code)
	A.1 Reporting Ranges			A.2 Enter Estimate		
	0	1–499	500–999			
6.1 Discharge to POTW					6.1b ☐	
6.2 Other off-site location (Enter block number from Part II, Section 2.) ☐					6.2b ☐	6.2c ☐☐☐
6.3 Other off-site location (Enter block number from Part II, Section 2.) ☐					6.3b ☐	6.3c ☐☐☐
6.4 Other off-site location (Enter block number from Part II, Section 2.) ☐					6.4b ☐	6.4c ☐☐☐

☐ (Check if additional information is provided on Part IV-Supplemental Information)

7. WASTE TREATMENT METHODS AND EFFICIENCY

A. General Wastestream (enter code)	B. Treatment Method (enter code)	C. Range of Influent Concentration (enter code)	D. Sequential Treatment? (check if applicable)	E. Treatment Efficiency Estimate	F. Based on Operating Data? Yes	No
7.1a ☐	7.1b ☐☐☐	7.1c ☐	7.1d ☐	7.1e %	7.1f ☐	☐
7.2a ☐	7.2b ☐☐☐	7.2c ☐	7.2d ☐	7.2e %	7.2f ☐	☐
7.3a ☐	7.3b ☐☐☐	7.3c ☐	7.3d ☐	7.3e %	7.3f ☐	☐
7.4a ☐	7.4b ☐☐☐	7.4c ☐	7.4d ☐	7.4e %	7.4f ☐	☐
7.5a ☐	7.5b ☐☐☐	7.5c ☐	7.5d ☐	7.5e %	7.5f ☐	☐
7.6a ☐	7.6b ☐☐☐	7.6c ☐	7.6d ☐	7.6e %	7.6f ☐	☐
7.7a ☐	7.7b ☐☐☐	7.7c ☐	7.7d ☐	7.7e %	7.7f ☐	☐
7.8a ☐	7.8b ☐☐☐	7.8c ☐	7.8d ☐	7.8e %	7.8f ☐	☐
7.9a ☐	7.9b ☐☐☐	7.9c ☐	7.9d ☐	7.9e %	7.9f ☐	☐
7.10a ☐	7.10b ☐☐☐	7.10c ☐	7.10d ☐	7.10e %	7.10f ☐	☐
7.11a ☐	7.11b ☐☐☐	7.11c ☐	7.11d ☐	7.11e %	7.11f ☐	☐
7.12a ☐	7.12b ☐☐☐	7.12c ☐	7.12d ☐	7.12e %	7.12f ☐	☐
7.13a ☐	7.13b ☐☐☐	7.13c ☐	7.13d ☐	7.13e %	7.13f ☐	☐
7.14a ☐	7.14b ☐☐☐	7.14c ☐	7.14d ☐	7.14e %	7.14f ☐	☐

☐ (Check if additional information is provided on Part IV-Supplemental Information.)

8. OPTIONAL INFORMATION ON WASTE MINIMIZATION

(Indicate actions taken to reduce the amount of the chemical being released from the facility. See the instructions for coded items and an explanation of what information to include.)

A. Type of modification (enter code)	B. Quantity of the chemical in the wastestream prior to treatment/disposal			C. Index	D. Reason for action (enter code)
	Current reporting year (lbs/yr)	Prior year (lbs/yr)	Or percent change		
☐☐	_____	_____	_____ %	☐☐	☐☐

(This space for EPA use only.)

EPA FORM R
PART IV. SUPPLEMENTAL INFORMATION

Use this section if you need additional space for answers to questions in Parts I and III.
Number or letter this information sequentially from prior sections (e.g., D,E, F, or 5.54, 5.55).

ADDITIONAL INFORMATION ON FACILITY IDENTIFICATION (Part I - Section 3)			
3.5	SIC Code		
3.7	Dun & Bradstreet Number(s)		
3.8	EPA Identification Number(s) RCRA I.D. No.)		
3.9	NPDES Permit Number(s)		
3.10	Name of Receiving Stream(s) or Water Body(s)		

ADDITIONAL INFORMATION ON RELEASES TO LAND (Part III - Section 5.5)							
Releases to Land		A. Total Release (lbs/yr)				B. Basis of Estimate (enter code)
		A.1 Reporting Ranges			A.2 Enter Estimate	
		0	1-499	500-999		
5.5___ (enter code)	5.5___a					5.5___b
5.5___ (enter code)	5.5___a					5.5___b
5.5___ (enter code)	5.5___a					5.5___b

ADDITIONAL INFORMATION ON OFF-SITE TRANSFER (Part III - Section 6)							
		A. Total Transfers (lbs/yr)				B. Basis of Estimate (enter code)	C. Type of Treatment/ Disposal (enter code)
		A.1 Reporting Ranges			A.2 Enter Estimate		
		0	1-499	500-999			
6.___ Discharge to POTW	6.___a					6.___b	
6.___ Other off-site location (Enter block number from Part II, Section 2.)	6.___a					6.___b	6.___c.
6.___ Other off-site location (Enter block number from Part II, Section 2.)	6.___a					6.___b	6.___c.

ADDITIONAL INFORMATION ON WASTE TREATMENT (Part III - Section 7)						
A. General Wastestream (enter code)	B. Treatment Method (enter code)	C. Range of Influent Concentration (enter code)	D. Sequential Treatment? (check if applicable)	E. Treatment Efficiency Estimate	F. Based on Operating Data? Yes	No
7.___a	7.___b	7.___c	7.___d	7.___e %	7.___f	
7.___a	7.___b	7.___c	7.___d	7.___e %	7.___f	
7.___a	7.___b	7.___c	7.___d	7.___e %	7.___f	
7.___a	7.___b	7.___c	7.___d	7.___e %	7.___f	
7.___a	7.___b	7.___c	7.___d	7.___e %	7.___f	

b. Instructions.

INSTRUCTIONS FOR COMPLETING EPA FORM R, THE TOXIC CHEMICAL RELEASE REPORTING FORM

GENERAL INFORMATION

A complete report Form R must be submitted for each toxic chemical manufactured, processed, or otherwise used at each covered facility as prescribed in the reporting rule in 40 CFR Part 372. These instructions supplement and elaborate on the requirements in the reporting rule. Together with the reporting rule, they constitute the reporting requirements; you should read both before attempting to complete Form R. All references in these instructions are to sections in the reporting rule unless otherwise indicated.

The *Toxic Chemical Release Reporting Form*, EPA *Form R*, consists of four parts:

- Part I, Facility Identification Information;
- Part II, Off-Site Locations to Which Toxic Chemicals are Transferred in Wastes;
- Part III, Chemical Specific Information; and
- Part IV, Supplemental Information.

Form R is designed so that a majority of the information required in Part I and all of the information required in Part II should be the same for each chemical reported by your facility. If the information in Parts I and II are identical for two or more chemicals, you may submit photostatic copies of those parts for those chemicals as long as each Part I has an original signature on the certification statement. Part III must be completed separately for each chemical. Part IV provides additional space, if needed, to complete the information required by the preceding sections of the form.

A complete report for any listed toxic chemical that is not claimed trade secret consists of the following completed parts:

- Part I with an original signature on the certification statement (Section 2);
- Part II;
- Part III (Section 8 is optional); and
- If applicable, Part IV.

A complete report for a toxic chemical claimed trade secret includes all of the above items plus the following:

- A completed trade secret substantiation form;
- A "sanitized" version of the report in which the chemical identity items (Part III, Sections 1.2 and 1.3) have been left blank but in which a generic chemical name has been supplied (Part III, Section 1.4); and
- A "sanitized" version of the trade secret substantiation form.

WHEN THE REPORT MUST BE SUBMITTED

The report for any calendar year must be submitted on or before July 1 of the following year (e.g., the report for calendar year 1987, January through December, must be submitted on or before July 1, 1988).

WHERE TO SEND THE REPORT

Submit reports, including reports containing trade secret claims (i.e., sanitized) to:

U.S. Environmental Protection Agency
P.O. Box 70266
Washington, D.C. 20024-0266
Attn: Toxic Chemical Release Inventory

In addition, you must send a copy of the report to the State (State of the U.S., the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the U.S. Virgin Islands, the Northern Mariana Islands, and any other territory or possession over which the U.S. has jurisdiction) in which the facility is located. States will provide addresses where the copies of the reports are to be sent. Copies of the report sent to the State should be the "sanitized," non-trade-secret version of the report, unless the State specifically requests otherwise. For additional information, refer to the discussion of trade secret/confidentiality claims in the instructions for completing Part III, Section 1, of the form.

HOW TO OBTAIN FORMS AND OTHER INFORMATION

Additional copies of EPA Form R and related guidance documents may be obtained from:

Emergency Planning and Community Right-to-Know Hotline
U.S. Environmental Protection Agency
WH-562A
401 M Street, S.W.
Washington, D.C. 20460
(800) 535-0202
(202) 479-2449 (Washington D.C. and Alaska)

INSTRUCTIONS FOR COMPLETING SPECIFIC SECTIONS OF EPA FORM R

The following are specific instructions for completing each section of EPA Form R. The number designations of the parts and sections of these instructions correspond to those in Form R unless otherwise indicated.

PART I. FACILITY IDENTIFICATION INFORMATION

1.1 Does This Report Contain Trade Secret Information?

You must answer this question only after you have completed the rest of the report. The specific identity of the toxic chemical being reported in Part III, Sections 1.2 and 1.3 may be designated as trade secret. If you are making a trade secret claim, answer by marking the "yes" box and proceed to Section 1.2. (See Part III, Section 1, of these instructions for specific instructions on trade secrecy claims.) If the answer is no, proceed to Section 1.3.

1.2 Is This a Sanitized Copy?

You must answer this question only after you have completed the rest of the report. Answer yes if this copy of the report is the public "sanitized" version of a report where the chemical identity is claimed trade secret in Part III, Section 1.4 of the report. Otherwise, answer no.

1.3 Reporting Year

In Section 1.3, you must enter the year to which the reported information applies, not the year in which you are submitting the report.

2. Certification

The certification statement must be signed by the owner or operator, or a senior official with management responsibility for the person (or persons) completing the form. The owner, operator, or official must certify the accuracy and completeness of the information reported on the form by signing and dating the certification statement. Each report must contain an original signature. Print or type the name and title of the person who signs the statement in the space provided. This certification statement applies to all the information supplied on the form and should be signed only after the form has been completed.

3. Facility Identification

3.1 Facility Name and Location

You must enter the name of your facility (plant site name or appropriate facility designation), street address, city, county, state, and zip code in the space provided. You may not use a post office box number for this location information. The address provided should be the location where the chemicals are manufactured, processed, or otherwise used.

3.2 Full or Partial Facility Indication

You must indicate whether your report is for the covered facility as a whole or for part of a covered facility. Check box a. if the report contains information about a chemical for an entire covered facility. Check box b. if the report contains information about a chemical but for only part of a covered facility.

The SIC code system classifies business "establishments," which are defined as "distinct and separate economic activities [which] are performed at a single physical location." Under section 372.30(c) of the reporting rule, you may choose to submit a separate Form R for each establishment, or for groups of establishments, in your covered facility. This allows you the option of reporting separately on the activities involving a toxic chemical at each establishment, or group of establishments (e.g., part of a covered facility), rather than submitting a single Form R for that chemical for the entire facility. You may do this provided that all releases of the toxic chemical from the entire covered facility are reported. However, if an establishment or group of establishments does not manufacture, process, otherwise use, or release a toxic chemical, then you do not have to submit a report on that chemical from that establishment or group of establishments.

3.3 Technical Contact

You must enter the name and telephone number (including area code) of a technical representative whom EPA or State officials may contact for clarification of the information reported on the form. This person does not have to be the person who prepares the report or signs the certification statement. However, this person must have detailed knowledge of the report to be able to respond to questions.

3.4 Public Contact

You must enter the name and telephone number of a person who can respond to questions from the public about the report. If you choose to designate the same person as both the technical and the public contact, enter "same as 3.3" in this space. If no public contact is designated in Section 3.4, EPA will treat the technical contact as the public contact.

3.5 Standard Industrial Classification (SIC) Code

You must enter the appropriate 4-digit primary Standard Industrial Classification (SIC) code for your facility. If the report covers more than one establishment, enter the primary 4 digit SIC code for each establishment. You are only required to enter SIC codes for establishments within the facility that fall within SIC codes 20 through 39 as identified in section 372.22 of the reporting rule. Use the Supplemental Information sheet (Part IV) if you need to enter more than three SIC codes.

3.6 Latitude and Longitude

Enter the latitudinal and longitudinal coordinates of your facility. You must supply the latitude and longitude for calendar year 1987 reports if the information is readily available to you. Sources of these data include EPA permits (e.g., NPDES permits), county property records, facility blueprints, and site plans. If these geographic coordinates are not readily available to you for calendar year 1987 reports, enter not applicable [N/A]. All facilities are required to provide this information in reports submitted for the calendar year 1988 and subsequent years. Use leading place holding zeros.

3.7 Facility Dun and Bradstreet Number

You must enter the number assigned by Dun and Bradstreet for your facility or each establishment within your facility. This may be available from your facility's financial office. If none of your establishments have been assigned Dun and Bradstreet Numbers, indicate this in Section 3.7 by entering not applicable [N/A] in box a. If only some of your establishments have been assigned Dun and Bradstreet numbers, indicate this in Section 3.7 by entering those numbers. Use leading place holding zeros. For more than two establishments, use the Supplemental Information sheet (Part IV).

3.8 EPA Identification Number

If your facility has been assigned EPA Identification Numbers, you must enter those numbers. The EPA I.D. Number is a 12-digit number assigned to facilities covered by hazardous waste regulations under the Resource Conservation and Recovery Act (RCRA). Facilities not covered by RCRA are not likely to have an assigned EPA I.D. Number. If your facility does not have an EPA I.D. Number, enter not applicable [N/A] in box a. If your facility has more than two numbers, use the Supplemental Information sheet (Part IV). Use leading place holding zeros.

3.9 NPDES Permit Numbers

You must enter the numbers of any permits your facility holds under the National Pollutant Discharge Elimination System (NPDES). This 9-digit permit number is assigned to your facility by EPA or the State under the authority

of the Clean Water Act. If your facility has more than two permits, use the Supplemental Information sheet (Part IV). Use leading place holding zeros. If your facility does not have a permit, enter not applicable [N/A] in box a.

3.10 Name of Receiving Stream or Water Body

You must enter the name of each surface water body or receiving stream to which chemicals being reported are directly discharged. Report the name of each receiving stream or water body as it appears on the NPDES permit for the facility. Enter not applicable [N/A] to any unneeded spaces. If your facility discharges the toxic chemical to more than three receiving streams or water bodies, use the Supplemental Information sheet (Part IV).

3.11 Underground Injection Well Code (UIC) Identification Number

If your facility has a permit to inject chemical-containing waste which includes any toxic chemical being reported into Class 1 deep wells, you must enter the Underground Injection Control (UIC) 12-digit identification number assigned by EPA or by the State under the authority of the Safe Drinking Water Act. If your facility does not hold such a permit, enter not applicable [N/A] in this space.

4. Parent Company Information

You must provide information on your parent company. For purposes of this form, parent company is defined as a company which directly owns at least 50 percent of the voting stock of another company.

4.1 Name of Parent Company

You must enter the name of the corporation or other business entity that is your parent company. If you have no parent company, enter not applicable [N/A].

4.2 Parent Company's Dun & Bradstreet Number

If applicable, you must enter the Dun and Bradstreet Number for your parent company. The number may be obtained from the treasurer or financial officer of the company. If your parent company does not have a Dun and Bradstreet number, enter not applicable [N/A]. Use leading place holding zeros.

PART II. OFF-SITE LOCATIONS TO WHICH TOXIC CHEMICALS ARE TRANSFERRED IN WASTES

This section requires a listing of all off-site locations to which you transfer wastes containing the toxic chemical. The information that you enter in this section relates to data to be reported in Part III, Section 6, of the form. List only publicly owned treatment works (POTW) and treatment or disposal facilities. Do not list locations to which products containing the toxic chemical are shipped for sale or distribution in commerce or for further use. Also, do not list locations to which wastes containing the chemical are sold or sent for recovery, recycling, or reuse of the toxic chemical.

1. Publicly Owned Treatment Works (POTW)

You must enter the name and address of the POTW to which your facility discharges wastewater containing any toxic chemical you are reporting. If you do not discharge wastewater containing reported toxic chemicals to a POTW, enter not applicable [N/A]. If you discharge wastewater containing toxic chemicals to more than one POTW, use additional copies of Part II.

2. Other Off-Site Locations

In the block next to the heading "Other off-site location," enter a number. For the first such off-site location enter "1" in the block. Continue numbering the off-site locations in ascending order. This is the block number required by Part III, Section 6. If your facility transfers the toxic chemical to more than three off-site locations, use additional copies of Part II and continue numbering these locations in ascending order.

In the spaces provided, you must enter the name and address of each location (other than POTWs) to which you ship or transfer wastes containing the toxic chemical. Also enter the RCRA I.D. Number (EPA I.D. Number) for each such location, if known to you. Such information may be found on the Uniform Hazardous Waste Manifest which is required by RCRA regulations.

You must also indicate in the space provided whether the location is owned or controlled by your facility or your parent company.

PART III. CHEMICAL SPECIFIC INFORMATION

1.1 Trade Secret Block

If you are claiming chemical identity as a trade secret, you must mark the trade secret claim box in Section 1.1. In addition, you must attach a completed trade secret substantiation form to the report, as set forth in the trade secret rule in 40 CFR Part 350. When the chemical identity is claimed trade secret, you must also provide a generic name in Section 1.4.

Note: If you complete and submit your Toxic Chemical Release Inventory Reporting Form before the trade secret rule is in effect, you are still required to substantiate your claim that the specific chemical identity is a trade secret. Accordingly, you should follow the provisions of the proposed trade secret rule and use the proposed trade secret substantiation form which appeared in the FEDERAL REGISTER of October 15, 1987 (52FR 38312-38377).

1.2 CAS Registry Number

You must enter the Chemical Abstracts Service (CAS) registry number that appears in section 372.65 of the reporting rule for the chemical being reported. Use leading place holding zeros. If you are reporting one of the chemical categories in section 372.65 of the rule (e.g., copper compounds), enter [N/A] in the CAS number space. CAS numbers are cross-referenced with an alphabetical list of trade names and chemical names in section 372.65 of the rule.

1.3 Chemical or Chemical Category Name

You must enter in the space provided the name of the chemical or chemical category as it is listed in section 372.65 of the reporting rule. Only use names listed in section 372.65.

1.4 Generic Chemical Name

You must complete Section 1.4 if you are claiming the specific chemical identity of the toxic chemical as a trade secret and have marked the trade secret block in

Section 1.1. The generic chemical name must be descriptive of the chemical structure. You must limit the generic name to seventy characters (e.g., numbers, letters, spaces, punctuation) or less.

2. Mixture Component Identity

Use this section to report a mixture component that you know exceeds a threshold. Do not complete this section if you have completed Section 1 of Part III.

You may have received a mixture or trade name product from another person which you were told contains a section 313 toxic chemical, but that person did not tell you the specific chemical name or CAS number of the toxic chemical. The person may have given you a generic chemical name and the percentage composition of the toxic chemical in the mixture or trade name product under section 372.45 of the reporting rule. If you determine that you have imported, processed, or otherwise used the toxic chemical in the mixture or trade name product in excess of an applicable threshold, you must enter the generic chemical name given to you by your supplier in Section 2. If your supplier did not give you a generic chemical name, you must enter the name by which the supplier identified the chemical to you. (In some cases, this may be the same as the name of the mixture or trade name product.)

For example, your facility uses 20,000 pounds of a solvent which your supplier has told you contains eighty percent "chlorocyclocarbon," his generic name for a chemical subject to reporting under section 313. You therefore know that you have exceeded the use threshold for this toxic chemical. You would enter the name "chlorocyclocarbon," in the space provided in Section 2.

3. Activities and Uses of the Chemical at the Facility

This section requires an indication of whether the chemical is manufactured (including imported), processed, or otherwise used at the facility for which the form is being filed and the general nature of such activities and uses at the facility during the calendar year. Report activities that take place only at your facility, not activities that take place at other facilities involving your products. You must mark all of the appropriate blocks in this Section that apply to the activities at your facility. Refer to the definitions of "manufacture," "process," and "otherwise used" in section 372.3 of the reporting rule for explanations supplementing those provided below.

3.1 Manufacture

a. Produce.
A chemical included in this category is produced at the facility.

b. Import.
A chemical included in this category is imported to the facility.

c. For on-site use/processing.
A chemical included in this category is manufactured and then further processed or otherwise used at the same facility.

d. For sale/distribution.
A chemical in this category is manufactured specifically for sale or distribution outside the manufacturing facility.

e. As a byproduct.
A chemical in this category is produced coincidentally during the production, processing, use, or disposal of another chemical substance or mixture, and following its production, is separated from that other chemical substance or mixture.

f. As an impurity.
A chemical in this category is produced coincidentally with another chemical substance, and is processed, used, or distributed with it.

3.2 Process (incorporative-type activities)

a. As reactant.
A natural or synthetic chemical used in chemical reactions for the manufacture of another chemical substance or of a product. Includes, but is not limited to, feedstocks, raw materials, intermediates, and initiators.

b. As a formulation component.
A chemical added to a product or product mixture prior to further distribution of the product that aids the performance of the product in its use. Examples include, but are not limited to, additives, dyes, reaction diluents, initiators, solvents, inhibitors, emulsifiers, surfactants, lubricants, flame retardants, and rheological modifiers.

c. As an article component.
A chemical substance that becomes an integral component of an article distributed for industrial, trade, or consumer use.

d. Repackaging only.
Processing or preparation of a chemical or product mixture for distribution in commerce in a different form, state, or quantity.

3.3 Otherwise Used (non-incorporative-type activities)

a. As a chemical processing aid.
A chemical that is added to a reaction mixture to aid in the manufacture or synthesis of another chemical substance but does not intentionally remain in or become part of the product or product mixture. Examples of such chemicals include, but are not limited to, process solvents, catalysts, inhibitors, initiators, reaction terminators, and solution buffers.

b. As a manufacturing aid.
A chemical whose function is to aid the manufacturing process but does not become part of the resulting product. Examples include, but are not limited to, lubricants, metalworking fluids, coolants, refrigerants, and hydraulic fluids.

c. Ancillary or other use.
A chemical in this category is used at a facility for purposes other than as a chemical processing aid or manufacturing aid as described above. Includes, but is not limited to, cleaners, degreasers, lubricants, and fuels.

4. Maximum Amount of the Chemical On Site at Any Time During the Calendar Year

You must insert the appropriate code (see below) that indicates the maximum quantity of the chemical (in storage tanks, process vessels, on-site shipping containers, etc.) at your facility at any time during the calendar year. If the chemical was present at several locations within your facility, use the maximum <u>total</u> amount present at the entire facility at any one time.

Range Code	Weight Range in Pounds From...	To....
01	0	99
02	100	999
03	1,000	9,999
04	10,000	99,999
05	100,000	999,999
06	1,000,000	9,999,999
07	10,000,000	49,999,999
08	50,000,000	99,999,999
09	100,000,000	499,999,999
10	500,000,000	999,999,999
11	1 billion	more than 1 billion

If the toxic chemical was present at your facility as part of a mixture or trade name product, to determine the maximum quantity of the chemical present at the facility you must calculate only the weight of the toxic chemical, not the weight of the entire mixture or trade name product. See section 372.30(b) of the reporting rule for further information on how to calculate the weight of the chemical in the mixture or trade name product.

5. Releases of the Chemical to the Environment

In Section 5 you must account for the total aggregate releases of the toxic chemical from your facility to the environment for the calendar year. Releases to the environment include emissions to the air, discharges to surface waters, and releases to land and underground injection wells.

All air releases of the chemical from the facility must be covered. In case of doubt about whether an air release is a point or non-point release, it is important that the release be included as one or the other rather than omitted. Do not enter information on individual emission points or releases. Enter only the total release.

5.1 Fugitive or non-point air emissions.

These are releases to the air that <u>are not</u> released through stacks, vents, ducts, pipes, or any other confined air stream. You must include (1) fugitive equipment leaks from valves, pump seals, flanges, compressors, sampling connections, open-ended lines, etc.; (2) evaporative losses from surface impoundments; (3) releases from building ventilation systems; and (4) any other fugitive or non-point air emissions.

5.2 Stack or point air emissions.

These are releases to the air that are through stacks, vents, ducts, pipes, or other confined air streams. You must include storage tank emissions. Air releases from control equipment would generally fall in this category.

5.3 Discharges to water

You must enter the applicable letter code for the receiving stream or water body from Section 3.10 of Part I of the form. Also, you must enter the total annual amount of the chemical released from all discharge points at the facility to each receiving stream or water body. You must include process outfalls such as pipes and open trenches, releases from on-site wastewater treatment systems, and the contribution from stormwater runoff if applicable (see instructions for column C below). Do not include "indirect" discharges to surface waters such as to a POTW or off-site wastewater treatment facility. These must be reported in Section 6.

5.4 Underground injection

You must enter the total annual amount of the chemical that was injected into wells, including Class I and other types, at the facility.

5.5 Releases to land

You must report quantities of the chemical that were landfilled, impounded, or otherwise disposed of <u>at the facility</u>. Do not report land disposal at off-site locations in this section. You must enter the appropriate disposal code from the following list:

<u>Disposal Codes</u>

D02 Landfill
D03 Land Treatment/Application/Farming
D05 Surface Impoundment (to be closed as a Landfill)
D99 Other Disposal

Three lines are provided in this section of the form to accommodate various types of land disposal.

For the purpose of this form, a surface impoundment is considered "final disposal." Quantities of the chemical released to surface impoundments that are used merely as part of a wastewater treatment process generally must not be reported in this section of the form. However, if the impoundment accumulates sludges containing the chemical, you must include an estimate in this section unless the sludges are removed and otherwise disposed of (in which case they should be reported under the appropriate section of the form). For the purposes of this reporting, storage tanks are not considered to be a type of disposal and are not to be reported in this section of the form.

A. Total Release

Only releases of the toxic chemical to the environment for the calendar year are to be reported in this section of the form. The total releases from your facility <u>do not</u> include transfers or shipments of the chemical from your facility for sale or distribution in commerce or of wastes to other facilities for treatment or disposal (see Section 6.1). Both routine releases, such as fugitive air emissions, and accidental or non-routine releases, such as chemical spills, must be included in your estimate of the quantity released.

A.1 Reporting Ranges

For reports submitted for calendar years 1987, 1988, and 1989 <u>only</u>, you may take advantage of range reporting for releases that are less than 1,000 pounds for the year to an environmental medium. You may mark one of the three boxes, 0, 1-499, or 500-999, corresponding to releases of the chemical to any environmental medium (i.e., any line item); however, you do not have to use these range check boxes. You have the option of providing a specific figure in column A.2 as described below.

For releases of 1,000 pounds or more for the year to any medium, you must provide an estimate in pounds per year in column A.2. Any estimate provided in column A.2 is required to be accurate to no more than two significant figures. Beginning with reports for calendar year 1990, you may not use ranges to report; you must report in column A.2.

A.2 Enter Estimates

You must provide your estimates of releases in pounds for the year in column A.2. This estimate is required to be accurate to no more than two significant figures.

Calculating Releases

To provide the release information required in both Sections A.1 and A.2 in this section of the form, you must use all readily available data (including relevant monitoring data and emissions measurements) collected at your facility pursuant to other provisions of law or as part of routine plant operations, to the extent you have it for the toxic chemical.

When relevant monitoring data or emission measurements are not readily available, reasonable estimates of the amounts released must be made using published emission factors, material balance calculations, or engineering calculations. You may not use emission factors or calculations to estimate releases if more accurate data are available.

No additional monitoring or measurement of the quantities or concentrations of any toxic chemical released into the environment, or of the frequency of such releases, is required for the purpose of completing this form, beyond that which is required under other provisions of law or regulation or as part of routine plant operations.

You must estimate as accurately as possible the quantity in pounds of the chemical or chemical category that is released annually to each environmental medium. Do not include the quantity of components of a waste stream other than the toxic chemical in this estimate.

If the toxic chemical was present at your facility as part of a mixture or trade name product, you must calculate the releases of the chemical only. Do not include releases of the other components of the mixture or trade name product. If you only know about or are only able to estimate the releases of the mixture or trade name product as a whole, you must assume that the toxic chemical is released in proportion to its concentration in the mixture or trade name product. See section 372.30(b) of the reporting rule for further information on how to calculate the concentration and weight of the chemical in the mixture or trade name product.

If you are reporting a chemical category listed in section 372.65(c) of the reporting rule rather than a specific chemical, you must combine the release data for all chemicals in the listed chemical category (e.g., all glycol ethers or all chlorophenols) and report the aggregate amount for that chemical category. Do not report releases of each individual chemical in that category separately. For example, if your facility releases 3,000 pounds per year of 2-chlorophenol, 4,000 pounds per year of 3-chlorophenol, and 4,000 pounds per year of 4-chlorophenol, you should report that your facility releases 11,000 pounds per year of chlorophenols. (Other than for listed chemical categories in section 372.65(c) of the rule, each form must report for an individual chemical.

Listed chemicals with the qualifier "solution," such as sodium sulfate, in concentrations of 1 percent (or 0.1 percent in the case of a carcinogen) or greater, must be factored into threshold and release calculations, because threshold and release amounts relate to the amount of chemical in solution, not the amount of solution.

For metal compound categories (e.g., chromium compounds), report releases of only the parent metal. For example, a user of various inorganic chromium salts would report the total chromium released in each waste type regardless of the chemical form (e.g., as the original salts, chromium ion, oxide, etc.), and exclude any contribution to mass made by other species in the molecule.

B. Basis of Estimate

For each release estimate you are required to indicate the principal method by which the quantity was derived. Enter the letter code to identify the method which applies to the largest portion of the total estimated quantity.

For example, if 40 percent of stack emissions of the reported substance were derived using monitoring data, 30 percent by mass balance, and 30 percent by emission factors, you would enter the code letter "M" for monitoring. The codes are as follows:

M - Based on monitoring data or measurements for the toxic chemical as released to the environment and/or off-site facility.

C - Based on mass balance calculations, such as calculation of the amount of the toxic chemical in streams entering and leaving process equipment.

E - Based on published emission factors, such as those relating release quantity to throughput or equipment type (e.g., air emissions factors)

O - Based on other approaches such as engineering calculations (e.g., estimating volatilization or solubility using published mathematical formulas) or best engineering judgment. This would include applying an estimated removal efficiency to a wastestream even if the composition of stream before treatment was fully characterized by monitoring data.

If the monitoring data, mass balance, or emission factor used to estimate the release is not specific to the toxic chemical, the estimate should be reported as based on engineering calculations or judgment.

C. Percent From Stormwater

This column only relates to Section 5.3 - Discharges to Water. The quantity of the chemical released to any receiving stream or water body in each box in column A must include the amount contributed by stormwater runoff from the facility which contains the chemical. In addition, the percentage of the total quantity (by weight) of the chemical contributed by stormwater must be entered in column C. If your facility has monitoring data on the chemical and an estimate of flow rate, you must use this data to determine percent stormwater.

If your facility does not have periodic measurements of stormwater releases of the chemical but has submitted chemical specific monitoring data in permit applications, then these data must be used to calculate the percent contribution from stormwater. Flow rate data can be estimated by multiplying the annual amount of rainfall times the land area times the runoff coefficient. The runoff coefficient represents the fraction of rainfall that does not infiltrate into the ground but runs off as stormwater. The runoff coefficient is directly related to the land uses located in the drainage area and ranges from 0.5-0.8 for light industrial areas and 0.6-0.9 for heavy industrial areas. Site specific determinations can

be calculated using the following formula:

(1 x fractional paved or roofed area) + (0.2 x fractional grass area) + (0.3 x fractional graveled area) = site runoff coefficient

If you have monitored stormwater but did not detect the chemical, enter zero (0) in this space. If your facility has no stormwater monitoring data for the of the chemical, enter no data [N/D] in this space on the form.

6. Transfers of the Chemical in Waste to Off-Site Locations

You must report in this section the total annual quantity of the chemical sent to any of the off-site disposal, treatment, or storage facilities for which you have provided an address in Part II.

Line 6.1 is for transfers to a POTW. Lines 6.2 through 6.4 are provided for transfers to other off-site locations, including privately owned wastewater treatment facilities.

Enter, from Section 2 of Part II, the block number that corresponds to the off-site location to which you transferred waste containing the chemical. If you need additional space (i.e., you ship waste to more than three off-site locations), check the box at the bottom of Section 6 and use the Supplemental Information sheet (Part IV).

A. Total Transferred

You must follow the instructions for providing estimates as presented in the instructions for column A of Section 5 above. You must enter the amount in pounds of only the toxic chemical that is being transferred; do not enter the total poundage of wastes, including mixtures or trade name products containing the chemical. As with Section 5, you may report in ranges only for calendar years 1987, 1988, and 1989.

B. Basis of Estimate

You must identify the basis for your estimate. Follow the instructions and use the same codes as presented in the instructions for column B of Section 5.

C. Type of Treatment/Disposal

You must enter one of the following codes to identify the type of treatment or disposal method used by the off-site location for the chemical being reported. You may have this information in your copy of EPA Form SO, Item S of the Annual/Biennial Hazardous Waste Treatment, Storage, and Disposal Report (RCRA). Applicable codes for this section are as follows:

M10 Storage Only
M20 Reuse as Fuel/Fuel Blending
M40 Solidification/Stabilization
M50 Incineration/Thermal Treatment
M61 Wastewater Treatment (Excluding POTW)
M69 Other Treatment
M71 Underground Injection
M72 Landfill/Disposal Surface Impoundment
M73 Land Treatment
M79 Other Land Disposal
M90 Other Off-Site Management
M91 Transfer to Waste Broker
M99 Unknown

7. Waste Treatment Methods and Efficiency

In Section 7, you must provide the following information related to the chemical whose releases are being reported: (A) the general wastestream types containing the chemical being reported; (B) the waste treatment methods (if any) used on all wastestreams containing the chemical; (C) the range of concentrations of the chemical in the influent to the treatment method (D) whether sequential treatment is used; (E) the efficiency or effectiveness of each treatment method in removing the chemical; and (F) whether the treatment efficiency figure was based on actual operating data. You must use a separate line in Section 7 for each treatment method used on a wastestream. This section is to be used to report only treatment of wastestreams at your facility, not treatment off-site.

A. General Wastestream

For each waste treatment method report you must indicate the type of wastestream containing the chemical that is treated. Enter the letter code that corresponds to the general wastestream type:

A = Gaseous (including gases, vapors, airborne particulates)
W = Wastewater (aqueous waste)
L = Liquid waste (non-aqueous waste)
S = Solid waste (including sludges and slurries)

If a waste is a mixture of water and organic liquid, you must report it under wastewater unless the organic content exceeds 50 percent. Slurries and sludges containing water must be reported as solid waste if they contain appreciable amounts of dissolved solids, or solids that may settle, such that the viscosity or density of the waste is considerably different from that of process wastewater.

B. Treatment Method

Codes for treatment methods are included in Table I of these instructions. You must enter the code for each treatment method used on a wastestream containing the toxic chemical, regardless of whether this treatment method actually removes the specific chemical. Treatment methods must be reported by type of waste being treated (i.e., gaseous wastes, aqueous wastes, liquid non-aqueous wastes, and solids).

Wastestreams containing the chemical may have a single source or may be aggregates of many sources. For example, process water from several pieces of equipment at your facility may be combined prior to treatment. Report treatment methods that apply to the aggregate wastestream as well as treatment methods that apply to individual wastestreams. If your facility treats various wastewater streams containing the chemical in different ways, the different treatment methods must each be listed separately.

Your facility may have several pieces of equipment performing a similar service. It is not necessary to enter four lines of data to cover four scrubber units, for example, if all four are treating wastes of similar character (e.g., sulfuric acid mist emissions), have similar influent concentrations, and have similar removal efficiencies. If, however, any of these parameters differ from one unit to the next, each scrubber must be listed separately.

C. Range of Influent Concentration

The form requires an indication of the range of concentration of the toxic chemical in the wastestream (i.e., the influent) as it typically enters the treatment equipment. You must enter in the space provided one of

the following code numbers corresponding to the concentration of the chemical in the influent:

1 = Greater than 1 percent
2 = 100 parts per million (0.01 percent) to 1 percent (10,000 parts per million)
3 = 1 part per million to 100 parts per million
4 = 1 part per billion to 1 part per million
5 = Less than 1 part per billion

Note that parts per million (ppm) is milligrams/kilogram (mass/mass) for solids and liquids; cubic centimeters/cubic meter (volume/volume) for gases; milligrams/liter for solutions or dispersions of the chemical in water; and milligrams of chemical/kilogram of air for particulates in air. If you have particulate concentrations (at standard temperature and pressure) as grains/cubic foot of air, multiply by 1766.6 to convert to parts per million: if in mg/m^3, multiply by 0.773 to obtain ppm. (Note: Factors are for standard conditions of $0^{\circ}C$ ($32^{\circ}F$) and 760 mmHg atmospheric pressure).

D. Sequential Treatment?

You may use various treatment steps in a sequence but only be able to estimate the treatment efficiency of the overall treatment process. If this is the case, you must enter codes for all of the treatment steps in the process. You must check the column D "sequential treatment?" box for all of these steps in the same sequence. With respect to information that must be supplied in columns C and E, you must provide the range of influent concentrations (column C) in connection with the first step of the sequential treatment. Then provide the treatment efficiency (column E) in connection with the last step in the treatment. You do not need to complete C or E for any intermediate step in the sequence.

E. Treatment Efficiency Estimate

In the space provided, you must enter the number that indicates the percentage of the toxic chemical that is removed from the wastestream. The treatment efficiency (expressed as percent removal) represents any destruction, biological degradation, chemical conversion, or physical removal of the chemical from the wastestream being treated. This efficiency must represent the mass or weight percentage of chemical destroyed or removed, not just changes in volume or concentration of the chemical or the wastestream. The efficiency indicated for a treatment method must refer only to the percent conversion or removal of the listed toxic chemical from the wastestream, not the percent conversion or removal of other wastestream constituents (alone or together with the listed chemical), and not the general efficiency of the method for any wastestream.

For some treatments, the percent removal will represent removal by several mechanisms, as in secondary wastewater treatment, where a chemical may evaporate, be biodegraded, or be physically removed in the sludge.

Percent removal must be calculated as follows:

$$\frac{(I - E)}{I} \times 100$$

where I = mass of the chemical in the influent wastestream and E = mass of the chemical in the effluent wastestream.

The mass or weight of chemical in the wastestream being treated must be calculated by multiplying the concentration (by weight) of the chemical in the wastestream times the flow rate. When calculating or estimating percent removal efficiency for various wastestreams, the percent removal must compare the gaseous effluent from treatment to the gaseous influent, the aqueous effluent from treatment to the aqueous influent, and similarly for organic liquid and solid waste. However, some treatment methods may not result in a comparable form of effluent wastestream. Examples are incineration or solidification of wastewater. In these cases, the percent removal of the chemical from the influent wastestream would be reported as 100 percent because the wastestream does not exist in a comparable form after treatment.

Some of the treatments listed in Table I do not destroy, chemically convert, or physically remove the chemical from its wastestream. Some examples include fuel blending and evaporation. For these treatment methods, an efficiency of zero must be reported.

For metal compounds, the reportable concentration and treatment efficiency must be calculated based on the weight of the parent metal and not the weight of the metal compounds. Metals are not destroyed but can only be physically removed or chemically converted from one form into another. The treatment efficiency reported must only represent physical removal of the parent metal from the wastestream, not the percent chemical conversion of the metal compound. If a listed treatment method converts but does not remove a metal (e.g., chromium reduction), the method must be reported, but the treatment efficiency must be reported as zero.

All data available at your facility must be utilized to calculate treatment efficiency and influent chemical concentration. You are not required to collect any new data for the purposes of this reporting requirement. If data are lacking, estimates must be made using best engineering judgment or other methods.

F. Based on Operating Data?

This column requires you to indicate "Yes" or "No" to whether the treatment efficiency estimate is based on actual operating data. For example, you would check "Yes" if the estimate is based on monitoring of influent and effluent wastes under typical operating conditions. If the efficiency estimate is based on published data for similar processes or on equipment supplier's literature, or if you otherwise estimated either the influent or effluent waste comparison or the flow rate, you must check "No."

8. Optional Information on Waste Minimization

Information provided in Part III, Section 8, of the form is optional. This section allows you to identify waste minimization efforts relating to the reported toxic chemical that may not have been reflected in your responses to previous sections of the form.

A. Type of modification

Enter one code from the following list that best describes the type of waste minimization activity:

M1 - Recycling/reuse on-site.
M2 - Recycling/reuse off-site.
M3 - Equipment/technology modifications.
M4 - Process procedure modifications.
M5 - Reformulation/redesign of product.
M6 - Substitution of raw materials.
M7 - Improved housekeeping training, inventory control.
M8 - Other waste minimization technique.

B. Quantity of the chemical in the wastestream prior to treatment/ disposal

Enter the pounds of the toxic chemical in wastes in the reporting year and the pounds in wastes in the year prior to implementing waste minimization (the "base year"). Alternatively, to protect confidential information, you may wish to enter only the percentage by which the weight of the chemical in the wastes has changed. This figure (percentage) may be calculated using the following formula:

$$\frac{\text{toxic chemical in wastes in reporting year - toxic chemical in wastes in prior year}}{\text{toxic chemical in wastes in prior year.}} \times 100$$

The resulting figure may be either negative or positive.

C. Index

Enter the ratio of reporting-year production to production in the base year. This index should be calculated to most closely reflect activities involving the chemical. Examples of acceptable indices include:

- Chemical produced in 1987/chemical produced in 1986.
- Paint produced in 1987/paint produced in 1986.
- Appliances coated in 1987/appliances coated in 1986.
- Square feet of solar collector fabricated in 1987/square feet of solar collector fabricated in 1986.
- Value of sales in 1987/value of sales in 1986.

For example, a company manufactures 200,000 pounds of a chemical in 1986 and 250,000 pounds of the same chemical in 1987. The index figure to report would be 1.3 (1.25 rounded). The index provides a means for users of the data to distinguish the effects of changes in business activity from the effects specifically of waste minimization efforts. It is not necessary to indicate the units on which the index is based.

D. Reason for action

Finally, enter the codes from the following list that best describe the reason for initiating the waste minimization effort:

R1 - Regulatory requirement for the waste.
R2 - Reduction of treatment/disposal costs.
R3 - Other process cost reduction.
R4 - Self-initiated program.
R5 - Other (e.g., discontinuation of product, occupational safety, etc.).

TABLE I
TREATMENT CODES

AIR EMISSIONS TREATMENT

A01 Flare
A02 Condenser
A03 Scrubber
A04 Absorber
A05 Electrostatic Precipitator
A06 Mechanical Separation
A07 Other Air Emission Treatment

BIOLOGICAL TREATMENT

B11 Biological Treatment -- Aerobic
B21 Biological Treatment -- Anaerobic
B31 Biological Treatment -- Facultative
B99 Biological Treatment -- Other

CHEMICAL TREATMENT

C01 Chemical Precipitation -- Lime or Sodium Hydroxide
C02 Chemical Precipitation -- Sulfide
C09 Chemical Precipitation -- Other
C11 Neutralization
C21 Chromium Reduction
C31 Complexed Metals Treatment (other than pH Adjustment)
C41 Cyanide Oxidation -- Alkaline Chlorination
C42 Cyanide Oxidation -- Electrochemical
C43 Cyanide Oxidation -- Other
C44 General Oxidation (including Disinfection) -- Chlorination
C45 General Oxidation (including Disinfection) -- Ozonation
C46 General Oxidation (including Disinfection) -- Ozonation
C99 Other Chemical Treatment

INCINERATION/THERMAL TREATMENT

F01 Liquid Injection
F11 Rotary Kiln with Liquid Injection Unit
F19 Other Rotary Kiln
F31 Two Stage
F41 Fixed Hearth
F42 Multiple Hearth
F51 Fluidized Bed
F61 Infra-Red
F71 Fume/Vapor
F81 Pyrolytic Destructor
F82 Wet Air Oxidation
F83 Thermal Drying/Dewatering
F99 Other Incineration/Thermal Treatment

SOLIDIFICATION/STABILIZATION

G01 Cement Processes (including Silicates)
G09 Other Pozzolonic Processes (including Silicates)
G11 Asphaltic Processes
G21 Thermoplastic Techniques
G99 Other Solidification Processes

PHYSICAL TREATMENT

P01 Equalization
P09 Other Blending
P11 Settling/Clarification
P12 Filtration
P13 Sludge Dewatering (non-thermal)
P14 Air Flotation
P15 Oil Skimming
P16 Emulsion Breaking -- Thermal
P17 Emulsion Breaking -- Chemical
P18 Emulsion Breaking -- Other
P19 Other Liquid Phase Separation
P21 Adsorption -- Carbon
P22 Adsorption -- Ion Exchange (other than for recovery/reuse)
P23 Adsorption -- Resin
P29 Adsorption -- Other
P31 Reverse Osmosis (other than for recovery/reuse)
P41 Stripping -- Air
P42 Stripping -- Steam
P49 Stripping -- Other
P51 Acid Leaching (other than for recovery/reuse)
P61 Solvent Extraction (other than recovery/reuse)
P99 Other Physical Treatment

RECOVERY/REUSE

R01 Reuse as Fuel -- Industrial Kiln
R02 Reuse as Fuel -- Industrial Furnace
R03 Reuse as Fuel -- Boiler
R04 Reuse as Fuel -- Fuel Blending
R09 Reuse as Fuel -- Other
R11 Solvents/Organics Recovery -- Batch Still Distillation
R12 Solvents/Organics Recovery -- Thin-Film Evaporation
R13 Solvents/Organics Recovery -- Fractionation
R14 Solvents/Organics Recovery -- Solvent Extraction
R19 Solvents/Organics Recovery -- Other
R21 Metals Recovery -- Electrolytic
R22 Metals Recovery -- Ion Exchange
R23 Metals Recovery -- Acid Leaching
R24 Metals Recovery -- Reverse Osmosis
R26 Metals Recovery -- Solvent Extraction
R29 Metals Recovery -- Other
R99 Other Reuse or Recovery

APPENDIX C

RELEASE GUIDANCE

APPENDIX C - RELEASE GUIDANCE

The matrices in this appendix present information on air releases, wastewater releases, solid and nonaqueous liquid releases, and occupational exposures. The information provided includes:

- Types of releases.
- Release frequency.
- Controls in use.
- Release estimation method.

Additional offsite and onsite information is provided for solid and nonaqueous liquid releases. The occupational exposure matrices contain information on types of exposure, exposure frequency, and controls in use. A listing of the chemicals in each subcategory (and a description of each chemical) is provided at the bottom of each matrix. The information provided in these matrices is currently in draft stage and under review at the Agency.

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Solvent-based adhesive	Evaporation from mixing tank during adhesive formation	Intermittent	Enclosed system, condenser, scrubber	1) Engineering estimate 2) Monitoring data	Process upsets, spills	Sporadic	None	Engineering estimate	None	Disposal of residue in drums, mixing tanks	Sporadic	None	Engineering estimate based on plant disposal records	Sampling	Routine	None
														Maintenance	Intermittent	Personal protective equipment
														Production	Continuous	Enclosure, local exhaust ventilation
	Storage (breathing losses)	Continuous	Unknown	Engineering estimate	None	N/A	None	N/A	None	None	N/A	None	N/A	None	N/A	None
	Transfer	Routine	Unknown	Engineering estimate using EPA/API methods	None	N/A	None	N/A	None	None	N/A	None	N/A	Transfer operation	Routine	Personal protective equipment
	Evaporation during adhesive application	Continuous	Condenser	Mass balance based on usage of the chemical	Spills	Sporadic	None	Engineering estimate	None	None	N/A	None	N/A	Production	Continuous	General ventilation, local exhaust ventilation
														Maintenance	Sporadic	Personal protective equipment
Water-based adhesive	None	N/A	None	N/A	Cleaning of mixing tank	Intermittent	None	Engineering estimate	None	None	N/A	None	N/A	Cleaning of tank	Intermittent	Personal protective equipment
					Cleaning of adhesive application equipment	Sporadic	None	Engineering estimate	None	None	N/A	None	N/A	Production	Continuous	General ventilation
														Maintenance	Sporadic	Personal protective equipment

Subcategory	Chemical	Comment
Solvent-based adhesive	Butyl acrylate	Used in solvent-based adhesives
	Butyl benzyl phthalate	Used as an additive in the packaging industry
	Dimethyl sulfate	Polyurethane adhesive component
	Methyl ethyl ketone	Solvent in adhesives
	Methyl isobutyl ketone	Solvent in adhesives
	Methyl methacrylate	Dental adhesive, bone cement
	Toluene	Solvent for adhesives
	Toluene-2,4-diisocyanate	Sealant
	1,1,1-Trichloroethane	Miscellaneous solvent adhesive uses
Water-based adhesive	Ethyl acrylate	Water emulsion vehicle in adhesives
	Melamine	Used in adhesives, resins for gluing lumber, plywood

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Agricultural chemical	Process vents	Intermittent	Scrubber, adsorption, absorption, incineration	Engineering estimate	Process wastewater	Continuous	Neutralization, ion exchange, lagoons, aeration	1) Monitoring data 2) Engineering estimate	None	Disposal of still bottoms, off-spec product, solids from lagoon	Routine	Recovery of metals	Engineering estimate from plant disposal records	Handling of agriculture chemicals	Routine	Local exhaust ventilation, personal protective equipment
	Storage vents	Continuous	Scrubber	Engineering estimate using EPA/ API methods												
	Transfer losses	Routine	Unknown	Engineering estimate using EPA/ API methods												
	Fugitive	Continuous	Inspection/maintenance	Emission factor with some composition, leak-rate, component count measurement												
	Releases during application	Continuous	Unknown	Engineering estimate based on volatility of the liquid product or percent particulates remaining airborne	Run-off	Intermittent	None	Engineering estimate	Releases during application	None	Continuous	None	Mass balance based on usage and quantity released to other sources	Exposure during application	Routine	Personal protective equipment (gloves)
Consumptive intermediate in agricultural chemical manufacture	Process vents	Intermittent	Unknown	Engineering estimate	Process upsets, spills	Sporadic	Unknown	Engineering estimate based on plant records on upsets and spills	None	Disposal of still bottoms and off-spec products	Sporadic	Unknown	1) Engineering estimate 2) Mass balance	Handling of chemical prior to consumption	Intermittent	Closed-loop transfer, personal protective equipment
	Storage vents	Continuous	Unknown	Engineering estimate using EPA/ API methods												
	Transfer losses	Routine	Unknown	Engineering estimate using EPA/ API methods												
	Fugitive	Continuous	Inspection/maintenance	Emission factor with some composition, leak-rate, component count measurement												

Subcategory	Chemical	Comment
Agricultural chemical	Ammonium nitrate (solution)	Direct fertilizer application
	Ammonium sulfate (solution)	Nitrogen fertilizer
	Quintozene	Seed dressing agent
Consumptive intermediate in agricultural chemical manufacture	Ammonia	Fertilizer and fertilizer intermediate
	Bromomethane	Miscellaneous uses such as intermediate for manufacture of agricultural chemicals
	Chloromethane	Production of agricultural chemicals
	Maleic anhydride	Derivative for agricultural chemicals
	2-Methoxyethanol	Plant growth regulator raw material
	Nitric acid	Ammonium nitrate fertilizer
	Phosphoric acid	Manufacture of wet process H_2PO_4 for phosphate fertilizers
	Sulfuric acid	Manufacture of wet process H_2PO_4 for phosphate fertilizers

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Gas	Storage and handling losses	Continuous	Inspection/maintenance	Engineering estimate using EPA/API method	None	N/A	None	N/A	None	None	N/A	None	N/A	Leak	Sporadic	None
Liquid	Handling losses prior to addition to reaction vessel or during reclamation of catalyst	Intermittent	Closed-loop transfer	Engineering estimate using EPA/API method	None	N/A	None	N/A	None	Disposal of spent catalyst	Intermittent	Reclamation of catalyst	Engineering estimate from plant records	Handling of catalyst prior to or after use	Intermittent	Personal protective equipment
Solid	Loss of catalyst during catalyst regeneration (e.g., by oxidation)	Routine	Particulate controls such as scrubber	Engineering estimate	None	N/A	None	N/A	None	Disposal of spent catalyst	Intermittent	Regeneration of catalyst	Engineering estimate from plant records	Handling of catalyst	Intermittent	Personal protective equipment

Subcategory	Chemical	Comment
Gas	Chloromethane	Catalyst solvent used in the manufacture of butyl rubber
Liquid	Acetonitrile	Used in catalyst and metal complex catalysts
	Allyl chloride	Used in resin catalysts
	1,2-Dichloropropane	Catalyst reclamation
	Titanium tetrachloride	Catalyst used for organic synthesis
Solid	Aluminum oxide	Used in miscellaneous catalysts
	Ethylene thiourea	Accelerator for epichlorohydrin
	Osmium tetroxide	Used as an oxidant in catalytic oxidation

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Processing solvent	Release during separation of solvent from product	Continuous	Process enclosure, condenser, carbon adsorber, flare	Mass balance based on usage less releases by other sources	Process upset, spills	Sporadic	Aeration, biological treatment of wastewater	Engineering estimate from plant records of upsets, and spills	None	Waste solvent	Intermittent	Solvent reclamation	Engineering estimate from plant disposal records	Inhalation and dermal exposure	Routine	Local exhaust ventilation, personal protective equipment

Subcategory	Chemical	Comment
Processing solvent	Acetone	Solvent for cellulose acetate
	Acetonitrile	Solvent for distillation of butadiene
	Bis(2-chloro-1-methylethyl) ether	Solvents for fats, waxes, etc.
	Bis(2-chloroethyl) ether	Solvents for fats, waxes, etc.
	tert-Butyl alcohol	Chemical solvent
	Chlorobenzene	TDI processing solvent
	Cyclohexane	Solvent uses
	1,2-Dichlorobenzene	TDI processing solvent and other solvent uses
	1,2-Dichloroethylene	Extraction solvent
	Ethylbenzene	Solvent applications
	Freon 113	Inert solvent
	Hexachloronaphthalene	Solvent
	Isopropyl alcohol	General solvent
	Methanol	Solvent
	Methyl isobutyl ketone	Solvent for extraction
	Methylene bromide	Solvent
	2-Nitropropane	Industrial solvent
	1,2,4-Trichlorobenzene	Solvent in (ClCN)3 production
	1,1,2-Trichloroethane	Solvent in manufacture of chlorinated rubbers
	Trichloroethylene	Industrial solvent

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Metal degreasing	Liquid drag out	Routine	Drain rack, increased drain time	1) Engineering estimate 2) Emission factor	Water condensate from refrigerated condenser released to sewer	Routine	None	Engineering estimate	None	Spent solvent disposal	Intermittent	Solvent reclamation	Engineering estimate based on plant disposal records	Handling of solvent and parts to be cleaned	Routine	Refrigerated condensers, local exhaust ventilation, personal protective equipment
	Evaporation from degreaser	Continuous	Raised freeboard, lid, refrigerated condensers, carbon adsorbtion	1) Engineering estimate 2) Emission factor												
Textile cleaning	Dryer vent	Continuous	Carbon adsorber, refrigerated condenser	1) Mass balance based on chemical usage 2) Emission factor	Water condensate from refrigerated condenser released to sewer	Routine	None	Engineering estimate	None	Disposal of filter canister or diatomaceous earth filter material	Intermittent	None	Engineering estimate based on plant disposal records	Leaks in washer or dryer	Continuous	Inspection/maintenance
														Handling of cleaned clothes	Routine	None
	Fugitive	Continuous	Inspection/maintenance	Emission factor										Spotting of clothes	Intermittent	Local exhaust ventilation

Subcategory	Chemical	Comment
Metal degreasing	Chlorobenzene	Degreasing solvent
	Chloroform	Degreasing solvent
	Cresol (mixed isomers)	Cleaning compound componnet
	Dichloromethane	Vapor degreasing and cold degreasing solvent
	1,4-Dioxane	Stabilizer in chlorinated cleaning solvents
	Freon 113	Degreasing solvent
	Tetrachloroethylene	Degreasing solvent
	Nitrolotriacetic acid	Metal cleaning (plating) solvent
	Sodium hydroxide (solution)	Metal degreasing
	Thiourea	Silver tarnish remover
	1,1,1-Trichloroethane	Vapor degreasing and cold degreasing solvent
	Trichloroethylene	Vapor degreasing and cold degreasing solvent
Textile cleaning	Bis(2-chloro-1-methylethyl) ether	Spotting and cleaning solutions
	Freon 113	Dry cleaning solvent
	Tetrachloroethylene	Dry cleaning solvent

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Solvent in inks	Evaporation during ink formulation	Continuous	Lid on mixing tank	Engineering estimate based on solvent losses during formulation	For water-based inks only there is potential for release during tank cleaning	Intermittent	None	Engineering estimate	None	Disposal of off-spec ink	Sporadic	None	Plant disposal records	Tank cleaning and maintenance	Intermittent	General ventilation, personal protective equipment
	Evaporation during drying and curing of inks	Continuous	Vapor recovery, carbon adsorption, incineration	Engineering estimate based on ink usage, composition and control efficiency	For water-based inks only there is potential for release during press cleanup	Routine	None	Engineering estimate	None	Waste solvent from press cleaning	Intermittent	Solvent recovery	Plant disposal records	Press operator	Continuous	General ventilation
														Press cleaning and maintenance	Routine	General ventilation, personal protective equipment
Solvent in coatings	Evaporation during coating formulation	Continuous	Lid on mixing tank	Engineering estimate based on solvent losses during formulation	For water-based coatings only there is potential for release during tank cleaning	Intermittent	None	Engineering estimate	None	Disposal of off-spec coating	Sporadic	None	Plant disposal records	Tank cleaning and maintenance	Intermittent	General ventilation, personal protective equipment
	Evaporation during drying and curing of coatings	Continuous	In factory application - vapor recovery, carbon adsorption, incineration	Factory application - engineering estimate based on usage, composition and control efficiency	For water-soluble coatings only there is potential for release during application equipment cleanup	Routine	None	Engineering estimate	None	Waste solvent from cleaning of application equipment	Intermittent	Solvent recovery	Plant disposal records	Coating application	Continuous	Paint spray booth, other local exhaust ventilation, personal protective equipment
														Equipment cleaning	Routine	Paint spray booth, other local exhaust ventilation, personal protective equipment
			Non-factory application - no controls	Non-factory application: based on 100% usage												
Solid in inks	None	N/A	N/A	N/A	For water-based inks only there is potential for release during press equipment cleanup	Routine	None	Engineering estimate	None	Pigment in waste solvent from cleaning of press or application equipment	Intermittent	None	Plant disposal records	Ink application	Continuous	Personal protective equipment

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Solid in coatings	None	N/A	N/A	N/A	For water-based coatings only there is *potential* for release during application equipment cleanup	Routine	None	Engineering estimate	None	Pigment in waste solvent from *cleaning of* application equipment	Intermittent	None	Plant disposal records	Coating application	Continuous	Personal protective equipment

Subcategory	Chemical	Comment
Solvent in inks	Dibutyl phthalate	Printing ink ingredient
	2-Ethoxyethanol	Used in inks
	2-Methoxyethanol	Used in inks
	Methyl ethyl ketone	Printing inkssolvent
	Methyl isobutyl ketone	Solvent for inks
Solvent in coatings	Acetone	Solvent in coatings
	Acetonitrile	Miscellaneous uses in coating compounds
	Butyl acrylate	Used in coatings and inks
	n-Butyl alcohol	Solvent in coatings formulations
	Cresol (mixed isomers)	Wire enamel solvent
	o-Cresol	Wire enamel solvent
	p-Cresol	Wire enamel solvent
	1,4-Dioxane	Solvent in paints, etc.
	2-Ethoxyethanol	Used in coatings
	Ethyl acrylate	Used in inks
	Ethyl acrylate	Used in coatings
	Isopropyl alcohol	Solvent in coatings
	2-Methoxyethanol	Used in coatings
	Methyl acrylate	Used in coatings
	Methyl ethyl ketone	Coatings solvent
	Methyl isobutyl ketone	Solvent for coatings
	Methyl methacrylate	Protective coatings
	Toluene-2,4-diisocyanate	Used in coatings
	Xylene	Solvent in paints and coatings
Solid in inks	Michler's ketone	Initiators in UV-cured inks
	Titanium dioxide	Whitener and opacifier for inks
	Toluene	Solvent for inks
Solid in coatings	Acetamide	Antacid and plasticizer in coatings (lacquers)
	Aluminum (fume or dust)	Used in paints
	Titanium dioxide	Whitener and opacifier for coatings, paper, and paperboard
	Toluene	Solvent for coatings
	2,4,5-Trichlorophenol	Anti-microbial agent in paint

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Gas	Process vents	Intermittent	Scrubber, flare	Engineering estimate	None likely; if product is gas dissolved in water, spills could be released to water	Sporadic	None; aeration used for treatment of other chemicals would also remove the gases; for acids, neutralization is also used	Plant records of spills of gas in water solutions	None	None	N/A	None	N/A	Sampling	Routine	Closed-loop sampling
														Maintenance	Intermittent	Personal protective equipment
	Storage pressure relief vents	Sporadic	None	Engineering estimate												
	Fugitive emissions	Continuous	Inspection/maintenance	Emission factor with some composition/ leak rate/ component count measurement												
Liquid	Process vents	Intermittent	Scrubber, condenser	1) Engineering estimate 2) Monitoring data 3) Emission factor	Process upset, spills	Sporadic	Surface impoundment or lagoon with biological treatment, aeration, or POTW	Engineering estimate based on plant records of upsets and spills	None	Disposal of still bottoms, off-spec product	Sporadic	Solvent recovery, incineration	Engineering estimate from plant disposal records	Transfer operations	Routine	Closed-loop transfer, personal protective equipment
														Maintenance	Intermittent	Personal protective equipment
	Transfer losses	Routine	Closed-loop transfer, vapor recovery for volatile liquids only	1) Engineering estimate using EPA/ API method 2) Emission factor												
	Fugitive emissions	Continuous	Inspection/maintenance for volatile liquids only	1) Emission factor with some composition/ leak rate/ component count measurement												
Solid	Dusting during material transfer	Intermittent	Fabric filter	Engineering estimate	If solid in water solution, spills could be released to sewer	Sporadic	None	Engineering estimate	None	Disposal of unreacted waste	Sporadic	None	Engineering estimate from plant disposal records	Dusting during material transfer	Intermittent	Local exhaust ventilation, personal protective equipment (gloves)

Subcategory	Chemical	Comment
Gas	Ammonia	Polymer, explosive, and animal feed intermediate
	Carbonyl sulfide	Herbicide intermediate
	Chlorine	Chemical intermediate
	Chloromethane	Production of methyl cellulose, quaternary amines, tetramethyl lead
	Diazomethane	Synthesis of pyrazolines & methyl alkyl sulfates and alkykation reactions of hydroperoxides
	Ethylene	Manufacturing of ethylene oxide, ethylene dichloride, etc.
	Ethylene oxide	Manufacturing of ethylene glycol, ethanolamines, etc.
	Hydrogen fluoride	Manufacturing of fluorocarbon, fluoride, and aluminum fluoride products
	Propylene	Manufacturing of acrylonitrile, propylene oxide, cumene, etc.
	Propylene oxide	Manufacturing of propylene glycol, glycol ethers, di propylene glycol, and isopropanolamines
Liquid	Acetaldehyde	Intermediate for a variety of chemicals
	Acetone	Intermediate for Bisphenol A, MIBK, etc.
	Acrolein	Intermediate for a variety of chemicals
	Acrylonitrile	Intermediate for adiponitrile and acrylamide
	Allyl chloride	Medical, polymer, and agricultural intermediate
	Aniline	Production of MDI, rubber processing chemicals
	o-Anisidine hydrochloride	Intermediate for guaiacol
	o-Anisidine	Intermediate for guaiacol
	Benzal chloride	Benzaldehyde intermediate
	Benzene	Chemical intermediate
	Benzoyl chloride	Variety of intermediate uses
	Bis (2-chloro-1-methylethyl) ether	Intermediate for other biphenols
	n-Butyl alcohol	Variety of intermediate uses
	sec-Butyl alcohol	Variety of intermediate uses
	tert-Butyl alcohol	Rubber and cosmetic intermediate
	1,2-Butylene oxide	Polymer intermediate
	Butyraldehyde	Variety of uses
	Carbon disulfide	Polymer and chemical intermediate
	Carbon tetrachloride	Production of Fluorocarbon 11 and 12, ethylene dichloride, perchloroethylene
	Chlorobenzene	Variety of intermediate uses
	Chloroform	Fluorocarbon 22, ethylene dichloride production
	Chloromethyl methyl ether	Ion exchange resin intermediate
	Cresol (mixed isomers)	Cresylic acid production
	o-Cresol	Variety of uses
	Cumene	Polymer and chemical intermediate
	Cumene hydroperoxide	Phenol and acetone intermediate
	Cyclohexane	Nylon intermediate
	1,2-Dibromoethane	Intermediate in plant growth regulator
	1,3-Dichlorobenzene	m-Chlorophenol intermediate, intermediate in the production of isocyanates
	1,2-Dichloroethane	Ethyl chloride production, production of chlorinated solvents, vinylidene chloride, etc.
	1,2-Dichloroethylene	Chlorinated ethylene intermediate
	1,2-Dichloropropane	Intermediate for chlorinated solvents
	1,3-Dichloropropylene	D-D mixture (poison) intermediate
	Diethyl sulfate	Alkylation reaction intermediate
	Dimethyl sulfate	Alkylating agent to produce methyl derivatives of thiols, etc.
	N,N-Dimethylaniline	Synthesis of vanillin, and used in alkyating agents
	Epichlorohydrin	Glycerine manufacturing
	2-Ethoxyethanol	Organic synthesis
	Ethylbenzene	Styrene monomer intermediate
	Formaldehyde	Production of hexamethylene-triamine, pentaerythritol, 1,4-butadiene, trimethylpropane, phthalic anhydride, solid urea, acetylene chemicals, MDI, etc.
	Hexachlorocyclopentadiene	Flame retardant, insect, and resin intermediate
	pentadiene	resin intermediate
	Hydrogen cyanide	Manufacturing of adiponitrile, methyl methacrylate, etc.
	Isopropyl alcohol	Manufacturing of acetone, etc.
	Methanol	Manufacturing of formaldehyde, methyl and butyl ethers, acetic acid, chloromethanes, etc.
	Methyl acrylate	Film and polymer intermediate

Subcategory	Chemical	Comment
Liquid	Nitrobenzene	Derivative of aniline
	Phosgene	Toluene diisocyanate production, methylene diisocyanate production
	Propionaldehyde	Manufacturing of propionic acid
	Pyridine	Manufacturing of piperidine, quaternary salts, etc.
	Quinoline	Manufacturing of dihydroquinolines, quinophthalones
	Safrole	Heliotropin intermediate
	Sodium hydroxide (solution)	Manufacturing of sodium salts, sodium chlorite, sodium chloroacetate, sodium cyanide,
	Sodium hydroxide (solution)	sodium formate, etc.
	Styrene oxide	Manufacturing of betaphenethyl alcohol
	Tetrachloroethylene	Manufacturing of fluorocarbons
	Titanium tetrachloride	Manufacturing of metals, organics, and inorganics containing titanium
	Toluene	Benzoic acid, benzaldehyde production, manufacturing of benzene and TDI
	1,1,2-Trichloroethane	Manufacturing of 1,1-dichloroethylene
	1,2,4-Trimethylbenzene	Manufacturing of trimetallic anhydride
	Vinyl acetate	Manufacturing of ethylene/vinyl acetate
	Vinylidene chloride	Tetrachloroethylene/trichloroethylene production, raw material to produce refrigerant 426
	Xylene (mixed isomers)	Manufacturing p-xylene, o-xylene, and m-xylene
	m-Xylene	Manufacturing of isophthalic acid
	o-Xylene	Manufacturing of phthalic anhydride
	p-Xylene	Manufacturing of tetephthalic acid
	2,6-Xylidine	Manufacturing of lidocaine, and bipivacaine
Solid	Acetamide	Raw material in organic synthesis
	Aluminum oxide	Aluminum metal intermediate
	Benzamide	Benzonitrile intermediate
	Biphenyl	Intermediate for other biphenyls
	Calcium cyanamide	Cyanamide and calcium cyanide intermediate
	Catechol	Variety of uses
	Chloroacetic acid	Variety of uses
	m-Cresol	Pharmaceutical and flavors, rubber intermediate
	p-Cresol	Variety of intermediate uses
	4,4'-Diaminodiphenyl ether	Polymer intermediate
	Diaminotoluene (mixed isomers)	TDI intermediate
	1,4-Dichlorobenzene	Production of 1,2,4-trichlorobenzene
	1,2-Diphenylhydrazine	Benzidine intermediate
	Hexachlorobenzene	Manufacturing of pentachlorophenol
	4,4'-Isopropylidenediphenol	Manufacturing of tetrabromobisphenol A
	Maleic anhydride	Manufacturing of fumeric and maleic acids
	4,4'-Methylenedianiline	Manufacturing of methyl isocyanates
	Molybdenum trioxide	Manufacturing of molybenum compounds
	Naphthalene	Derivative for phthalic anhydride, synthesis of tanning agents
	5-Nitro-o-anisidine	Manufacturing of diazo compounds
	4-Nitrophenol	Derivative for acetomenophen
	p-Nitrosodiphenylamine	Manufacturing of vinyl monomer, polymer inhibitor
	Octachloronaphthalene	Manufacturing of tetrachloro-
	Osmium tetroxide	Potassium osmate production
	Phenol	Caprolactum production, manufacturing of bisphenol A, alkyl phenols, xyenols, and aniline
	Phosphorus (yellow or white)	Manufacturing of pentasulfide, phosphorus trichloride, potassium, calcium, and sodium phosphates
	Picric acid	Manufacturing of picamic acid and inhibitor in chloroprene storage
	Quinone	Manufacturing of hydroquinone
	2,4,5-Trichlorophenol	Variety of uses

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Liquid	Volatilization during mixing of disinfectant/ repellant	Routine	Process enclosure	Engineering estimate	If product is water-based, spills can be released to water	Sporadic	None	Plant records of spills	None	Disposal of off-spec product	Sporadic	None	Engineering estimate from plant disposal records	Volatilization during mixing	Routine	Process enclosure
	Application of disinfectant/ repellant	Routine	None	Engineering estimate	None	N/A	None	N/A	None	None	N/A	None	N/A	Inhalation and dermal exposure	Routine	Personal protective equipment
Solid	Processing of solid into product form	Continuous	None	Engineering estimate	None	N/A	None	N/A	None	Disposal of off-spec product	Sporadic	None	Engineering estimate from plant records	Dusting of product during handling	Intermittent	Local exhaust ventilation, personal protective equipment (gloves)

Subcategory	Chemical	Comment
Liquid	Dibutyl phthalate	Insect repellent
	Dimethyl phthlate	Insect (mosquito) repellent
	Peracetic acid	Disinfectant and antiseptic in research
	Sodium hydroxide (solution)	Disinfectant
Solid	o-Cresol	Active ingredient in disinfectants
	Hexachloroethane	Moth repellent
	Naphthalene	Moth repellent

Subcategory	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Dye/pigment	Release of particulates during transfer of powder dye/ pigment	Intermittent	Use of separate room to store and mix dyes	Engineering estimate	For water-based dyes potential release from cleanup and spills	Sporadic	None	Engineering estimate	None	None	N/A	None	N/A	Exposure to dye powder prior to mixing	Intermittent	Use of separate room with ventilation to store and mix dyes
														Dermal exposure to dye/pigment after mixing	Sporadic	Personal protective equipment
Dye additive	Release during handling of addditive prior to formulation of dye	Intermittent	Same as those used to control dye or pigment	Engineering estimate	For water-based dyes potential release from cleanup and spills	Sporadic	None	Engineering estimate	None	None	N/A	None	N/A	Exposure to additive prior to mixing	Intermittent	Personal protective equipment
														Dermal exposure to additive after mixing	Sporadic	Personal protective equipment
Consumptive intermediate in dye/pigment manufacture	Release during handling of chemical during production of dye/pigment prior to dye/ pigment formation	Routine	Similar to consumptive intermediate category with controls based on physical state of the chemical	Engineering estimate	Spills of chemical prior to consumptive use to produce dye/pigment	Sporadic	None	Engineering estimate	None	None	N/A	None	N/A	Exposure to chemical prior to consumptive use to produce dye/pigment	Sporadic	Personal protective equipment
Dye carrier solvent	Release during drying of dye	Continuous	Condenser	Mass balance based on usage of the chemical less quantity re-covered from condenser and quantity retained in textile	If water soluble may be released during cleaning operations or during textile drying	Sporadic	None	Engineering estimate	None	None	N/A	None	N/A	Cleaning and other maintenance	Intermittent	Personal protective equipment

Subcategory	Chemical	Comment
Dye/pigment	Acetonitrile	Textile dyeing
	Aluminum oxide	Pigment use
	C.I. Acid Blue 9, diammonium salt	Acid dye for wool, silk, nylon, and leather; intermediate for production of pigments, food dye
	C.I. Acid Blue 9, disodiumsalt	Acid dye for wool, silk, nylon, and leather; intermediate for production of pigments, food dye
	C.I. Acid Green 3	Acid dye for many applications and pigment intermediate
	C.I. Basic Green 4	Basic dye for many applications and pigment intermediate
	C.I. Basic Red 1	Basic dye for many applications and pigment intermediate
	C.I. Disperse Yellow 3	Dispersion dye
	C.I. Food Red 15	Dye
	C.I. Food Red 5	Dye and pigment intermediate
	C.I. Solvent Orange 7	Solvent dye

Subcategory	Chemical	Comment
Dye/pigment	C.I. Solvent Yellow 14	Solvent dye
	C.I. Solvent Yellow 3	Solvent dye
	C.I. Solvent Yellow 34	Solvent dye
	C.I. Vat Yellow 4	Dye for cotton, silk, wool, and paper
	Catechol	Oxidation base for fur and hair dye preparations
	3,3'-Dimethoxybenzidine	Pigment
	Direct Black 38	Dye
	Direct Blue 6	Dye
	Direct Brown 95	Dye
Dye additive	Biphenyl	Accelerant in formulation of dye carriers for textile dyeing
	2,4-Diaminoanisole sulfate	Oxidation base for fur dyeing; previously used in hair dyes
	2,4-Diaminoanisole	Oxidation base for fur dyeing and dye intermediates
	2,4-Diaminotoluene	Developer for direct dyes and dye and pigment intermediate
	N,N-Dimethylaniline	Used in dyes
	4-Nitrophenol	Used in dyestuffs
Consumptive intermediate in dye/pigment manufacture	1-Amino-2-methylanthraquinone	Dye intermediate
	2-Aminoanthraquinone	Anthraquinone dye intermediate
	4-Aminoazobenzene	Solvent dye intermediate
	4-Aminobiphenyl	Once used as dye intermediate
	Aniline	Used in the production of dyes and pigments
	o-Anisidine hydrochloride	Dye intermediate
	o-Anisidine	Dye intermediate
	p-Anisidine	Dye and liquid crystal intermediate
	Benzoic trichlorid	Dye intermediate
	C.I. Acid Blue 9, diammonium salt	Acid dye for wool, silk, nylon, and leather; intermediate for production of pigments, food dye
	C.I. Acid Blue 9, disodiumsalt	Acid dye for wool, silk, nylon, and leather; intermediate for production of pigments, food dye
	C.I. Acid Green 3	Acid dye for many applications and pigment intermediate
	C.I. Basic Green 4	Basic dye for many applications and pigment intermediate
	C.I. Basic Red 1	Basic dye for many applications and pigment intermediate
	C.I. Food Red 5	Dye and pigment intermediate
	p-Cresidine	Dye intermediate
	2,4-Dichlorophenol	Dye intermediate
	4-Dimethylaminoazobenzene	Used in Solvent Yellow 2 manufacture
	3,3-Dimethylbenzidine	Manufacture of yellow, orange, and red dyes
	2,4-Dinitrophenol	Dye intermediate
	2,6-Dinitrotoluene	Dye intermediate
	4,4'-Methylenebis (N,N-dimethyl) benzenamine	Dye intermediate
	4,4'-Methylenedianiline	Dye intermediate
	Michler's ketone	Dye intermediate
	alpha-Naphthylamine	Dye intermediate
	beta-Naphthylamine	Azo dye intermediate
	5-Nitro-o-ansidine	Manufacturing of diazo compounds
	p-Nitrosodiphenylamine	Dye intermediate
	p-Phenylenediamine	Dye delveloping and hair dye, Violet 3, and Direct Black intermediate
	Sulfuric acid	Used to manufacture inorganic dyes
	4,4-Thiodianiline	Mordant Yellow 16 intermediate
	Titanium tetrachloride	Used to manufacture titanium dioxide pigments
	o-Toluidine	Dye intermediate
	2,6-Xylidine	Dyestuffs intermediate
Dye carrier solvent	Acetamide	Dye solvent for textiles
	Diethyl phthalate	Dye carrier to accelerate drying
	Dimethyl phthalate	Dye carrier

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Component etching	Process and storage vents	Intermittent	Scrubber	Mass balance based on usage	Spills, water rinse after etching	Sporadic	Neutralization	pH measurement	None	Disposal of waste acids	Intermittent	Neutralization	Engineering estimate based on plant disposal records	Handling of chemicals prior to use	Intermittent	Closed-loop transfer, personal protective equipment
Solvent	Evaporation of solvent during use	Continuous	Condenser or carbon adsorber	Mass balance based on solvent usage	Spills	Sporadic	None	1) Monitoring data 2) Emission factors	None	None	N/A	None	N/A	Handling of solvents prior to use	Intermittent	Personal protective equipment
														Evaporation of solvents during use	Continuous	None
Other	Handling losses	Intermittent	Unknown	Engineering estimate	None	N/A	None	N/A	None	None	N/A	None	N/A	Handling of chemical prior to use	Intermittent	Personal protective equipment

Subcategory	Chemical	Comment
Component etching	Chlorine	Etching compound
	Formaldehyde	Etching compound
	Hydrochloric acid	Etching compound
	Hydrogen fluoride	Etching compound
	Nitric acid	Etching compound
	Phosphoric acid	Etching compound
	Sodium hydroxide (solution)	Etching compound
	Sulfuric acid	Etching compound
Solvent	Acetone	Solvent used in semiconductor manufacturing
	Aniline	Solvent used in semiconductor manufacture
	Chlorobenzene	Solvent used in semiconductor manufacture
	Chloroform	Solvent used in semiconductor manufacture
	Chloromethane	Solvent used in semiconductor manufacture
	Dichloromethane	Solvent
	2-Ethoxyethanol	Solvent used in printed circuit boards
	Freon 113	Solvent
	Methanol	Solvent used in semiconductor manufacture
	2-Methoxyethanol	Solvent used in printed circuit boards
	Methyl ethyl ketone	Solvent used in semiconductor manufacture
	Methyl ethyl ketone	Solvent used in semiconductor manufacture
	Tetrachloroethylene	Solvent
	Toluene	Solvent used in photoresist film
	1,1,1-Trichlorethane	Solvent
	Trichloroethylene	Solvent
	Xylene (mixed isomers)	Solvent used in photoresist film
Other	Bromoform	Q/A programs in electronics
	Hexachloronaphthalene	Component in electrical encapsulating compounds and capacitor impregnants

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Explosive constituent	None	N/A	None	N/A	None	N/A	None	N/A	None	Disposal of off-spec product	Intermittent	Detonation	Engineering estimate	None	N/A	N/A
Consumptive intermediate in explosive manufacture	Handling losses prior to use in explosives	Intermittent	Depends on physical state of the chemical	Engineering estimate	Spills	Sporadic	None	Engineering estimate from plant records of spills	None	None	N/A	None	N/A	Depends on physical state of chemical	Intermittent	Personal protective equipment

Subcategory	Chemical	Comment
Explosive constituent	Aluminum (fume or dust)	Powder used in explosives manufacture
	Nitroglycerine	Dynamite and smokeless gun powder
	Picric acid	Secondary high explosive
Consumptive intermediate in explosive manufacture	Acetamide	Antacid in explosives manufacture
	Nitric acid	Manufacture of ammonium nitrate explosives

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Food additive	Release during handling of liquid additives	Intermittent	Closed-loop transfer systems	Engineering estimate	None	N/A	None	N/A	None	None	N/A	None	N/A	Handling of additive prior to food use	Intermittent	Personal protective equipment
Food processing	Process vents	Intermittent	Absorber, condenser, scrubber	1) Engineering estimate 2) Monitoring data 3) Emission factor	Spills	Sporadic	Unknown	Engineering estimate based on plant records of spills	None	Disposal of process waste	Sporadic	None	Engineering estimate based on plant disposal records	Handling of chemical prior to use in process	Intermittent	Personal protective equipment
	Storage vents	Continuous	Absorber	Engineering estimate using EPA/ API methods												
	Transfer losses	Routine	Solvent recovey system	1) Engineering estimate using EPA/ API methods 2) Emission factor												

Subcategory	Chemical	Comment
Food additive	Diepoxybutane	Prevents microbial spoilage
	Saccharin	Sweetener
Food processing	Dichloromethane	Used in spices and beer hops and coffee extraction solvent
	Hydrochloric acid	Food processing

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Fuel additive	Storage losses	Continuous	Condenser, flare, absorber	Engineering estimate using EPA/API method	Fuel spills	Sporadic	None	Plant records of spills	None	None	N/A	None	N/A	Transfer operations	Routine	Closed-loop transfer, personal protective equipment
	Transfer losses	Routine	Floating roof tank, vent to flare or condenser	Engineering estimate using EPA/API method												
Nuclear fuel	None	N/A	None	N/A	None	N/A	None	N/A	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Rocket fuel	Storage losses	Continuous	Unknown	Engineering estimate using EPA/API method	None	N/A	None	N/A	None	None	N/A	None	N/A	Transfer operations	Routine	Closed-loop transfer, personal protective equipment
	Transfer losses	Routine	Closed-loop transfer	Engineering estimate using EPA/API method												

Subcategory	Chemical	Comment
Fuel additive	tert-Butyl alcohol	High octane blending component in gasoline
	1,2-Dibromoethane	Gasoline additive
	2-Methoxyethanol	Anti-icing fuel additive
	Methyl tert-butyl ether	High octane additive
	Toluene	Octane-boosting component
Nuclear fuel	Thorium dioxide	Fuel in nuclear reactors
Rocket fuel	Aluminum (fume or dust)	Constituent in rocket fuels
	Dibutyl phthalate	Propellant plasticizer
	1,1-Dimethyl hydrazine	Rocket fuel propellant
	Methyl hydrazine	Rocket propellant
	Nitroglycerin	Propellant

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Additive	Dusting during handling prior to addition to fluid	Intermittent	None	Engineering estimate	Washing of spills, leaks down sewer	Intermittent	None	Engineering estimate	None	Collection for disposal or recycle	Intermittent	Use to recover heat value	Plant disposal records	Dermal exposure	Sporadic	Personal protective equipment (gloves)
Hydraulic/heat exchange fluid	Leaks	Sporadic	Absorbants to collect liquid spills	Engineering estimate	Washing of spills, leaks down sewer	Intermittent	None	Engineering estimate	None	Collection for disposal or recycle	Intermittent	Recycle by filtration and/or distillation; use to recover heat value	Plant disposal records	Inhalation or dermal exposure	Sporadic	Personal protective equipment (gloves)
Lubricant	Spills, leaks	Sporadic	Absorbants to collect spills	Engineering estimate	Washing of spills, leaks down sewer	Intermittent	None	Engineering estimate	None	Collection for disposal or recycle	Intermittent	Recycle by filtration and/or distillation; use to recover heat value	Plant disposal records	Dermal exposure	Sporadic	Personal protective equipment (gloves)

Subcategory	Chemical	Comment
Additive	Hexachloroethane	Formulation of extreme pressure lubricants
	Maleic anhydride	Lube oil additives
	4,4'-Methylenedianiline	Antioxidant in lube oils
	Octachloronaphthalene	Cutting oil coolants
	2-Phenylphenol	Disinfectant in cutting oils
Hydraulic/heat exchange fluid	Biphenyl	Heat transfer and hydraulic fluid
	Bis(2-ethylhexyl) adipate	Hydraulic fluid
	sec-Butyl alcohol	Hydraulic brake fluid
	Ethylene glycol	Antifreeze
	Freon 113	Refrigerant
	Polychlorinated biphenyls	Insulating fluid in transformers and hydraulic fluids
Lubricant	Bis(2-ethylhexyl) adipate	Lubricant
	Chloromethane	Production of lubricants

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Indicator/stain	None	N/A	None	N/A	Disposal down sanitary drain	Sporadic	None	Estimate based on usage records	None	None	N/A	None	N/A	Potential dermal exposure	Sporadic	Personal protective equipment (gloves)
Laboratory reagent or solvent	Released from lab hood	Sporadic	None	Mass balance based on usage less quantity consumed in reaction, disposed of down sanitary sewer or disposed of as solid waste	Disposal down sanitary drain	Sporadic	None	Mass balance based on usage less quantity released from lab hood or disposed of as solid waste	None	Disposal of lab waste	Intermittent	None	Engineering estimate from lab records	Inhalation or dermal exposure during usage	Intermittent	Laboratory hood, personal protective equipment (gloves)
Research chemical	Released from lab hood	Sporadic	None	Mass balance based on usage less quantity consumed in reaction, disposed of down sanitary sewer or disposed of as solid waste	Disposal down sanitary drain	Sporadic	None	Mass balance based on usage less quantity consumed in reaction, released from lab hood, or disposed of as solid waste	None	Disposal of lab waste	Sporadic	None	Engineering estimate from lab records	Inhalation or dermal exposure during use	Sporadic	Laboratory hood, personal protective equipment (gloves)

Subcategory	Chemical	Comment
Indicator/stain	C.I. Acid Blue 9, diammonium salt	Indicator, biological stain
	C.I. Acid Blue 9, disodium salt	Indicator, biological stain
	C.I. Acid Green 3	Indicator and biological stain
	C.I. Solvent Yellow 3	Biological stain
Laboratory reagent or solvent	Acetonitrile	Solvent in HPLC
	p-Anisidine	Analytical reagent
	Bromoform	Lab reagent
	C.I. Solvent Yellow 3	Analytical reagent
	Catechol	Analytical reagent
	Chloromethyl methyl ether	Reagent
	Hydrazine sulfate	Analytical testing of blood
	Thioacetamide	Lab chemical
Research chemical	2-Acetylaminofluorene	No commercial use
	Benzidine	Research chemical
	Bis(chloromethyl)ether	No commercial use
	Dichlorobromomethane	No commercial use
	Diepoxybutane	Reasearch reagent

Subcategory	Chemical	Comment
Research chemical	Hexamethylphosphoramide	Research use
	4-Nitrobiphenyl	No commercial use
	2-Nitrophenol	No commercial use
	N-Nitroso-N-ethylurea	Research use
	N-Nitroso-N-methylurea	Research use
	N-Nitrosodi-n-butylamine	Research use
	N-Nitrosodi-n-propylamine	Research use
	N-Nitrosodiethylamine	Research use
	N-Nitrosodimethylamine	Research use
	N-Nitrosomethylvinylaniline	Research use
	N-Nitrosomorpholine	Research use
	N-Nitrosonornicotine	Research use
	N-Nitrosopiperidine	Research use
	Quinoline	Analytical reagent
	1,1,2,2-Tetrachloroethane	Analytical reagent
	o-Toluidine hydrochloride	Research use
	Triaziquone	No commercial use
	2,4,6-Trichlorophenol	Research use
	Tris (2,3-dibromopropyl) phosphate	No commerical use
	Urethane	Biochemical research

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Gas	Process vents	Intermittent	Flare, scrubber	1) Engineering estimate 2) Monitoring data	Not likely; if product is gas dissolved in water spills could be released to water	Sporadic	Aeration used for treatment of other chemicals would also remove these gases	Plant records of spills of gas in water solutions	None	None	N/A	None	N/A	Sampling	Routine	Closed-loop sampling
														Maintenance	Intermittent	Personal protective equipment
	Storage pressure relief valves	Sporadic	Vent to flare	Engineering estimate												
	Fugitive emissions	Continuous	Inspection/maintenance	Emission factor with some composition/ leak rate/ component count												
Volatile liquid	Process vents	Intermittent	Condenser, flare, absorber, scrubber	1) Engineering estimate 2) Monitoring data 3) Emission factor	Process upset, spills	Sporadic	Surface impoundment or lagoon with biological treatment, aeration, or POTW	Engineering estimate based on plant records of upsets and spills	None	Disposal of still bottoms, off-spec product	Sporadic	Solvent recovery, incineration	Engineering estimate from plant disposal records	Sampling	Routine	Closed-loop sampling
														Maintenance	Intermittent	Personal protective equipment
	Storage vents	Continuous	Floating roof tanks, vent to flare or condenser	1) Engineering estimate using EPA/ API method 2) Emission factor										Transfer operations	Routine	Closed-loop transfer, personal protective equipment
	Transfer losses	Routine	Closed-loop transfer, vapor recovery	1) Engineering estimate using EPA/ API method 2) Emission factor												
	Fugitive emissions	Continuous	Inspection/maintenance	1) Emission factor with some composition/ leak rate, component count measure-ments												

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Low volatile liquid	Process vents	Sporadic	Condenser, flare, absorber, scrubber	1) Engineering estimate 2) Monitoring data	Process upsets, spills	Sporadic	Surface impoundment, lagoon with biological treatment, aeration, or POTW	Engineering estimate based on plant records of upsets and spills		Disposal of still bottoms, off-spec product	Sporadic	Solvent recovery, incineration	Engineering estimate from plant disposal records	Sampling	Routine	Closed-loop sampling
														Maintenance	Intermittent	Personal protective equipment
														Transfer operations	Routine	Closed-loop transfer, personal protective equipment
	Storage vents	Continuous	Because of low volatility, probably no controls	Engineering estimate from EPA/ API method												
	Transfer losses	Routine	Because of low volatility, probably no controls	Engineering estimate from EPA/ API method												
	Fugitive emissions	Continuous	None	Engineering estimate basd on comparison with volatile chemicals adjusted for difference in vapor pressure												
Solid	Release of particulates during drying and packaging	Continuous	Fabric filter, scrubber	Engineering estimate	Release from water based manufacturing processes or from scrubber wastewater	Continuous	Settling tanks, filtration	1) Monitoring data 2) Engineering estimate	Process waste	Process waste	Intermittent	None	Engineering estimate	Dusting of product during packaging	Routine	Local exhaust ventilation, personal protective equipment
Water solution	Mixing of chemical and water to form solution	Sporadic	Control of dusting prior to mixing with water	Engineering estimate	Spills of chemical in water solution	Sporadic	None	Plant records of spills	None	None	N/A	N/A	N/A	Dermal exposure to solution	Sporadic	Personal protective equipment

Subcategory	Chemical			
Gas	Ammonia	Chlorine dioxide	Ethylene	Mustard gas
	1,3-Butadiene	Chloroethane	Ethylene oxide	Propylene
	Carbonyl sulfide	Chloromethane	Freon 113	Vinyl bromide
	Chlorine	Diazomethane	Hydrogen fluoride	Vinyl chloride
Volatile liquid	Acetaldehyde	Chloromethyl methyl ether	Hexachloro-1,3-butadiene	Propionaldehyde
	Acetone	Chloroprene	Hexachlorocyclopentadiene	beta-Propriolactone
	Acetonitrile	Cresol (mixed isomers)	Hexamethylphosphoramide	Propylene oxide
	Acrolein	m-Cresol	Hydrazine	Propyleneimine
	Acrylic acid	Cumene	Hydrochloric acid	Pyridine
	Acrylonitrile	Cumene hydroperoxide	Hydrogen cyanide	Quinoline
	Allyl chloride	Cyclohexane	Isobutyraldehyde	Safrole
	Aniline	1,2-Dibromoethane	Isopropyl alcohol	Styrene
	Benzal chloride	Dichlorobenzene (mixed isomers)	Methanol	Styrene oxide
	Benzene	1,2-Dichlorobenzene	2-Methoxyethanol	1,1,2,2-Tetrachloroethane
	Benzoic trichloride	1,3-Dichlorobenzene	Methyl acrylate	Tetrachloroethylene
	Benzoyl chloride	Dichlorobromomethane	Methyl ethyl ketone	Titanium tetrachloride
	Benzyl chloride	1,2-Dichloroethane	Methyl hydrazine	Toluene
	Bis(2-chloro-1-methyl ethyl) ether	1,2-Dichloroethylene	Methyl iodide	Toluene-2,6-diisocyanate
	Bis(2-chloroethyl) ether	Dichloromethane	Methyl isobutyl ketone	o-Toluidine hydrochloride
	Bis(2-ethylhexyl) adipate	1,2-Dichloropropane	Methyl isocyanate	o-Toluidine
	Bis(chloromethyl) ether	1,3-Dichloropropylene	Methyl methacrylate	1,2,4-Trichlorobenzene
	Bromoform	Diepoxybutane	Methyl tert-butyl ether	1,1,1-Trichloroethane
	Bromomethane	1,1-Dimethyl hydrazine	Methylene bromide	1,1,2-Trichloroethane
	Butyl acrylate	Dimethyl sulfate	Nitric acid	Trichloroethylene
	n-Butyl alcohol	N,N-Dimethylaniline	Nitrobenzene	1,2,4-Trimethylbenzene
	sec-Butyl alcohol	Dimethylcarbamyl chloride	Nitrogen mustard	Vinyl acetate
	tert-Butyl alcohol	1,4-Dioxane	Nitroglycerin	Vinylidene chloride
	1,2-Butylene oxide	Epichlorohydrin	2-Nitropropane	Xylene (mixed isomers)
	Butyraldehyde	2-Ethoxyethanol	N-Nitrosodiethylamine	m-Xylene
	Carbon disulfide	Ethyl acrylate	N-Nitrosomethylvinylaniline	o-Xylene
	Carbon tetrachloride	Ethylbenzene	Peracetic acid	p-Xylene
	Chlorobenzene	Ethyleneimine	Phosgene	2,6-Xylidine
	Chloroform	Formaldehyde		
Low volatile liquid	o-Anisidine hydrochloride	Dibutyl phthalate	N-Nitrosodi-n-butylamine	Polychlorinated biphenyls
	o-Anisidine	Diethyl phthalate	N-Nitrosodi-n-propylamine	Propane sultone
	p-Anisidine	Diethyl sulfate	N-Nitrosodimethylamine	Sulfuric acid
	Butyl benzyl phthalate	Dimethyl phthalate	N-Nitrosonornicotine	Toluene-2,4-diisocyanate
	Di-(2-ethylhexyl) phthalate	n-Dioctyl phthalate	N-Nitrosopiperidine	Tris (2,3-dibromopropyl) phosphate
	2,4-Diaminoanisole sulfate	Ethylene glycol	Phosphoric acid	

Subcategory	Chemical			
Solid	Acetamide	Cupferron	Hydroquinone	N-Nitrosomorpholine
	2-Acetylaminofluorene	Decabromodiphenol oxide	4,4'-Isopropylidenediphenol	Octachloronaphthalene
	Acrylamide	2,4-Diaminoanisole	Maleic anhydride	Osmium tetroxide
	Aluminum (fume or dust)	4,4'-Diaminodiphenyl ether	Melamine	Pentachlorophenol
	Aluminum oxide	Diaminotoluene (mixed isomers)	Methylenebis (phenylisocyanate)	Phenol
	1-Amino-2-methylanthraquinone	2,4-Diaminotoluene	4,4'-Methylenebis (2-chloroaniline)	p-Phenylenediamine
	2-Aminoanthraquinone	3,3'-Dichlorobenzidine	4,4'-Methylenebis (N,N-dimethyl) benzenamine	2-Phenylphenol
	4-Aminoazobenzene	2,4-Dichlorophenol	4,4'-Methylenedianiline	Phosphorus (yellow or white)
	4-Aminobiphenyl	Diethanolamine	Michler's ketone	Phthalic anhydride
	Anthracene	3,3'-Dimethoxybenzidine	Molybdenum trioxide	Picric acid
	Asbestos	4-Dimethylaminoazobenzene	Naphthalene	Quinone
	Benzamide	3,3'-Dimethylbenzidine	alpha-Naphthylamine	Saccharin
	Benzidine	2,4-Dimethylphenol	beta-Naphthylamine	Terephthalic acid
	Benzoyl peroxide	2,4-Dinitrophenol	Nitrilotriacetic acid	Thioacetamide
	Biphenyl	2,4-Dinitrotoluene	5-Nitro-o-anisidine	4,4'-Thiodianiline
	Calcium cyanamide	2,6-Dinitrotoluene	4-Nitrobiphenyl	Thiourea
	Catechol	1,2-Diphenylhydrazine	2-Nitrophenol	Thorium dioxide
	Chloroacetic acid	Ethylene thiourea	4-Nitrophenol	Titanium dioxide
	2-Chloroacetophenone	Hexachlorobenzene	N-Nitroso-N-ethylurea	Triaziquone
	p-Cresidine	Hexachloroethane	N-Nitroso-N-methylurea	2,4,5-Trichlorophenol
	o-Cresol	Hexachloronapthalene	N-Nitrosodiphenylamine	2,4,6-Trichlorophenol
	p-Cresol	Hydrazine sulfate	p-Nitrosodiphenylamine	Urethane
Water solution	Ammonium nitrate (solution)	Ammonium sulfate (solution)	Sodium hydroxide (solution)	Sodium sulfate (solution)

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Gas	Storage leaks	Sporadic	None	Engineering estimate from plant records of leaks	None	N/A	None	N/A	None	None	N/A	None	N/A	Storage leaks	Intermittent	None
Liquid	Handling losses	Routine	Unknown	Engineering estimate	Uses too diverse to generalize	Unknown	Unknown	Unknown	Uses too diverse to generalize	Unknown	Unknown	Unknown	Unknown	Exposure from handling of chemical	Intermittent	Personal protective equipment (gloves)
Solid	Handling losses	Routine	Unknown	Engineering estimate	Uses too diverse to generalize	Unknown	Unknown	Unknown	Uses too diverse to generalize	Unknown	Unknown	Unknown	Unknown	Exposure from handling of chemical	Intermittent	Personal protective equipment (gloves)

Subcategory	Chemical	Comment
Gas	Chlorine dioxide	Odor control agent
	Hydrogen fluoride	Nuclear uses
	Mustard gas	Used in warfare
	Vinyl bromide	Fiber flame retardant
Liquid	Acetonitrile	Stabilizer for chlorinated solvents
	Ammonium sulfate (solution)	Caprolactum manufacturing
	Bis(2-chloro-1-methyl ethyl) ether	Extractant
	Bromoform	Fluid for ore separation
	tert-Butyl alcohol	Denaturated for alcohol mixtures
	1,2-Butylene oxide	Acid scavenger for chlorinated compounds
	N,N-Dimethyl aniline	Used in sealants
	2-Ethoxyethanol	Extraction chemical
	Hexachloro-1,3-butadiene	Manufacture of pinhole free films
	Hydrochloric acid	Steel pickling, chemical manufacturing
	Hydrogen cyanide	Chelating agent
	Isobutyraldehyde	Corrosion inhibitor
	Isopropyl alcohol	Various cosmetic uses
	Methyl ethyl ketone	Used in magnetic tapes
	Methyl iodide	Methylating agent
	Methylene bromide	Gauge fluid
	Nitric acid	Manufacturing of adipic acid, TDI, nitrobenzeneaniline
	Propane sultone	Derivatizing agent
	Propyleneimine	Specialty chemical derivatives
	Quinoline	Corrosion inhibitor
	Sodium hydroxide (solution)	Refining of vegetable oils, pH control, alkaline bottle washing formulations, washing napththalene, stabilization of sodium hydrochloric, petroleum refining, etc.
	Sodium sulfate (solution)	Glass mill reparing
	Sulfuric acid	Copper leaching, alkylation of isobutane, inorganic chemicals, industrial organic chemicals
	Titanium tetrachloride	Smoke screen devices for the military
	1,2,4-Trichlorobenzene	Wood preservative agent against insects
	1,1,1-Trichloroethane	Solvent in aerosol dispensing products
Solid	Acetamide	Soldering flux, stabilizer, accelerator, and plasticizer in leather and films, antacid in cosmetic industry
	Aluminum (fume or dust)	Powdered aluminum alloys used in manufacturing of bushing, gears, tool, and machine parts

Subcategory	Chemical	Comment
Solid	Aluminum oxide	Flame retardant fillers, absorbants, ceramics, etc.
	Anthracene	Oil for wood, and making screens, etc.
	Arsenic	Glass production
	Asbestos	Cements, flooring, roofing, packing, insulation, etc.
	Benzoyl peroxide	Bleaching agent
	Calcium cyanamide	Used in steel nitridation and desulfurization
	Catechol	Leather tanning agent
	Cupferron	Reagent chemical for chelating metals
	Decabromodiphenol oxide	Flame retardant
	Diethanolamine	Acid absorption and corrosion inhibitor
	3,3'-Dimethoxybenzidine	Coupling agent also used in warfare
	Hexachlorobenzene	Adds blue color to polytechnics
	Hexachloroethane	Degreaser in Al and Mg metals manufacturing and chain transfer agents
	Hexachloronapthalene	Gauge and instrument fluid, electroplating stop-off chemical
	Hydrazine sulfate	Soldering flux, refining rare metals
	4,4'-Methylenedianiline	Iron corrosion inhibitor
	Osmium tetroxide	Used in aqua regia refining
	Picric acid	Oxidizer in fireworks
	Saccharin	Cosmetics
	Thorium dioxide	Incandescent agent in gas lighting
	2,4,5-Trichlorophenol	Perservative for rubber gaskets

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Solvent in paint and varnish removers	Release during formulation	Continuous	Closed lid on mixing tank	Engineering estimate	Spills	Sporadic	None	Engineering estimate	None	None	N/A	None	N/A	Inhalation and dermal exposure	Continuous	Lid on mixing tank, local exhaust ventilation, personal protective equipment
	Evaporation during application	Continuous	None	1) Emission factors 2) Mass balance based on usage less quantity released to water or solid waste	Spills	Sporadic	None	1) Emission factors 2) Mass balance based on usage less quantity released to water or solid waste	None	Disposal of old paint	Intermittent	Incineration	Engineering estimate based on plant disposal	Inhalation and dermal exposure	Continuous while stripping	General ventilation, local exhaust ventilation, personal protective equipment

Subcategory	Chemical	Comment
Solvent in paint and varnish removers	Acetone	Paint, varnish, and nail polish remover
	Bis(2-chloro-1-methyl ethyl) ether	Paint and varnish remover
	Dibutyl phthalate	Nail polish remover
	Dichloromethane	Paint stripper
	2-Ethyoxyethanol	Paint and varnish remover
	2-Nitropropane	Paint and varnish remover
	Sodium hydroxide (solution)	Paint remover

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Solid	Release of particulates during drying and packaging	Continuous	Filtration, scrubber	Engineering estimate	Release form water based manufacturing processes or scrubber wastewater	Continuous	Settling tanks, filtration	1) Monitoring data 2) Engineering estimate	None	Process waste	Intermittent	None	Engineering estimate	Handling of pesticides, insecticides, herbicides, fungicides produced	Routine	Process enclosure, local exhaust ventilation, personal protective equipment
	Releases during aerial spray application	Continuous	None	Engineering estimate based on usage and percent of chemical remaining airborne	Run-off, and over spray into water sources	Intermittent	None	Engineering estimate	Releases during application	None	Continuous	None	Mass balance based on usage and quantity released to other sources	Exposure during spraying	Routine	Personal protective equipment
	Releases during other application methods	Continuous	Electrostatic charge on dusting machine,	Engineering estimate based on volatility of the liquid product or percent particulates remaining airborne	Run-off	Intermittent	None	Engineering estimate	Releases during application	None	Continuous	None	Mass balance based on usage and quantity released to other sources	Exposure during spraying	Routine	Personal protective equipment
Liquid	Process vents	Intermittent	Unknown	Engineering estimate	Process upsets, spills	Sporadic	Unknown	Engineering estimate based on plant records on upsets and spills	None	Disposal of still bottoms and off-spec product	Sporadic	Unknown	Engineering estimate from plant disposal records	Handling of pesticides, insecticides, herbicides, fungicides produced	Routine	Process enclosure, local exhaust ventilation, personal protective equipment
	Storage vents	Continuous	Unknown	Engineering estimate using EPA/ API methods												
	Transfer losses	Routine	Closed-loop transfer	Engineering estimate using EPA/ API methods												
	Fugitive	Continuous	Inspection/maintenance	Emission factor with some composition, leak-rate, component count measurement												

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Liquid	Released during aerial spray application	Continuous	None	Engineering estimate based on usage and percent of chemical remaining airborne	Run-off, and over spray into water sources	Intermittent	None	Engineering estimate	Releases during application	None	Continuous	None	Mass balance based on usage and quantity released to other sources	Exposure during spraying	Routine	Personal protective equipment
	Released during other application methods	Continuous	Electrostatic charge on dusting machine,	Engineering estimate based on volatility of the liquid product or percent particulates remaining airborne	Run-off	Intermittent	None	Engineering estimate	Releases during application	None	Continuous	None	Mass balance based on usage and quantity released to other sources	Exposure during spraying	Routine	Personal protective equipment
Consumptive intermediate in pesticides, etc. manufacture	Process vents	Intermittent	Unknown	1) Engineering estimate 2) Monitoring data 3) Emission factor	Process upsets, spills	Sporadic	Unknown	Engineering estimate based on plant records on upsets and spills	None	Disposal of still bottoms and off-spec product	Sporadic	Unknown	1) Engineering estimate 2) Mass balance	Handling of chemical prior to reaction	Intermittent	Closed-loop transfer, personal protective equipment
	Storage vents	Continuous	Unknown	Engineering estimate												
	Transfer losses	Routine	Unknown	Engineering estimate using EPA/API methods												
	Fugitive	Continuous	Inspection/maintenance	Emission factor with some composition, leak-rate, component count measurement												

Subcategory	Chemical	Comment
Solid	Aldrin	Insecticide for moth control only
	Calcium cyanamide	Herbicide and soil treatment for soilborne diseases
	Captan	Fungicide
	Carbaryl	Insecticide
	Chloramben	Herbicide manufacture
	Chlorothalonil	Fungicide, mildewcide
	2,4-D	Herbicide

Subcategory	Chemical	Comment
Solid	1,4-Dichlorobenzene	Moth control agent
	Dicofol	Acaricide
	4,6-Dinitro-o-cresol	Herbicide
	Fluometuron	Herbicide
	Heptachlor	Termite insecticide
	Hydrazine sulfate	Biocide for fungi and molds
	Lindane	Insecticide
	Maneb	Fungicide
	Methoxychlor	Insecticide
	Nitrofen	Herbicide
	Propoxur	Insecticide
	Quintozene	Soil fungicide
	Tetrachlorvinphos	Insecticide (houseflies)
	Toxaphene	Insecticide
	Trichlorfon	Insecticide
	Trifluralin	Herbicide
	Zineb	Fungicide
Liquid	Bromomethane	Soil and space fumigant
	Chlordane	Insecticide, no longer produced
	Chlorobenzilate	Acaricide
	Diallate	Herbicide
	1,2-Dibromo-3-chloropropane	Pineapple pesticide
	1,2-Dibromoethane	Fumigant
	Dichlorvos	Insecticide
	Ethyl chloroformate	Herbicide
	Ethyleneimine	Insecticide and cotton treatment
	Hexamethylphosphoramide	Insect chemosterilant (experimental)
	Isobutyraldehyde	Insecticide
	Parathion	Insecticide
	1,2,4-Trichlorobenzene	Herbicide and soil treatment for termites
Consumptive intermediate in pesticides, etc. manufacture	Aniline	Pesticide production
	Arsenic	Pesticide production
	Benzoic trichloride	Herbicide intermediate
	Chlorobenzene	Solvent in pesticides formulation
	Diazomethane	Fungicide intermediate
	Dibenzofuran	Fungicide intermediate
	Dichlorobenzene (mixed isomers)	Acaricide raw material
	1,2-Dichlorobenzene	3-Dichloroaniline herbicide
	2,4-Dichlorophenol	Herbicide raw material
	1,1-Dimethyl hydrazine	Raw material for pesticides
	Dimethylcarbamyl chloride	Raw material for insecticides and herbicides
	1,4-Dioxane	Raw material for insecticide
	Hydrazine	Used in herbicide and plant growth regulators
	Methyl acrylate	Raw material for herbicide
	Methyl hydrazine	Raw material for wild oat herbicide
	Methyl isocyanate	Raw material for insecticides and herbicides
	Methylene bromide	Raw material for insecticides and nematocides
	Naphthalene	Derivative for insecticides
	alpha-Naphthylamine	Raw material for herbicides
	2-Nitropropane	Raw material for pesticides
	Phosgene	Herbicide, pesticide production
	Pyridine	Manufacture of paraquat and chlorpyrifos
	Quinoline	Derivative in herbicides and insecticides
	Quinone	Chloroneb manufacture
	Safrole	Raw material for insecticides

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Consumptive intermediate in pharmaceutical manufacture	Process	Intermittent	Some processes may vent to condensers or carbon adsorber	Engineering estimate	Process upset, spills	Sporadic	None	Engineering estimate based on plant records of upsets and spills	None	Disposal of reaction waste or off-spec product	Sporadic	None	Engineering estimate from plant disposal records	Transfer operations	Routine	Closed-loop transfer, personal protective equipment
	Storage and transfer losses	Continuous	Some tanks may vent to condenser or carbon adsorber	Engineering estimate using EPA/API methods												
Solvent in pharmaceutical manufacture	Release during drying of pharmaceuticals	Continuous	Condenser	1) Mass balance based on usage of the chemical less quantity recovered from condenser and quantity retained in pharm. 2) Emission factor	None	N/A	None	N/A	None	None	N/A	None	N/A	Cleaning and other maintenance	Sporadic	Personal protective equipment
														Production worker	Intermittent	General ventilation
Pharmaceutical product	Particulate losses during drying and handling of product	Continuous	None	Engineering estimate	None	N/A	None	N/A	None	Disposal of off-spec product	Sporadic	None	Engineering estimate from plant disposal records	Product handing operations	Intermittent	Local exhaust ventilation, personal protective equipment

Subcategory	Chemical	Comment
Consumptive intermediate in pharmaceutical manufacture	Aniline	Pharmaceutical intermediate
	Bromomethane	Pharmaceutical intermediate
	2-Chloroacetophenone	Pharmaceutical intermediate
	Chloroethane	Pharmaceutical intermediate
	p-Nitrosodiphenylamine	Intermediate for pharmaceuticals
	Osmium tetroxide	Intermediate to manufacture glucorticoids and androgen
	Quinoline	Derivatives used for synthetic medicinals
	Urethane	Intermediate for pharmaceuticals
Solvent in pharmaceutical manufacture	Acetone	Solvent in pharmaceutical manufacture
	Acetonitrile	Recovable reaction medium in pharmaceuticals
	Carbon tetrachloride	Solvent in pharmaceutical manufacture
	Chloroform	Solvent in pharmaceutical manufacture
	Isopropyl alcohol	Solvent in pharmaceutical manufacture

Subcategory	Chemical	Comment
Pharmaceutical product	Acetamide	Antidote for monofluoroacetamide poisoning
	Benzoyl peroxide	Active acne ingredient
	Calcium cyanamide	Antialcoholic drug
	2-Ethoxyethanol	Anesthetics
	Hexachloroethane	Anthelmintic in veterinary medicine
	Nitrogen mustard	Cancer chemotherapy
	Nitroglycerin	Vasodilator
	beta-Propriolactone	Influenza vaccine
	Saccharin	Pharmaceuticals

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Developer	Evaporation of developer during use	Continuous	None	Engineering estimate	Potential disposal of developer down sanitary sewer	Routine	None	Mass balance based on usage, percent chemical in developer, and consumption in developing process	None	Disposal of used developer as waste	Routine	Possible reaction of developer and fixer prior to disposal	Engineering estimate	Dermal exposure of hands in developer	Routine	Personal protective equipment (gloves)
														Evaporation of developer	Continuous	Local exhaust ventilation
Consumptive intermediate in photographic dye manufacture	Released during handling of chemical during production of dye prior to dye formulation	Routine	Similar to chemical intermediate category with controls based on physical state of the chemical	Engineering estimate	Spills of chemical prior to consumptive usage	Sporadic	None	Engineering estimate	None	None	N/A	None	N/A	Exposure of chemical prior to consumptive use	Sporadic	Personal protective equipment
Solvent in photographic film manufacture	Evaporation of solvent during film making process	Continuous	Condenser or carbon adsorber	Mass balance based on solvent usage records	None	N/A	None	N/A	None	None	N/A	None	N/A	Potential exposure from leaks in solvent evaporation/ reclamation system	Sporadic	Leak repair

Subcategory	Chemical	Comment
Developer	Catechol	Developer
	Hydroquinone	Developer
	p-Phenylenediamine	Color developer
Consumptive intermediate in photographic dye manufacture	Acetonitrile	Reaction solvent in photographic dye manufacture
	Aniline	Raw material for photographic dyes
Solvent in photographic film manufacture	Dichloromethane	Solvent in photographic film manufacture and photoresist stripping

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Consumptive intermediate in polymer, etc. manufacture	Process	Intermittent	Some processes may use condenser, flare, adsorber	1) Engineering estimate 2) Emission factor	Process upsets, spills	Sporadic	Some facilities may have surface impoundment or lagoon with biological treatment, aeration or POTW	Engineering estimate based on plant records of upsets and spills	None	Disposal of reactor waste	Sporadic	None	Enginering estimate based on plant disposal records	Maintenance of chemical storage	Intermittent	Personal protective equipment
	Storage	Continuous	Some tanks may vent to flare or condenser	1) Engineering estimate 2) Emission factor										Transfer operations	Routine	Closed-loop transfer, personal protective equipment
	Fugitive	Continuous	None	1) Engineering estimate 2) Emission factor												
Liquid additive	Release during handling	Intermittent	Closed transfer systems	Engineering estimate	Spills	Sporadic	None	N/A	None	None	N/A	None	N/A	Potential inhalation or dermal exposure during handling	Intermittent	Closed-loop transfer, personal protective equipment
Solid additive	Potential dusting during handling	Intermittent	None	Engineering estimate	None	N/A	None	N/A	None	None	N/A	None	N/A	Potential dusting during handling	Intermittent	Personal protective equipment
Resin carrier solvent	Release during drying after extrusion	Continuous	Condenser, carbon adsorber	Mass balance based on usage of the chemical less quantity recovered	None	N/A	None	N/A	None	None	N/A	None	N/A	Production worker	Intermittent	General ventilation
														Maintenance worker	Sporadic	Personal protective equipment

Subcategory	Chemical	Comment
Consumptive intermediate in polymer, etc. manufacture	Acrylamide	Monomer use (polyacrylamides)
	Acrylic acid	Monomer
	Acrylonitrile	Monomer, acrylic fibers, ABS resins, nitrile rubber
	1,3-Butadiene	Polymer and rubber intermediate
	Butyl acrylate	Monomer for emulsion polymers and acrylic elastomers
	Chloroprene	Monomer for polychloroprene
	1,4-Dichlorobenzene	Derivative for polyphenylene sulfide resins
	1,2-Dichloroethane	Vinyl monomer
	1,2-Dichloropropane	Derivative for ion-exchange resins
	3,3'-Dimethylbenzidine	Polyurethane elastomers
	Epichlorohydrin	Epoxy resins, epichlorohydrin elastomers
	Ethyl acrylate	Monomer for acrylic resins
	Ethylene	Derivative LDPE, HDPE
	Ethylene glycol	Polyester manufacture, PET materials
	Ethylenimine	Monomer for polyaziridine and polymer modifier
	Formaldehyde	
	Isobutyraldehyde	Used in the manufacture of resins and rubber

Subcategory	Chemical	Comment
Consumptive intermediate in polymer, etc. manufacture	4,4'-Isopropylidenediphenol	Epoxy and polycarbonate resins
	Maleic anhydride	Polyurethane resins and copolymer use
	Melamine	Used in laminates, molding compounds, textile treatment resins
	Methyl methacrylate	Plastic sheets and moldings, extrusion compounds
	Methylenebis (phenylisocyanate)	Derivative of plastics and elastomers and urethane resins
	Phenol	Nylon to manufacture phenolic resins
	Phosgene	Polycarbon resins
	Quinone	Manufacture of unsaturated polyesters
	Styrene	Polystyrene, ABS resins, polyester resins, SBR rubber
	Sulfuric acid	Synthetic plastics and rubber
	Terephthalic acid	Polyester fibers, polyethylene terephthalate polymer films and plastics
	Toluene-2,4-diisocyanate	Polyurethanes
	Toluene-2,6-diisocyanate	Polyurethanes
	Vinyl acetate	Polyvinyl chloride copolymer, polyvinyl emulsions
	Vinyl chloride	PVC manufacture
	Vinylidene chloride	
Liquid additive	Bis(2-ethylhexyl) adipate	Plasticizer for various polymers
	Butyl benzyl phthalate	Plasticizer for vinyl, vinyl acetate, and other polymers
	Cumene hydroperoxide	Polymerization initiator
	Di-(2-ethylhexyl)	Plasticizer for PVC and others
	Diepoxybutane	Polymer curative
	Diethyl phthalate	Plasticizer for PVC
	Dimethyl phthalate	Plasticizer
	n-Dioctyl phthalate	Plasticizer for PVC and other plastics and elastomers
	1,4-Dioxane	Plasticizer
	2-Ethoxyethanol	Plasticizer
	Hydrazine	Blowing agent in foamed plastics
	Peracetic acid	Epoxy resins, plasticizers and bleaching agent for nylon and acrylic fibers
	Propylene oxide	Urethane polyols
	Quinoline	Imparts ion exchange capacity in polymers
	Sodium hydroxide (solution)	Rubber latex stabilizer
Solid additive	Benzoyl peroxide	Initiator and cross link agent in polymer manufacture
	Biphenyl	Plasticizer in PVC
	3,3'-Dichlorobenzidine	Coupling agent, curing agent
	Diethanolamine	Polyurethane crosslinker, rubber curing agent
	2,4-Dinitrotoluene	Chain extender, monomer, and plasticizer
	2,6-Dinitrotoluene	Chain extender, monomer
	Ethylene thiourea	Accelerator and vulcanizer in rubber
	Hexachloroethane	Plasticizer
	Hexachloronapthalene	Components in electrical encapsulating compounds
	Hydroquinone	Polymerization inhibitor, anti-oxidants, curing agent
	4,4'-Methylenebis (2-chloroaniline)	Curing agent and insulator in epoxy systems
	4,4'-Methylenedianiline	Rubber antioxidant, resin intermediate
	alpha-Naphthylamine	Rubber antioxidant
	p-Nitrosodiphenylamine	Inhibitor in production of styrene
	p-Phenylenediamine	Aramid fibers, thermoplastics, antioxidant for polyolefin plastics, rubber oxidant
	Phthalic anhydride	Phthalic ester plasticizers, polyesters, alkyd resins
	Titanium dioxide	Plastics
	2,4,5-Trichlorophenol	Preservative in polymer manufacture
Resin carrier solvent	Acetonitrile	Solvent for polymers
	Dichloromethane	Extrusion of triacetate fiber, blowing agent, and bonding agent
	Freon 113	Blowing agent for polyurethane foams
	Nitrobenzene	Polyester solvent
	2-Phenylphenol	Dye stuff carrier for polyester fibers

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Pulp processing	Release from pulping process	Routine	Vent to scrubber or boiler	Engineering estimate	Process wastewater	Routine	Aeration, biological treatment	Engineering estimate	Disposal of process wastes	None	Routine	Incineration in waste boilers	Engineering estimate	Release from process and process waste	Routine	Personal protective equipment
	Wastewater aeration	Continuous	None	1) Engineering estimate 2) Emission factor	None	N/A	None	N/A								
Paper processing	Handling of chemical prior to paper use	Sporadic	None	Engineering estimate	None	N/A	None	N/A	None	None	N/A	None	N/A	Handling of chemical prior to paper use	Intermittent	Personal protective equipment
Textile processing	Release from textile process (liquids)	Continuous	Condenser	Engineering estimate	Process wastewater	Routine	Aeration, biological treatment	Engineering estimate	None	None	N/A	None	N/A	Release from process and process waste	Routine	Personal protective equipment

Subcategory	Chemical	Comment
Pulp processing	Chlorine	Bleaching agent in pulp manufacture
	Chlorine dioxide	Bleach for wood pulp
	Chloroform	
	Nitrilotriacetic acid	Pulp processing
	Sodium hydroxide (solution)	Wood pulp, groundwood pulp bleaching, woodboard made from agricultural residues
	Sodium sulfate (solution)	Kraft pulping agent
	Sulfuric acid	Pulp processing
Paper processing	Acetamide	Humectant for paper
	Acrolein	Slimicide in paper
	Chlorine	Bleaching agent in paper manufacture
	Melamine	Used in paper coatings
	Nitrilotriacetic acid	Paper processing
	2-Phenylphenol	Preservative in timber and paper
	Sulfuric acid	Paper processing
	2,4,5-Trichlorophenol	Antimicrobial-paper
Textile processing	Aniline	Intermediate in the production of fibers
	Bis(2-chloro-1-methyl ethyl) ether	Textile processing component
	Bis(2-chloroethyl) ether	Textile scouring agent
	Chlorine dioxide	Bleach for textile
	Diethanolamine	Used in textile specialities
	Nitrilotriacetic acid	Textile treatment
	Sodium hydroxide (solution)	Textile processing
	Tetrachloroethylene	Textile processing
	2,4,5-Trichlorophenol	Antimicrobial-textile
	Vinyl bromide	Used with vinyl chloride to impregnate or laminate fibers

	Air releases				Wastewater releases				Solid and nonaqueous liquid releases					Occupational exposures		
Subcategory	Types of releases	Release frequency	Controls in use	Release estimation method	Types of releases	Release frequency	Controls in use	Release estimation method	Onsite land release	Offsite transfer	Release or transfer frequency	Onsite treatment methods	Release estimation method	Types of exposures	Exposure frequency	Controls in use
Corrosion inhibitor	Water cooling tower	Continuous	None	1) Emission factor 2) Engineering estimate	Boiler blowdown	Intermittent	None	Engineering estimate	None	None	N/A	None	N/A	Spills of the chemical	Sporadic	None
Disinfectant	Storage pressure relief valves (acids)	Sporadic	Vent to scrubber	Engineering estimate	Potential release during upset conditions	Sporadic	None	Engineering estimate based on usage of the chemical	None	None	N/A	None	N/A	Potential dermal exposure	Sporadic	Personal protective equipment (gloves)
Neutralization	Storage pressure relief valves (acids)	Sporadic	Vent to scrubber	Engineering estimate	Spills or upset condition	Sporadic	None	Engineering estimate	None	None	N/A	None	N/A	Potential dermal exposure	Sporadic	Personal protective equipment

Subcategory	Chemical	Comment
Corrosion inhibitor	Hydrazine	Corrosive protection for boilers, hot-water systems, and in oil-well casings
	Nitrolotriacetic acid	Boiler water treatment chemical
Disinfectant	Chlorine	Disinfectant
	Chlorine dioxide	Disinfectant
Neutralization	Hydrochloric acid	Neutralization
	Sodium hydroxide (solution)	Neutralization

APPENDIX D

HAZARDOUS SUBSTANCE FACT SHEETS

APPENDIX D - HAZARDOUS SUBSTANCE FACT SHEETS

Fact sheets for Section 313 chemicals are available from State and EPA Regional Section 313 contacts. The EPA fact sheets are based on ones developed for the workplace by the New Jersey Department of Health. A sample hazardous substance fact sheet is attached. Each chemical-specific fact sheet contains:

- A hazard summary.
- A brief description of the chemical.
- Workplace exposure limits.
- Acute and chronic health effects.
- Medical testing.
- Definitions of terms.

It is important to note, however, that these fact sheets contain occupational data based on a healthy male worker population. Therefore, the information presented (such as workplace exposure limits) do not reflect environmental exposures and may not be protective of the general human population (which includes women, children, and sensitive populations).

HAZARDOUS SUBSTANCE FACT SHEET

United States Environmental Protection Agency
Office of Toxic Substances

Ethylene oxide
Chemical Abstract Service # 75-21-8

A MESSAGE FROM THE ENVIRONMENTAL PROTECTION AGENCY

The Emergency Planning and Community Right To Know Act of 1986 requires the Environmental Protection Agency to establish the Toxic Release Inventory, a national data base containing information on the release of 328 toxic chemicals from manufacturing plants in the United States. This Fact Sheet, prepared by the New Jersey Department of Health, concerns one of these chemicals. EPA is distributing copies of this Fact Sheet in order to help the public understand the potential health effects of exposure to chemical releases identified in the Toxic Release Inventory.

Readers should be aware that determining the health effects of chemicals is a very complex process. These Fact Sheets are summaries of facts about the chemicals. In addition, there may be subtle but important differences in the ways in which the State of New Jersey, EPA, and other scientific institutions might state their conclusions regarding the health effects of particular chemicals according to potential exposures. However, we believe these New Jersey Fact Sheets are very useful sources of summary information.

Since New Jersey wrote these Fact Sheets for workers who may be exposed to the chemicals where they work, several sections of the Fact Sheets are about workplace, rather than community situations. Levels of exposure at work--such as in factories or repair shops--are often much higher than community exposures. In addition, the ways that community residents are exposed may also be different. For example, workers may be exposed to a particular chemical by air and skin contact, but residents may be exposed to the same chemical through their drinking water.

Finally, readers should note most chemicals have not been tested for toxicity in a comprehensive manner. There are scientific gaps in our knowledge about the health effects of most chemicals. These Fact Sheets can only provide information on health effects where testing for toxicity has actually been done or where comparisons with similar chemicals can be drawn. As further scientific knowledge is acquired, additional information will be made available.

July 1988

HAZARDOUS SUBSTANCE FACT SHEET

Contents prepared by the
New Jersey Department of Health
Right to Know Program

Distributed by the United States
Environmental Protection Agency
Office of Toxic Substances

Common Name: **ETHYLENE OXIDE**

CAS Number: 75-21-8
DOT Number: UN 1040

RTK Substance number: 0882
Date: 11/3/86

HAZARD SUMMARY

* **Ethylene Oxide** can affect you when breathed in.
* **Ethylene Oxide** is a CARCINOGEN--HANDLE WITH EXTREME CAUTION.
* It may damage the developing fetus.
* Contact with liquid can cause severe burns and frostbite.
* The vapor may cause headaches, nausea, vomiting, diarrhea, difficulty in breathing, drowsiness, weakness, and loss of muscle control. Higher exposures may cause a build-up of fluid in the lungs (pulmonary edema). This can cause death.
* It is a HIGHLY FLAMMABLE LIQUID/GAS and a DANGEROUS FIRE and EXPLOSION HAZARD.

IDENTIFICATION

Ethylene Oxide is normally a colorless gas or liquid. It has an ether-like odor and is used to make antifreeze, polyesters, laundry detergents and as an industrial sterilant.

REASON FOR CITATION

* **Ethylene Oxide** is on the Hazardous Substance List because it is regulated by OSHA and cited by NIOSH, ACGIH, IARC and NFPA.
* This chemical is on the Special Health Hazard Substance List because it is a CARCINOGEN, a MUTAGEN, and is REACTIVE.
* Definitions are attached.

HOW TO DETERMINE IF YOU ARE BEING EXPOSED

* Exposure to hazardous substances should be routinely evaluated. This may include collecting air samples. Under OSHA 1910.20, you have a legal right to obtain copies of sampling results from your employer. If you think you are experiencing any work-related health problems, see a doctor trained to recognize occupational diseases. Take this Fact Sheet with you.
* **ODOR THRESHOLD = 430 ppm.**
* This odor threshold is well above the exposure limits and should not be considered as a warning of exposure.

WORKPLACE EXPOSURE LIMITS

OSHA: The legal airborne permissible exposure limit (PEL) is 1 ppm averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit is less than 0.1 ppm averaged over an 8-hour workshift and 5 ppm, not to be exceeded during any 10 minute work period in any single day.

ACGIH: The recommended airborne exposure limit is 1 ppm averaged over an 8-hour workshift.

* **Ethylene Oxide** is a PROBABLE CARCINOGEN in humans. There may be no safe level of exposure to a carcinogen, so all contact should be reduced to the lowest possible level.

WAYS OF REDUCING EXPOSURE

* A regulated, marked area should be established where **Ethylene Oxide** is handled, used, or stored as required by the OSHA standard 1910.1047.
* Wear protective work clothing when working with the liquid.
* Wash thoroughly immediately after exposure to **Ethylene Oxide** and at the end of the workshift.
* Post hazard and warning information in the work area. In addition, as part of an ongoing education and training effort, communicate all information on the health and safety hazards of **Ethylene Oxide** to potentially exposed workers.

This Fact Sheet is a summary source of information of all potential and most severe health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

HEALTH HAZARD INFORMATION

Acute Health Effects

The following acute (short-term) health effects may occur immediately or shortly after exposure to Ethylene Oxide:

* Exposure to Ethylene Oxide may cause headaches, nausea, vomiting, diarrhea, difficulty in breathing, drowsiness, weakness, and loss of muscle control. Higher exposures may cause passing out and even death.
* Ethylene Oxide vapor can irritate the eyes, nose and throat, and may irritate the lungs, causing coughing and/or shortness of breath. Higher exposures can cause a build-up of fluid in the lungs (pulmonary edema). This can cause death.
* Numbing of the sense of smell can occur, making exposure harder to detect.
* Contact with the undiluted liquid can cause frostbite.
* Contact with solutions of Ethylene Oxide in water can cause skin burns with blistering and redness. Skin ulcers may be delayed, often appearing 1 to 5 hours after contact.

Chronic Health Effects

The following chronic (long-term) health effects can occur at some time after exposure to Ethylene Oxide and can last for months or years:

Cancer Hazard

* Ethylene Oxide is a PROBABLE CARCINOGEN in humans. There is some evidence that it causes leukemia in humans and it has been shown to cause leukemia and abdominal cavity cancer in animals.
* Many scientists believe that there is no safe level of exposure to a carcinogen.

Reproductive Hazard

* It may damage the developing fetus.
* There is an increased incidence of gynecological disorders and spontaneous abortions among workers in Ethylene Oxide production. Its role in this increase is unclear at this time.

Other Long-Term Effects

* Ethylene Oxide may damage the nervous system, causing numbness, "pins and needles", and/or weakness in the hands and feet.
* It may damage the liver and kidneys.
* It may cause a skin allergy. If an allergy develops, very low future exposures can cause itching and a skin rash.

MEDICAL

Medical Testing

For those with frequent or potentially high exposure (half the TLV or greater), the following are recommended before beginning work and at regular times after that:

* Lung function tests.

If symptoms develop or overexposure is suspected, the following may be useful:

* Consider chest x-ray after acute overexposure.
* Evaluation by a qualified allergist, including careful exposure history and special testing, may help diagnose skin allergy.
* Liver and kidney function tests.

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under OSHA 1910.20.

Mixed Exposures

Because smoking can cause heart disease, as well as lung cancer, emphysema, and other respiratory problems, it may worsen respiratory conditions caused by chemical exposure. Even if you have smoked for a long time, stopping now will reduce your risk of developing health problems.

WORKPLACE CONTROLS AND PRACTICES

Unless a less toxic chemical can be substituted for a hazardous substance, **ENGINEERING CONTROLS** are the most effective way of reducing exposure. The best protection is to enclose operations and/or provide local exhaust ventilation at the site of chemical release. Isolating operations can also reduce exposure. Using respirators or protective equipment is less effective than the controls mentioned above, but is sometimes necessary.

In evaluating the controls present in your workplace, consider: (1) how hazardous the substance is, (2) how much of the substance is released into the workplace and (3) whether harmful skin or eye contact could occur. Special controls should be in place for highly toxic chemicals or when significant skin, eye, or breathing exposures are possible.

In addition, the following controls are recommended:

* Where possible, automatically pump liquid Ethylene Oxide from drums or other storage containers to process containers.
* Specific engineering controls are required by OSHA and recommended for this chemical by NIOSH. Refer to the NIOSH criteria document: Occupational Exposure to *Ethylene Oxide #77-200* and the OSHA standard 1910.1047.
* Before entering a confined space where Ethylene Oxide may be present, check to make sure that an explosive concentration does not exist.

Good **WORK PRACTICES** can help to reduce hazardous exposures. The following work practices are recommended:

* Workers whose clothing has been contaminated by the liquid should remove clothing promptly and allow Ethylene Oxide to evaporate.
* If there is the possibility of skin exposure, emergency shower facilities should be provided.
* On skin contact with liquid, immediately wash with warm water. At the end of the workshift, wash any areas of the body that may have had contact with Ethylene Oxide in solution, whether or not known skin contact has occurred.
* Do not eat, smoke, or drink where Ethylene Oxide is handled, processed, or stored, since the chemical can be swallowed. Wash hands carefully before eating or smoking.

PERSONAL PROTECTIVE EQUIPMENT

WORKPLACE CONTROLS ARE BETTER THAN PERSONAL PROTECTIVE EQUIPMENT. However, for some jobs (such as outside work, confined space entry, jobs done only once in a while, or jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

The following recommendations are only guidelines and may not apply to every situation.

Clothing

* Avoid skin contact with Ethylene Oxide. Wear protective gloves and clothing. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation.
* All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.
* ACGIH recommends *Chlorinated Polyethylene* as a protective material.

Eye Protection

* Eye protection is included in the recommended respiratory protection.

Respiratory Protection

IMPROPER USE OF RESPIRATORS IS DANGEROUS. Such equipment should only be used if the employer has a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing and medical exams, as described in OSHA 1910.134.

* At <u>any</u> exposure level, use a MSHA/NIOSH approved supplied-air respirator with a full facepiece operated in the positive pressure mode or with a full facepiece, hood, or helmet in the continuous flow mode, or use a MSHA/NIOSH approved self-contained breathing apparatus with

a full facepiece operated in pressure-demand or other positive pressure mode.

* Exposure to 8,000 ppm is immediately dangerous to life and health. If the possibility of exposures above 8,000 ppm exists, use a MSHA/NIOSH approved self-contained breathing apparatus with a full facepiece operated in continuous flow or other positive pressure mode.

HANDLING AND STORAGE

* Prior to working with Ethylene Oxide you should be trained on its proper handling and storage.
* A regulated, marked area should be established where Ethylene Oxide is handled, used, or stored.
* It must be stored to avoid contact with even small amounts of ACIDS (such as NITRIC or SULFURIC ACIDS); ALKALIS (such as SODIUM HYDROXIDE or POTASSIUM HYDROXIDE); CATALYTIC ANHYDROUS CHLORIDES of IRON, ALUMINUM or TIN; IRON or ALUMINUM OXIDE; or METALLIC POTASSIUM, since it may react by itself, liberating much heat and causing a possible explosion.
* Ethylene Oxide should not contact OXIDIZERS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, and NITRATES) since an explosion could occur.
* Store in tightly closed containers in a cool well-ventilated area away from HEAT, SPARKS, or SUNLIGHT.
* Sources of ignition such as smoking and open flames are prohibited where Ethylene Oxide is handled, used, or stored.
* Metal containers involving the transfer of 5 gallons or more of Ethylene Oxide should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs, and flame arresters.
* Use only non-sparking tools and equipment, especially when opening and closing containers of Ethylene Oxide.
* Wherever Ethylene Oxide is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings.

QUESTIONS AND ANSWERS

Q: If I have acute health effects, will I later get chronic health effects?
A: Not always. Most chronic (long-term) effects result from repeated exposures to a chemical.

Q: Can I get long-term effects without ever having short-term effects?
A: Yes, because long-term effects can occur from repeated exposures to a chemical at levels not high enough to make you immediately sick.

Q: What are my chances of getting sick when I have been exposed to chemicals?
A: The likelihood of becoming sick from chemicals is increased as the amount of exposure increases. This is determined by the length of time and the amount of material to which someone is exposed.

Q: Don't all chemicals cause cancer?
A: No. Most chemicals tested by scientists are not cancer-causing.

Q: Should I be concerned if a chemical causes cancer in animals?
A: Yes. Most scientists agree that a chemical that causes cancer in animals should be treated as a suspected human carcinogen unless proven otherwise.

Q: But don't they test animals using much higher levels of a chemical than people usually are exposed to?
A: Yes. That's so effects can be seen more clearly using fewer animals. But high doses alone don't cause cancer unless it's a cancer agent. In fact, a chemical that causes cancer in animals at high doses could cause cancer in humans exposed to low doses.

Q: Who is at the greatest risk from reproductive hazards?
A: Pregnant women are at greatest risk from chemicals that harm the developing fetus. However, chemicals may affect the <u>ability</u> to have children, so both men and women of childbearing age are at high risk.

>>>>>>>>>>>>>>>>>> E M E R G E N C Y I N F O R M A T I O N <<<<<<<<<<<<<<<<<

Common Name: **ETHYLENE OXIDE**
DOT Number: **UN 1040**
DOT Emergency Guide code: **69**
CAS Number: **75-21-8**

NJ DOH Hazard rating	
FLAMMABILITY	4
REACTIVITY	3

HIGHLY FLAMMABLE AND REACTIVE GAS/LIQUID
POISONOUS GAS IS PRODUCED IN FIRE
CONTAINERS MAY EXPLODE IN FIRE

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

FIRE HAZARDS

* **Ethylene Oxide** is an extremely FLAMMABLE GAS or LIQUID. The gas easily forms explosive mixtures with air.
* Fight a fire from an explosion-resistant location. Use dry chemical, CO_2, water spray, or foam extinguishers.
* POISONOUS GAS IS PRODUCED IN FIRE.
* CONTAINERS MAY EXPLODE IN FIRE.
* The vapor or gas is heavier than air and may travel a distance to cause a fire or explosion far from the source.
* If employees are expected to fight fires, they must be trained and equipped as stated in OSHA 1910.156.

SPILLS AND EMERGENCIES

If **Ethylene Oxide** is spilled or leaked, take the following steps:

* Restrict persons not wearing protective equipment from area of spill or leak until clean-up is complete.
* Remove all ignition sources.
* Ventilate area of spill or leak.
* If in the gaseous form, stop the flow of gas. If the source of the leak is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to a safe place in the open air and repair the leak or allow the cylinder to empty.
* Keep **Ethylene Oxide** out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations.
* It may be necessary to contain and dispose of **Ethylene Oxide** as a HAZARDOUS WASTE. Contact your state Environmental Program for specific recommendations.

FOR LARGE SPILLS AND FIRES immediately call your fire department.

HANDLING AND STORAGE (See page 4)

FIRST AID

POISON INFORMATION

Eye Contact

* Immediately flush with large amounts of water. Continue without stopping for at least 30 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately.

Skin Contact

* Quickly remove contaminated clothing. Immediately wash contaminated skin with large amounts of soap and water. Seek medical attention.
* If contact with liquified **Ethylene Oxide** occurs, immerse affected part in warm water. Seek medical attention.

Breathing

* Remove the person from exposure.
* Begin rescue breathing if breathing has stopped and CPR if heart action has stopped.
* Transfer promptly to a medical facility.
* Medical observation is recommended for 24 to 48 hours after breathing overexposure, as pulmonary edema may be delayed.

PHYSICAL DATA

Vapor Pressure: 1,095 mm Hg at 68°F
Flash Point: Less than 0°F
Water Solubility: Miscible

OTHER COMMONLY USED NAMES

Chemical Name: Oxirane
Other Names and Formulations: 1,2-Epoxyethane; Dimethylene Oxide; ETO

NEW JERSEY DEPARTMENT OF HEALTH
Right to Know Project
CN 368, Trenton, NJ 08625-0368

APPENDIX E

FEDERAL LAWS

APPENDIX E - FEDERAL LAWS

CLEAN AIR ACT (CAA)
(Office of Air Quality Planning and Standards)

The Clean Air Act was enacted into law in 1970 and amended in 1974, 1977, and 1981. The 1970 amendments set emissions standards for automobiles and required EPA to set and periodically review three different types of national air standards. The first are National Ambient Air Quality Standards (NAAQSs). The NAAQSs define the principal types of pollution and the levels of each that should not be exceeded for the protection of human health and welfare. EPA formally adopted the first NAAQSs in 1971. Once EPA sets a NAAQS, State governments have the responsibility to determine how NAAQSs can be met and maintained most efficiently at the local level. The primary mechanism States use to characterize local air quality and define strategies to achieve national standards is the State Implementation Plan (SIP). EPA is responsible for the review, approval, and general oversight of all SIPs.

In addition, EPA is required under this Act to define allowable New Source Performance Standards (NSPSs) which establish allowable emissions limitations for different kinds of stationary sources. The regulations include general criteria for preconstruction permit programs, and for new and modified stationary sources of air emissions. Again, while EPA was given the authority to develop these regulations, Congress recognized that State governments are best suited to issuing and enforcing permits. EPA is also required to set National Emissions Standards for Hazardous Air Pollutants (NESHAPs) for which no ambient air quality standards exist. Eight substances are currently listed under NESHAPs: arsenic, asbestos, benzene, beryllium, coke oven emissions, mercury, radon-222, and vinyl chloride. Facility emissions standards have been established for all these substances (except coke oven emissions). (U.S. EPA, 1987b, pp. 1-2.) Under Title II of the Act, EPA is required to prescribe and manage programs to test and certify new motor vehicle engines for compliance with national standards, and also to enforce provisions related to in-use emissions from vehicles.

CLEAN WATER ACT (CWA)
(Office of Water Regulations and Standards)

The Clean Water Act was passed in 1972 and amended several times, most recently in 1987. The Act established a national goal of achieving fishable and swimmable waters wherever attainable by 1983, and eliminating pollutant discharges into the Nation's waterways by 1985. The primary objective of the Act is "...to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Under the Clean Water Act, EPA established water quality criteria for the development of:

- Water quality standards.
- Technology-based effluent limitation guidelines.
- Pretreatment standards.
- New source performance standards.
- A national permit program to regulate the discharge of pollutants.

The CWA provides for the National Pollutant Discharge Elimination System (NPDES) which incorporates and applies effluent limitations in individual permits for both municipal and direct industrial dischargers. Under these permits, dischargers are subject to both technology-based treatment requirements, and where necessary to protect a designated use, controls based on water quality standards. States are responsible for setting their own water quality standards and developing water quality management programs.

The technology-based limitations prescribe minimum standards of performance for municipal and industrial dischargers without regard to the quality of receiving waters. By contrast, water quality standards identify intended uses of particular water bodies, and on the basis of water quality criteria guidance developed by EPA, set the biological and chemical conditions necessary to sustain those uses.

The Act also establishes a program to identify those water bodies not achieving water quality standards because of toxic pollutants discharges. The

states must assess and identify affected water bodies and by February 1989, set specific effluent limitations for these discharges in NPDES permits. These individual control strategies must assure water quality standards are attained. (U.S. EPA, 1987b, pp. 6-7.)

COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT OF 1980 (CERCLA) AND THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986 (SARA)
(Office of Emergency and Remedial Response)

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or "Superfund") was enacted into law in 1980 when it became apparent that the regulatory framework of RCRA (see below) was not adequate to cope with the uncontrolled disposal of toxic chemicals. CERCLA authorizes the federal government to respond directly to releases or threatened releases of hazardous substances, pollutants, or contaminants that may endanger the public health, welfare, or the environment. This legislation also established a $1.6 billion fund to cover the costs of cleaning up abandoned hazardous waste chemical sites.

The statute was amended in 1986. Title I of the Superfund Amendments and Reauthorization Act (SARA) contains provisions relating primarily to response and liability. Title II contains miscellaneous provisions. Title III contains the emergency planning and community right-to-know provisions. Section 313, the Emissions Inventory, is part of Title III. (U.S. EPA, 1987b, p. 29.)

FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT (FIFRA)
(Office of Pesticide Programs)

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was passed in 1947 and amended in 1972, 1975, and 1978. It was administered by the Department of Agriculture until 1970 when jurisdiction was transferred to the EPA. The purpose of the Act is to control the use of pesticides to safeguard

the health of the public and to prevent adverse effects on the environment. Under FIFRA, EPA is authorized to:

- Register pesticide products on the basis of both safety and benefits. (This balancing of risks and benefit underlies all basic regulatory decisions under the Act.)
- Specify the terms and conditions of pesticide use prior to being marketed.
- Remove unreasonably hazardous pesticides from the marketplace. (U.S. EPA, 1987b, p. 15.)

MARINE PROTECTION, RESEARCH, AND SANCTUARIES ACT (MPRSA)
(Office of Marine and Estuarine Protection)

MPRSA was passed to protect the marine environment and public health from the dumping of all materials in ocean waters. Section 102(b) of the law states that it is the policy to "regulate the dumping of all types of materials into ocean waters and to prevent or strictly limit the dumping into ocean waters of any material which would adversely affect human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities."

NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)

The National Environmental Policy Act was enacted into law in 1969. NEPA directs federal agencies to plan their policies and actions in light of the environmental consequences. Agencies must prepare an environmental impact statement (EIS) for any major federal action that will significantly affect the quality of the human environment. EISs must identify and discuss the environmental effects of the proposed action and identify, analyze, and compare options. (U.S. EPA, 1987b, p. 39.)

RESOURCE CONSERVATION AND RECOVERY ACT OF 1976 (RCRA) AND THE HAZARDOUS AND SOLID WASTE AMENDMENTS OF 1984 (HSWA)

Congress passed the Solid Waste Disposal Act in 1965. This Act was the first federal law to require safeguards and encourage environmentally sound methods for disposal of household, municipal, commercial, and industrial refuse. Congress amended this law in 1970 by passing the Resource Recovery Act and again in 1976 by passing the Resource Conservation and Recovery Act (RCRA). RCRA was updated and amended by the Hazardous and Solid Waste Act (HSWA) of 1985. The primary goals of RCRA are to:

- Protect human health and the environment from the potential hazards of waste disposal.
- Conserve energy and natural resources.
- Reduce the amount of waste generated, including hazardous waste.
- Ensure that wastes are managed in an environmentally sound manner.

In addition, the Act is designed to promote the conservation of natural resources through the recovery of usable energy and materials. RCRA authorizes the EPA to regulate hazardous wastes from their generation to disposal; to foster the establishment of regulatory programs in the states for controlling the disposal of solid wastes on land and prohibiting the use of open dumps; and to assist in developing national conservation and recovery policies. (U.S. EPA, 1986i, pp. 3-4.)

SAFE DRINKING WATER ACT (SDWA)
(Office of Drinking Water)

The Safe Drinking Water Act provides for the safety of drinking water supplies throughout the United States. It was passed in 1974 and amended in 1976, 1979, and 1986. Under the Act, EPA has the primary responsibility to:

- Establish National Primary Drinking Water Regulations (NPDWRs) which govern public water supplies for the protection of public health.

- Establish National Secondary Drinking Water Regulations (NSDWRs) which govern the taste, odor, and appearance of drinking water.

- Review and approve applications from the various states to assume primacy in the enforcement of those standards. Implementation of the SDWA regulations rests primarily with the states. A state must apply for primary enforcement status (primacy) which requires that states have regulations at least as stringent as federal standards.

- Supervise public water supply systems and other sources of drinking water.

The Act also includes provisions to control the underground injection of water and other substances which might endanger drinking water sources. EPA implemented several programs for protecting ground water under the Act as enacted in 1974. One of these programs, the Underground Injection Control Program, regulates the injection of any fluid, including disposal of industrial wastes in deep underground wells. (U.S. EPA, 1987b, p. 10.)

TOXIC SUBSTANCES CONTROL ACT (TSCA)
(Office of Toxic Subtances)

The Toxic Substances Control Act was enacted into law in 1976. TSCA gives EPA broad regulatory authority over chemical substances during all phases of their life cycle, from before their manufacture to final disposal. The Act establishes a national effort to prevent unreasonable risk to human health and the environment. There are three major TSCA activities:

- The premanufacture notification program. This program provides for scrutiny of health and environmental effects of new chemicals, so that their safety can be ensured before being released into the environment.

- Testing. When EPA believes that a chemical may present an unreasonable risk to health of the environment, testing can be required under TSCA. To require testing, EPA must find that there is insufficient data on the chemical substance and that further testing is necessary before a risk determination can be made.

- Control of existing chemicals. EPA can take various regulatory measures to control existing chemicals that pose an unreasonable risk to health or the environment.

Under TSCA, EPA also compiles and periodically amends a list of chemical substances manufactured or processed for commerical purposes - the TSCA Chemical Inventory. The Inventory contains approximately 63,000 chemical substances. (U.S. EPA, 1987, p. 19.)

APPENDIX F

REPORTABLE QUANTITIES (RQS) AND DATA FOR SECTION 313 CHEMICALS THAT ARE CERCLA HAZARDOUS

RQS FOR THE TOXIC CHEMICALS THAT ARE CERCLA HAZARDOUS SUBSTANCES AND FOR CERCLA HAZARDOUS SUBSTANCES THAT ARE MEMBERS OF TOXIC CHEMICAL CATEGORIES

CASRN	Toxic Chemical/Hazardous Substance	AQTX[1]	Acute[2]	CTX[3]	PC[4]
50000	Formaldehyde	1000	1000	100	10
51285	2,4-Dinitrophenol	10	1000	100	
51796	Carbamic acid, ethyl ester		5000		100
52686	Trichlorfon	1000	5000	100	
53963	2-Acetylaminofluorene		5000		1
55185	N-Nitrosodiethylamine		5000		1
55630	Nitroglycerine				
56235	Carbon tetrachloride	1000	5000	100	10
56382	Parathion	10	100	100	
57125	Cyanides (soluble cyanide salts), not elsewhere specified	10			
57147	Hydrazine, 1,1-dimethyl-		1000		10
57749	Chlordane	1	1000		10
58899	Hexachlorocyclohexane (gamma isomer)	1	1000		10
60117	Dimethylaminoazobenzene		5000		10
60344	Methyl hydrazine		1000		
62533	Aniline	1000	1000		
62555	Thioacetamide	5000			10
62566	Thiourea		5000		10
62737	Dichlorvos	10	1000		
62759	Dimethylnitrosamine		1000		10
63252	Carbaryl	100	5000		
67561	Methanol	5000	5000		
67641	Acetone	5000			
67663	Chloroform	1000	5000		10
67721	Hexachloroethane	100	5000	1000	100
71363	n-Butyl alcohol		5000		
71432	Benzene	100	5000	1000	10
71556	1,1,1-Trichloroethane	1000	5000	1000	
72435	Methoxychlor	1	5000		
74839	Methyl bromide	5000	1000		
74873	Methyl chloride	5000	5000	1000	100
74884	Methyl iodide		5000		100
74908	Hydrocyanic acid	10	100		
74953	Methylene bromide	5000	1000		
75003	Chloroethane	5000	5000		
75014	Vinyl chloride	5000	100	1000	1
75058	Acetonitrile	5000	5000	1000	
75070	Acetaldehyde	1000	5000		
75092	Methylene chloride	5000	5000	1000	
75150	Carbon disulfide	5000	1000	100	
75218	Oxirane	1000	1000		10
75252	Bromoform	1000	5000	100	
75274	Dichlorobromomethane		5000		
75354	1,1-Dichloroethylene	5000	1000	1000	100
75445	Phosgene	5000	10		
75558	2-Methylaziridine		1000		1

RQS FOR THE TOXIC CHEMICALS THAT ARE CERCLA HAZARDOUS SUBSTANCES AND FOR CERCLA HAZARDOUS SUBSTANCES THAT ARE MEMBERS OF TOXIC CHEMICAL CATEGORIES - Continued

CASRN	Toxic Chemical/Hazardous Substance	AQTX[1]	Acute[2]	CTX[3]	PC[4]
75569	Propylene oxide	5000	5000		
76448	Heptachlor	1	1000		1
77474	Hexachlorocyclopentadiene	1	5000	10	
77781	Dimethyl sulfate	1000	100		10
78875	1,2-Dichloropropane	5000	5000		
78933	Methyl ethyl ketone	5000	5000	1000	
79005	1,1,2-Trichloroethane	1000	5000		100
79016	Trichloroethylene	1000	5000	1000	100
79061	Acrylamide		5000		
79107	Acrylic acid		5000		
79345	1,1,2,2-Tetrachloroethane	100	5000	1000	100
79447	Dimethylcarbamoyl chloride		5000		1
79469	2-Nitropropane		1000		10
80159	Hydroperoxide, 1-methyl-1-phenylethyl-		1000		
80626	Methyl methacrylate	5000	5000	1000	
81072	Saccharin and salts				100
82688	Pentachloronitrobenzene		5000	1000	100
84662	Diethyl phthalate	1000	5000	5000	
84742	n-Butyl phthalate	10	5000	1000	
85449	Phthalic anhydride		5000		
85687	Butyl benzyl phthalate	100			
86306	N-Nitrosodiphenylamine	100	5000		
87683	Hexachlorobutadiene	1	1000	1000	100
87865	Pentachlorophenol	10	100	1000	
88062	2,4,6-Trichlorophenol	10	5000		100
88755	2-Nitrophenol	100	5000		
91203	Naphthalene	100	5000		
91225	Quinoline	1000	5000		
91598	2-Naphthylamine	100	5000		1
91941	3,3'-Dichlorobenzidine		5000		10
92875	Benzidine	100	5000	100	1
94597	Safrole		5000		100
94757	2,4-D Acid	100	1000	1000	
95501	o-Dichlorobenzene	100	5000	1000	
95807	Toluenediamine		5000		10
95954	2,4,5-Trichlorophenol	10	5000	1000	
96128	1,2-Dibromo-3-chloropropane		1000		1
96457	Ethylene thiourea	5000			10
97632	Ethyl methacrylate		5000		
98077	Benzotrichloride		1000		10
98828	Cumene		5000		
98873	Benzal chloride		5000		
98884	Benzoyl chloride	1000			
98953	Nitrobenzene	1000	5000		
100027	p-Nitrophenol	100	5000		
100414	Ethylbenzene	1000	5000	5000	

RQS FOR THE TOXIC CHEMICALS THAT ARE CERCLA HAZARDOUS SUBSTANCES AND FOR CERCLA HAZARDOUS SUBSTANCES THAT ARE MEMBERS OF TOXIC CHEMICAL CATEGORIES - Continued

CASRN	Toxic Chemical/Hazardous Substance	AQTX[1]	Acute[2]	CTX[3]	PC[4]
100425	Styrene	1000	5000		
100447	Benzyl chloride	100	1000		100
100754	N-Nitrosopiperidine		5000		10
101144	Benzenamine, 4,4'-methylenebis(2-chloro-				10
105679	2,4-Dimethylphenol	100	5000		
106467	1,4-Dichlorobenzene	100	5000	1000	
106514	p-Benzoquinone	10	5000		
106898	Epichlorohydrin	1000	1000	100	100
106934	Ethylene dibromide	1000	1000		1
107028	Acrolein	1	100		
107051	Allyl chloride	1000	1000		
107062	1,2-Dichloroethane	5000	5000	1000	100
107131	Acrylonitrile	100	1000	100	10
107302	Chloromethyl methyl ether	5000	1000	100	1
108054	Vinyl acetate	1000	5000		
108101	Methyl isobutyl ketone		5000		
108316	Maleic anhydride	5000	5000		
108601	Bis(2-chloroisopropyl) ether		5000	1000	
108883	Toluene	1000	5000	1000	
108907	Chlorobenzene	100	5000	1000	
108952	Phenol	1000	5000	1000	
110805	2-Ethoxyethanol	5000	5000	1000	
110827	Cyclohexane	1000	5000		
110861	Pyridine	5000	5000	100	
111444	Bis (2-chloroethyl) ether	5000	1000		10
115322	Kelthane	10	5000		
117817	Bis(2-ethylhexyl)phthalate		5000		100
117840	Di-n-octyl phthalate				
118741	Hexachlorobenzene		5000	100	10
119904	3,3'-Dimethoxybenzidine		5000		10
119937	3,3'-Dimethylbenzidine		5000		10
120127	Anthracene				
120821	1,2,4-Trichlorobenzene	100	5000	1000	
120832	2,4-Dichlorophenol	100	5000	1000	
121142	2,4-Dinitrotoluene	1000	5000	100	10
122667	Hydrazine, 1,2-diphenyl-	10	5000	100	10
123911	1,4-Dioxane	5000	5000		100
126727	Tris(2,3-dibromopropyl) phosphate		5000		10
127184	Tetrachloroethylene	1000	5000	1000	100
131113	Dimethyl phthalate		5000		
133062	Captan	10	5000	1000	
134327	1-Naphthylamine	100	5000		
140885	Ethyl acrylate	5000	5000		
151564	Aziridine		100		1
302012	Hydrazine				1
309002	Aldrin	1	1000		10

RQS FOR THE TOXIC CHEMICALS THAT ARE CERCLA HAZARDOUS SUBSTANCES AND FOR CERCLA HAZARDOUS SUBSTANCES THAT ARE MEMBERS OF TOXIC CHEMICAL CATEGORIES - Continued

CASRN	Toxic Chemical/Hazardous Substance	AQTX[1]	Acute[2]	CTX[3]	PC[4]
492808	Auramine				100
510156	Ethyl 4,4'-dichlorobenzilate		5000		10
534521	4,6-Dinitro-o-cresol and salts	10	100	100	
541731	1,3-Dichlorobenzene	100		1000	
542756	1,3-Dichloropropene	100	5000	100	
542881	Bis(chloromethyl) ether		100		1
584849	Toluene diisocyanate	100	100		
606202	2,6-Dinitrotoluene	1000	5000	100	100
621647	Di-n-propylnitrosamine		5000		10
624839	Methyl isocyanate		100		
636215	o-Toluidine hydrochloride		5000		100
684935	N-Nitroso-N-methylurea		5000		1
759739	N-Nitroso-N-ethylurea		5000		1
924163	N-Nitrosodi-n-butylamine		5000		10
1120714	1,3-Propane sultone		5000		10
1310732	Sodium hydroxide	1000	5000		
1319773	Cresols	100	5000	100	
1330207	Xylene (mixed)	1000	5000		
1332214	Asbestos			10	1
1336363	Polychlorinated biphenyls (PCBs)	1			10
1464535	2,2'-Bioxirane		1000		10
2303164	Diallate		5000		100
4549400	N-Nitrosomethylvinylamine		1000		10
7439921	Lead		5000		
7439976	Mercury	1	100		
7440020	Nickel		100	100	100
7440224	Silver		5000	1000	
7440280	Thallium		1000		
7440360	Antimony				
7440382	Arsenic				1
7440417	Beryllium	1000			10
7440439	Cadmium		5000		10
7440473	Chromium				
7440508	Copper				
7440666	Zinc			1000	
7647010	Hydrochloric acid	5000	5000		
7664382	Phosphoric acid	5000	5000		
7664393	Hydrofluoric acid	5000	1000	100	
7664417	Ammonia	10	5000	1000	
7664939	Sulfuric acid	1000	1000		
7697372	Nitric acid	1000	1000		
7723140	Phosphorus	1	1000		
7782492	Selenium		100		
7782505	Chlorine	10	1000		
8001352	Toxaphene	1	1000		10
20816120	Osmium oxide		1000		

RQS FOR THE TOXIC CHEMICALS THAT ARE CERCLA HA[redacted]US SUBSTANCES AND FOR CERCLA HAZARDOUS SUBSTANCES THAT ARE MEMBERS OF TOXIC[redacted]ICAL CATEGORIES - Continued

CASRN	Toxic Chemical/Hazardous Substance	AQTX[1]	Acute[2]	CTX[3]	PC[4]
25321226	Dichlorobenzene (mixed)	100		1000	
Antimony Compounds					
1309644	Antimony trioxide	5000		1000	
7440360	Antimony				
7647189	Antimony pentachloride	1000	5000		
7783564	Antimony trifluoride	1000			
7789619	Antimony tribromide	1000			
10025919	Antimony trichloride	1000	5000		
28300745	Antimony potassium tartrate	1000	5000	100	
Arsenic Compounds					
75605	Cacodylic acid		5000		1
692422	Diethylarsine				1
696286	Dichlorophenylarsine		100		1
1303282	Arsenic pentoxide	100	100	1000	1
1303328	Arsenic disulfide	5000			1
1303339	Arsenic trisulfide	5000		100	1
1327522	Arsenic acid		1000	1000	1
1327533	Arsenic trioxide	100	100	10	1
7440382	Arsenic				1
7631892	Sodium arsenate	1000	1000	1000	1
7778441	Calcium arsenate	1000	1000	100	1
7784341	Arsenic trichloride	100	1000	100	1
7784409	Lead arsenate	5000	1000	1000	1
7784410	Potassium arsenate	1000		1000	1
7784465	Sodium arsenite	1000	1000	10	1
10124502	Potassium arsenite	1000	1000	10	1
12002038	Cupric acetoarsenite	100	1000		1
52740166	Calcium arsenite	1000		100	1
Barium Compounds					
542621	Barium cyanide	10			
Beryllium Compounds					
7440417	Beryllium	1000			10
7787475	Beryllium chloride	1000	1000	10	1
7787497	Beryllium fluoride	5000	1000	10	1
13597994	Beryllium nitrate	5000		10	1

RQS FOR THE TOXIC CHEMICALS THAT ARE CERCLA HAZARDOUS SUBSTANCES AND FOR CERCLA HAZARDOUS SUBSTANCES THAT ARE MEMBERS OF TOXIC CHEMICAL CATEGORIES - Continued

CASRN	Toxic Chemical/Hazardous Substance	AQTX[1]	Acute[2]	CTX[3]	PC[4]
Cadmium Compounds					
543908	Cadmium acetate	100		10	10
7440439	Cadmium		5000		10
7789426	Cadmium bromide	100		10	10
10108642	Cadmium chloride	100	1000	10	10
Chlorophenols					
58902	2,3,4,6-Tetrachlorophenol	10	5000	100	
87650	2,6-Dichlorophenol	100	5000		
87865	Pentachlorophenol	10	100	1000	
88062	2,4,6-Trichlorophenol	10	5000		100
95578	2-Chlorophenol	100	5000		
95954	2,4,5-Trichlorphenol	10	5000	1000	
120832	2,4-Dichlorophenol	100	5000	1000	
25167822	Trichlorophenol	10			100
Chromium Compounds					
1066304	Chromic acetate	1000			
7440473	Chromium				
7775113	Sodium chromate	1000			1
7778509	Potassium bichromate	1000	5000		1
7788989	Ammonium chromate	1000			1
7789006	Potassium chromate	1000			1
7789062	Strontium chromate	1000			1
7789095	Ammonium bichromate	1000			1
10049055	Chromous chloride	1000	5000		
10101538	Chromic sulfate	1000			
10588019	Sodium bichromate	1000	1000		1
11115745	Chromic acid	1000		100	1
13765190	Calcium chromate	1000		100	1
14307358	Lithium chromate	1000			1
Cobalt Compounds					
544183	Cobaltous formate	1000			
7789437	Cobaltous bromide	1000			
14017415	Cobaltous sulfamate	1000			
Copper Compounds					
142712	Cupric acetate	100	5000	1000	
544923	Copper cyanide	10			
815827	Cupric tartrate	100		1000	

RQS FOR THE TOXIC CHEMICALS THAT ARE CERCLA HAZARDOUS SUBSTANCES AND FOR CERCLA HAZARDOUS SUBSTANCES THAT ARE MEMBERS OF TOXIC CHEMICAL CATEGORIES - Continued

CASRN	Toxic Chemical/Hazardous Substance	AQTX[1]	Acute[2]	CTX[3]	PC[4]
3251238	Cupric nitrate	100		1000	
5893663	Cupric oxalate	100			
7440508	Copper				
7447394	Cupric chloride	10		1000	
7758987	Cupric sulfate	10	5000	1000	
10380297	Cupric sulfate ammoniated	100		1000	
12002038	Cupric acetoarsenite	100	1000		1
Cyanide compounds (ionically bonded)					
74908	Hydrocyanic acid	10	100		
143339	Sodium cyanide	10	100		
151508	Potassium cyanide	10	100		
506616	Potassium silver cyanide	1	1000		
506649	Silver cyanide	1	5000		
542621	Barium cyanide	10			
544923	Copper cyanide	10			
557197	Nickel cyanide	10		10	100
557211	Zinc cyanide	10			
592018	Calcium cyanide	10	1000		
592041	Mercuric cyanide	1	1000		
Glycol Ethers					
None					
Lead Compounds					
78002	Tetraethyl lead	100	1000	10	
301042	Lead acetate	5000	5000	100	100
592870	Lead thiocyanate	5000		100	
1314870	Lead sulfide	5000	5000		100
1335326	Lead subacetate			100	100
7428480	Lead stearate	5000	5000		100
7439921	Lead		5000		100
7446277	Lead phosphate			100	100
7758954	Lead chloride	5000		100	
7783462	Lead fluoride	1000		100	
7784409	Lead arsenate	5000	1000	1000	1
10099748	Lead nitrate	5000	5000	100	
10101630	Lead iodide	5000		100	
13814965	Lead fluoborate	5000	1000	100	
15739807	Lead sulfate	5000		100	

F-7

RQS FOR THE TOXIC CHEMICALS THAT ARE CERCLA HAZARDOUS SUBSTANCES AND FOR CERCLA HAZARDOUS SUBSTANCES THAT ARE MEMBERS OF TOXIC CHEMICAL CATEGORIES - Continued

CASRN	Toxic Chemical/Hazardous Substance	AQTX[1]	Acute[2]	CTX[3]	PC[4]
Manganese Coumpounds					
7722647	Potassium permanganate	100	5000		
Mercury Compounds					
62384	Phenylmercuric acetate		1000	100	
592041	Mercuric cyanide	1	1000		
592858	Mercuric thiocyanate	10			
628864	Mercury fulminate				
7439976	Mercury	1	10		
7783359	Mercuric sulfate	10	1000		
10045940	Mercuric nitrate	10		10	
10415755	Mercurous nitrate	10	5000		
Nickel Compounds					
557197	Nickel cyanide	10		10	100
7440020	Nickel		5000	100	100
7718549	Nickel chloride	5000	5000	100	100
12054487	Nickel hydroxide	1000		10	100
13463393	Nickel carbonyl	1000	100	10	10
14216752	Nickel nitrate	5000		100	100
15699180	Nickel ammonium sulfate	5000		100	100
77786814	Nickel sulfate	5000		100	100
Polybrominated Biphenyls					
None					
Selenium Compounds					
630104	Selenourea		1000		
7446084	Selenium dioxide	1000	1000	10	
7488564	Selenium disulfide		5000		100
7782492	Selenium		100		
7783008	Selenious acid	1000	1000	10	
10102188	Sodium selenite	1000	100	100	
Silver Compounds					
506616	Potassium silver cyanide	1	1000		
506649	Silver cyanide	1	5000		
7440224	Silver		5000	1000	
7761888	Silver nitrate	1	1000		

RQS FOR THE TOXIC CHEMICALS THAT ARE CERCLA HAZARDOUS SUBSTANCES AND FOR CERCLA HAZARDOUS SUBSTANCES THAT ARE MEMBERS OF TOXIC CHEMICAL CATEGORIES - Continued

CASRN	Toxic Chemical/Hazardous Substance	AQTX[1]	Acute[2]	CTX[3]	PC[4]
Thallium Compounds					
563688	Thallium(I) acetate		1000	100	
1314325	Thallium(III) oxide		1000	100	
6533739	Thallium(I) carbonate		1000	100	
7440280	Thallium		1000		
7446186	Thallium(I) sulfate	1000	1000	100	
7791120	Thallium(I) chloride		1000	100	
10102451	Thallium(I) nitrate		1000	100	
12039520	Thallium(I) selenide		1000		
Zinc Compounds					
127822	Zinc phenolsulfonate	5000			
557211	Zinc cyanide	10			
557346	Zinc acetate	1000	5000	1000	
557415	Zinc formate	1000		1000	
1314847	Zinc phosphide	1000	1000		
1332076	Zinc borate	1000		1000	
3486359	Zinc carbonate	1000		1000	
7440666	Zinc			1000	
7646857	Zinc chloride	5000	5000	1000	
7699458	Zinc bromide	5000		1000	
7733020	Zinc sulfate	1000	5000	1000	
7779864	Zinc hydrosulfite	1000			
7779886	Zinc nitrate	5000		1000	
7783495	Zinc fluoride	1000		1000	
16871719	Zinc silicofluoride	5000	5000		
52628258	Zinc ammonium chloride	5000		1000	

Notes:

1. RQ based upon aquatic toxicity.
2. RQ based upon acute toxicity to mammals.
3. RQ based upon chronic toxicity to mammals.
4. RQ based upon evidence of potential carcinogenicity.

DATA FOR THE TOXIC CHEMICALS THAT ARE CERCLA HAZARDOUS SUBSTANCES AND FOR CERCLA HAZARDOUS SUBSTANCES THAT ARE MEMBERS OF TOXIC CHEMICAL CATEGORIES

CASRN	Toxic Chemical/Hazardous Substance	Aquatic Tox.[1]	Oral Toxicity Spec.	Test[2]	Val.[3]	Inhalation Tox. Spec.	Test[4]	Val.[5]	Dermal Toxicity Spec.	Test[2]	Val.[3]	CTX CS[6]	CARC WOE[7]
50000	Formaldehyde	10-100	Rat	LD_{50}	800	Rat	LC_{lo}	250	Rbt	LD_{50}	270	39	B1
51285	2,4-Dinitrophenol	0.6	Rat	LD_{50}	30							30	
51796	Carbamic acid, ethyl ester		Mus	LD_{50}	2500								B2
52686	Trichlorfon	10-100	Rat	LD_{50}	450							30	
53963	2-Acetylaminofluorene		Mus	LD_{50}	1020								B2
55185	N-Nitrosodiethylamine		Rat	LD_{50}	280								B2
56235	Carbon tetrachloride	10-100	Rat	LD_{50}	2800	Rat	LC_{50}	4000				25.3	B2
56382	Parathion	0.4	Rat	LD_{50}	2	Rat	LC_{lo}	10	Rat	LD_{50}	6.8	32	
57125	Cyanides (soluble cyanide salts), not elsewhere specified	0.1-1											
57147	Hydrazine, 1,1-dimethyl-					Rat	LC_{50}	252					B2
57749	Chlordane	<0.1	Rbt	LD_{50}	100				Rat	LD_{50}	700		B2
58899	Hexachlorocyclohexane (gamma isomer)	<0.1	Rat	LD_{50}	76				Rat	LD_{50}	500		B2/C
60117	Dimethylaminoazobenzene		Rat	LD_{50}	200								B2
60344	Methyl hydrazine		Rat	LD_{50}	33	Rat	LC_{50}	74					
62533	Aniline	10-100	Rat	LD_{50}	440	Rat	LC_{lo}	250					
62555	Thioacetamide		Rat	LD_{50}	200								B2
62566	Thiourea		Rat	LD_{50}	125								B2
62737	Dichlorvos	0.1-1	Rat	LD_{50}	56								
62759	Dimethylnitrosamine		Rat	LD_{50}	26	Rat	LC_{50}	78					B2
63252	Carbaryl	1-10	Rat	LD_{50}	250								
67561	Methanol	>1000	Rat	LD_{50}	13000								
67641	Acetone	>1000											
67663	Chloroform	10-100	Rat	LD_{50}	800	Rat	LC_{50}	8000					B2
67721	Hexachloroethane	1-10	Rat	LD_{50}	6000							15.2	C
71363	n-Butyl alcohol		Rat	LD_{50}	790								
71432	Benzene	1-10	Rat	LD_{50}	3800	Rat	LC_{50}	10000				17	A
71556	1,1,1-Trichloroethane	10-100	Rat	LD_{50}	10300	Rat	LC_{lo}	1000				6.0	
72435	Methoxychlor	<0.1	Rat	LD_{50}	5000							*	
74839	Methyl bromide	>1000				Gpg	LC_{lo}	300					
74873	Methyl chloride	1000				Mus	LC_{50}	3146				20	C
74884	Methyl iodide		Rat	LD_{50}	150								C
74908	Hydrocyanic acid	<1	Mus	LD_{50}	3.7	Mus	LC_{50}	323					
75003	Chloroethane	1000				Gpg	LC_{50}	4000				I.D.	
75014	Vinyl chloride	1000	Rat	LD_{50}	500	Gpg	LC_{lo}	20				20	A
75058	Acetonitrile	1000	Rat	LD_{50}	3800								
75070	Acetaldehyde	10-100	Rat	LD_{50}	1930	Rat	LC_{lo}	4000				19.2	
75092	Methylene chloride	100-1000	Rat	LD_{50}	167							10	
75150	Carbon disulfide	100-500	Hmn	LD_{lo}	14							22.6	
75218	Ethylene oxide	10-100	Rat	LD_{50}	72								B1/B2
75252	Bromoform	46-56	Mus	LD_{50}	1400							25.8	
75274	Dichlorobromomethane		Mus	LD_{50}	450								
75354	1,1-Dichloroethylene	100-1000	Rat	LD_{50}	200	Mus	LC_{50}	98				19	C
75445	Phosgene	100-500				Mus	LC_{lo}	5					
75558	2-Methylaziridine		Rat	LD_{50}	19								B2
75569	Propylene oxide	>1000	Rat	LD_{50}	930	Rat	LC_{lo}	4000					

1

DATA FOR THE TOXIC CHEMICALS THAT ARE CERCLA HAZARDOUS SUBSTANCES AND FOR CERCLA HAZARDOUS SUBSTANCES THAT ARE MEMBERS OF TOXIC CHEMICAL CATEGORIES - Continued

CASRN	Toxic Chemical/Hazardous Substance	Aquatic Tox.[1]	Oral Toxicity Spec.	Test[2]	Val.[3]	Inhalation Tox. Spec.	Test[4]	Val.[5]	Dermal Toxicity Spec.	Test[2]	Val.[3]	CTX CS[6]	CARC WOE[7]
76448	Heptachlor	<0.1	Rat	LD_{50}	40				Rat	LD_{50}	119		B2
77474	Hexachlorocyclopentadiene	<0.1	Rat	LD_{50}	113				Rbt	LD_{50}	430	62	
77781	Dimethyl sulfate	10-100	Rat	LD_{50}	440	Rat	LC_{lo}	32					B2
78875	1,2-Dichloropropane	140-320	Rat	LD_{50}	1900	Rat	LC_{lo}	1500				I.D.	
78933	Methyl ethyl ketone	>1000	Rat	LD_{50}	3400							8.8	
79005	1,1,2-Trichloroethane	10-100	Rat	LD_{50}	1140	Rat	LC_{lo}	500				I.D.	C
79016	Trichloroethylene	10-100	Rat	LD_{50}	4920							20	B2
79061	Acrylamide		Rat	LD_{50}	170	Rat	LC_{50}	103	Rbt	LD_{lo}	1000		
79107	Acrylic acid		Rat	LD_{50}	340								
79345	1,1,2,2-Tetrachloroethane	1-10	Dog	LD_{lo}	300	Rat	LC_{lo}	1000				17.5	C
79447	Dimethylcarbamoyl chloride		Rat	LD_{50}	1000								B2
79469	2-Nitropropane		Rat	LD_{50}	500	Rat	LC_{50}	400					B2
80159	Hydroperoxide, 1-methyl-1-phenylethyl		Rat	LD_{50}	382	Rat	LC_{50}	220					
80626	Methyl methacrylate	100-1000	Rat	LD_{lo}	8000	Rat	LC_{50}	3750				16.8	
81072	Saccharin												C
82688	Pentachloronitrobenzene		Rat	LD_{50}	1650							10.4	C
84662	Diethyl phthalate	98.2	Rbt	LD_{lo}	1000							4	
84742	n-Butyl phthalate	0.17-1.3	Mus	LD_{50}	12000								
85449	Phthalic anhydride		Rat	LD_{50}	4020								
85687	Butyl benzyl phthalate	2-40											
86306	N-Nitrosodiphenylamine	1-10	Rat	LD_{50}	1650								
87683	Hexachlorobutadiene	<0.1	Rat	LD_{50}	90							10.3	C
87865	Pentachlorophenol	0.2-0.6	Rat	LD_{50}	50	Rat	LC_{50}	11.7	Rat	LD_{50}	105	20	
88062	2,4,6-Trichlorophenol	0.1-1	Rat	LD_{50}	820							I.D.	B2
88755	2-Nitrophenol		Rat	LD_{50}	2828							I.D.	
91203	Naphthalene	1-10	Rat	LD_{50}	1780							I.D.	
91225	Quinoline	10-100	Rat	LD_{50}	331				Rbt	LD_{50}	540		
91598	beta-Naphthylamine	1-10	Rat	LD_{50}	727								A
91941	3,3'-Dichlorobenzidine		Rat	LD_{lo}	4740							I.D.	B2
92875	Benzidine	1-10	Rat	LD_{50}	309							28	A
94597	Safrole		Rat	LD_{50}	1950								B2
94757	2,4-D Acid	1-10	Dog	LD_{50}	100				Rat	LD_{50}	1500	18	
95501	o-Dichlorobenzene	1-10	Rat	LD_{50}	500							8.8	
95534	o-Toluidine												B2
95807	Toluenediamine		Rat	LD_{50}	260								B2
95954	2,4,5-Trichlorophenol	0.1-1	Rat	LD_{50}	820							13	
96128	1,2-Dibromo-3-chloropropane		Rat	LD_{50}	170								B2
96457	Ethylene thiourea		Rat	LD_{50}	1832								B2
98077	Benzotrichloride					Rat	LC_{50}	125					B2
98828	Cumene		Rat	LD_{50}	1400								
98873	Benzal chloride		Rat	LD_{50}	3249								
98884	Benzoyl chloride	10-100											
98953	Nitrobenzene	10-100	Rat	LD_{50}	640				Rat	LD_{50}	2100	I.D.	
100027	p-Nitrophenol	1-10	Rat	LD_{50}	350							I.D.	
100414	Ethylbenzene	10-100	Rat	LD_{50}	3500							5	

DATA FOR THE TOXIC CHEMICALS THAT ARE CERCLA HAZARDOUS SUBSTANCES AND FOR CERCLA HAZARDOUS SUBSTANCES THAT ARE MEMBERS OF TOXIC CHEMICAL CATEGORIES - Continued

CASRN	Toxic Chemical/Hazardous Substance	Aquatic Tox.[1]	Oral Toxicity Spec.	Test[2]	Val.[3]	Inhalation Tox.[5] Spec.	Test[4]	Val.	Dermal Toxicity Spec.	Test[2]	Val.[3]	CTS[6]	CARC WOE[7]
100425	Styrene	10-100	Mus	LD_{50}	316	Rat	LC_{lo}	5000					
100447	Benzyl chloride	1-10	Rat	LD_{50}	1231	Rat	LC_{50}	150					B2
100754	N-Nitrosopiperidine		Rat	LD_{50}	200								B2
101144	4,4'-Methylenebis(2-chloroaniline)												B2
105679	2,4-Dimethylphenol	1-10	Rat	LD_{50}	3200								
106467	1,4-Dichlorobenzene	1-10	Rat	LD_{50}	500							9.0	
106514	p-Benzoquinone	0.1-1	Rat	LD_{50}	130							I.D.	
106898	Epichlorohydrin	10-100	Rat	LD_{50}	90	Rat	LC_{lo}	250	Rat	LD_{lo}	1000	2[6]	B2
106934	Ethylene dibromide	10-100	Rbt	LD_{50}	55	Rat	LC_{50}	400				*	B2
107028	Acrolein	<0.1	Rat	LD_{50}	46	Rat	LC_{lo}	8					
107051	Allyl chloride	10-100	Rat	LD_{lo}	64	Rat	LC_{lo}	290	Rbt	LD_{50}	2200		
107062	1,2-Dichloroethane	100-1000	Mus	LD_{lo}	600	Rat	LC_{lo}	1000				18.4	B2
107131	Acrylonitrile	1-10	Rat	LD_{lo}	82	Rat	LC_{lo}	500				30	B1
107302	Chloromethyl methyl ether	100-1000	Rat	LD_{50}	817	Rat	LC_{50}	55				30.4	A
108054	Vinyl acetate	10-100	Rat	LD_{50}	2920	Rat	LC_{lo}	4000					
108101	Methyl isobutyl ketone		Rat	LD_{50}	2080								
108316	Maleic anhydride	100-500	Mus	LD_{50}	465				Rbt	LD_{50}	2620		
108601	Bis(2-chloroisopropyl) ether		Rat	LD_{50}	240	Rat	LC_{50}	700				12	
108883	Toluene	10-100	Rat	LD_{50}	5000	Rat	LC_{lo}	4000				7	
108907	Chlorobenzene	1-10	Rat	LD_{50}	2910							11.6	
108952	Phenol	10-100	Rat	LD_{50}	414				Rat	LD_{50}	669	35	
110805	2-Ethoxyethanol	100-1000	Rat	LD_{50}	3000	Rat	LC_{lo}	4000	Rbt	LD_{50}	3500	13.6	
110827	Cyclohexane	10-100	Mus	LD_{50}	1297								
110861	Pyridine	100-1000	Rat	LD_{50}	891							21	
111444	Bis (2-chloroethyl) ether	100-1000	Rat	LD_{50}	75	Rat	LC_{50}	1000					B2
115322	Kelthane	0.52	Rat	LD_{50}	575				Rat	LD_{50}	100		
117817	Bis(2-ethylhexyl) phthalate		Rat	LD_{50}	31000								B2
118741	Hexachlorobenzene		Rat	LD_{50}	10000							29.5	B2
119904	3,3'-Dimethoxybenzidine		Rat	LD_{50}	1920								B2
119937	3,3'-Dimethylbenzidine		Rat	LD_{50}	404								B2
120127	Anthracene											I.D.	
120821	1,2,4-Trichlorobenzene	1-10	Rat	LD_{50}	756							12.6	
120832	2,4-Dichlorophenol	1-10	Rat	LD_{50}	580							11.9	
121142	2,4-Dinitrotoluene	10-100	Rat	LD_{50}	268							32	B2
122667	Hydrazine, 1,2-diphenyl	0.1-1	Rat	LD_{50}	301							28	B1
123911	1,4-Dioxane	100-1000	Rat	LD_{50}	4200								B2
126727	Tris(2,3-dibromopropyl) phosphate		Rat	LD_{50}	1010								B2
127184	Tetrachloroethylene	10-100	Mus	LD_{50}	8100	Rat	LC_{lo}	4000				10	B2
131113	Dimethyl phthalate		Rat	LD_{50}	6900								
133062	Captan	0.1-1	Rat	LD_{50}	10000							17	
134327	alpha-Naphthylamine	1-10	Rat	LD_{50}	779								
140885	Ethyl acrylate	100-1000	Rat	LD_{50}	1020								
151564	Aziridine		Rat	LD_{50}	15	Rat	LC_{lo}	25				I.D.	B2
302012	Hydrazine					Mus	LC_{50}	252					B2
309002	Aldrin	<0.1	Rat	LD_{50}	39								B2
492808	Auramine												B2

DATA FOR THE TOXIC CHEMICALS THAT ARE CERCLA HAZARDOUS SUBSTANCES AND FOR CERCLA HAZARDOUS SUBSTANCES THAT ARE MEMBERS OF TOXIC CHEMICAL CATEGORIES - Continued

CASRN	Toxic Chemical/Hazardous Substance	Aquatic Tox.[1]	Oral Toxicity Spec.	Test[2]	Val.[3]	Inhalation Tox. Spec.	Test[4]	Val.[5]	Dermal Toxicity Spec.	Test[2]	Val.[3]	CTX CS[6]	CARC WOE[7]
510156	Ethyl 4,4'-dichlorobenzilate		Rat	LD_{50}	700								B2
534521	4,6-Dinitro-o-cresol and salts	0.2-0.4	Rat	LD_{50}	10				Rat	LD_{50}	200	39.2	
541731	1,3-Dichlorobenzene	1-10										9.0	
542756	1,3-Dichloropropene	1-10	Rat	LD_{50}	250							23.5	
542881	Bis(chloromethyl) ether		Rat	LD_{50}	210	Rat	LC_{50}	7				I.D.	A
584849	Toluene diisocyanate	1-10	Rat	LD_{50}	5800	Mus	LC_{50}	10					
606202	2,6-Dinitrotoluene	10-100	Rat	LD_{50}	177							30	C
621647	Di-n-propylnitrosamine		Rat	LD_{50}	480								B2
624839	Methyl isocyanate		Rat	LD_{50}	71	Rat	LC_{50}	5					
636215	o-Toluidine hydrochloride		Rat	LD_{50}	2951								B2
684935	N-Nitroso-N-methylurea		Rat	LD_{50}	110								B2
759739	N-Nitroso-N-ethylurea		Rat	LD_{50}	300								B2
924163	N-Nitrosodi-n-butylamine		Rat	LD_{50}	1200								B2
1120714	1,3-Propane sultone								Mus	LD_{50}	1000		B2
1310732	Sodium hydroxide	10-100	Rbt	LD_{10}	500								
1319773	Cresols	1-10	Mus	LD_{50}	861				Rbt	LD_{50}	2000	21.2	
1330207	Xylene (mixed)	10-100	Rat	LD_{50}	4300	Rat	LC_{50}	5000					
1332214	Asbestos											79	A
1336363	Polychlorinated biphenyls (PCBs)	<0.1											B2
1464535	2,2'-Bioxirane		Rat	LD_{50}	78	Rat	LC_{50}	90					B2
2303164	Diallate		Rat	LD_{50}	395								C
4549400	N-Nitrosomethylvinylamine		Rat	LD_{50}	24								B2
7439921	Lead		Pgn	LD_{10}	160							I.D.	
7439976	Mercury	<0.1				Rbt	LC_{10}	3.5				*	
7440020	Nickel		Gpg	LD_{10}	500							26	C
7440224	Silver		Mus	LD_{50}	100							7	
7440280	Thallium		Rat	LD_{50}	15.8							I.D.	
7440360	Antimony											I.D.	
7440382	Arsenic											I.D.	A
7440417	Beryllium	10-100										I.D.	B2
7440439	Cadmium		Rat	LD_{50}	225							I.D.	B1
7440473	Chromium											I.D.	A
7440508	Copper											I.D.	
7440666	Zinc											17.6	
7647010	Hydrochloric acid		Rbt	LD_{50}	900	Rat	LC_{50}	3124					
7664382	Phosphoric acid	100-1000	Rat	LD_{50}	1530				Rbt	LD_{50}	2740		
7664393	Hydrofluoric acid	100-500				Rat	LC_{50}	1276				20.5	
7664417	Ammonia	0.1-1	Rat	LD_{50}	350							15.5	
7664939	Sulfuric acid	10-100	Rat	LD_{50}	2140	Rat	LC_{10}	178					
7697372	Nitric acid	10-100	Hmn	LD_{10}	430	Rat	LC_{50}	65				I.D.	
7723140	Phosphorus	<0.1	Dog	LD_{10}	50							*	
7782492	Selenium											I.D.	
7782505	Chlorine	<1				Mus	LC_{50}	137					
8001352	Toxaphene	<0.1	Rat	LD_{50}	40				Rar	LD_{50}	600		B2
20816120	Osmium oxide		Rat	LD_{50}	14	Rat	LC_{10}	40					
25321226	Dichlorobenzene (mixed)	1-10										8.8	

DATA FOR THE TOXIC CHEMICALS THAT ARE CERCLA HAZARDOUS SUBSTANCES AND FOR CERCLA HAZARDOUS SUBSTANCES THAT ARE MEMBERS OF TOXIC CHEMICAL CATEGORIES - Continued

CASRN	Toxic Chemical/Hazardous Substance	Aquatic Tox.[1]	Oral Toxicity Spec. Test[2]	Val.[3]	Inhalation Tox. Spec. Test[4]	Val.[5]	Dermal Toxicity Spec. Test[2]	Val.[3]	CTX CS[6]	CARC WOE[7]
Antimony Compounds										
1309644	Antimony trioxide	500-100							18	
7440360	Antimony								I.D.	
7647189	Antimony pentachloride	100-10	Rat LD_{50}	1115					I.D.	
7783564	Antimony trifluoride	100-10							I.D.	
7789619	Antimony tribromide	100-10							I.D.	
10025919	Antimony trichloride	100-10	Rat LD_{50}	525					I.D.	
28300745	Antimony potassium tartrate	100-10	Rat LD_{50}	115					38	
Arsenic Compounds										
75605	Cacodylic acid		Rat LD_{50}	700						A
692422	Diethylarsine								I.D.	A
696286	Dichlorophenylarsine						Rat LD_{50}	16	I.D.	A
1303282	Arsenic pentoxide	10-1	Rat LD_{50}	8					19	A
1303328	Arsenic disulfide	500-100							I.D.	A
1303339	Arsenic trisulfide	500-100							35	A
1327522	Arsenic acid		Rat LD_{50}	48					18	A
1327533	Arsenic trioxide	10-1	Rat LD_{50}	20					41	A
7440382	Arsenic								I.D.	A
7631892	Sodium arsenate	100-10	Rbt LD_{10}	12.5					16	A
7778441	Calcium arsenate	100-10	Rat LD_{50}	20					33.1	A
7784341	Arsenic trichloride	10-1			Mus LC_{10}	338			39	A
7784409	Lead arsenate	500-100	Rat LD_{50}	100					13	A
7784410	Potassium arsenate	100-10							16	A
7784465	Sodium arsenite	100-10	Rat LD_{50}	41			Rat LD_{50}	150	41	A
10124502	Potassium arsenite	100-10	Rat LD_{50}	14			Rat LD_{50}	150	41	A
12002038	Cupric acetoarsenite	10-1	Rat LD_{50}	22					I.D.	A
52740166	Calcium arsenite	40							39	A
Barium Compounds										
542621	Barium cyanide	0.1-1								
Beryllium Compounds										
7440417	Beryllium	100-10							I.D.	B2
7787475	Beryllium chloride	100-10	Rat LD_{50}	86					46.7	B2
7787497	Beryllium fluoride	500-100	Rat LD_{50}	98					49.6	B2
13597994	Beryllium nitrate	500-100							44	B2
Cadmium Compounds										
543908	Cadmium acetate	10-1							41	B1

DATA FOR THE TOXIC CHEMICALS THAT ARE CERCLA HAZARDOUS SUBSTANCES AND FOR CERCLA HAZARDOUS SUBSTANCES THAT ARE MEMBERS OF TOXIC CHEMICAL CATEGORIES - Continued

CASRN	Toxic Chemical/Hazardous Substance	Aquatic Tox.[1]	Oral Toxicity Spec.	Test[2]	Val.[3]	Inhalation Tox.[5] Spec.	Test[4]	Val.	Dermal Toxicity Spec.	Test[2]	Val.[3]	CTX CS[6]	CARC WOE[7]
7440439	Cadmium		Rat	LD_{50}	225							I.D.	B1
7789426	Cadmium bromide	10-1										41	B1
10108642	Cadmium chloride	1.94	Rat	LD_{50}	88							42	B1
Chlorophenols													
58902	2,3,4,6-Tetrachlorophenol	1-0.1	Rat	LD_{50}	140				Rbt	LD_{50}	250	32	
87650	2,6-Dichlorophenol	5	Rat	LD_{50}	2940							I.D.	
87865	Pentachlorophenol	0.6-0.2	Rat	LD_{50}	50	Rat	LC_{50}	11.7	Rat	LD_{50}	105	20	D
88062	2,4,6-Trichlorophenol	1-0.1	Rat	LD_{50}	820								B2
95578	2-Chlorophenol	8-20	Rat	LD_{50}	670							I.D.	
95954	2,4,5-Trichlorphenol	1-0.1	Rat	LD_{50}	820							13	D
120832	2,4-Dichlorophenol	5-10	Rat	LD_{50}	580							11.9	
25167822	Trichlorophenol	1-0.1											B2
Chromium Compounds													
1066304	Chromic acetate	100-10										I.D.	
7440473	Chromium											I.D.	D
7775113	Sodium chromate	100-10										I.D.	A
7778509	Potassium bichromate	100-10	Dog	LD_{lo}	2829							I.D.	A
7788989	Ammonium chromate	100-10											A
7789006	Potassium chromate	100-10										I.D.	A
7789062	Strontium chromate	100-10											A
7789095	Ammonium bichromate	100-10										I.D.	A
10049055	Chromous chloride	100-10	Rat	LD_{50}	1870							I.D.	
10101538	Chromic sulfate	100-10										I.D.	
10588019	Sodium bichromate	100-10	Rat	LD_{50}	50							I.D.	A
11115745	Chromic acid	100-10										31.2	A
13765190	Calcium chromate	28										29	A
14307358	Lithium chromate	100-10										I.D.	A
Cobalt Compounds													
544183	Cobaltous formate	100										I.D.	
7789437	Cobaltous bromide	100										I.D.	
14017415	Cobaltous sulfamate	100										I.D.	
Copper Compounds													
142712	Cupric acetate	10-1	Rat	LD_{50}	595							15	
544923	Copper cyanide	0.1-1											
815827	Cupric tartrate	10-1										15	
3251238	Cupric nitrate	10-1										13.9	
5893663	Cupric oxalate	10-1										I.D.	
7440508	Copper											I.D.	

DATA FOR THE TOXIC CHEMICALS THAT ARE CERCLA HAZARDOUS SUBSTANCES AND FOR CERCLA HAZARDOUS SUBSTANCES THAT ARE MEMBERS OF TOXIC CHEMICAL CATEGORIES - Continued

CASRN	Toxic Chemical/Hazardous Substance	Aquatic Tox.[1]	Oral Toxicity Spec.	Test[2]	Val.[3]	Inhalation Tox. Spec.	Test[4]	Val.[5]	Dermal Toxicity Spec.	Test[2]	Val.[3]	CTX CS[6]	CARC WOE[7]
7447394	Cupric chloride	1-0.1										16.5	
7758987	Cupric sulfate	1-0.1	Rat	LD_{50}	300							16	
10380297	Cupric sulfate ammoniated	10-										14.5	
12002038	Cupric acetoarsenite	10-1	Rat	LD_{50}	22							I.D.	A
Cyanide compounds (ionically bonded)													
74908	Hydrocyanic acid	< 1	Mus	LD_{50}	3.7	Rat	LC_{50}	484					
143339	Sodium cyanide	0.1-1	Rat	LD_{50}	6.44								
151508	Potassium cyanide	1-0.1	Rat	LD_{50}	10								
506616	Potassium silver cyanide	< 0.1	Rat	LD_{50}	21								
506649	Silver cyanide	< 0.1	Rat	LD_{50}	123								
542621	Barium cyanide	0.1-1											
544923	Copper cyanide	0.1-1											
557197	Nickel cyanide	0.1-1										49	
557211	Zinc cyanide	1-0.1										I.D.	
592018	Calcium cyanide	1-0.1	Rat	LD_{50}	39								
592041	Mercuric cyanide	< 0.1	Mus	LD_{50}	33								
Glycol Ethers													
	None												
Lead Compounds													
78002	Tetraethyl lead	10-1	Rat	LD_{10}	17	Rat	LC_{10}	850mg/m^3				49	
301042	Lead acetate	500-100	Dog	LD_{50}	300							32	B2
592870	Lead thiocyanate	500-100										32	
1314870	Lead sulfide	>1000	Gpg	LD_{10}	10000								B2
1335326	Lead subacetate											33	B2
7428480	Lead stearate	500-100	Gpg	LD_{10}	6000							I.D.	B2
7439921	Lead		Pgn	LD_{10}	160							I.D.	B2
7446277	Lead phosphate											33	B2
7758954	Lead chloride	500-100										33	
7783462	Lead fluoride	100-10										34	
7784409	Lead arsenate	500-100	Rat	LD_{50}	100							13	A
10099748	Lead nitrate	Gpg	LD_{10}	500								31	
10101630	Lead iodide	500-100										30	
13814965	Lead fluoborate	500-100	Rat	LD_{10}	50							31	
15739807	Lead sulfate	500-100										32	
Manganese Compounds													
7722647	Potassium permanganate	100-1	Rat	LD_{50}	1090								

DATA FOR THE TOXIC CHEMICALS THAT ARE CERCLA HAZARDOUS SUBSTANCES AND FOR CERCLA HAZARDOUS SUBSTANCES THAT ARE MEMBERS OF TOXIC CHEMICAL CATEGORIES - Continued

CASRN	Toxic Chemical/Hazardous Substance	Aquatic Tox.[1]	Oral Toxicity Spec.[2]	Test[2]	Val.[3]	Inhalation Tox.[5] Spec.[4]	Test[4]	Val.[5]	Dermal Toxicity Spec.[2]	Test[2]	Val.[3]	CTFA CS[6]	CARC WOE[7]
Mercury Compounds													
62384	Phenylmercuric acetate		Rat	LD_{50}	30							37	
592041	Mercuric cyanide	< 0.1	Mus	LD_{50}	33								
592858	Mercuric thiocyanate	1-0.1										I.D.	
628864	Mercury fulminate											I.D.	
7439976	Mercury	< 0.1				Rbt	LC_{1o}	29mg/m^3					
7783359	Mercuric sulfate	1-0.1	Rat	LD_{50}	57							I.D.	
10045940	Mercuric nitrate	1-0.1										42.4	
10415755	Mercurous nitrate	1-0.1	Rat	LD_{50}	297							I.D.	
Nickel Compounds													
557197	Nickel cyanide	1-0.1										49	
7440020	Nickel		Gpg	LD_{1o}	500							26	C
7718549	Nickel chloride	500-100	Rat	LD_{50}	105							40	
12054487	Nickel hydroxide	100-10										50	
13463393	Nickel carbonyl	100-10				Rat	LC_{1o}	35				49	B2
14216752	Nickel nitrate	500-100										38	
15699180	Nickel ammonium sulfate	500-100										35	
77786814	Nickel sulfate	500-100										39	
Polybrominated Biphenyls													
None													
Selenium Compounds													
630104	Selenourea		Rat	LD_{50}	50							I.D.	
7446084	Selenium dioxide	100-10	Rat	LD_{1o}	25							43	
7488564	Selenium disulfide		Rat	LD_{50}	138							I.D.	B2
7782492	Selenium					Rat	LC_{1o}	33mg/m^3				I.D.	
7783008	Selenious acid	100-10	Rat	LD_{1o}	25							42	
10102188	Sodium selenite	100-10	Rat	LD_{50}	7							40	
Silver Compounds													
506616	Potassium silver cyanide	< 0.1	Rat	LD_{50}	21								
506649	Silver cyanide	< 0.1	Rat	LD_{50}	123								
7440224	Silver		Mus	LD_{50}	100							7	
7761888	Silver nitrate	< 0.1	Mus	LD_{50}	50								
Thallium Compounds													
563688	Thallium(I) acetate		Mus	LD_{50}	35							22.4	
1314325	Thallium(III) oxide		Rat	LD_{50}	22							21.6	

DATA FOR THE TOXIC CHEMICALS THAT ARE CERCLA HAZARDOUS SUBSTANCES AND FOR CERCLA HAZARDOUS SUBSTANCES THAT ARE MEMBERS OF TOXIC CHEMICAL CATEGORIES - Continued

CASRN	Toxic Chemical/Hazardous Substance	Aquatic Tox.[1]	Oral Toxicity Spec.	Test[2]	Val.[3]	Inhalation Tox. Spec.	Test[4]	Val.[5]	Dermal Toxicity Spec.	Test[2]	Val.[3]	CTX CS[6]	CARC WOE[7]
6533739	Thallium(I) carbonate		Mus	LD_{50}	21							22.4	
7440280	Thallium		Rat	LD_{50}	15.8							I.D.	
7446186	Thallium(I) sulfate	100-10	Mus	LD_{50}	29							22.4	
7791120	Thallium(I) chloride		Rat	LD_{50}	24							22.4	
10102451	Thallium(I) nitrate		Mus	LD_{50}	33							22.4	
12039520	Thallium(I) selenide		Rat	LD_{50}	50							I.D.	
Zinc Compounds													
127822	Zinc phenolsulfonate	500-100										I.D.	
557211	Zinc cyanide	1-0.1										I.D.	
557346	Zinc acetate	100-10	Rat	LD_{50}	2510							12.8	
557415	Zinc formate	100-10										13.6	
1314847	Zinc phosphide	100-10	Rat	LD_{50}	40							I.D.	
1332076	Zinc borate	100-10										14.4	
3486359	Zinc carbonate	100-10										9	
7440666	Zinc											17.6	
7646857	Zinc chloride	500-100	Rat	LD_{50}	350							14.4	
7699458	Zinc bromide	500-100										11.2	
7733020	Zinc sulfate	100-10	Mus	LD_{50}	1891							12.8	
7779864	Zinc hydrosulfite	100-10										I.D.	
7779886	Zinc nitrate	500-100										12	
7783495	Zinc fluoride	100-10										19	
16871719	Zinc silicofluoride	500-100	Rat	LD_{lo}	100							I.D.	
52628258	Zinc ammonium chloride	500-100										11.2	

Abbreviations:

CARC = potential carcinogenicity

CASRN = Chemical Abstracts Service registry number

CS = composite score

CTX = chronic toxicity

Gpg = guinea pig

Hmn = human

kg = kilogram

mg = milligram

Mus = mouse

Rbt = rabbit

WOE = weight of evidence

Notes:

1. Aquatic toxicity is given as the LC_{50}, or that concentration of the material dissolved in water in parts per million or milligrams/liter (which is equivalent) that will kill 50% of the test organism population in 96 hours. Some of the data are shown in a range of ppm, as cited in the following sources:

   Supplement to Development Document: Hazardous Substances Regulations, Section 311 of the Federal Water Pollution Control Act as Amended 1972, (EPA-440/9-75-009), November 1975.

   The Registry of Toxic Effects of Chemical Substances (RTECS), U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health, Publication No. 83-107, 1981-1982, and Publication No. 86-1036, November 1985 (supplement).

   Additional sources for determining aquatic toxicity are listed in the Technical Background Document to Support Rulemaking Pursuant to CERCLA Section 102, Volume 1, March 1985.

2. The test used to determine the toxicity value is LD_{50} or LD_{lo}. LD_{50} is the lethal dose to 50% of the test animal population in milligrams per kilogram of body weight. LD_{lo} is the lowest dose in milligrams per kilogram of body weight known to have had a lethal effect on the test animal species.

3. Units are mg/kg.

4. The test used to determine the toxicity value is LC_{50} or LC_{lo}. LC_{50} is the lethal concentration in parts per million to 50% of the test animal population. LC_{lo} is the lowest concentration in parts per million known to have had a lethal effect on the test animal species.

5. Units are parts per million.

6. The chronic toxicity RQ is based on the composite score. The composite score is the product of the dose rating value and the effect rating value. The dose rating value may range from 1 to 10, depending on toxicity, with 10 being most toxic. Similarly, the type of effect is given an effect rating value from 1 to 10, with 10 being most severe. A composite score is then determined by multiplying the RVd by the RVe, with a possible range of 1 to 100. Thus, the highest scores are most toxic. An "I.D." is assigned when insufficient data are available to make an assessment. An "*" is assigned when the substance is known to have a chronic effect, but the RQ has already been set at the 1-pound level on the basis of some other criterion, and no further evaluation was made.

7. Part of the methodology used to adjust the statutory RQs of potential carcinogens evaluates the strength of the evidence that a substance causes cancer. Each potential carcinogen is assigned to one of the following weight-of-evidence categories, which, along with the potency factor, determines the potential carcinogenicity RQ for the substance:

   Group A--Human Carcinogen -- An agent is placed in this group only when there is "sufficient" evidence from epidemiologic studies to support a causal association between exposure to the agent(s) and cancer.

Group B--Probable Human Carcinogen -- This group includes agents for which the weight-of-evidence of human carcinogenicity based on epidemiologic studies is "limited" and also includes agents for which the weight-of-evidence of carcinogenicity based on animal studies is "sufficient." The group is divided into two groups. Group B1 is usually reserved for agents for which there is "limited" evidence of carcinogenicity from epidemiologic studies. It is reasonable, for practical purposes, to regard an agent for which there is "sufficient" evidence of carcinogenicity in animals as if it presented a carcinogenic risk to humans. Therefore, agents for which there is "sufficient" evidence from animal studies and for which there is "inadequate" evidence or "no data" from epidemiologic studies (human) would usually be categorized under Group B2.

Group C--Possible Human Carcinogen -- This group is used for agents with "limited" evidence of carcinogenicity in animals in the absence of human data. It includes a wide variety of evidence, for example: (a) a malignant tumor response in a single, well-conducted experiment that does not meet conditions for "sufficient" evidence; (b) tumor responses of marginal, statistical significance in studies having inadequate design or reporting; (c) benign but not malignant tumors with an agent showing no response in a variety of short-term tests for mutagenicity; and (d) responses of marginal statistical significance in a tissue known to have a high or variable background rate of cancer.

This list only includes entries for those toxic substances/hazardous substances for which data are available to derive an RQ on the basis of acute inhalation toxicity.

Specific xylene and cresol isomers which are toxic substances are not specifically listed as CERCLA hazardous substances, and are therefore not listed here. However, data on the specific isomers of xylene and cresol were used to derive the RQs for mixed xylenes and cresols which are specifically listed as CERCLA hazardous substances. These mixed isomers of xylene are listed in the table as "xylene (mixed)."

APPENDIX G

SYSTEMS AND MODELS FOR RISK ASSESSMENTS ON ENVIRONMENTAL POLLUTANTS

This appendix describes several systems and models that may be appropriate for Section 313 data interpretation. The appendix has three components. First, each system is described in detail. Following each system description is a flow diagram that illustrates the way the system works. Finally, a table with supplementary information concerning each system is provided in the back of this appendix. This table should be useful in comparing and evaluating the systems for your particular uses. References are provided in the bibliography to this manual.

APPENDIX G - SYSTEMS AND MODELS FOR EVALUATING RISKS OF ENVIRONMENTAL POLLUTANTS

Chemical Scoring System for Hazard and Exposure Assessment (CSSHEA)

CSSHEA is a qualitative ranking system used by the EPA Office of Toxic Substances (OTS) to screen and prioritize chemicals for further assessment. It is a first-cut, rapid way of evaluating a large number of chemicals to assist in focusing resources at later stages of assessment. CSSHEA incorporates both hazard and exposure potential.

For each chemical, scientists with relevant expertise separately score eleven exposure and hazard parameters on a scale of 0 to 9. Each parameter is scored independently by two professionals who resolve differences if scores differ by more than one point. To score, the scientists review a source document, such as an EPA Health and Environmental Effects Profile, that summarizes the relevant human, animal, genotoxic, and environmental data on the chemical. Scorers use objective criteria to assign a numerical score when data are available, or analog/structure-activity relationships in the absence of data. Scorers may raise or lower a score based on professional judgment, and must provide a rationale for each assigned score.

Scoring is performed on all or any combination of the eleven parameters. The scores are not added, weighted, or combined. They are simply provided as an overall hazard "profile." At OTS, any chemical with at least one hazard parameter and one exposure parameter of 8 or 9 is assigned a high priority for further assessment. Scored chemicals can be used as benchmarks against which to compare the exposure and hazard potential of newly scored chemicals.

Input Data: The system relies on the availability of a major source document (such as a HEEP) that reviews and summarizes the relevant literature for the chemical. In addition, information on chemical analogs and structure-activity relationships may be required. Data from these sources are evaluated and scored in the following areas: (1) toxicity parameters: carcinogenicity, genotoxicity, developmental toxicity, acute and chronic mammalian toxicity, and aquatic toxicity; (2) exposure parameters: bioconcentration, chemical production volume, occupational exposure, consumer exposure, environmental fate, and environmental exposure. Currently, HEEPs, CHIPs and OTS submissions are used as the basis for scores. Each chemical takes approximately one month to score.

Output: Qualititative scores on a scale of 0 to 9 for up to eleven hazard and exposure parameters.

The main obstacle to using this system for Section 313 data evaluation is hat a source document (that reviews and summarizes the literature) is ssential to scoring. Only a small portion of the Section 313 chemicals have een scored by OTS. The "Environmental Exposure" parameter is based largely n the amount released to the environment; the current scoring criteria for his parameter would have to be modified, since they are based on total stimated nationwide emissions, not on emissions from a single facility.

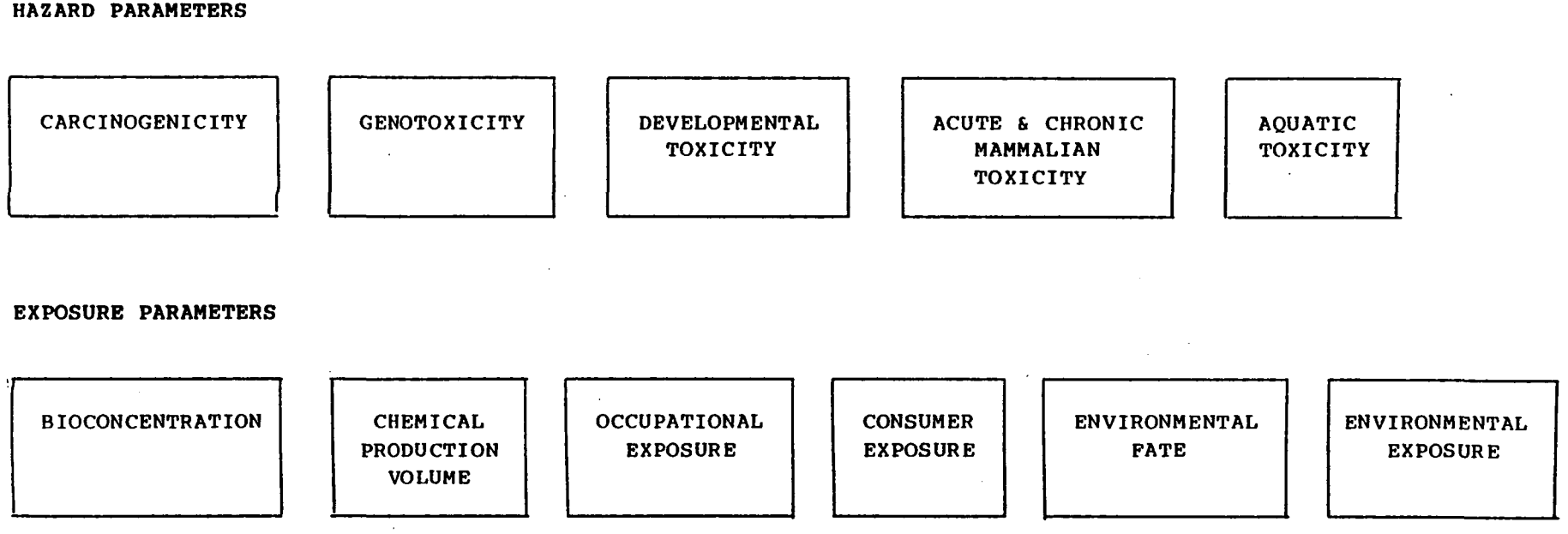


Figure G-1. Chemical scoring system for hazard and exposure assessment.

THE GRAPHICAL EXPOSURE MODELING SYSTEM (GEMS)

The EPA Office of Toxic Substances developed the Graphical Exposure Modeling System (GEMS) as an interactive information management tool designed to assist in a quick and meaningful analysis of environmental problems. GEMS, as an operating environment, ties together several previously discrete tools into a coordinated system that allows for multiple types of analyses. These tools include environmental fate and transport models, chemical property estimation techniques, statistical analysis, and graphical and mapping programs. These discrete systems are handled under a common environment and the user interacts with the computer through an interface consisting of a uniform set of menu screens which eliminate the usual requirements to learn specific application languages. Under development since 1981, GEMS has several uses:

- Environmental Fate and Transport Modeling.
- Chemical Property Estimation.
- Data Management.
- Graphics.
- Geographic Data Analysis and Mapping.
- Statistical Analysis.

GEMS has many features that make the system easy to access and operate:

- Accessed by telephone from virtually anywhere in the U.S.
- Supports a variety of terminals.
- Supports SAS and Tektronics graphics.
- Includes a sophisticated modeling system for ease of data input and analysis of output results for environmental simulation models.
- Provides geographic data analysis and mapping capabilities.
- Includes a powerful file management capability along with many on-line databases that support routine use of the models.

- Requires no previous knowledge of computer programming to operate the system.

- Complemented by a microcomputer version (PCGEMS).

BASIC STRUCTURE OF GEMS

GEMS resides on the VAX Cluster at the USEPA National Computer Center at Research Triangle Park, NC. Originally developed on a VAX 11/780, GEMS currently runs on MicroVAX II and VAX 8600 computers. GEMS is designed under a unique concept which integrates the computerized tools of graphics, mapping, statistics, file management, and special functions such as modeling and chemical property estimation under a user oriented and simple-to-learn interface. The system has three basic structural components.

- Data Management The GEMS File Management Facility allows for the creation and manipulation of GEMS datasets. It is designed to handle data in a variety of data formats and provides the user with a common interface for all data accessed. This operation also allows the user to import data from outside of GEMS for use with GEMS procedures.

- Analytical and Mapping Tools The modeling operation in GEMS allows users to simulate chemical behavior in various environmental media. The GEMS interface allows users to build input data via standard prompts and menus and to store model output results in a standard format which then may be used with the statistics and graphics operations of GEMS. The statistics and graphics operations provide data analysis by use of SAS and IMSL routines and functions. Mapping ofindustrial facilities, rivers, population distributions, and modeled results is supported by SAS and Tektronics routines.

- User-Friendly Interface Users respond to menus and prompts produced by the system's user interface. Responses to system prompts are in plain English and extensive "help" information is widely available.

THE GEMS DATA BASES

The GEMS data base supports most types of environmental data useful for exposure assessments of toxic substances. One of the features that makes GEMS so powerful is the ready availability of data for use with the models and mapping procedures. These datasets include:

- Industrial Facility Discharge Data (EPA NPDES Permitted Facilities).
- Meteorological Data (392 STAR Stations and 3000 State Climatic Divisions).
- Chemical Property Data.
- Water Supply Data (WSDB and FRDS).
- Groundwater Data for Selected U.S. Cities.
- Stream Flow and Reach Data (USGS & EPA).
- Economic Census Data.
- Zip Code Location Data.
- Census Population Data for 1980 and 1983.
- Soil Textural Data (USDA-SCS).
- Geoecology County-level Environmental Characteristics Data.

Descriptions of each data set are provided in the GEMS User's Guide. The user also has the capability of importing and installing external files as part of the User Owned Data Sets which then may be used with GEMS.

ANALYTICAL CAPABILITIES OF GEMS

The use of GEMS and a description of its analytical capabilities are described in the GEMS User's Guide. The system has several operations for analysis of environmental data:

- Modeling in Atmospheric, Aquatic, and Soil Environments.
- Chemical Property Estimation.
- Data Management.
- Graphics, Mapping, and Geographic Data Analysis.
- Statistical Analysis.

The brief discussion of a modeling analysis may best provide the reader with a sense of the integrated nature of GEMS. For our purposes let us assume

that a user has data quantifying the mass of a carcinogenic chemical released annually from a stack. With the assumption of no threshold for carcinogens, an annual total emission is adequate for exposure and risk calculations. Stack parameters are needed to characterize the release for an adequate estimation of exposure.

The user selects the Industrial Source Complex Long Term Model (ISCLT) under the Modeling Option and specifies the geographic coordinates of the facility. A zipcode centroid is used if nothing else is available. When the user specifies the facility location, a meteorological data base is searched and the names and distances to several meteorological reporting stations are returned for selection of the data to be used. The joint frequency data and supplemental files are automatically inserted into the ISCLT model input file in the correct format. The user then enters the release information, selects either 1980 or 1983 estimated census population data, and runs the model.

Population data are automatically extracted from the Census Population database and combined with the model estimated concentrations to estimate the number of people exposed to various levels. A post-processor for the model also estimates number of people at various levels of risk, if a potency slope factor is available for the chemical.

Graphical routines lend support to this analysis. The STAR Rose routine generates wind roses and allows examination of the meteorological data in summary tabular form. An isopleth mapping routine plots chemical concentration over population density for a qualitative description of population exposure.

MAPPING CAPABILITIES OF GEMS

GEMS has the capability of producing maps at various spatial scales. Maps of study areas depicting state and county boundaries may be produced using high resolution graphics terminals. Any data set in GEMS which contains geographic identification information may be used to generate overlays.

Choropleth mapping is also supported. Examples of information that can be plotted on maps include:

- River Reaches from the EPA Reach File.
- Wastewater Treatment Facilities.
- Meteorological Stations.
- Dischargers of Industrial Wastes.
- Choropleths Depicting Levels of Use of Pesticides by County.

USER INTERFACE

GEMS comes with two basic types of menus, navigational menus and parameter editing menus.

Navigational menus help the user navigate through GEMS. They present a list of options from which to select. After selecting one the user will proceed to either another navigational menu or to a parameter editing menu.

Parameter editing menus assist with data entry and creation of input files for subsequent analyses. The user simply enters the desired parameter value into the field provided and the files will be created with the proper structure and format.

ACCESSING GEMS

Employees of the USEPA wishing access to GEMS need only contact their local ADP Coordinators to obtain and complete TSSMSS Form N258. GEMS is also available to members of other federal government agencies, state governments, and private industry with billing handled through the National Technical Information Service. The NTIS contact person is Ms. Cathy Metzler (703)487-4807.

PCGEMS

In order to meet the growing demands of EPA modelers for access to the features of GEMS, the Personal Computer (PC) version of the Graphical Exposure Modeling System (PCGEMS) has been adapted from the VAX version. PCGEMS has many of the same features as GEMS but is accessible at a local level on a desk top computer. PCGEMS features work both independently and in concert with their more powerful counterparts on the mainframe. PCGEMS is designed to reduce the reliance on the VAX by providing the following independent capabilities:

- Environmental Fate and Transport Modeling.
- Chemical Property Estimation.
- File Management.
- Graphical Display of Modeled Analyses.
- Mapping.
- Selected GEMS Data Sets.

In addition to its many stand-alone features, PCGEMS also works in concert with GEMS on the EPA VAX Cluster. This allows much of the task of setting up modeling runs to be accomplished locally with files uploaded to the VAX for execution of the model and downloading of files to the PC for subsequent analysis.

PCGEMS requires the following hardware:

- IBM XT/AT or compatible with 640 K RAM.
- Hard Disk and Floppy Drive.
- Graphics Board.
- DOS Version 2.2 or higher.
- 8087 or 80287 Math Co-Processor.
- Minimum of 10 Mb of available space on the hard disk; less space may be required if the user installs only a few features of PCGEMS.

While some specialized graphics and file manipulation routines have been developed for PCGEMS, generalized graphics and database management procedures have not been developed because there are many commercially available packages that perform these functions on PCs. The PCGEMS Utilities Function allows the user to identify and set the path to the database management software, graphics package, spreadsheet, etc. and to further customize PCGEMS with the user's favorite programs. Furthermore, PCGEMS contains some programs that convert between PCGEMS, ASCII, dBASE, and LOTUS files thereby supporting dBASE and LOTUS use with PCGEMS.

PCGEMS is still under development; consequently, the distribution mechanism has not yet been established. Development of Release Version 1 of PCGEMS is expected to be completed in the summer of 1988. Information as to its availability may be obtained at that time from the author (202) 382-3928.

INPUT AND OUTPUT REQUIREMENTS

Input Data: On line computer data bases assist the assessor in characterizing the receiving environment. Other input data are standard for the various environmental models.

For instance, the ISCLT model requires the location of the emission (latitude and longitude, Universal Transverse Mercator coordinates, or zip codes); pollutant emission rate (grams per second); physical stack height (meters); internal stack diameter (meters); stack gas exit velocity (meters per second); and stack gas temperature (degrees Kelvin). Optional data include height and width of nearby buildings and distance from the stack to the buildings. If the emissions are classified as fugitive or non-point emissions, then they should be modeled from area sources. Data required include the width of the area source and the height of release. Stack parameters, of course, are non existent for area sources. Meteorological data (Stability Array) are available from GEMS databases as are human population data. Optional data also include the cancer potency factor $(mg/kg\ day)^{-1}$ or the cancer unit risk factor $(ug/m^3)^{-1}$.

If the PTPLU model is being used for a screening analysis, ambient air temperature (degrees Kelvin) and mixing height (meters) data are required. These data may be obtained from GEMS databases for the area of interest. Stack parameters as described above are also required.

The ReachScan model requires identification of the geographic area by USGS Hydrologic Accounting Unit. Within an accounting unit you can search by NPDES Number, Facility Name, SIC Code, Water Utility Name, or Reach Number. Pollutant emission loading is specified in kg/day.

Output: The output of the ISCLT model includes the predicted maximum concentration; number of people estimated to be exposed at various concentration levels; number of people residing in the area specified; population exposure; predicted concentration by distance and direction; maximum lifetime risk; and estimated annual number of cancer cases. The output of the PTPLU model includes maximum concentration (grams per cubic meter) by distance for each atmospheric stability class.

Output from the ReachScan model includes concentration in reaches with drinking water intakes, identities of discharging facilities upstream of a drinking water utility, and identities and locations of drinking water utilities downstream from discharging facilities.

The main obstacle to using GEMS for Section 313 assessment is the absence of information on TRI reporting form. For example, stack parameters are not requested for emissions to air and all releases are reported as annual totals.

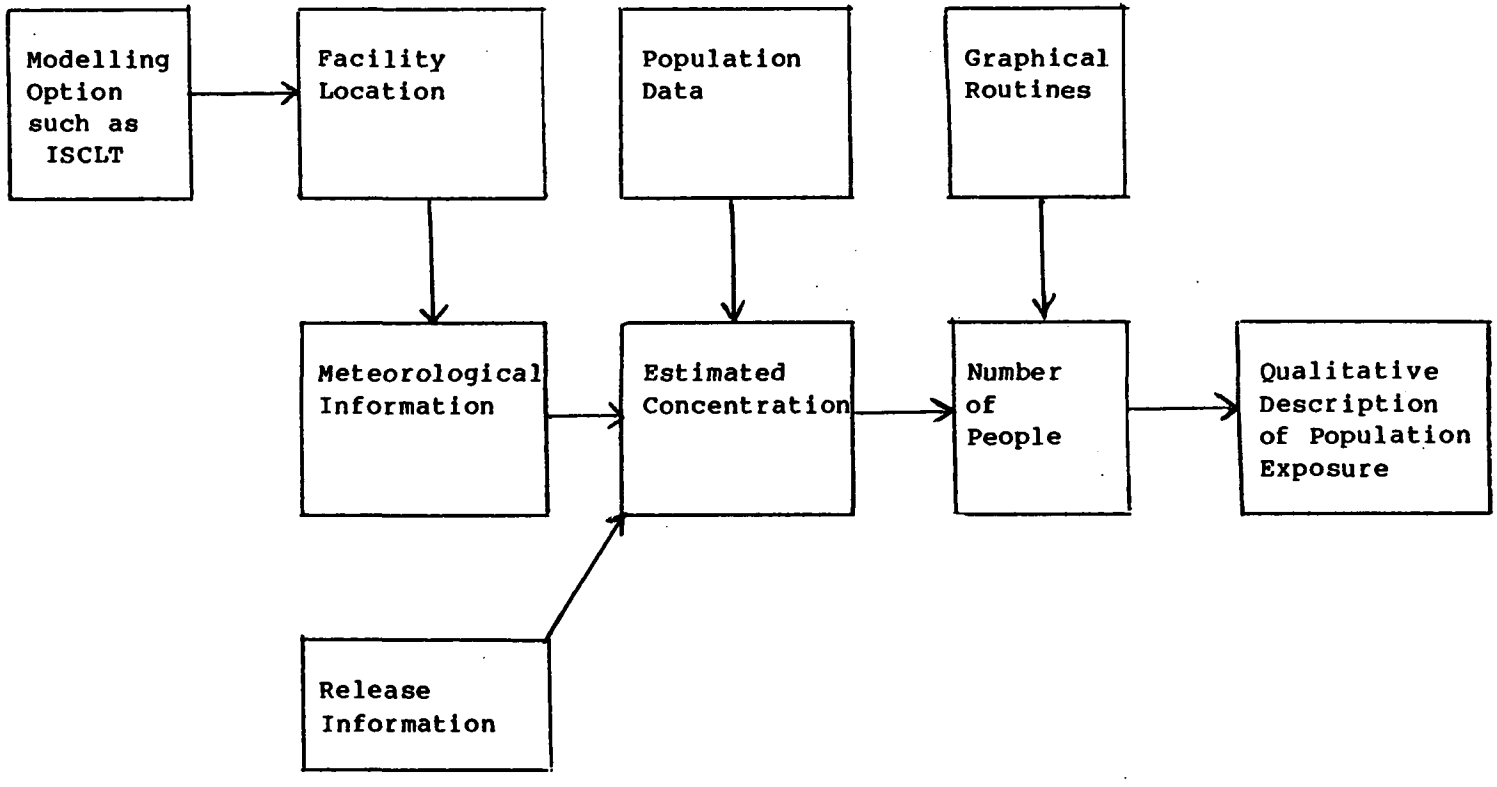


Figure G-2. Graphical Exposure Modeling System - Sample analysis.

Hazard Assessment Model

The Hazard Assessment Model was developed by EPA's Office of Toxic Substances to help Local Emergency Planning Committees (LEPCs) assess the lethal hazards related to potential airborne releases of hazardous substances, particularly the extremely hazardous substances listed under Section 302 of Title III of SARA.

The analysis process is applied first with screening assumptions, and then with planning assumptions. Reporting facilities may be screened using credible best or worst case assumptions. The screening helps planners prioritize facilities so that a more detailed hazard analysis can be conducted for facilities that pose the greatest risk should a release occur. These facilities could then be visited to get more information and input data. After the initial screening, a reevaulation and adjustment of the quantity released and/or the rate of release of chemical can be made. Reevaluation and adjustment of variables--wind speed and air stability; selection of a higher level of concern--can also be performed.

The analysis process consists of three basic hazard analysis steps: (1) hazard identification, (2) vulnerability zone estimation, and (3) risk analysis. Hazard identification typically provides specific information on situations that have the potential for causing injury to life or damage to property and the environment due to a hazardous materials spill or release. Vulnerability analysis identifies areas that may be affected or exposed; individuals who may be subject to injury or death from certain specific hazardous materials; and what facilities, property, or environment may be susceptible to damage should a hazardous materials release occur. Risk analysis is a judgement of probability and severity of consequences based on the history of previous incidents, local experience, and the best available current technological information. A relative ranking of hazards combined with site-specific evaluations such as the vulnerability analysis will complete much of the risk analysis process.

Input Data: The initial estimated screening zones are based on the following assumptions:

- Rate of release to air: Total quantity of gases, powdered solids, or solids in solution are assumed to be released in 10 minutes. Liquids and molten solids are released instantaneously and evaporate. The release rate is based on the rate of evaporation.

- Topographic conditions: Urban or rural setting.

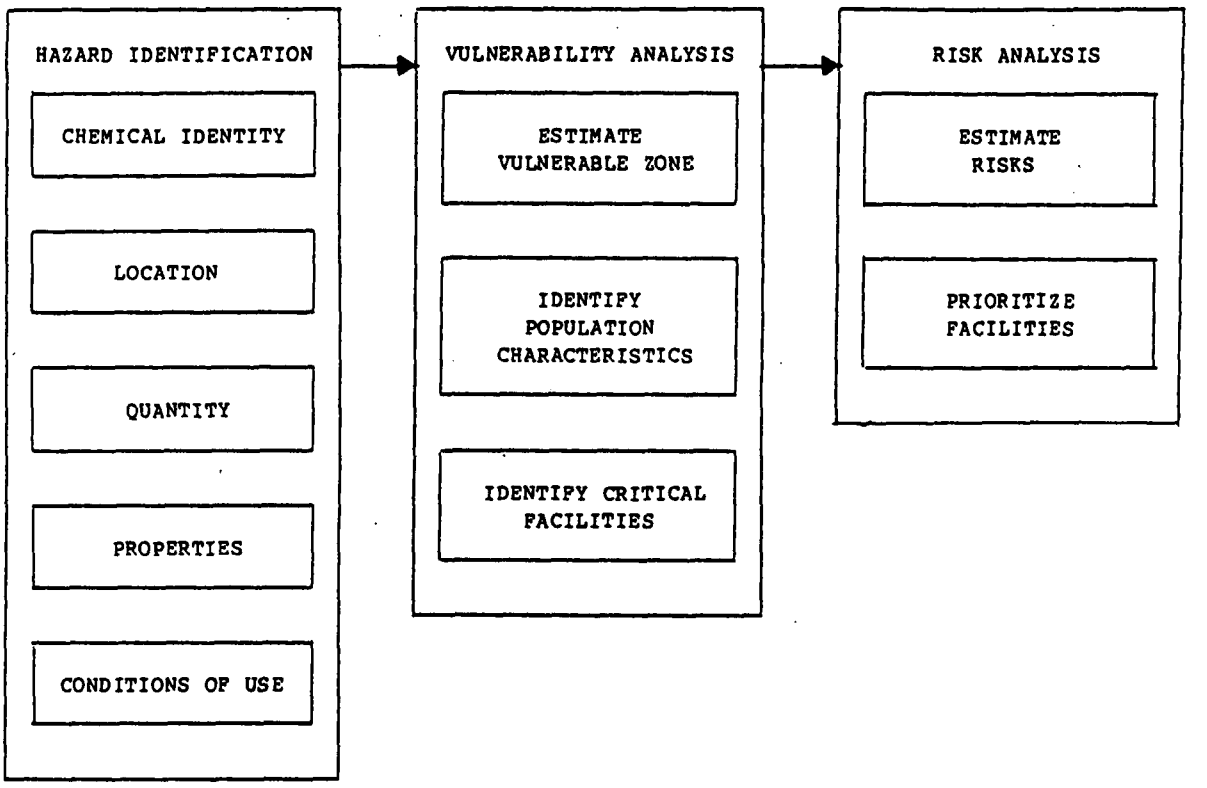
- Meteorological conditions: Wind speed = 3.4 mph; Atmospheric stability = F

- Level of Conern (LOC): One-tenth of the (NIOSH) published (IDLH) or one-tenth of its approximation. Pseudo IDLH = (1/10 LC_{50}) or (1/100 LD_{50}) (oral or dermal) or (LC_{LO}) or (LD_{LO} x 1/10)*

Output: The likelihood of a hazard occurrence and the severity of consequences are assessed as high, medium, or low. An emergency response plan, required under Title III of SARA, can be formulated based on the information gleaned through this process.

The perceived complexity of this system is an obstacle to Section 313 assessment. The numerical values used for Level of Concern and the calculations that must be performed for assessing liquid releases may be perceived as difficult by some users. Additionally, this model has been primarily used for assessing accidental (generally, short-term) releases of extremely hazardous substances. While some of the Section 313 chemicals will also be listed under Section 302, many of the Section 313 chemicals will be much less toxic and will be released over a longer period of time.

I. INITIAL SCREENING



II. EVALUATION OF FACILITIES BY PRIORITY

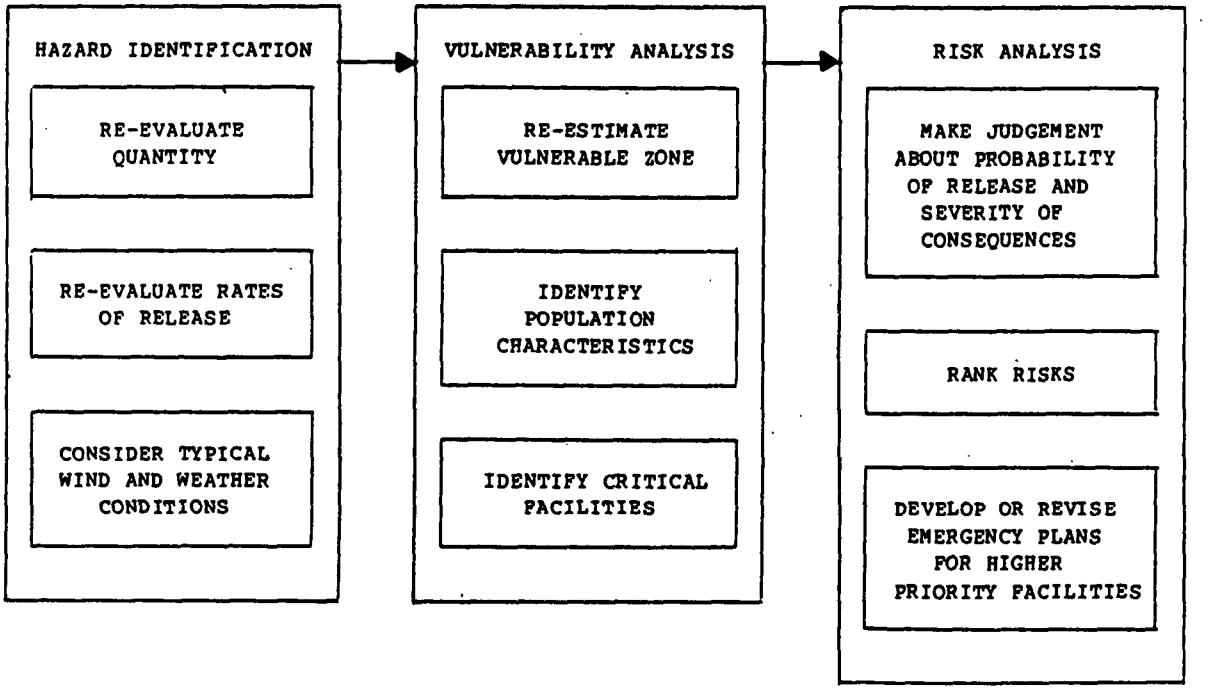


Figure G-3. Hazard assessment model.

Human Exposure Model

The Human Exposure Model (HEM) produces quantitative expressions of public exposure and carcinogenic risk to ambient air concentrations of pollutants emitted from stationary sources. Used by the EPA Office of Air Quality Planning and Standards (OAQPS), HEM is a screening method that provides rough, but not necessarily conservative, estimates of exposure and risk.

The HEM contains 1) an atmosphere dispersion model (Gaussian); 2) multiple-year meteorological data (STAR) at 314 airports across the U.S.; and 3) a population distribution estimate based on 1980 U.S. Bureau of Census data (by block/group/enumeration of district). Based on emission and stack parameters and frequency of wind direction, wind speed, and atmospheric stability classes, HEM estimates the magnitude and distribution of ambient air concentations of the pollutant in the vicinity of the source. The model is programed to estimate these concentrations within a radial distance of 50 kilometers (30.8 miles) from the source. If other radial distances are preferred, an override feature allows the user to select the distance desired.

If the user wishes to use a dispersion model other than the one contained in HEM, HEM can accept the concentrations from the alternative model if they are put into the appropriate format. Based upon the source location and the radial distance specified, HEM combines numerically the distribution of pollutant concentrations with the people estimated to reside near the source to produce quantitative expressions of public exposure to the pollutant. If the pollutant of interest is one for which a cancer potency estimate has been derived, and this potency has been input to HEM, public cancer risk is calculated.

The HEM also contains an area source model that is often used to estimate exposure and risks from mobile sources or sources too numerous to model individually. The area source model can be used in limited geographical

areas, e.g., parts of cities, entire counties, entire cities. The HEM can be accessed on the National Computer Center Office of Research and Development and Development VAX computer.

Input Data: Inputs which are required for the model are the latitude and longitude of the source of the emissions (degrees, minutes, seconds); pollutant emission rate (kilograms per year); physical stack height (meters); internal stack diameter (meters); stack exit velocity (meters per second); and stack exit temperature (degrees Kelvin). Optional data are cancer potency estimate (micrograms per cubic meter^{-1}); indication whether source is subject to urban or rural meteorological conditions; and the five digit STAR (Stability Array) meteorological station identifier.

Output: This output of the model are the predicted maximum concentration; number of people estimated to be exposed to the maximum concentration; number of people residing within the area specified; public exposure (people X concentrations to which they are expected to be exposed to); table of predicted concentrations by wind direction and distance; maximum lifetime risk; and estimated annual number of cancer cases.

[NOTE: In September, 1988, an improved HEM will be available. This model will be completely menu driven and user friendly. It will contain ISCLT, and will be able to quantify uncertainties associated with dispersion modeling and calculation of exposure. The modified HEM will also address population mobility; indoor/outdoor relationships; and population cohort analysis such that risks to specified sensitive subpopulations can be estimated. The model may also contain a stable of dispersion models including a short-term model, a dense gas release model, and various multimedia models.]

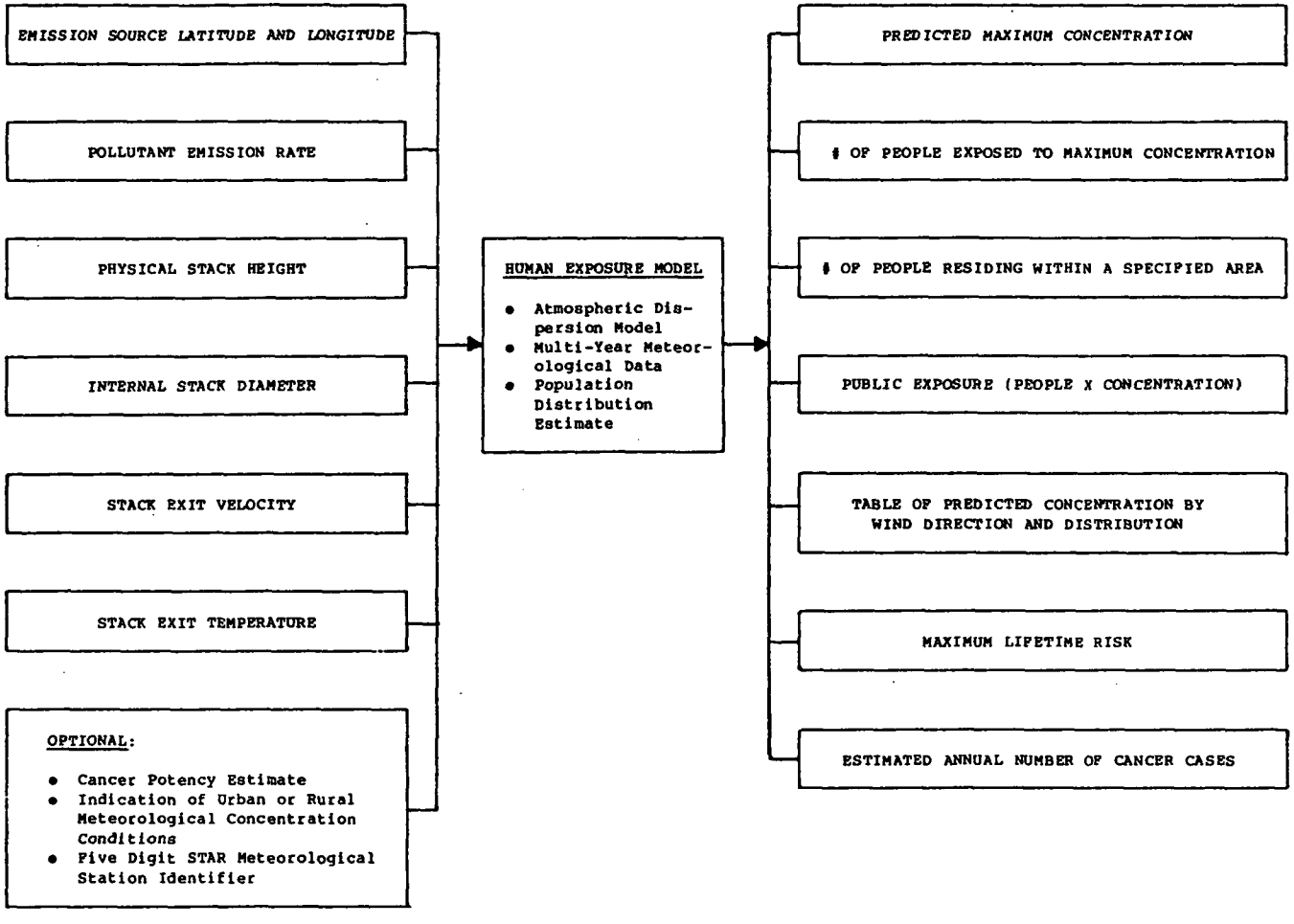


Figure G-4. Human Exposure Model (HEM).

Methodology for Reportable Quantities Adjustments

Reportable quantities (RQs) are reporting triggers for episodic and continuous releases of hazardous substances into the environment. The National Response Center (NRC) under CERCLA Section 103, and the State Emergency Response Commission (SERC) and the Local Emergency Planning Committee (LEPC) under SARA Section 304 must be notified if there is a spill of release of any hazardous substance (as defined in CERCLA Section 101) equal to or greater than its RQ. There are five RQ levels: 1, 10, 100, 1,000, and 5,000 lbs. These levels provide an indication of relative hazard but not of exposure or risk.

EPA establishes RQs by separately evaluating six intrinsic physical, chemical, and toxicological properties associated with the hazardous substance: aquatic toxicity (LC_{50}); acute mammalian toxicity (oral, dermal, and inhalation LD_{50}s); chronic toxicity (including a consideration of minimum effective dose and the severity of the effect); potential carcinogenicity; ignitability; and reactivity. A separate RQ is assigned for each criteria, and the lowest (most stringent) of these is used as the primary RQ. This primary RQ may then be adjusted based on the chemical's potential to biodegrade, hydrolyze, and photolyze (BHP), and the hazards associated with its BHP products.

Input Data: Existing data on carcinogenicity; chronic toxicity (including a consideration of minimum effective dose and the severity of the effect); acute mammalian toxicity (oral, dermal and inhalation LD_{50}s); aquatic toxicity (LC_{50}); ignitibility; and reactivity.

Output: A level (1, 10, 100, 1,000, and 5,000 lbs.) at which a release of the substance must be reported to the NRC, SERC, and LEPC.

About two-thirds of the Section 313 chemicals have RQs. EPA may develop RQs for the rest.

DEVELOPMENT OF RQs

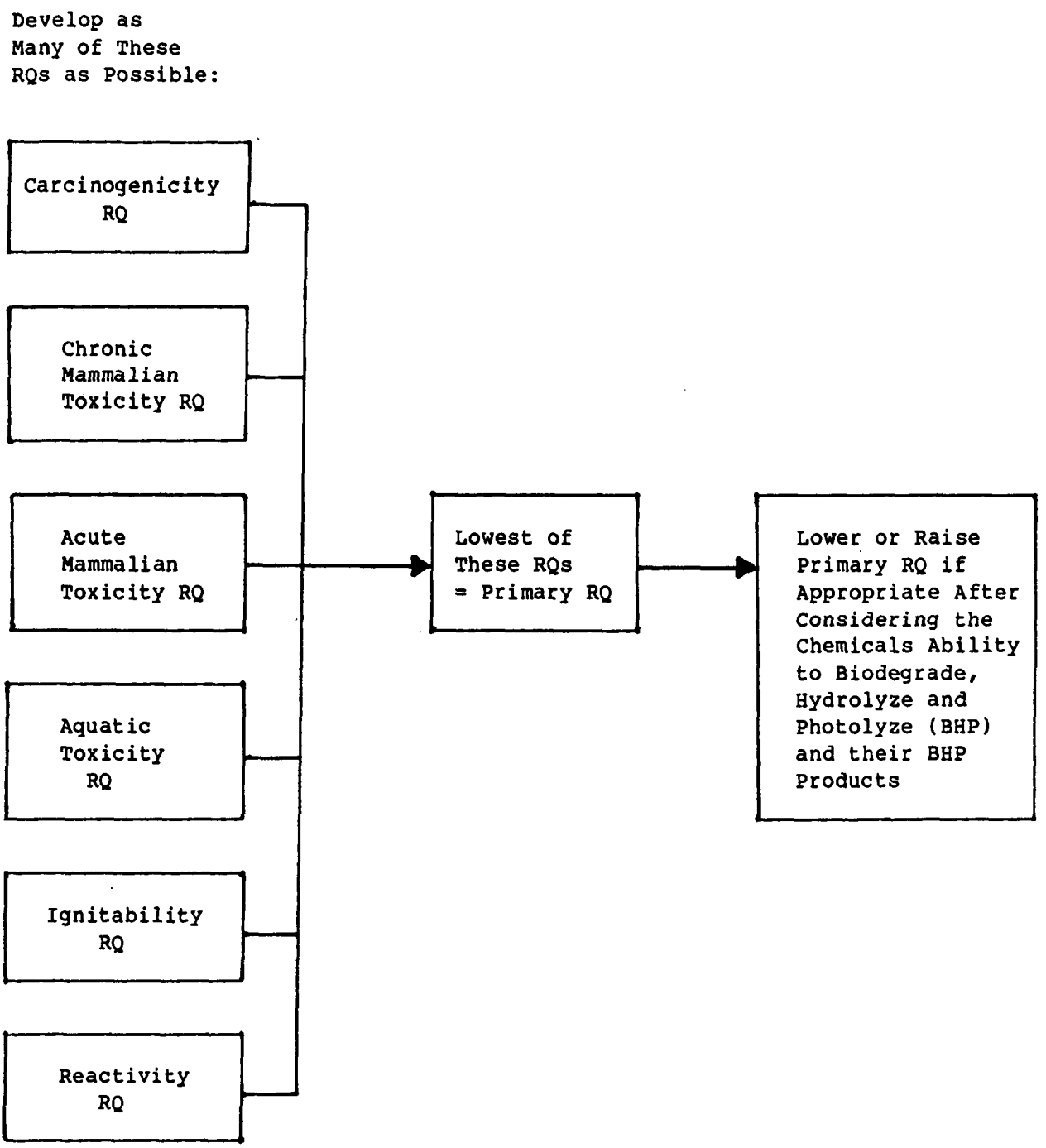


Figure G-5. Development of RQs.

Modified Hazardous Air Pollutant Prioritization System (MHAPPS)

MHAPPS is a qualitative computerized system used by the EPA Office of Air Quality Planning and Standards to rank hazardous air pollutants for further assessment. The system prioritizes substances by scoring them in eight factors that reflect the concerns of EPA air programs: oncogenicity, mutagenicity, reproductive and developmental toxicity, effects other than acute lethality, acute lethality, potential for airborne release, bioaccumulation, and existing standards. Worksheets formatted on a PC are used to compile the relevant data from seven standard references, including the Registry of Toxic Effects of Chemical Substances (RTECS) and the Merck Index. Based on these data, scores for each of the eight factors are calculated separately using specific criteria, and the scores of closely related factors are then normalized and combined to give five group scores. Finally, the group scores are weighted (to account for their relative importance), normalized and combined to give an overall score that is used to rank the substance. The main obstacle to using MHAPPS for Section 313 assessment is that the system can be used only to prioritize chemicals released into the air.

Input Data: Data from readily available summary and reference documents and computerized data bases (particularly RTECS). Data are needed on oncogenicity, mutagenicity, reproductive and developmental toxicity, effects other than acute lethality, acute lethality, potential for airborne release, bioaccumulation, and existing standards. The potential for airborne release is based on production volume and vapor pressure. Any fields with missing data are given no weight in the ranking.

Output: Relative ranking score.

[NOTE: The Office of Air Quality Planning and Standards (OAQPS) is currently developing a ranking system that will prioritize groups of emmissions sources (source categorizing) rather than individual compounds. This system will employ the current MHAPPS health effects scoring system but will replace the potential for exposure factor with exposure data specific to airborne releases.]

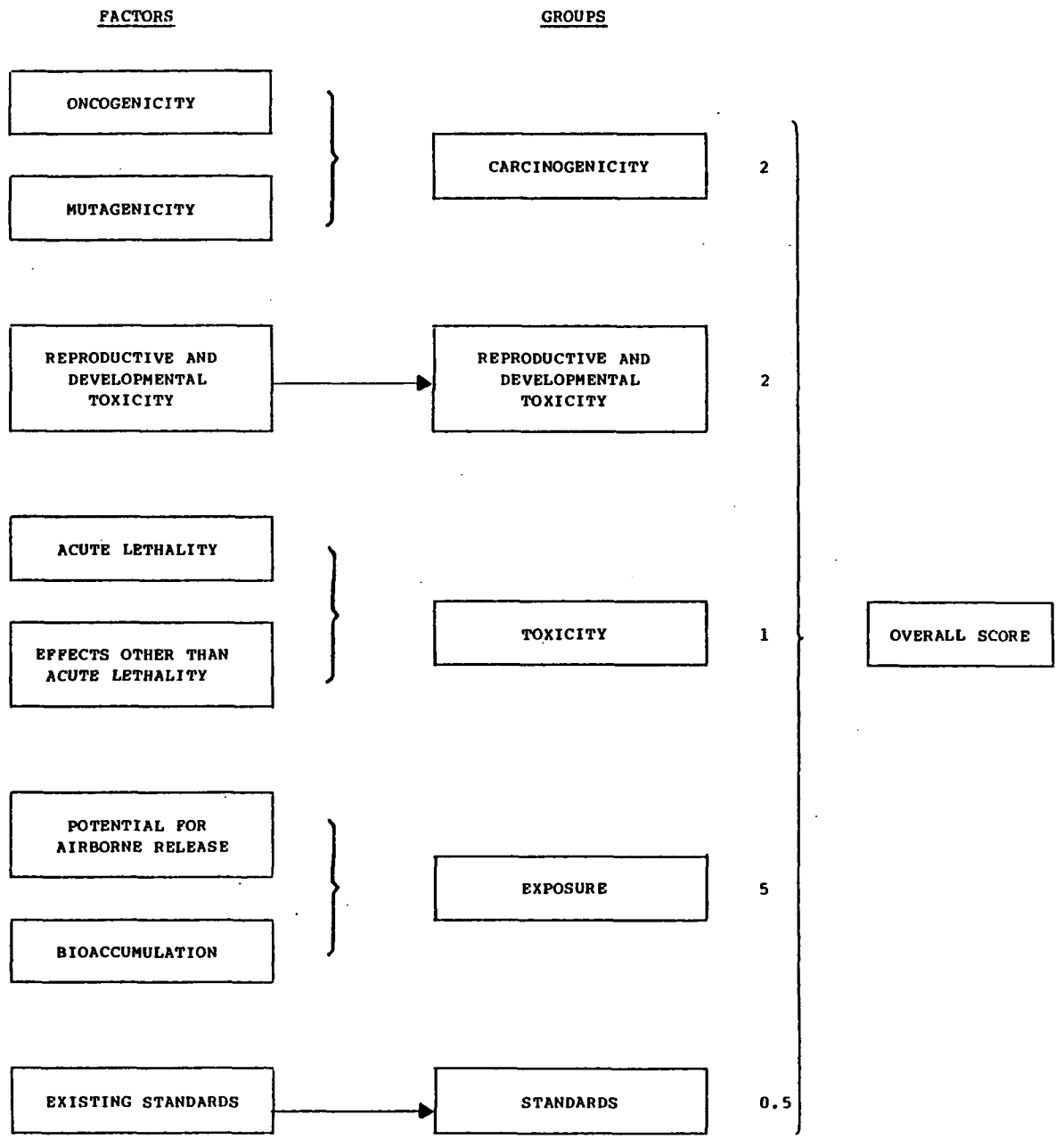


Figure G-6. Hazardous Air Pollution Prioritization System.

Remedial Action Priority System

The Remedial Action Priority System (RAPS) was developed by the U.S. Department of Energy (DOE) to help DOE prioritize its hazardous waste sites for further investigation and possible remedial action. RAPS is a computer model designed to estimate health risk from sites containing hazardous or radioactive waste. The health risks are estimated for the entired exposed individual assuming long-term average conditions of exposure (70 years). Currently, RAPS does not consider environmental risks; however, it could be modified to include an exposure and effects submodel for environmental receptors.

RAPS estimates human health risks from a site in four steps: source definition, transport, exposure, and health effects. A separate preliminary hazard index (PI) is developed using these steps for each chemical of concern at a site. The highest PI is then used as the basis for developing a single final site score. The site scores range from 1 to 100, with higher scores indicating greater risk. RAPS uses contaminant transport and exposure models to produce an estimate of the health effects associated with a site, and explicitly bases the overall score for each site on an index of health effects. Users can choose from among 22 transport-exposure models in RAPS.

Input Data: Several different data elements are required to run RAPS. RAPS can calculate or supply default data for some of the elements if the variables are not known.

- For the source definition submodel, over 20 different data inputs are required concerning site characteristics, contaminant characteristics, and climatological data.
- For the atmospheric transport submodel, RAPS incorporates over 30 different data elements concerning climatological information, characteristics of the point of release, physical characteristics of the contaminant, rates of emission, and location of human receptors.
- For the overland transport submodel, RAPS requires over 10 data elements relating to geology, precipitation, and topography.
- For the ground-water transport submodel, RAPS requires approximately 20 elements of geological data.

- For the surface water transport submodel, RAPS requires approximately 5 data elements related to discharge characteristics, flow parameters, and location of receptors.

- For the exposure assessment submodel, over 20 data elements are used, relating to irrigation, soil concentration, recreational water usage, aquatic food usage, and bioaccumulation and transfer potential.

- The health risk component of RAPS considers the type, time, and duration of exposure and the location and size of the exposed population.

Output: RAPS scores sites on a scale of 0 to 100, assigning higher scores to sites that pose greater potential risk. The system provides a quantitative expression of risk and explicitly bases the overall score for each site on an index of health effects.

An obstacle to using RAPS for Section 313 assessment is that the system requires RfDs and cancer potency factors (q_1*s) for the chemicals being assessed. A substantial number of 313 chemicals do not have these "toxicity scores." RAPS also requires a large amount of data that will be expensive and time-consuming to collect.

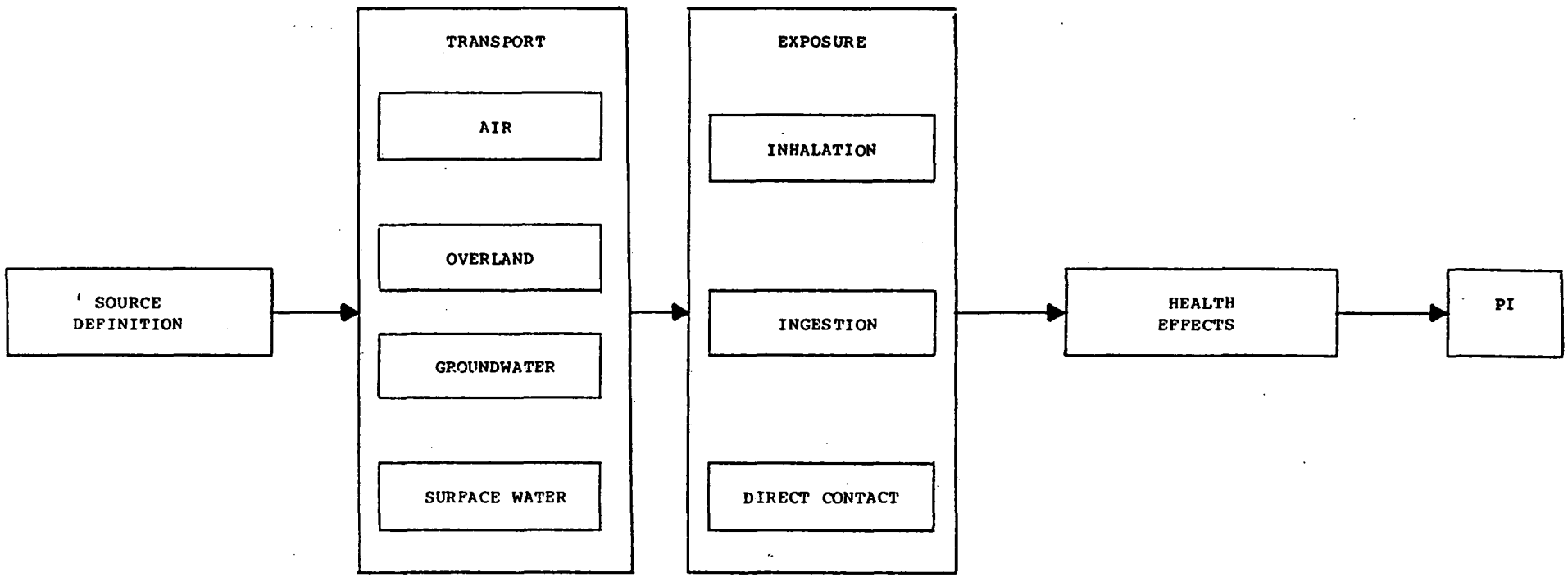


Figure G-7. Remedial Action Priority System.

TABLE G-1

SYSTEMS AND MODELS FOR EVALUATING RISKS OF ENVIRONMENTAL POLLUTANTS

MODEL	TYPE OF SYSTEM	STAGE OF DEVELOPMENT	CURRENT USE	CURRENT USERS	LEVEL OF EXPERTISE REQUIRED TO USE SYSTEM	TIME REQUIRED TO RUN A SCENARIO	CONFIDENCE IN THE DATA
Chemical Scoring System for Hazard and Exposure Assessment (CSSHEA)	Qualitative manual screening tool. Relatively unsophisticated. Does not discriminate well on specific exposure scenarios.	Developed in 1981 by ORNL for the Existing Chemical Assessment Division (ECAD) of OTS. It has since been modified and refined.	Primarily used to score chemicals in CHIPs and submissions under Section 8(a) of TSCA. Has never been used and is not intended for prioritizing risks.	In addition to OTS, the EPA Office of Air and Radiation; the Office of Solid Waste; and the Office of Policy, Planning, and Evaluation have also made use of the scoring system.	Individuals assigning scores must have expertise in the parameter being evaluated.	Once source documents and data for scoring each parameter are available, scores can be assigned in five minutes to one hour, depending on the amount of data to be evaluated.	Not appropriate for risk assessment.
Graphical Exposure Modeling System (GEMS)	Quantitative computerized exposure assessment system with common interface to environmental fate and transport models, chemical property estimation algorithms, statistical analysis tools, graphics and mapping programs, and a data management system with supporting data sets.	Under development since 1981, GEMS is a mature system, constantly undergoing enhancement.	Used in support of TSCA Sections 4, 5, and 6. GEMS has been used, with appropriate data, for risk prioritization.	U.S. EPA headquarters and regions; FDA; CDC; DOE; states; U.S. industries; West Germany and the Netherlands.	The user interfaces to the various applications make GEMS relatively easy to use. Individuals should be knowledgeable in the tools that they are using to properly interpret analyses and results.	Often, less than one hour, depending upon the complexity of the system.	Can provide a quantitative expression of exposure and risk, if appropriate data exist. Knowledgeable professionals can expect the system to provide good estimates of environmental concentrations, exposure, and (where appropriate) risk. Accuracy of assessments is linked to quality of the input data and, of course, to the assumptions of the various models.

TABLE G-1

SYSTEMS AND MODELS FOR EVALUATING RISKS OF ENVIRONMENTAL POLLUTANTS

MODEL	TYPE OF SYSTEM	STAGE OF DEVELOPMENT	CURRENT USE	CURRENT USERS	LEVEL OF EXPERTISE REQUIRED TO USE SYSTEM	TIME REQUIRED TO RUN A SCENARIO	CONFIDENCE IN THE DATA
Hazard Assessment Model	Semi-quantitative hazard assessment tool. Manual operation at present, but will incorporate computerized models in the future.	Developed in 1986 by OTS. An augmentation is in process to include other input data, models, etc.	Used to prepare emergency plans for review by SERCs. Can be used to screen and prioritize risks.	Local emergency response planners.	The system can be used by an untrained person.	A few minutes.	High likelihood for consistent results.
Human Exposure Model (HEM)	Quantitative exposure and risk screening method.	Will be updated in September 1988.	Produces expressions of public exposure and carcinogenic risk to ambient air concentrations of pollutants emitted from stationary sources.	EPA Office of Air Quality Planning and Standards	Currently, trained professionals. When updated, the model will be more user-friendly, but still require training in order to operate.	Takes only minutes to generate output.	Provides rough, but not necessarily conservative, estimates.
Methodology for Reportable Quantities (RQs) Adjustments	A relative hazard ranking system. Does not consider exposure or risk.	The methodology was proposed in 1983. It has since been modified.	Developing RQs for chemicals listed under CERCLA Section 101.	The Emergency Response Division of OSWER.	Trained professionals.	One-half day to two weeks, depending on whether the substance is evaluated for chronic toxicity and/or carcinogenicity.	Qualitative indicators of relative hazard, not risk.

TABLE G-1

SYSTEMS AND MODELS FOR EVALUATING RISKS OF ENVIRONMENTAL POLLUTANTS

MODEL	TYPE OF SYSTEM	STAGE OF DEVELOPMENT	CURRENT USE	CURRENT USERS	LEVEL OF EXPERTISE REQUIRED TO USE SYSTEM	TIME REQUIRED TO RUN A SCENARIO	CONFIDENCE IN THE DATA
Modified Hazardous Air Pollutant Prioritization System (MHAPPS)	Qualitative ranking system for air pollutants. Formatted for use on a personal computer. The system is user friendly.	Developed in 1982 and revised in 1986. MHAPPS was adapted from CSSHEA (see above).	Used to rank air pollutants for regulatory assessment and development under the Clean Air Act.	EPA Office of Air Quality Planning and Standards.	The system is not designed to utilize expert judgement in prioritizing chemicals.	Several substances can be prioritized a day.	Reasonably reliable method for ranking chemicals.
Remedial Action Priority System (RAPS)	Quantitative computerized risk screening model. RAPS, when finalized, will run on an IBM PC AT.	Developed by Battelle/Pacific Northwest Labs for DOE. Due to its complexity, RAPs is still under development.	Prioritizing DOE hazardous waste sites for further investigation and remedial action. Can be used to screen and prioritize risks and develop risk reduction strategies and options.	U.S. DOE, Office of Environment, Safety, and Health.	Knowledgeable professionals can be trained to use this system. Guidelines are being developed for users.	One hour or less, depending on the number of constituents and the number of exposure pathways chosen.	Can provide quantitative risk assessments; however, necessary data must be obtained. RAPs makes many assumptions and should only be used to approximate risk.

APPENDIX H

ACRONYMS AND GLOSSARY

ACRONYM LISTING

ACGIH	American Conference of Governmental Industrial Hygienists
ATSDR	Agency for Toxic Substances Disease Registry
BAT	Best available technology
BCF	Bioconcentration Factor
BPT	Best practicable technology
CAA	Clean Air Act
CAS	Chemical Abstracts Service
CD/ROM	Compact Disk/Read Only Memory
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CHIP	Chemical Hazard Information Profile
CSSHEA	Chemical Scoring System for Hazard and Exposure Assessment
CWA	Clean Water Act
DOE	U.S. Department of Energy
ECAD	Existing Chemical Assessment Division, U.S. EPA Office of Toxic Substances
EHS	Extremely hazardous substance
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
GEMS	Graphical Exposure Modeling System
HA	Health Advisory
HAPPS	Hazardous Air Pollution Prioritization System
HEEP	Health and Environmental Effects Profile
HEM	Human Exposure Model
HRS	Hazard Ranking System

HSWA	Hazardous and Solid Waste Amendments of 1984
IRIS	Integrated Risk Information System
ISCLT	Industrial source complex long-term model
LEPC	Local Emergency Planning Committee
LOC	Level of Concern
MATC	Maximum Acceptable Toxicant Concentrations
MPRSA	Marine Protection, Research, and Sanctuaries Act
NAAQSs	National Ambient Air Quality Standards
NATICH	National Air Toxics Information Clearinghouse
NCC	National Computer Center
NCIC	National Cartographic Information Center
NEPA	National Environmental Policy Act
NESHAPs	National Emissions Standards for Hazardous Air Pollutants
NIOSH	National Institute of Occupational Safety and Health
NLM	National Library of Medicine
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPDWRs	National Primary Drinking Water Regulations
NPL	National Priorities List
NRC	National Response Center
NRDC	Natural Resources Defense Council
NSDWRs	National Secondary Drinking Water Regulations
NSPSs	New Source Performance Standards
NTIS	National Technical Information Services
ODW	Office of Drinking Water, U.S. EPA
OIRM	Office of Information Resources Mangement, U.S. EPA
OPTS	Office of Pesticides and Toxic Substances, U.S. EPA
ORNL	Oak Ridge National Laboratory

OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response, U.S. EPA
OTS	Office of Toxic Substances, U.S. EPA
PEL	Permissible Exposure Limit
PI	Preliminary Hazard Index
POTW	Publicly owned treatment works
RAPS	Remedial Action Priority System
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RQ	Reportable Quantity
RTECS	Registry of Toxic Effects of Chemical Substances
SAB	Science Advisory Board
SARA	Superfund Amendments and Reauthorization Act of 1986
SDWA	Safe Drinking Water Act
SERC	State Emergency Response Commission
SIC	Standard Industrial Classification
SIP	State Implementation Plan
STAR	Stability Array
TLV	Threshold Limit Values
TPQ	Threshold Planning Quantity
TRI	Toxic Chemical Release Inventory
TSCA	Toxic Substances Control Act
UIC	Underground Injection Control
USGS	U.S. Geological Survey

GLOSSARY

Acute exposure	A one-time or short-term exposure (usually high level) that may or may not cause a health problem.
Additive effects	Exposure to chemical combinations that cause toxic effects to be added. For instance, if chemical A produces 1 unit of disease and chemical B produces 2 units of disease, then chemicals A and B produce 3 units of disease.
Adverse effect	A side effect which is never desirable and is deleterious to the well-being of organisms, such as allergic reactions.
Ambient	Surrounding. Ambient temperatures are temperatures of the surrounding area (e.g., air or water).
Antagonistic effects	When chemical combinations or mixtures produce a less than additive effect. For example, if chemical A produces 2 unit of disease and chemical B produces 4 units of disease, then chemicals A and B produce 3 units of disease.
Aquifer	An underground geologic formation containing water which may be a source of public drinking water.
Bioaccumulation	The accumulation and concentration of a chemical in an organism.
Bioavailability	The degree to which a substance becomes available to the target tissue after dministration or exposure.
Burst	A rapid release of short duration.
By-product	Material, other than the principal product, that is produced or generated as a consequence of an industrial process.
Carcinogen	A substance that increases the risk of cancer.
Chemical mixture	More than one substance that when combined, may or may not exhibit distinct toxic effects.

Chronic effect	An effect that becomes apparent or continues for some time after exposure to hazardous chemicals. See also health hazard.
Chronic exposure	Exposure (usually low-level) during a major portion of a lifetime to an environmental alteration that may or may not cause a health problem.
CD/ROM(Compact Disc/Read Only Memory)	An optically-read laser disc, capable of storing 550 million characters (as compared to a magnetic floppy disc, which can store only 1.2 million characters). Information can be read from the disc, but not added or deleted.
Criteria Pollutants	One of two general air pollutant types (the other type is toxic pollutants) regulated by the Clean Air Act (CAA). Criteria pollutants are covered in Sections 108-110 of the CAA and include ozone, carbon monoxide, particulate matter, and lead.
Developmental toxicity	Affecting the orderly changes by which a mature, functional cell, tissue, organ, organ system, or organism comes into existence.
Dose	Measurement of the amount received by the subject, whether animal or human.
Dose-response relationship	A component of risk assessment that describes the quantitative relationship between the amount of exposure to a substance and the extent of toxic injury or disease.
Epidemiological study	Study of human populations to identify causes of disease. Such studies often compare the health status of a group of persons who have been exposed to a suspect agent with that of a comparable unexposed group.
Exposure	The concentration of a toxic chemical in a substance at the point of contact with the body.

Exposure evaluation	A component of risk assessment that involves describing the nature and size of the population exposed to a substance and the magnitude and duration of exposure. The evaluation could concern past exposures, current exposures, or anticipated exposures.
Extrapolation	The estimation of a value beyond the known range on the basis of certain variables within the known range, from which the estimated value is assumed to follow.
EHSs (Extremely Hazardous Substances)	Chemicals with acute lethality have the potential for causing death in unprotected populations after relatively short exposure periods at low doses. On the basis of toxicity criteria, EPA identified a list of chemicals (Section 302 of Title III of SARA) with acute toxicity from the more than 60,000 chemicals in commerce.
Facility	All buildings, equipment, structures, and other stationary items which are located on a single site or on adjacent sites and which are owned or operated by the same person (or by any person which controls, is controlled by, or under common control with, such person).
Ground-Water Classification System Guidelines	EPA has established three classes of ground waters to receive different levels of protection under its Final Ground-Water Classification Guidelines and Ground-Water Protection Strategy (EPA, 1988 and 1984). Class I, or Special Ground Waters, are ground waters highly vulnerable to contamination and that are either irreplaceable sources of drinking water or ecologically vital ground waters (i.e., ground waters supplying a unique and easily disrupted ecosystem). Class II ground waters are all non-Class I current and potential sources of drinking water or water serving other beneficial purposes (e.g., irrigation, animal husbandry); Class II has been defined to include the majority of the

	nation's ground waters that may be affected by human activity. Class III ground waters are not a potential source of drinking water (using common current purification technologies), and have limited beneficial uses.
Health hazard	Acute--Immediate toxic effects. Chronic--Persistant or prolonged injury. Delayed--Toxic effect occuring after a lapse of time.
Individual risk	The probability that an individual person will experience an adverse effect.
LC_{LO} (Lethal Concentration Low)	The lowest concentration of a chemical at which some test animals died following inhalation exposure.
LC_{50} (Median Lethal Concentration)	Concentration level at which 50 percent of the test animals died when exposed by inhalation for a specified time period.
LD_{LO} (Lethal Dose Low)	The lowest dose of chemical at which some test animals died following exposure.
LD_{50} (Median Lethal Dose)	Dose at which 50 percent of test animals died following exposure. Dose is usually given in milligrams per kilogram of body weight of the test animal.
LEPC (Local Emergency Planning Committee)	A committee appointed by the State emergency response commission (SERC) as required by Sections 301 to 303 of Title III of SARA to formulate a comprehensive emergency plan for its district.
Lethal	Causing or capable of causing death.
LOC (Level of Concern)	The concentration of a chemical in the environment above which there may be serious irreversible health effects or deaths as a result of a single exposure for a relatively short period of time.

Log p (Octanol/water partition coefficient)	A measure of a substance's solubility in polar (water) vs. nonpolar (octanol) solvents. The higher the partition coefficient the greater the likelihood that a substance will accumulate in the organism.
MATCs (Maximum Acceptable Toxicant Concentrations)	Maximum allowable toxicant concentration: the mean value between the highest no-effect concentration and the lowest concentration causing a statistically significant effect in a chronic toxicity test on environmental species.
Mg	Milligram. One-thousandth of a gram (1 mg = 3.5×10^{-5} oz. = 0.000035 oz.)
Model	A mathematical function with parameters which can be adjusted so that the function closely describes a set of empirical data.
Mutagenic	Inducing genetic mutation.
Neurotoxicity	Exerting a destructive or poisonous effect on nerve tissue.
Non-point source (fugitive)	Chemicals not released from a confined air stream.
Point source	Chemicals released through stacks, vents, or other confined air streams.
Population center	The inhabitants of a geographic area of interest.
Population risk	The number of cases occurring in a group of people.
ppb	Parts per billion.
ppm	Parts per million.
Release	Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment (including the abandonment or discarding of barrels, containers, and other closed receptacles) of any toxic chemical.

RfD (Reference dose)	An estimate (with uncertainty spanning perhaps an order of magnitude or greater) of the daily exposure to the human population (including sensitive populations) that is likely to be without appreciable risk of deleterious effects during a lifetime. The Rfd is expressed in units of mg/kg/day.
Risk	Probability of injury, disease, or death under specific circumstances.
Risk analysis	In the context of Section 302 of SARA, risk analysis is the third of a three-step hazards analysis process for emergency planning. It requires an estimation of both the occurrence of an accidental chemical release (unique to this process) as well as the subsequent potential for exposure (with emphasis on human exposure to extremely hazardous substances). It is a flexible, judgemental exercise that results in qualitative risk statements.
Risk assessment	The process of estimating the probability of occurrence of adverse health or ecological effects. A chemical- or site-specific risk assessment has two major components:* (1) the estimation of the probability of exposure(s) resulting from reported releases, and (2) the estimation of the probability that adverse effects will result from exposures.
Risk management	Decisions about whether an assessed risk is sufficiently high to present a public health concern and about the appropriate means for control of a risk judged to be significant.

Risk screening	A type of risk assessment using limited data. The process results in a qualitative expression of risk (e.g., high, medium, low). Risk screening is useful for establishing risk-based priorities and information needs for follow-up chemical- or site-specific risk assessment activities. Although the risk screening process relies on general risk assessment principles, the data input requirements are less demanding than those for risk assessment.
Route of exposure	Method by which the chemical is introduced into the biological organism.
RQ (Reportable Quantity)	The quantity of a hazardous substance that triggers reporting under CERCLA. If a substance is released in a quantity that exceeds its RQ, the release must be reported to the National Response Center (NRC), as well as to the State Emergency Response Commission (SERC) and the Local Emergency Planning Committee (LEPC) for areas likely to be affected by the release.
Safe	Condition of exposure under which there is a "practical certainty" that no harm will result in exposed individuals.
Sensitive Environment	Geographical areas bounded by legal, social, commercial, or biological constraints. These include areas such as wetlands and national parks in need of protection by Federal, State, or even municipal statutes; areas deemed by society as desirable and therefore in need of protected from chemical contamination; areas where some human food source is grown (e.g., crops, catfish or rainbow trout) or areas that are used commercially (e.g., lakes or ponds where a fee is charged for boating or fishing); and areas vital for maintenance of a particular population (be it terrestrial or aquatic), including shoreline/wetland areas vital to the breeding or rearing

	of young, but not necessarily endangered species. Specialized habitats such as bogs and marshes may also be considered sensitive environments.
Sensitive populations	Groups of people that may be more susceptible than the general population (due to preexisting health conditions [e.g., asthmatics] or age [e.g., infants and the elderly]) to the toxic effects of a chemical release.
Site	Point of release of, or potential exposure to, Section 313 emission.
Source	The location from which a chemical may be released to the environment (e.g., drums or leaky valves).
Stability Array (STAR)	Meteorological stations around the country that provide meteorological input for modeling.
Stability classes, atmospheric	Pasquill stability classes (ranging from "A" to "F") are meteorological categories of atmospheric conditions. Class A represents unstable conditions under which there are strong sunlight, clear skies, and high levels of turbulence in the atmosphere--conditions that promote rapid mixing and dispersal of airborne contaminants. At the other extreme, class F represents light, steady winds, fairly clear nighttime skies, and low levels of turbulence. Under these conditions, airborne contaminants mix and disperse far more slowly with air and may travel at hazardous concentrations further downwind than in other cases.
State Emergency Response Commission (SERC)	Commission appointed by each State governor according to the requirements of Section 301 to 303 of Title III of SARA. Duties of the commission include designating emergency planning districts, appointing local emergency planning committees (LEPCs), supervising and coordinating the

	activities of planning committees, reviewing emergency plans, receiving chemical release notifications, and establishing procedures for receiving and processing requests from the public for information.
Storage	Methods of keeping raw materials, finished goods, or products while awaiting use, shipment, or consumption.
Subchronic effect	A biological change resulting from an environmental alteration lasting about 10 percent of a lifetime.
Subchronic exposure	An environmental alteration occuring over about 10 percent of a lifetime.
Superfund	Federal authority, established by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in 1980, to respond directly to releases or threatened releases of hazardous substances that may endanger health or welfare.
Synergistic effect	When chemical combinations or mixtures produce a greater than additive effect. For example, if chemical A produces 1 unit of disease and chemical B produces 2 units of disease, then chemicals A and B produce 5 units of disease.
Teratogenic	Tending to produce anomalities of formation or development.
Threshold dose	The dose that has to be exceeded to produce a toxic response.
Title III	A provision of the Superfund Amendments and Reauthorization Act (SARA) that became law in 1986. Also known as the Emergency Planning and Community Right-To-Know Act, Title III establishes requirements for federal, state, and local governments and industry regarding emergency planning and community right-to-know reporting on hazardous and toxic chemicals.

Toxic Chemical Release Form (Form R)	Information form required to be submitted by facilities that manufacture, process, or otherwise use (in quantities above a specified amount) chemicals listed in Section 313 of Title III of SARA.
Toxicity	The ability of a substance to cause damage to living tissue, impairment of the central nervous system, severe illness, or death when ingested, inhaled, or absorbed by the skin.
Toxicological potency evaluation	A determination of whether a chemical causes an adverse effect and, if so, at what dose the effect occurs.
Uncertainty factor	Factors used in operationally deriving the RfD from experimental data. These factors are intended to account for 1) the variation in sensitivity among the members of the human population; 2) the uncertainty in extrapolating animal data to the case of humans; 3) the uncertainty in extrapolating from data obtained in a study that is of less-than-lifetime exposure; and 4) the uncertainty in using LOAEL rather than NOAEL data.
Unit cancer risk	The increased likelihood of an individual developing cancer from exposure to one unit of a substance over a lifetime.
Vulnerable zone	An area over which the airborne concentration of a chemical involved in an accidental release could reach the level of concern (LOC).
Wellhead protection areas	As defined by the 1986 Safe Drinking Water Act Amendments, Subsection 1428(e), a wellhead protection area is the surface and subsurface area surrounding a water well or wellfield, supplying a public water system through which contaminants are reasonably likely to move toward and reach the water well or wellfield. The extent of a wellfield protection area within a State, necessary to provide protection

from contaminants which may have an adverse human health effect, is to be determined by the State according to its Wellhead Protection Area Program submitted in accordance with the Statute.

APPENDIX I

TECHNICAL AND RISK COMMUNICATIONS BIBLIOGRAPHIES

TECHNICAL BIBLIOGRAPHY

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