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Prevention and Toxics
Washington, DC 20460

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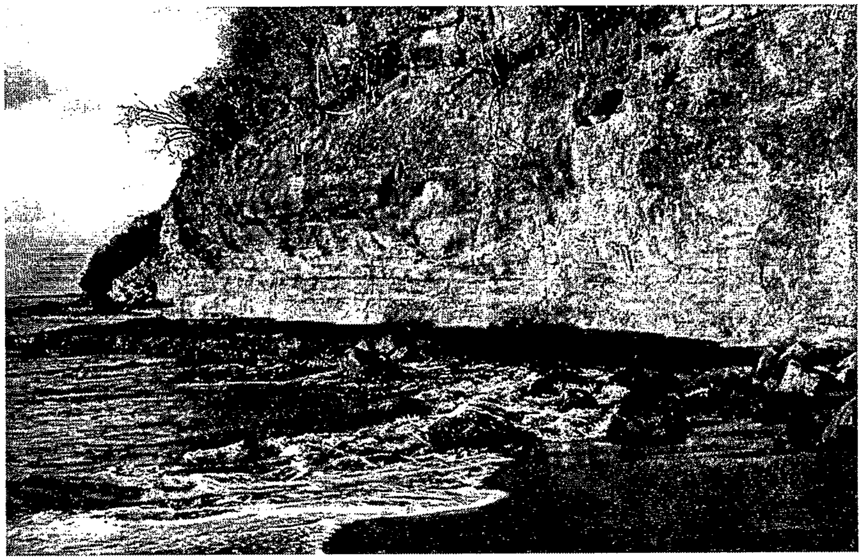
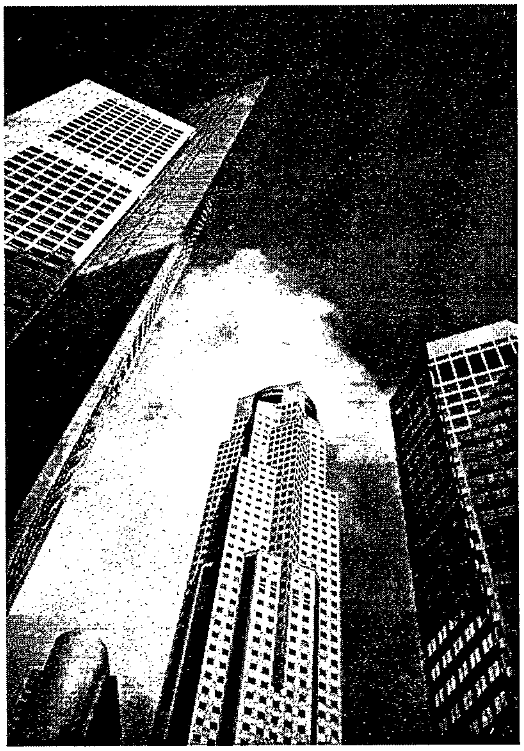
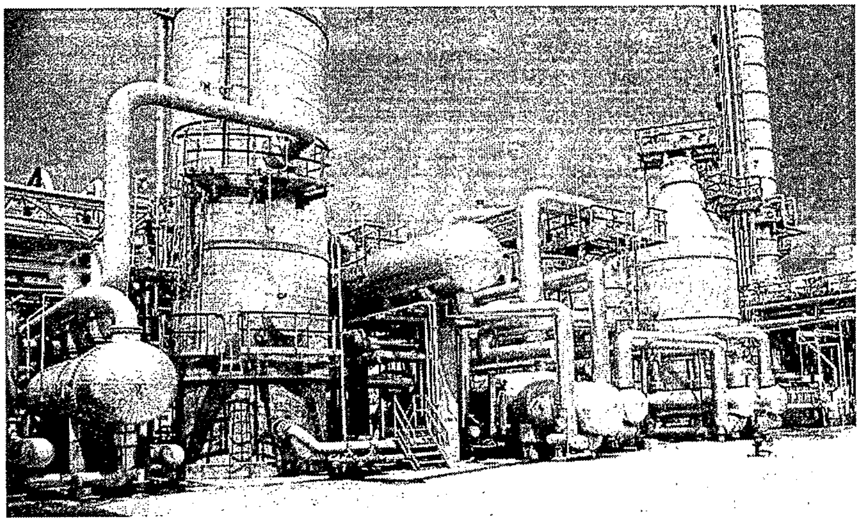
EPA

1996 Toxic Release Inventory

Data Quality Report







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EXECUTIVE SUMMARY

As part of a continuing effort to assess and improve the quality of the data contained in the Toxic Release Inventory (TRI) database, the U.S. Environmental Protection Agency (EPA) conducted TRI data quality site surveys for reporting year (RY) 1996. The goals of these site surveys were to:

- Provide a quantitative assessment of the accuracy of TRI data;
- Identify ways to improve the TRI data collection process; and
- Identify where further guidance on the completion of the TRI report forms (EPCRA Section 313 reports) would be beneficial.

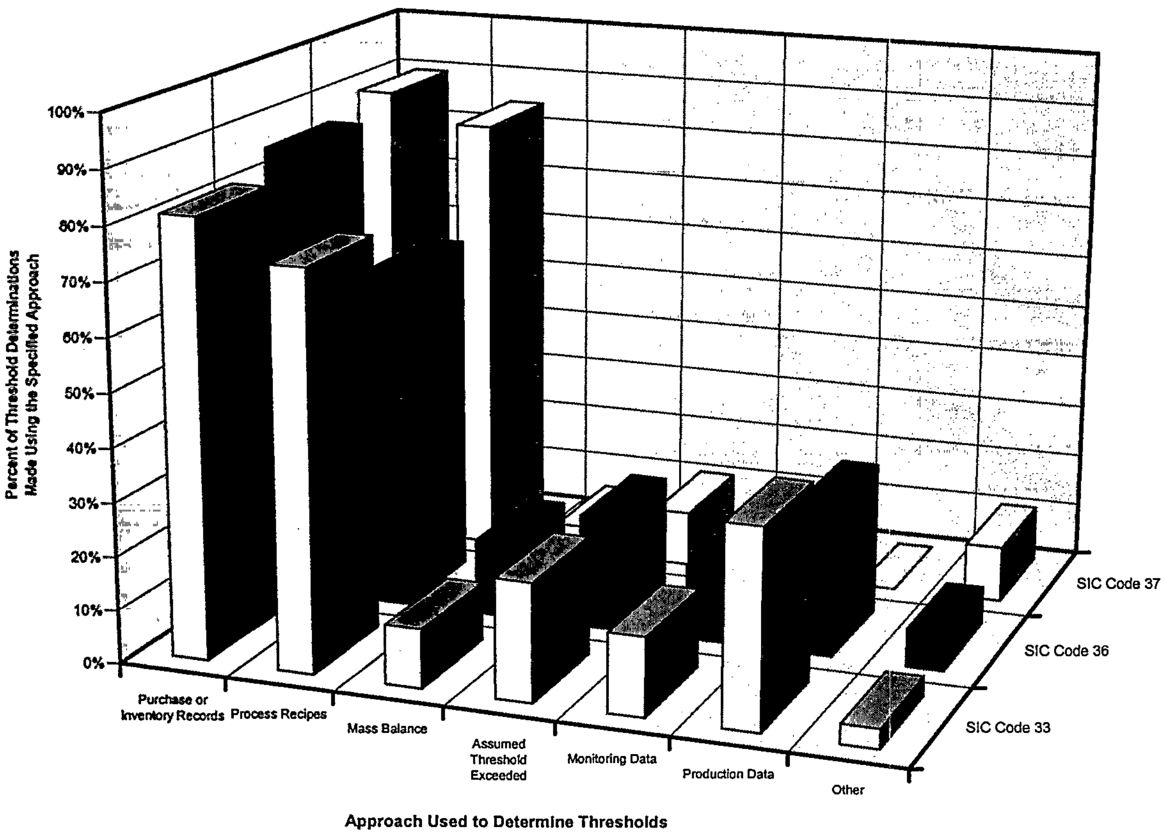
This summary presents the significant findings and conclusions from the site surveys conducted.

This report focuses on surveys completed for RY 1996. Previous reports have presented findings from site surveys for RYs 1987, 1988, 1994, and 1995. For RY 1996, site surveys were completed at 60 facilities:

- 27 facilities in SIC Code 33, the primary metals industry;
- 14 facilities in SIC Code 36, the electronic and other electrical equipment industry; and
- 19 facilities in SIC Code 37, the transportation equipment industry.

Accuracy of TRI Data

Evaluation of the methodologies used by facilities and accuracy of these methods in completing threshold determinations and release and other waste management estimates provide a basis to assess the accuracy of the TRI data. The following information presents the approaches used by facilities and the accuracy of those approaches for completing threshold determinations and release and other waste management estimates.



Information for this figure is discussed in Section 4.2.

Approaches Used by Facilities to Make Threshold Determinations

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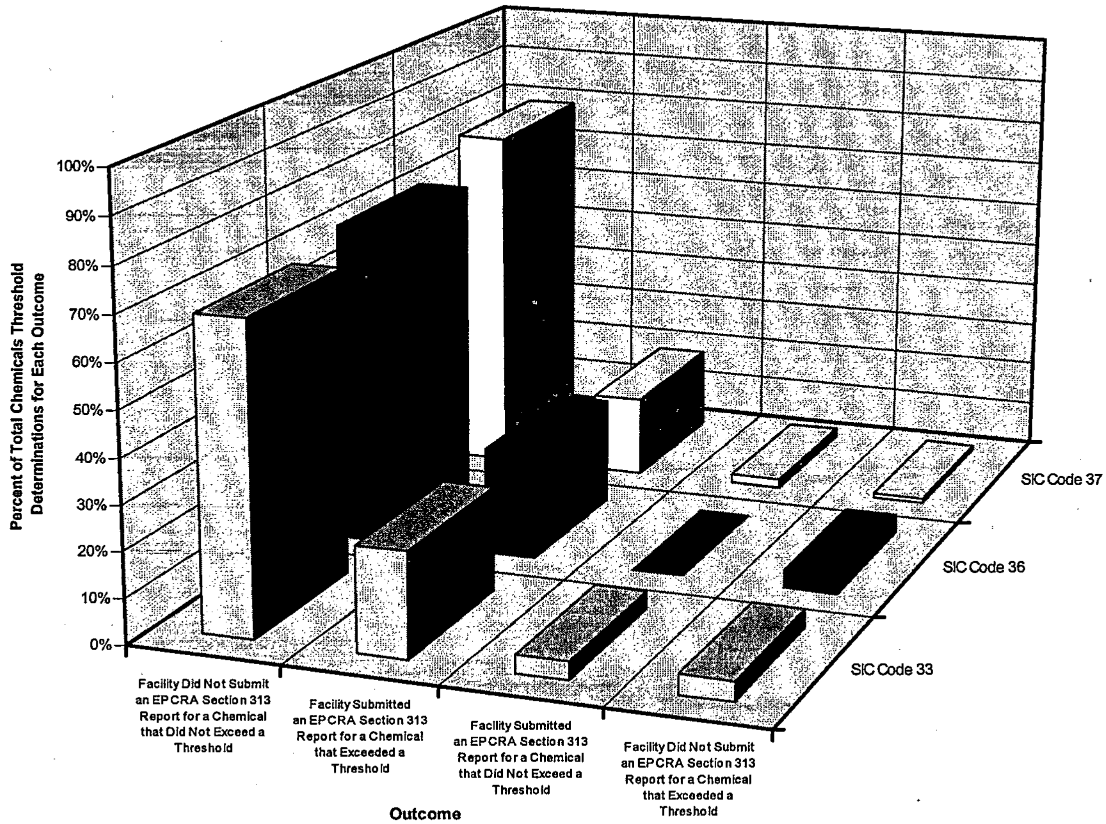
- Facilities primarily use purchase or inventory records, or process recipes to make threshold determinations.
- Facilities in the electronic and other electrical equipment industry (SIC Code 36) and primary metals industry (SIC Code 33) use production data more frequently than those facilities in the transportation equipment industry (SIC Code 37).
- Facilities in the primary metals industry (SIC Code 33) and the electronic and other electrical equipment industry (SIC Code 36) are more likely to assume thresholds are exceeded.

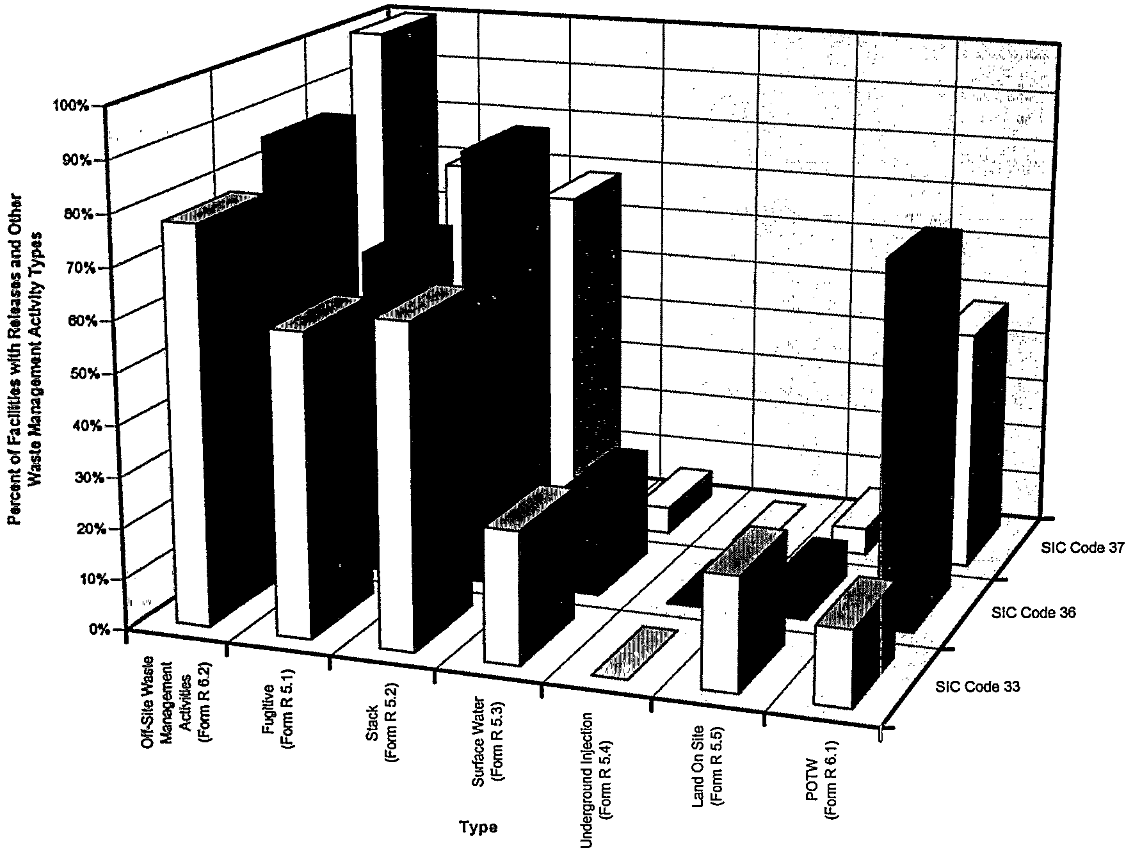


Note: The first two outcomes represent cases in which facilities correctly determine thresholds, while the last two outcomes represent cases in which facilities incorrectly determine thresholds.

Data for this figure can be found in Table 4-1.

Accuracy of Threshold Determinations

- Considering all EPCRA Section 313 chemicals used on-site, facilities determine thresholds correctly 95% of the time.
- Considering only EPCRA Section 313 chemicals that actually exceeded thresholds, facilities accurately identified the threshold exceedences 88% of the time.



Data for this figure can be found on Table 5-1.

Distribution of Release and Other Waste Management Activity Types

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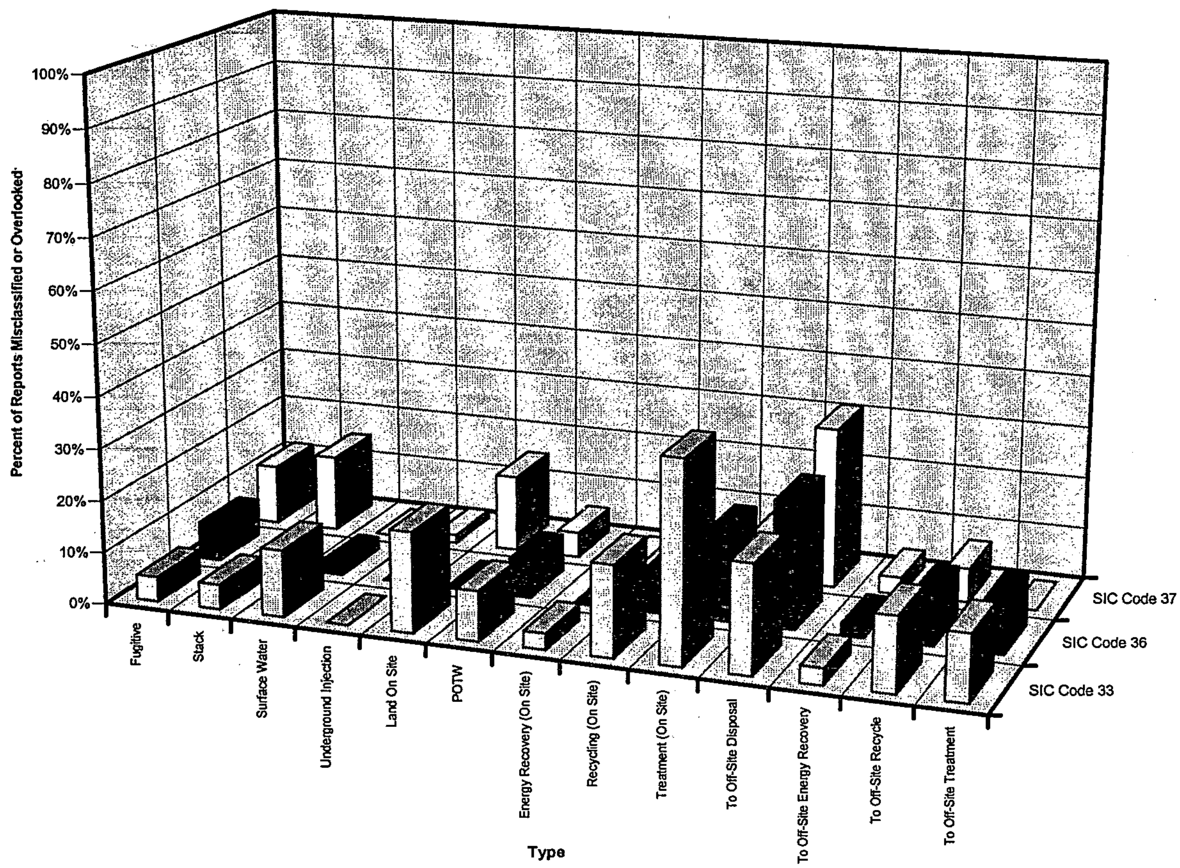
- Fugitive and stack releases and off-site transfers for further waste management activities were observed at most facilities in all industry sectors.
- No facilities in any industry sector visited had on-site underground injection.
- Most facilities in the electronic and other electrical equipment industry (SIC Code 36) had releases to Publicly Owned Treatment Works (POTW)s.

EXECUTIVE SUMMARY



Data for this figure can be found in Table 5-2.

Misclassified and Overlooked Types of Release and Other Waste management Activities

- Facilities often correctly identified release and other waste management activities that were occurring, but reported them to the wrong type (particularly between stack and fugitive releases and between various off-site transfers for further waste management activities).

- On-site treatment was misclassified or overlooked frequently in the primary metals industry (SIC Code 33) because facilities were confused as to whether air pollution control devices collecting metal should be reported as on-site treatment.

- Recycling, both on and off site, was frequently misclassified due to confusion over the definitions of recycling and reuse.

- Off-site disposal was frequently overlooked at facilities using EPCRA Section 313 Chemicals (typically metals) that were present in dust collected in baghouses, electrostatic precipitators, and rotoclones.

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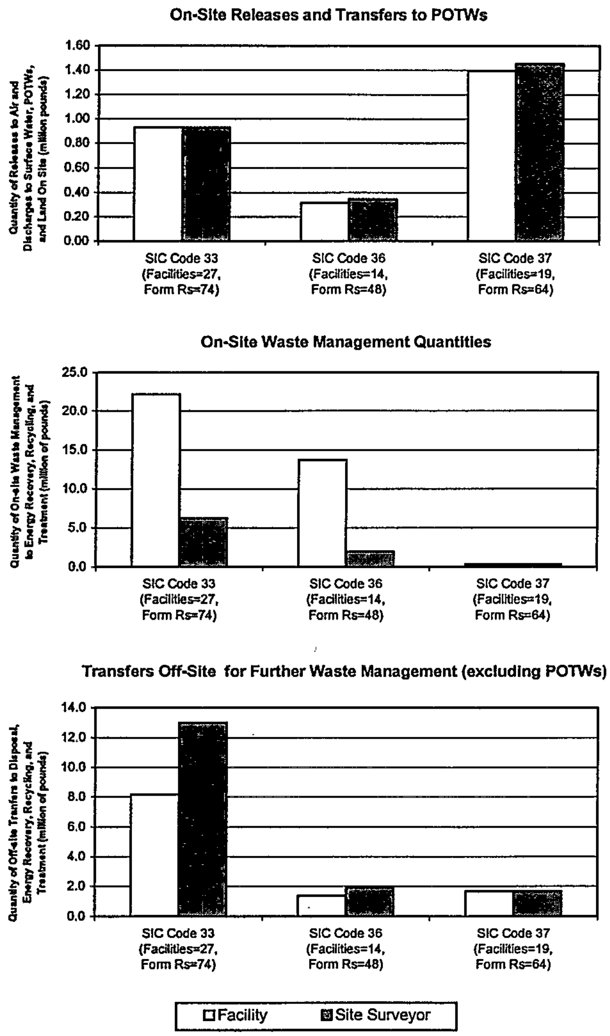


- Facility and site surveyor estimates agreed for the most part for the transportation equipment industry (SIC Code 37).

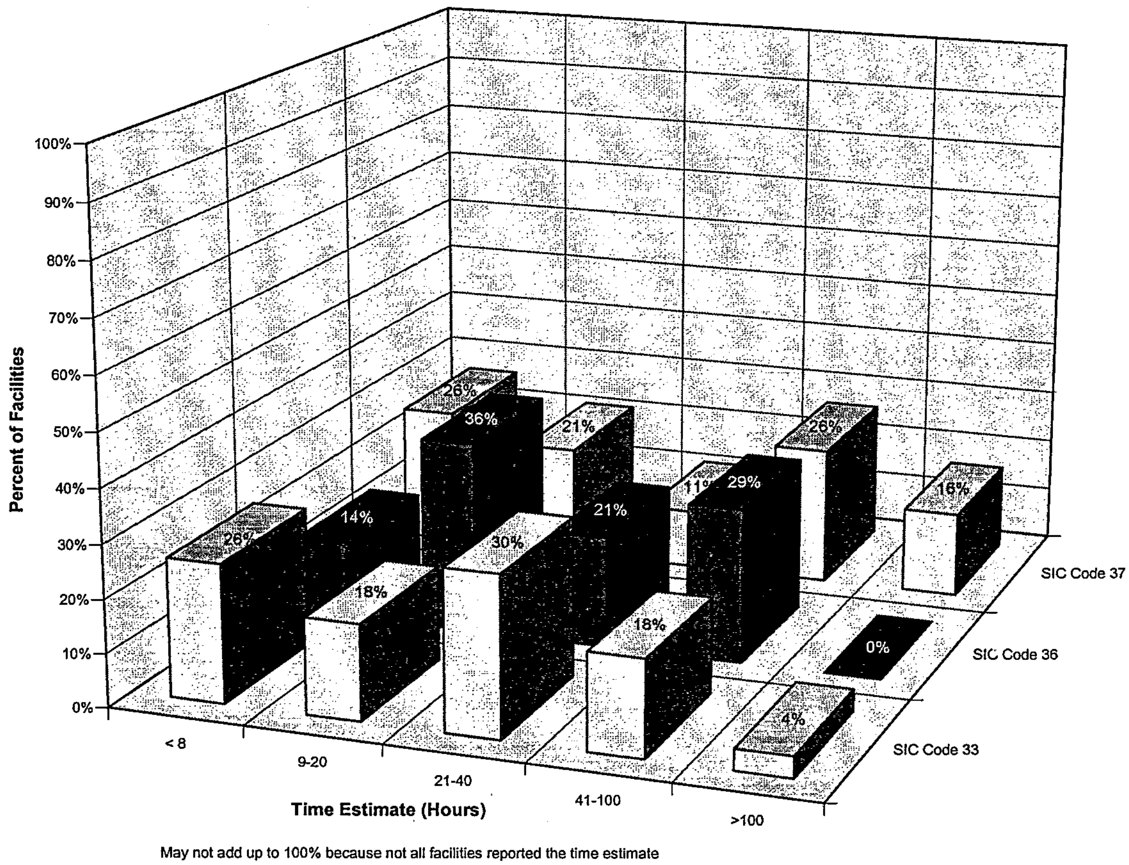
- Facility and site surveyor release and other waste management estimates for the primary metals industry (SIC Code 33) and the electronic and other electrical equipment industry (SIC Code 36) differed significantly, primarily due to the difference in recycling estimates. This difference is attributed to industry confusion over definitions of recycling and reuse.

- Facilities in the primary metals industry (SIC Code 33) processed millions of tons of metals. Thus, the releases, transfers, and other waste management quantities from this industry are much higher than the releases and transfers from the other industries visited.

EXECUTIVE SUMMARY

TRI Data Collection Process

The following section provides a summary of findings on the mechanics of the TRI data collection process. Time required to prepare EPCRA Section 313 reports, feedback on usage of the automated Form R, and usage of the EPCRA Hotline are presented.



Time Needed to Complete all Form Rs for Facilities Visited in SIC Codes 33, 36, and 37

- The average number of hours to complete each Form R across all three SIC Codes visited is 18 hours, less than the 43 hours per Form R estimated by EPA.

- It takes more time per Form R for a facility to complete one Form R, compared to multiple Form Rs. Facilities filing only one Form R took an average of 22 hours to complete it, while facilities filing more than one Form R took an average of 16 hours per Form R.

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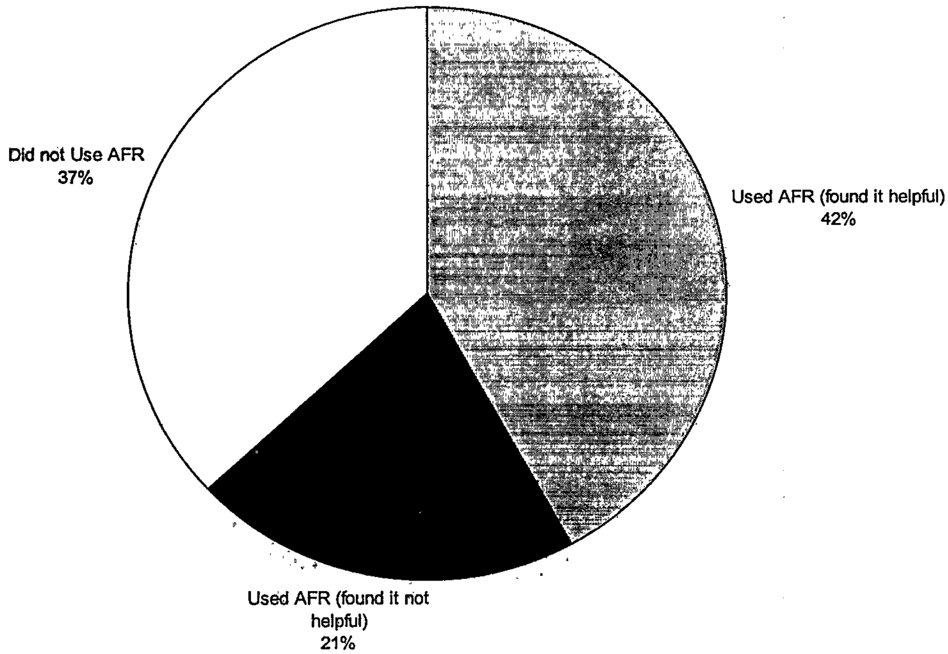
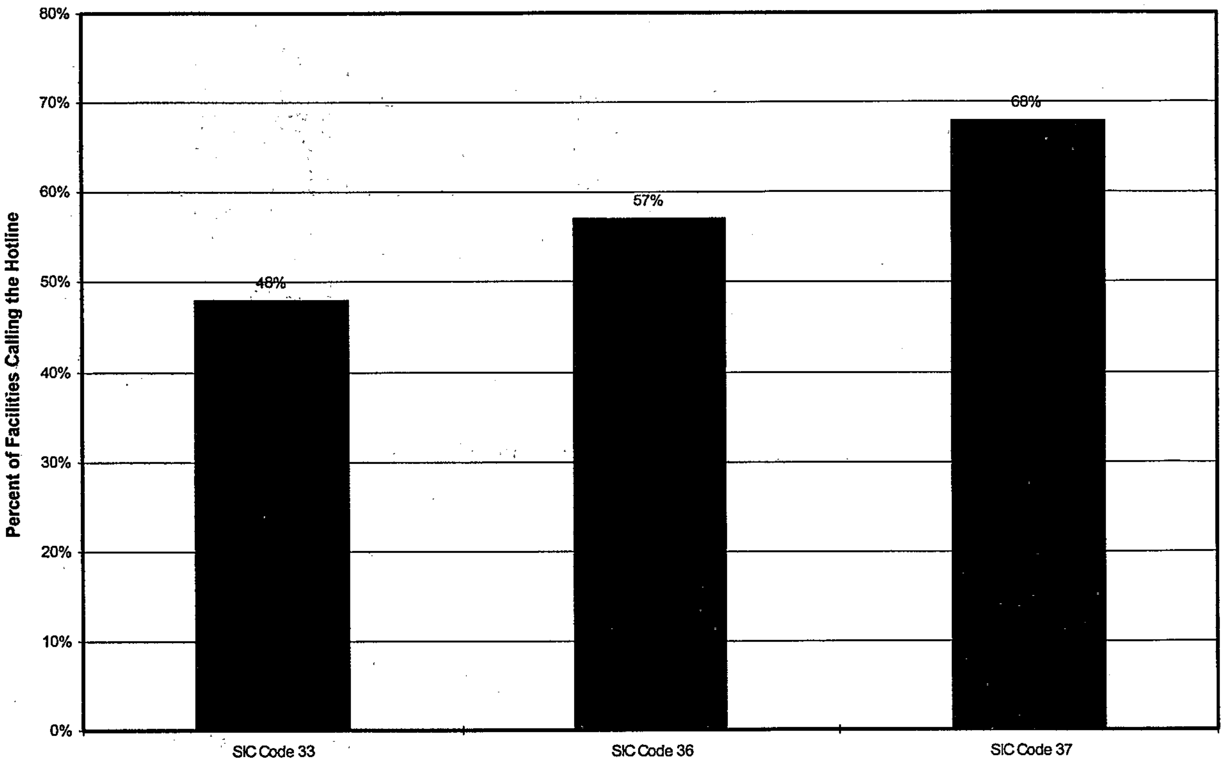


Percent of Facilities Using the Automated Form R

- Of the facilities using the Automated Form R (AFR), approximately two-thirds found it helpful.

- Use of the AFR should eliminate data entry errors and thereby increase the accuracy of data in the TRI database. However, site surveyors found several instances where data listed in the TRI database did not match the AFR submitted by the facility. The nature of these errors should be fixed within the AFR system and corrected.

- Facilities commented that they would use the AFR more often if certain printing problems, computer compatibility issues, and cross-section linkage problems were resolved.



Percent of Facilities Calling the Hotline by Industry

- Facilities in the transportation equipment industry (SIC Code 37) called the hotline 68% of the time, whereas the facilities in SIC Code 36 and SIC Code 33 called the hotline 57% and 48%, respectively. Facilities in the transportation equipment industry also made the least number of incorrect threshold determinations and release and other waste management estimates out of the three industries surveyed. While direct linkage is not certain, this finding suggests that contact with the EPCRA Hotline improves reporting.

EXECUTIVE SUMMARY

Further TRI Guidance

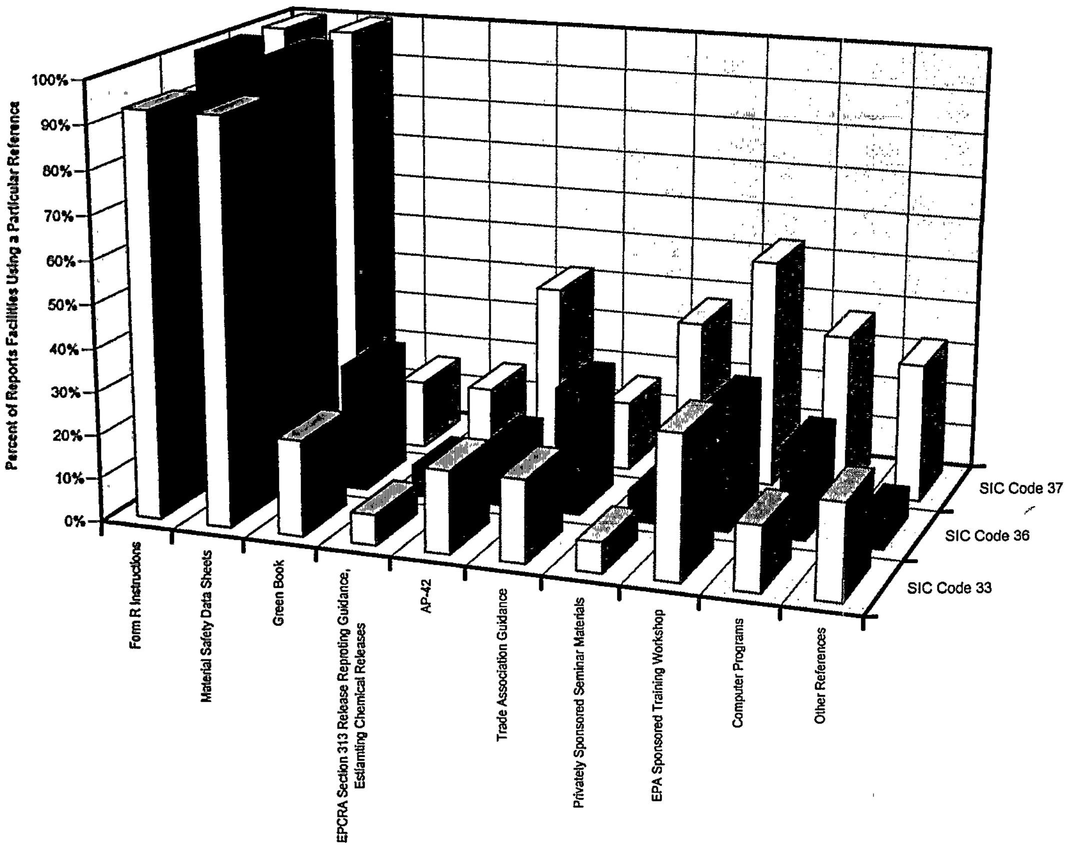
The following section discusses areas where additional instructions or guidance would improve EPCRA Section 313 reporting and increase the accuracy of the TRI database. The areas highlighted in this summary were commonly found in all of the industries surveyed.

Recommendations for Improving Accuracy in in EPCRA Section 313 Reporting

Area for Improvement	Recommendation for Improvement in Future TRI Reporting Years
Overlooked container residue	Instructions and guidance materials should emphasize that even a "RCRA empty" container is expected to contain a residual (possibly up to two inches) and that it must be considered for TRI reporting. Also, note that on-site container rinsing and disposal of the rinsate will result in a water discharge.
Overlooked acid aerosol manufacturing	Instructions and guidance materials should indicate that if H_2SO_4 or HCl is used anywhere in the plant as an aerosol, regardless of whether the process is enclosed or not, their usage should be applied to the threshold determination and release and other waste management calculations.
Incorrectly reporting disposition for off-site transfers	Instructions and guidance materials should emphasize that facilities should attempt to determine the type of receiving facility that is accepting the transfers and exactly how the material sent is being managed (or directly reused) by the receiving facility.
Definitions of recycling versus reuse	Provide a definition of recycling and include examples of streams that can be considered as being recycled in Sections 7 and 8 of the TRI reporting instructions. A good example would be handling of used metals or metal compounds. Specifically, a discussion of what waste management activity must be applied to a used metal for it to be considered recycled versus reused, would be helpful.

Area for Improvement	Recommendation for Improvement in Future TRI Reporting Years
Definitions of source reduction	Consider shortening the list of codes for source reduction and providing definitions for each code.
Clarification of on-site treatment of waste streams containing metals	Provide clarification of on-site treatment definitions pertaining to waste streams containing metals. Guidance is needed to instruct how to report collection of metals in an air pollution control device, whether a treatment efficiency or collection efficiency should be reported in Section 7A, and what to put in Section 8 of the Form R in this scenario.
Clarification of the treatment definitions in Sections 7 and 8 of the Form R for organic and inorganic chemicals. Section 7A applies to the waste stream containing the toxic chemical while Section 8 applies to the toxic chemical itself. These differences have caused confusion when reporting. Confusion occurs when chemicals go through a treatment system but are not destroyed.	Facilities need direct guidance in the TRI reporting instructions to claim zero efficiency, and then what to put in Section 8 (zero or NA).

Evaluation of common references used and the percentage of facilities that attended EPA training workshops assists in characterizing the usage of existing support materials for TRI reporting. The following illustrates the level of usage of support materials.



Common References Used to Compile Form Rs for RY 1996

- Most facilities surveyed use the Form R instructions and material safety data sheets as their main references in compiling Form Rs.
- Over half of the facilities visited in the transportation equipment industry (SIC Code 37) attended EPA-sponsored training workshops. It is noteworthy that threshold determinations and release and other waste management estimates in this sector were the most accurate of the industry sectors surveyed.
- Many facility contacts and a trade association representative in the primary metals industry (SIC Code 33) requested that EPA sponsor a training workshop specifically for their industry. In addition, facility contacts expressed an interest in a TRI guidance document specific to foundry operations, and another document specific to reporting for metals. Such efforts would improve accuracy, particularly if focused on metal versus metal compounds, *de minimus* applicability, the definitions of recycling versus reuse, and the reporting of metals collection/treatment.

1.0 INTRODUCTION

Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA) requires the U.S. Environmental Protection Agency (EPA) to collect information from manufacturers, processors, and users of listed toxic chemicals on release and other waste management activities of those chemicals to the environment. To collect such information, EPCRA requires that EPA implements a yearly reporting requirement from such facilities. EPCRA Section 313 reports, referred to as Form R/A reports, are due to EPA by July 1 each year to fulfill the reporting requirement for the previous calendar year. The reporting requirement was first implemented for the 1987 calendar year. The data from the Form R chemical reports are compiled in EPA's Toxics Release Inventory (TRI) database for future analysis, distribution, and evaluation. TRI data, as mandated by EPCRA, are made available to the public. The information collected under EPCRA Section 313 is useful in helping inform the general public and the communities surrounding affected facilities of release and other waste management activities of toxic chemicals, assisting the Agency to focus their research into the effects and control of toxic substances, and aiding in the development of regulations, guidelines, and standards.

The study discussed in this report reviewed data from the 1996 reporting year (RY 1996) to provide a quantitative assessment of the accuracy of the data collected, to identify areas in the TRI data collection process that could be improved, and to disseminate further guidance on the completion of EPCRA Section 313 reports.

The study was conducted by performing on-site surveys of TRI information at 60 randomly chosen facilities:

- 27 facilities in SIC Code 33, primary metals industry;
- 14 facilities in SIC Code 36, electronic and other electrical equipment industry; and
- 19 facilities in SIC Code 37, transportation equipment industry.

This report presents the data gathered for RY 1996 and compares it to data from similar studies completed for previous reporting years, where appropriate.

This data quality report is organized as follows:

- **Section 1** - Introduction, including site survey objectives;
- **Section 2** - Sample selection and approach;
- **Section 3** - Description of industrial processes surveyed;
- **Section 4** - Threshold determinations made by the facilities;
- **Section 5** - Sources and types of release and other waste management activities;
- **Section 6** - Quantity of release and other waste management activities;
- **Section 7** - Preparation of the Form R; and
- **Section 8** - Conclusions and recommendations.

1.1 EPA's Overall Quality Assurance Program

Because of the wide audience and many intended uses of the TRI data, EPA designed and implemented a program to assess the quality of the data collected under EPCRA Section 313 and to identify areas where better guidance materials would be useful for improving the accuracy of future reported data. The site surveys described in this report are a component of EPA's overall quality assurance program.

1.2 Site Survey Objectives

EPA's site surveys were designed to provide a quantitative assessment of the accuracy of the data submitted for a calendar year by identifying the frequency and the magnitude of errors in the Form R data and the reasons these errors occurred. EPA believed that on-site review of industrial processes, pollution control technologies, and documentation supporting the Form R reports would reveal errors in the database not obvious from review of a facility's Form R submissions. Expected error types included overlooked chemicals, incorrectly included chemicals, and errors in the release and other waste management quantity estimate calculations. The goal of the surveys was to obtain information that could be used to improve the Form R reporting instructions and definitions, and associated guidance materials, and thus improve the quality of data in the TRI database in future years.

Anyone who uses the results of the site survey program, as well as the TRI database itself, should be aware of a basic limitation of the EPCRA reporting process. Under EPCRA, facilities are not required to perform any additional monitoring or measurement of the quantity of toxic chemicals released to the environment to calculate Form R release and other waste management quantity estimates. Therefore, the methods selected by facilities to estimate release and other waste management quantities depend on the nature of the best readily available data. The accuracy of release and other waste management quantity information reported to EPCRA therefore depends on the accuracy of the best readily available data and any subsequent estimation methodologies.

At facilities where supporting data were available, site surveyors carefully examined the facility's estimation calculations and data sources and then recalculated the estimates. In many instances, the site surveyors were able to identify data sources overlooked by facility personnel. These new data were then used to recalculate release and other waste management quantity estimates during the site visits. However, site surveyors did not conduct any monitoring or measurements during the site visits. Site surveyors also assessed the quality of the estimation methods by recalculating release and other waste management quantities using alternative approaches where more accurate estimation methods were appropriate or where available data warranted the use of alternative approaches.

1.3 Prior Site Survey Efforts

EPA has conducted five sets of quality assurance site surveys since the first submittal of Form Rs from industry. The RY 1987 site surveys covered all SIC Codes affected by the EPCRA Section 313 requirements. The RY 1988 site surveys covered SIC Codes 28, 291, and 34 - 38. The RY 1994 site surveys covered SIC Codes 25, 281, 285, and 30; RY 1995 site surveys covered SIC Codes 26 and 286.

The results of the site surveys help EPA identify ways additional guidance can be structured to improve the overall quality of the data generated under EPCRA reporting.

2.0 APPROACH

The RY 1996 site survey program was conducted using the following steps:

(1) Revising the survey instrument;
(2) Selecting facilities to be visited (Sample selection);
(3) Training site surveyors (Training);
(4) Arranging site visits;
(5) Performing site visits (Site visit methodology);
(6) Data management and data quality assurance; and
(7) Data analysis and reporting.

This approach is presented schematically in Figure 2-1, and each of these steps is discussed in the following subsections. The approach was originally established for the RY 1987 and RY 1988 site survey programs to ensure consistency in conducting site surveys and accuracy of the results. It was improved for each of the RY 1994, RY 1995, and RY 1996 site survey programs based on experience and lessons learned from the previous programs.

2.1 Survey Instrument

The survey instrument, shown in Appendix A, was designed to standardize and facilitate the review of threshold determinations, and the calculations used to assess release and other waste management activities at facilities. The engineers and scientists who performed the site surveys used the survey instrument as a detailed checklist to ensure that all pertinent items were reviewed. The survey instrument also provided a consistent format for recording both the data collected during site surveys and the errors made by facility personnel on their Form R reports.

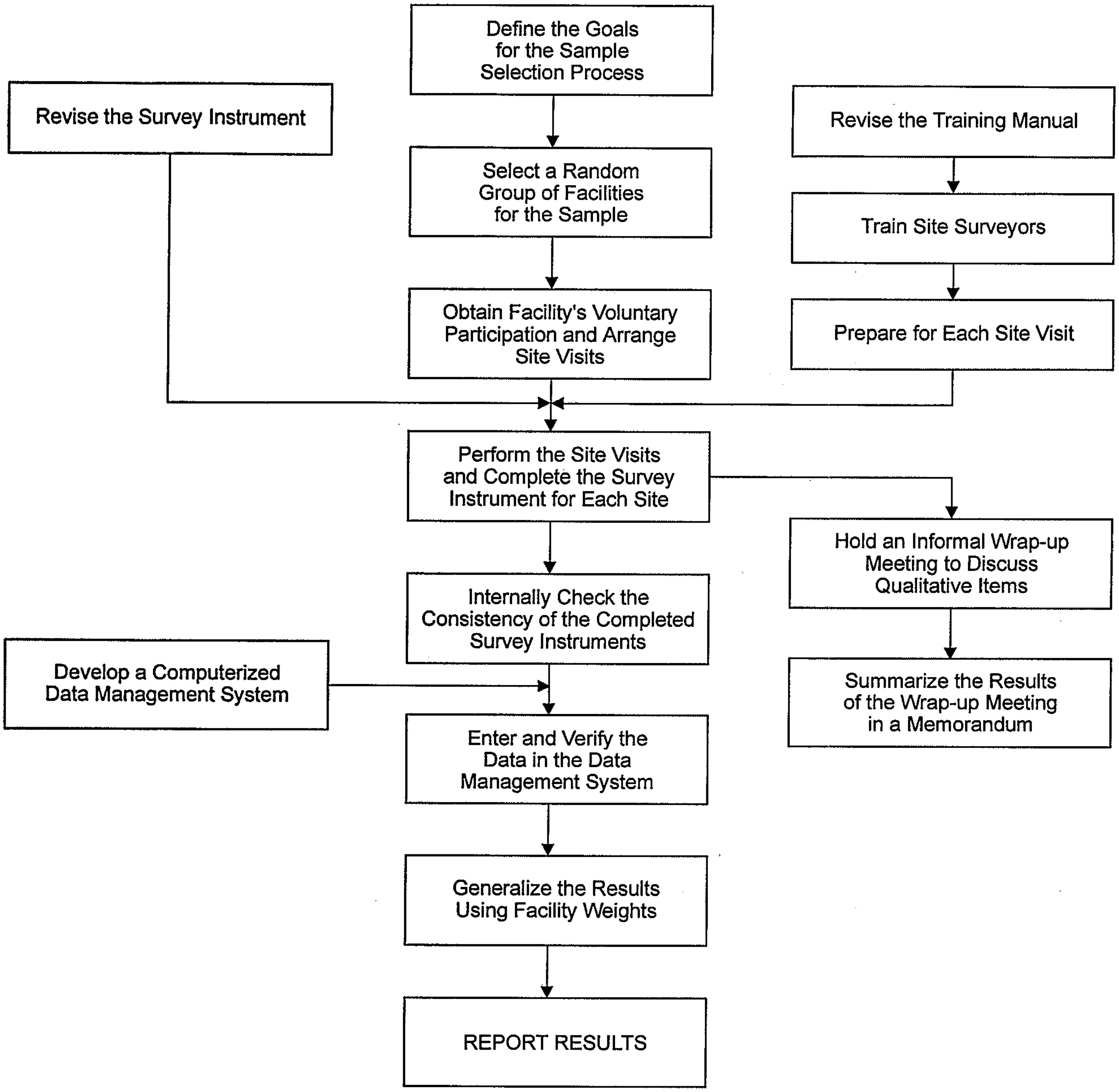


Figure 2-1. Approach Used to Perform the RY 1996 EPCRA Section 313 Site Survey Program

In addition to its primary focus on chemical-specific information, the survey instrument contains questions regarding the usefulness of the reporting instructions, EPCRA Section 313 hotline, and the other published guidance materials. Each section of the survey instrument focuses on identifying specific types of errors made by facility personnel on their Form R submittals.

The RY 1996 data quality site surveyors used a revised version of the survey instrument from previous site survey programs. Most of the questions remained the same, but some additional questions concerning available documentation, possible sources for threshold determinations, source reduction activities, pollution prevention technology, and use of the Form A were added to clarify information received during the site visits and to assess the usefulness of the new guidance and materials that are now available. The increments for amount of time needed to complete all Form Rs at the facility were adjusted slightly in the RY 1996 survey instrument to obtain a more precise estimate of time needed. The format was also revised to make the survey instrument easier for the site surveyors to use.

2.2 Sample Selection

For RY 1996, a total of approximately 64,000 Form R reports and 7,000 alternate threshold certification statements, referred to as Form A reports, covering all SIC Codes required to report toxic chemicals, were submitted to EPA by approximately 22,000 facilities and entered into the TRI database. At the time the site surveys for RY 1996 were conducted, the following number of Form Rs and Form As had been submitted and incorporated in the TRI database for the selected SIC Codes:

SIC Code	Number of Facilities	Number of Form Rs	Number of Form As
33	1,902	6,138	465
36	1,233	3,031	90
37	1,248	4,117	214

The primary objective of the sample selection approach was to obtain a random group of facilities from the key industry groups within the specific SIC Codes being surveyed to scale up appropriately the results to reflect the reporting of the entire SIC Code group. The RY 1996 site visit program targeted 60 completed site visits at facilities in SIC Codes 33, 36, and 37. These SIC Codes represent the primary metal industries, electronic and other electrical equipment and components, and transportation equipment, respectively. The SIC Codes ultimately visited were further defined as the three-digit SIC Codes 331, 332, 333, 334, 335, 367, 369, 371, and 372. The other three-digit codes within SIC Codes 33, 36, and 37 were not targeted by the survey so as to increase the confidence level of the sample by decreasing the target population size. The three-digit codes selected have the most Form Rs and facilities within the targeted two-digit SIC Code.

The number of facilities visited in each three-digit SIC Code was based on a statistical weighting technique, calculated as the product of the total number of targeted facilities (60) and the percentage of facilities in each three-digit SIC Code (with respect to the total number of facilities in all the three-digit SIC Codes listed above). The table below shows the number of facilities visited within each three-digit SIC Code.

SIC Code	SIC Description	Number of Facilities Visited
331	Steel works, blast furnaces, and rolling and finishing mills	8
332	Iron and steel foundries	7
333	Primary smelting, refining of nonferrous metals	1
334	Secondary smelting, refining of nonferrous metals	3
335	Rolling, drawing, extruding of nonferrous metals	8
367	Electronic components and accessories	11
369	Miscellaneous electrical machinery, equipment, and supplies	3
371	Motor vehicles and equipment	15
372	Aircraft and parts	4

Only facilities with 15 or fewer Form Rs were considered candidates for site visits due to time and budget considerations. Site visits to facilities with more than 15 Form Rs would have taken considerable time, and would have limited the total number of facilities that could be visited. Since the same facility personnel may complete multiple reports at a given facility, visiting more facilities gives a better indication of the range of reporting practices.

2.3 Site Surveyor Selection and Training

The engineers and scientists who staffed the site survey program were selected on the basis of their experience in performing environmental audits of industrial processing facilities, and thus were required to have a thorough understanding of chemistry, technical calculations, multimedia environmental concerns, and pollution control technologies.

A surveyor training program was developed to ensure consistency and high quality work among all site surveyors. The training program consisted of three steps:

1) Compiling a comprehensive training manual, including copies of EPA guidance documents and other references;

2) Holding training sessions to familiarize project personnel with program requirements; and

3) Conducting standardized reviews of the completed survey instruments with feedback to the site surveyor to maintain a consistent approach among all surveyors.

2.4 Arranging Site Visits

The goal in arranging site visits was to provide each facility in the sample with an equal opportunity to participate in the site visit program. Participation was voluntary; the facilities were not legally required to participate. A key factor encouraging voluntary participation was the assurance that the facilities would remain anonymous. Names, location, and all other facility identification data are shielded from EPA. Upon facility request, the contractors performing the site visits signed a written confidentiality agreement.

As a first step, introduction letters were sent to each facility's technical contact, and where appropriate, to each facility's senior management official (a sample of a letter is provided in Appendix B). This letter explained the purpose of the quality assessment program and the anticipated burden and benefits to the facility. They also provided assurance to the facility that all facility-specific data would be treated as confidential. EPA's contractors then called the technical contacts at the facilities to solicit their participation, to arrange a date for the site visit, and to review a preliminary agenda for the site visit.

2.5 Conducting Site Visits

The goal of the site visit was to collect all the information needed to complete the survey instrument accurately, while minimizing burdens on facility staff. On-site survey activities included tours of the facilities, which focused on material storage areas, industrial processing operations, and pollution control equipment; careful review of all readily available documentation, which could include MSDSs, production data, monitoring data, purchasing records, and facility spreadsheets or computer software with this information; and interviews with appropriate facility employees regarding documentation materials. Site surveyors did not perform any monitoring or measurements during the site visits.

The site visits were designed to determine:

- Overlooked chemicals;
- Release and other waste management activities;
- Errors in the Form R reports submitted to EPA;
- Whether more accurate release estimation methods could have been used, based on information available to the facilities; and
- Whether further EPA guidance is needed on certain issues for that particular industry.

Release and other waste management estimates were recalculated or recreated by site surveyors from available documentation during the visit. Site surveyors recorded these results on the survey instrument and reviewed the results with facility personnel before leaving the site. Site surveyors held a wrap-up meeting at the facility with the person who filled out the Form R reports at the end of the visit to discuss the facility contact's issues or questions and to review the conclusions and recommendations of the site surveyor. Site surveyors may have called the facility contact after the on-site visit occurred to discuss any remaining issues that required clarification or additional research.

2.5.1 Data Collection

Site surveyors reviewed 191 Form R chemical reports and 605 additional chemicals with amounts used or activities that did not meet the reporting criteria at the 60 facilities visited for RY 1996. Site surveyors reviewed threshold determinations, and release and other waste management estimates separately to identify the frequency, magnitude, and sources of errors in these areas. Site surveyors followed the steps described in the Form R reporting instructions for completing threshold determinations and release and other waste management estimates. The Form R reporting instructions state that facilities must first assess which chemicals are manufactured, processed, or otherwise used in excess of appropriate thresholds. Facilities must then estimate and report all release and other waste management quantities of listed chemicals exceeding thresholds.

2.5.2 Threshold Determinations

Facilities may make the following types of errors in determining which chemicals at their site meet a EPCRA Section 313 thresholds:

- Overlooking a chemical;
- Incorrectly calculating a threshold amount;
- Incorrectly applying *de minimus* exclusions;
- Incorrectly applying an exemption; and
- Misclassifying a chemical activity.

To identify errors in threshold determinations, site surveyors looked for problems in a facility's documentation. On the plant tour, site surveyors looked for evidence of chemicals that were reported but should not have been reported, and for evidence of chemicals that were not reported but should have been reported. The site surveyors reviewed each facility's documentation to track the decision process used to determine whether a chemical should have been reported. Furthermore, site surveyors used all available documentation to recalculate threshold estimates for reported chemicals and for chemicals present but not reported to verify the accuracy of facility calculations.

2.5.3 Release and Other Waste Management Estimates

Facilities most commonly make the following types of errors in calculating release and other waste management estimates for EPCRA Section 313 chemicals:

- Overlooking a chemical;
- Overlooking a source of data;
- Incorrectly calculating a release or other waste management quantity; and
- Incorrectly interpreting the reporting instructions.

During the site survey program, site surveyors used a two-part approach to identify facility errors in estimating release and other waste management activities. First, site surveyors always recalculated release and other waste management quantities using the same technical approach used by the facility. Second, whenever the site surveyor's experience and training indicated that a calculation approach different than the one used by the facility was appropriate, the surveyor attempted to obtain the data needed to calculate release and other waste management quantities using the more appropriate approach. In many such instances, data were not readily available during the site visit to recalculate these amounts using the alternative approach. In the cases where site surveyors were able to recalculate release and other waste management amounts using alternative approaches, they were able to assess the reasonableness of the estimation techniques used by facility personnel.

The surveyors quantified all numerical differences between the facility's estimates and the recalculated values, even in instances where surveyors identified only small differences. As discussed later, these numerical differences were used to assess quantitatively the accuracy of the total aggregate release and other waste management quantities contained in the TRI database.

2.6 Data Management/Data Quality Assurance

Many steps were taken to ensure the data quality of the surveyor's estimates and to verify the data in the survey database. This section outlines the procedures used to review the survey instruments after they were completed by the site surveyor, the database system, and the data entry into the master database; describes the verification procedures for the data entered into the database; presents the data weighting used to apply the results to the entire population of facilities for each SIC Code surveyed; and discusses potential sources of error in the site survey program.

2.6.1 Quality Review of Survey Instrument and Data Entry

All survey instruments were reviewed twice by a set of reviewers to ensure site survey calculations and methodologies used were correct and consistent for all site surveys. All data were double entered into the database, compared to each other, and then verified with the actual survey if an inconsistency was found. Project staff also reviewed the database entries for internal consistency and completeness by comparing responses to various questions as appropriate.

2.6.2 Data Weighting

To allow EPA to compare the site survey program results to the TRI database for the SIC Codes surveyed, weighting factors were applied to the site visit data. These factors or "weights" represent the number of facilities in the TRI database represented by each of the surveyed facilities. Each facility was randomly selected and the number of facilities chosen from each three-digit SIC Code was proportional to the percentage of facilities in any three-digit SIC Code; therefore, each facility was weighted equally.

The sample facilities weights in each SIC Code group are summed to represent the total population of facilities included in the TRI database for that SIC Code group. A total population of 1,492 facilities for SIC Code 33 (covering SIC Codes 331, 332, 333, 334, and 335), 781 facilities for SIC Code 36 (covering SIC Codes 367 and 369), and 1,034 facilities for SIC Code 37 (covering SIC Codes 371 and 372) represents the TRI data for RY 1996.

2.6.3 Limitations of the Analysis

The design and implementation of the survey may have introduced unavoidable inaccuracies in the study results. The three primary sources of error are:

- Sample selection bias;
- Survey implementation; and
- Data reduction and analysis.

The relatively small number of facilities sampled introduced a sample selection bias. The smaller the number of facilities sampled, the greater the likelihood that these facilities do not accurately represent the universe of reporting facilities. For the selected sample size of 60 facilities in SIC Codes 33, 36, and 37, the 90% confidence interval is plus or minus 11%. That is to say, if 50% of the visited facilities reported accurate data, a 90% probability exists that between 39% and 61% of the facilities in the national database reported accurate data.

Another possible source of error concerns the fact that approximately 15 different surveyors performed the survey. This source of inaccuracy was controlled to the extent possible by the use of a carefully designed survey instrument and extensive quality assurance provisions. Nevertheless, it is possible that different surveyors made different judgments in the course of the site surveys.

Finally, certain assumptions were made to simplify data analysis. The key assumption was that the facilities and Form Rs examined in the site visits accurately represent all facilities in their SIC Code group in terms of the accuracy of the data submitted. Aside from possible errors introduced by the relatively small size of the sample, the sampled facilities may not fully represent their SIC Code group because the sampled facilities excluded any facility with more than 15 Form Rs for budgetary reasons. In addition, we have observed that, in general, facilities that volunteer to participate in the program are smaller in size and have less throughput than facilities that decline to participate. To the extent that facilities submitting more than 15 Form Rs or larger facilities with more throughput report more (or less) accurate data than the sampled facilities, the facilities sampled may not fully reflect the universe of facilities in the database.

2.7 Data Analysis and Reporting

Once the results of the site surveys were loaded into a database and the database was validated through the quality assurance process described above, the data were evaluated to discern trends in the quality of data in the TRI forms. The results of that analysis are presented in the following sections.

3.0 DESCRIPTION OF INDUSTRIAL PROCESSES SURVEYED

This section describes the major industrial processes seen on the site visits in SIC Codes 33, 36, and 37. The manufacturing processes described include:

- Iron and Steel Manufacturing at facilities in SIC Code 33 (Section 3.1);
- Primary aluminum processing at facilities in SIC Code 33 (Section 3.2);
- Primary zinc processing at facilities in SIC Code 33 (Section 3.3);
- Semiconductor manufacturing at facilities in SIC Code 36 (Section 3.4);
- Printed board manufacturing at facilities in SIC Code 36 (Section 3.5);
- Motor vehicle equipment manufacturing at facilities in SIC Code 37 (Section 3.6); and
- Motor vehicle painting/finishing at facilities in SIC Code 37 (Section 3.7).

The section is designed to provide a general understanding of the industries surveyed, and to provide an overview of the inter-relationship between the industrial process, pollutant outputs, and pollution prevention opportunities within those industries.

This section specifically contains a description of commonly used production processes, associated raw materials, the byproducts produced, and the materials either recycled or transferred off-site for further waste management. This discussion, coupled with schematic drawings of the identified processes, provides a concise description of where wastes may be produced in the process. This section also describes the potential fate (air, water, land) of these waste products.

3.1 Iron and Steel Manufacturing and Processing

Steel is an alloy of iron usually containing less than one percent carbon. Steel production occurs in several sequential steps as shown in Figure 3-1. The two types of steelmaking technology in use today are the basic oxygen furnace (BOF) and the electric arc furnace (EAF). Although these two technologies use different input materials, the output for both furnace types is molten steel which is subsequently formed into steel mill products. The BOF input materials are molten iron, scrap, and oxygen. In the EAF, electricity and scrap are the input materials used. BOFs are typically used for high tonnage production of carbon steels, while EAFs are used to produce carbon steels and low tonnage alloy and specialty steels. The processes leading up to steelmaking in a BOF are very different than the steps preceding steelmaking in an EAF; the steps after each of these processes used to turn molten steel into steel mill products are the same.

3.1.1 Steelmaking Using the Basic Oxygen Furnace

The process of making steel in a BOF is preceded by cokemaking and ironmaking operations. In cokemaking, coke is produced from coal. In ironmaking, molten iron is produced from iron ore and coke. Each of these processes and the subsequent steelmaking process in the BOF are described below. Figure 3-1 shows the process overview of steelmaking using a BOF.

3.1.1.1 Cokemaking

Coal processing in the iron and steel industry typically involves producing coke, coke gas, and by-product chemicals from compounds released from the coal during the cokemaking process as shown in Figure 3-2. Coke is carbon-rich and is used as a carbon source and fuel to heat and melt iron ore in ironmaking. In cokemaking, pulverized coal is heated at high temperatures in the absence of air in batteries of ovens. Volatile byproducts are collected and processed for other uses. The solid carbon remaining in the oven (coke) is then processed for ironmaking. The necessary heat for coke distillation is supplied by external combustion of fuels (e.g., recovered coke oven gas, blast furnace gas) through flues located between ovens. At the end of the heating cycle, the coke is pushed from the oven into a rail quench car. The quench car takes it to the quench tower, where the hot coke is cooled with a water spray. The coke is then screened and sent to the blast furnace or to storage.

In the by-products recovery process, volatile components of the coke oven gas stream are recovered including the coke oven gas itself (which is used as a fuel for the coke oven), naphthalene, ammonium compounds, crude light oils, sulfur compounds, and coke breeze (coke fines). During the coke quenching, handling, and screening operation, coke breeze is produced. Typically, the coke breeze is reused in other manufacturing processes on-site (e.g., sintering) or sold off-site as a by-product.

3.1.1.2 Ironmaking

In the blast furnace, molten iron is produced, as shown in Figure 3-2. Iron ore, coke, and limestone are fed into the top of the blast furnace. Heated air is forced into the bottom of the furnace. The carbon monoxide from the burning of the coke reduces iron ore to iron. The acid part of the ores reacts with the limestone to create a slag which is drawn periodically from the furnace. This slag contains unwanted impurities in the ore. When the furnace is tapped, iron is removed through one set of runners and molten slag via another. The molten iron is tapped into refractory-lined cars for transport to the steelmaking furnaces. Residuals from the process are mainly sulfur dioxide or hydrogen sulfide, which are driven off from the hot slag. The slag is the largest by-product generated from the ironmaking process and is reused extensively in the construction industry. Blast furnace flue gas is cleaned and used to generate steam to preheat the air coming into the furnace, or it may be used to supply heat to other plant processes. The cleaning of the gas may generate air pollution control dust in removing coarse particulates (which may be reused in the sintering plant or landfilled), and water treatment plant sludge in removing fine particulates by venturi scrubbers.

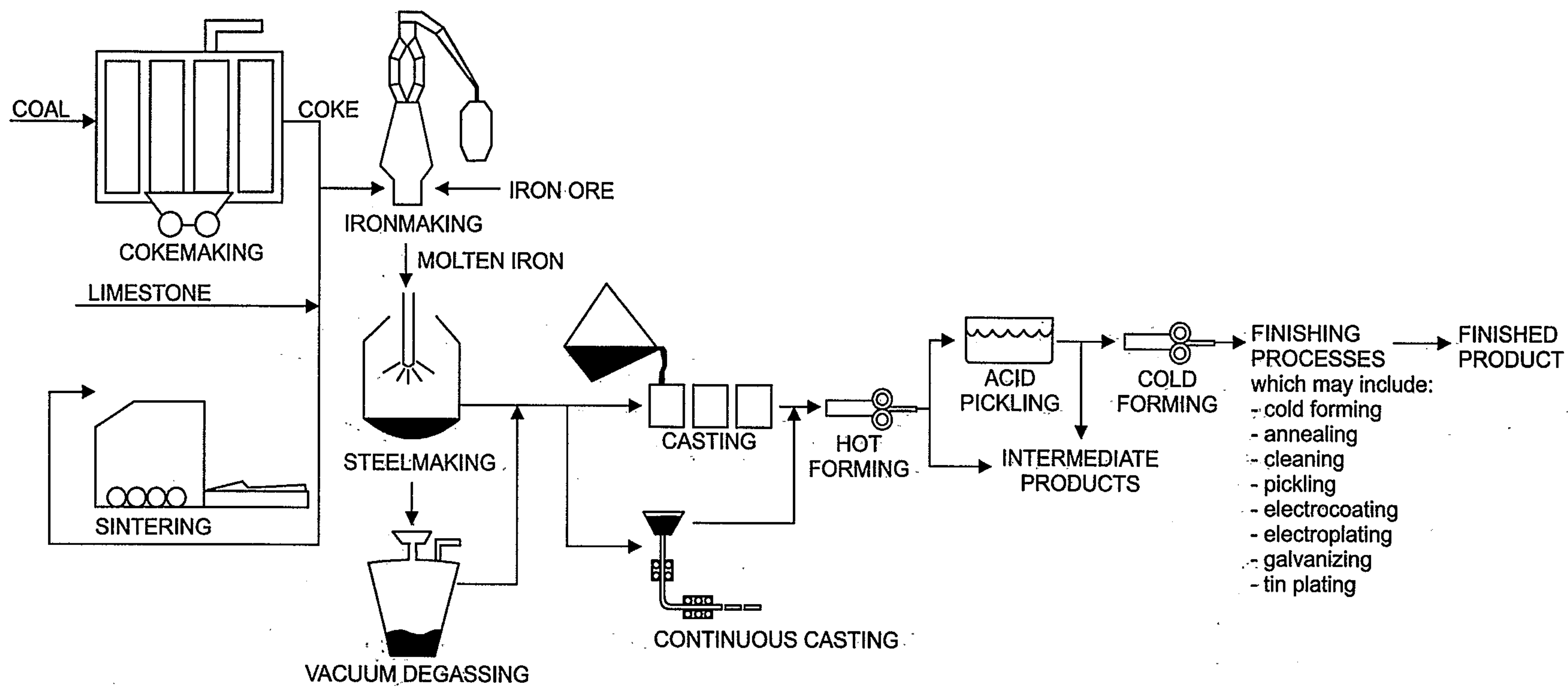


Figure 3-1. Iron and Steel Manufacturing Process Overview Using a BOF

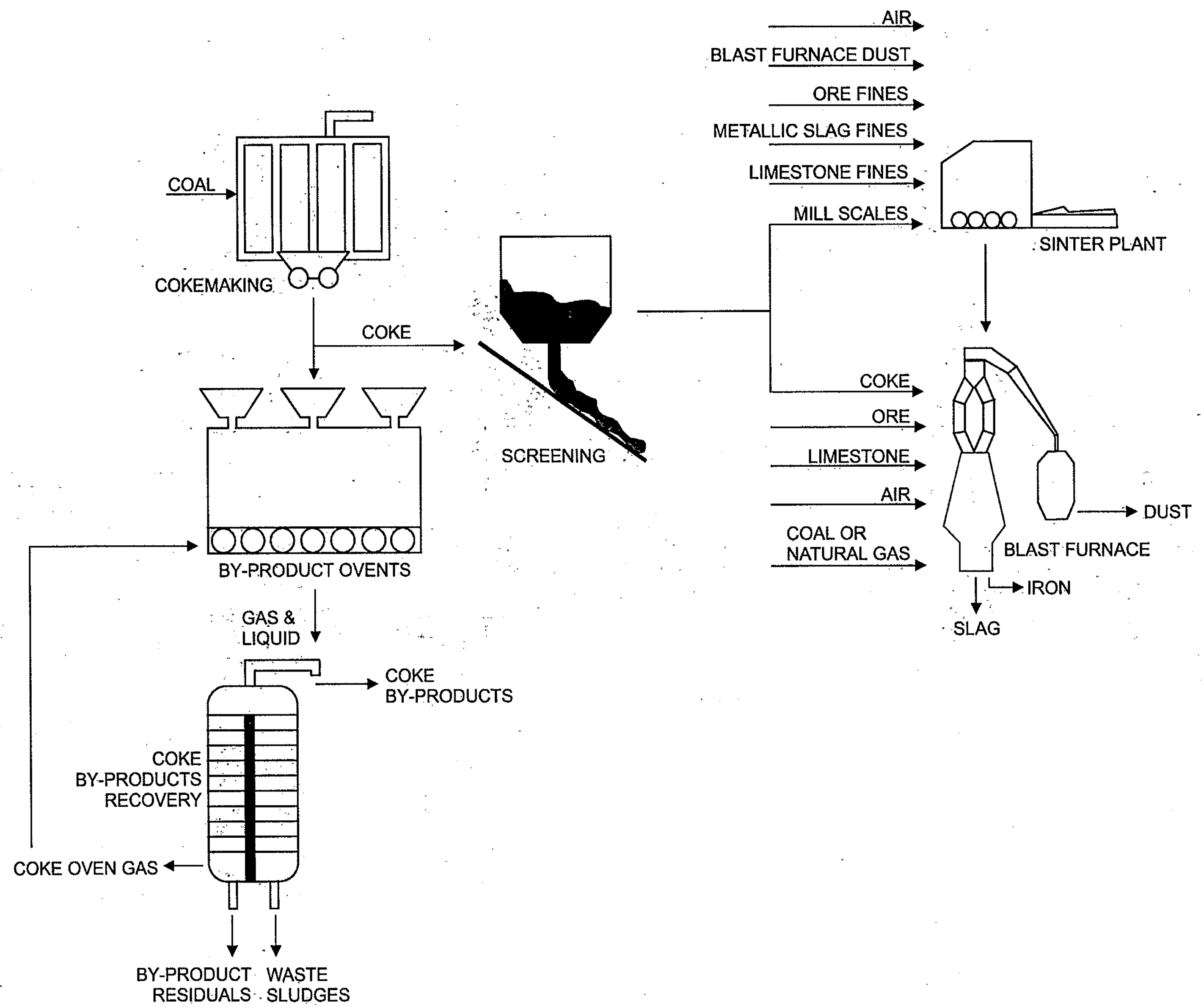


Figure 3-2. Iron and Steel Manufacturing Cokemaking and Iron Making

3-5

3.1.1.3 Sintering

Sintering is the process that agglomerates fines (including iron ore fines, pollution control dusts, coke breeze, water treatment plant sludge, and flux) into a porous mass for charging to the blast furnace. Through sintering operations, a mill can recycle iron-rich material, such as mill scale and processed slag. Not all mills have sintering capabilities. The input materials are mixed together, placed on a slow-moving grates and ignited. Windboxes under the grate draw air through the materials to deepen the combustion throughout the traveling length of the grate. The coke breeze provides the carbon source for sustaining the controlled combustion. In the process, the fine materials are fused into the sinter agglomerates, which can be reintroduced into the blast furnace along with ore. Air pollution control equipment removes the particulate matter generated during the thermal fusing process. If electrostatic precipitators or baghouses are used as the air pollution control equipment, the dry particulates captured are typically recycled as sinter feedstock, or are landfilled as solid waste.

3.1.1.4 Steelmaking

In a batch mode, molten iron from the blast furnace, flux, alloy materials, and scrap are placed in the BOF, melted and refined by injecting high-purity oxygen. A chemical reaction occurs, where the oxygen reacts with carbon and silicon generating the heat necessary to melt the scrap and oxidize impurities. Slag is produced from impurities removed by the combination of the fluxes with the injected oxygen. Various alloys are added to produce different grades of steel. The molten steel is typically cast into slabs, beams or billets.

The waste products from the basic oxygen steelmaking process include slag, carbon monoxide, and oxides of iron emitted as dust. Also, when the hot iron is poured into the furnace, iron oxide fumes are released and some of the carbon in the iron is precipitated as graphite (kish). The BOF slag can be processed to recover the high metallic portions for use in sintering or blast furnaces, but its applications as saleable construction materials are more limited than the blast furnace slag.

Basic oxygen furnaces are equipped with air pollution control systems for containing, cooling, and cleaning the volumes of hot gases and sub-micron fumes that are released during the process. Water is used to quench or cool the gases and fumes to temperatures at which they can be effectively treated by the gas cleaning equipment. The resulting waste streams from the pollution control processes include air pollution control dust and water treatment plant sludge. The principal pollutants removed from the off-gas are total suspended solids and metals (primarily zinc, and some lead).

3.1.2 Steelmaking Using the Electric Arc Furnace (EAF)

In the steelmaking process that uses an electric arc furnace (EAF), the primary raw material is scrap metal, which is melted and refined using electric energy. During melting, oxidation of phosphorous, silicon, manganese, carbon, and other materials occurs and a slag containing some of these oxidation products forms on top of the molten metal. Oxygen is used to decarburize the molten steel and to provide thermal energy. Since scrap metal is used instead of molten iron, there are no cokemaking or ironmaking operations associated with steel production that uses an EAF.

The process produces metal dusts, slag, and gaseous products. Particulate matter and gases evolve together during the steelmaking process and are conveyed into a gas cleaning system. These emissions are cleaned using a wet or dry system. The particulate matter that is removed as emissions in the dry system is referred to as EAF dust, or EAF sludge if it is from a wet system. The composition of EAF dust can vary greatly depending on the scrap composition and furnace additives. The primary component is iron or iron oxides, and it may also contain flux (lime and/or fluorspar), zinc, chromium and nickel oxides (when stainless steel is being produced) and other metals associated with the scrap. Oils are burned off "charges" of oil-bearing scrap in the furnace. Minor amounts of nitrogen oxides and ozone are generated during the melting process. The furnace is extensively cooled by water which is recycled through cooling towers.

3.1.3 Forming and Finishing Operations

Whether the molten steel is produced using a BOF or an EAF, to convert it into a product, it must be solidified into a shape suitable and finished.

3.1.3.1 Forming

The traditional forming method, called ingot teeming, has been to pour the metal into ingot molds, allowing the steel to cool and solidify. This method has been largely replaced by continuous casting. The continuous casting process bypasses several steps of the conventional ingot teeming process by casting steel directly into semifinished shapes. Molten steel is poured into a reservoir from which it is released into the molds of the casting machine. The metal is cooled as it descends through the molds, and before emerging, a hardened outer shell is formed. As the semifinished shapes proceed on the runout table, the center also solidifies, allowing the cast shape to be cut into lengths.

Process contact water cools the continuously cast steel and is collected in settling basins along with oil, grease, and mill scale generated in the casting process. The scale settles out and is removed and recycled for sintering operations, if the mill has a sinter plant. Waste treatment plant sludge is also generated.

The steel is further processed to produce slabs, strips, bars, or plates through various forming operations. The most common hot forming operation is hot rolling, where heated steel is passed between two rolls revolving in opposite directions. The final shape and characteristics of a hot formed piece depend on the rolling temperature, the roll profile, and the cooling process after rolling. Wastes generated from hot rolling include waste treatment plant sludge and scale.

In subsequent cold forming, the cross-sectional area of unheated steel is progressively reduced in thickness as the steel passes through a series of rolling stands. Generally, wires, tubes, sheet and strip steel products are produced by cold rolling operations. Cold forming is used to obtain improved mechanical properties, better machinability, special size accuracy, and the production of thinner gages than hot rolling can accomplish economically.

During cold rolling, the steel becomes hard and brittle. To make the steel more ductile, it is heated in an annealing furnace.

Process contact water is used as a coolant for rolling mills to keep the surface of the steel clean between roller passes. Cold rolling operations also produce a waste treatment plant sludge, primarily due to the lubricants applied during rolling. Grindings from resurfacing of the worn rolls and disposal of used rolls can be a significant contributor to the plant's wastestream.

3.1.3.2 Finishing

One of the most important aspects of a finished product is the surface quality. To prevent corrosion, a protective coating may be applied to the steel product. Prior to coating, the surface of the steel must be cleaned so the coating will adhere to the steel. Mill scale, rust, oxides, oil, grease, and soil are chemically removed from the surface of steel using solvent cleaners, pressurized water or air blasting, cleaning with abrasives, alkaline agents or acid pickling. In the pickling process, the steel surface is chemically cleaned of scale, rust, and other materials. Inorganic acids such as hydrochloric or sulfuric acid are most commonly used for pickling. Stainless steels are pickled with hydrochloric, nitric, and hydrofluoric acids.

Steel generally passes from the pickling bath through a series of rinses. Alkaline cleaners may also be used to remove mineral oils and animal fats and oils from the steel surface prior to cold rolling. Common alkaline cleaning agents include: caustic soda, soda ash, alkaline silicates, and phosphates.

Steel products are often given a coating to inhibit oxidation and extend the life of the product. Coated products can also be painted to further inhibit corrosion. Common coating processes include: galvanizing (zinc coating), tin coating, chromium coating, aluminizing, and terne coating (lead and tin). Metallic coating application processes include hot dipping, metal spraying, metal cladding (to produce bi-metal products), and electroplating. These coating processes contain many EPCRA Section 313 chemicals (mainly metals) that end up in the facility's wastestream.

3.2 Primary Aluminum Processing

Primary aluminum producers generally employ a three step process to produce aluminum ingots. First, alumina is extracted from bauxite ore using the Bayer process (Figure 3-3). In the Bayer process, finely crushed bauxite is mixed with an aqueous sodium hydroxide (caustic soda) solution to form a slurry. The slurry is then reacted at a high temperature under steam pressure in a vessel known as a digester, and creates a mixture of dissolved aluminum oxides and bauxite residues. During the reaction a majority of the impurities such as silicon, iron, titanium, and calcium oxides drop to the bottom of the digester and form a sludge. The remaining sodium aluminate solution is then flash cooled by evaporation and sent for clarification. During clarification, agents such as starch are added to help any fine impurities that remain in the slurry, such as sand, to drop out, further purifying the sodium aluminate solution. The solution is then fed into a precipitation tank to be crystallized. In the precipitation tank the sodium aluminate solution is allowed to cool with the addition of a small amount of aluminum hydroxide "seed." The seed stimulates the precipitation of solid crystals of aluminum hydroxide.

The aluminum hydroxide crystals settle to the tank bottom, and are removed. The crystals are then washed to remove any caustic soda residues, vacuum dewatered, and sent on for calcination. In the calciners (a type of rotating kiln) the aluminum hydroxide is roasted for further dewatering.

In the second step, the aluminum oxide (alumina) produced during the Bayer process is reduced to make pure molten aluminum. Alumina is dissolved in molten cryolite, and the alumina is separated into aluminum and oxygen by electric current. The electrolytic reduction process begins with the placement of the alumina into electrolytic cells, or "pots," filled with molten cyrolite. Within each pot a positive electric current is passed through the cryolite by means of a carbon anode submerged in the liquid cryolite. The oxygen atoms,

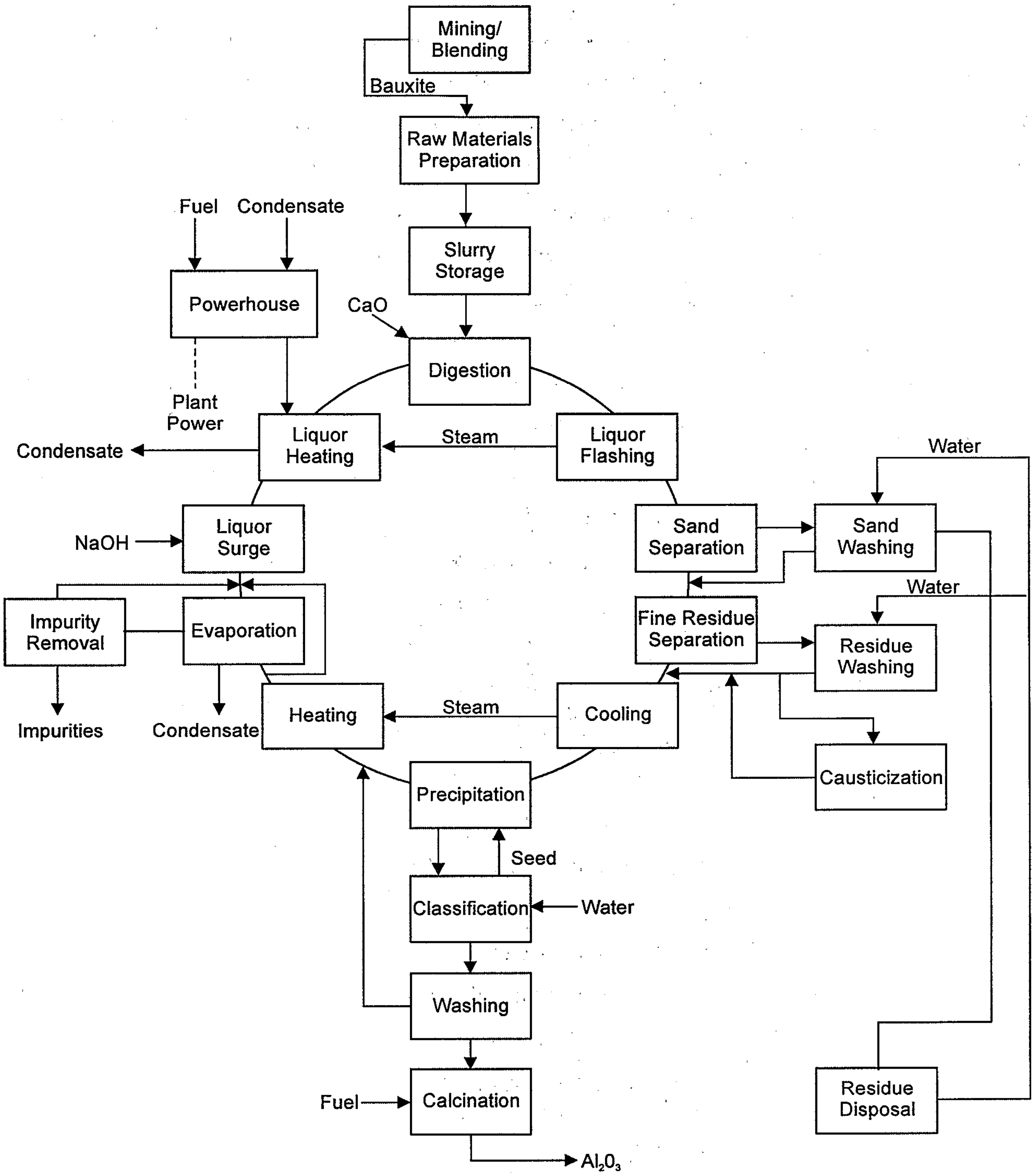


Figure 3-3. Bayer Process (Alumina Refining)

separated from aluminum oxide, carry a negative electrical charge and are attracted to the carbon anodes. The carbon and the oxygen combine immediately to form carbon dioxide and carbon monoxide. These gases bubble free of the melt. The nearly pure aluminum collects at the bottom of the pot, is siphoned off, placed into crucibles, and then transferred to melting/holding furnaces.

The third step consists of either mixing the molten aluminum with other metals to form alloys of specific characteristics, or casting the aluminum into ingots for transport to fabricating shops. Casting involves pouring molten aluminum into molds and cooling it with water. At some plants, the molten aluminum may be batch treated in furnaces to remove oxide, gaseous impurities, and active metals such as sodium and magnesium before casting. Some plants add a flux of chloride and fluoride salts and then bubble chlorine gas, usually mixed with an inert gas, through the molten mixture. Chloride reacts with the impurities to form HCl, and metal chloride emissions. A dross forms to float on the molten aluminum and is removed before casting.

Two types of anodes may be used during the reduction process: an anode paste or a pre-baked anode. Because the carbon is consumed during the refining process (about one-half pound of carbon is consumed for every pound of aluminum produced), if anode paste (Soderberg anode) is used, it needs to be continuously fed through an opening in the steel shell of the pot. The drawback to pre-baked anodes is that they require that a pre-baked anode fabricating plant be located nearby or on-site. Most aluminum reduction plants include their own facilities to manufacture anode paste and/or pre-baked anode blocks.

One waste material produced during the primary production of aluminum are fluoride compounds. Fluoride compounds are principally produced during the reduction process. One reason that pre-baked anodes are favored is that the closure of the pots during smelting facilitates the capture of fluoride emissions, though many modern smelters employ other methods to capture and recycle fluorides and other emissions.

Primary aluminum processing activities result in air emissions, process wastewaters, and other solid-phase wastes. Large amounts of particulates are generated during the calcining of hydrated aluminum oxide, but the economic value of this dust for reuse in the process is such that extensive controls are used to reduce emissions to relatively small quantities. Small amounts of particulates are emitted from the bauxite grinding and materials handling processes. Emissions from aluminum reduction processes are primarily gaseous hydrogen fluoride and particulate fluorides, alumina, carbon monoxide, volatile organics, and sulfur dioxide from the reduction cells; and fluorides, vaporized organics and sulfur dioxide from the anode baking furnaces. A variety of control devices such as wet scrubbers are used to abate emissions from reduction cells and anode baking furnaces.

Wastewaters generated from primary aluminum processing are produced during clarification and precipitation though much of this water is fed back into the process to be reused.

Solid-phase wastes are generated at two stages in the primary aluminum process; red mud produced during bauxite refining, and spent potliners from the reduction process. Red mud normally contains significant amounts of iron, aluminum, silicon, calcium, and sodium. The types and concentrations of minerals present in the mud depends on the composition of the ore and the operating conditions in the digesters. The carbon potliners used to hold the alumina/cryolite solution during electrolytic aluminum reduction process eventually crack and need to be removed and replaced. These potliners contain cyanide complexes which form during the aluminum reduction process.

3.3 Primary Zinc Processing

The primary production of zinc begins with the reduction of zinc concentrates to metal (the zinc concentration process consists of separating the ore, which may be as little as two percent zinc, from waste rock by crushing and flotation). Zinc reduction is accomplished in one of two ways: either pyrometallurgically by distillation (retorting in a furnace) or hydrometallurgically by electrowinning. Hydrometallurgical zinc refining is discussed in this section, as this was the process seen on the site visits.

Four stages are generally used in hydrometallurgic zinc refining: calcining, leaching, purification, and electrowinning. Calcining, or roasting, is performed to eliminate sulfur and form leachable zinc oxide. Roasting is a high-temperature process that converts zinc sulfide concentrate to an impure zinc oxide. Roaster types include multiple-hearth, suspension, or fluidized-bed. The gas zinc oxide stream is directed to the baghouse (filter) area where the zinc oxide is captured in baghouse dust. All of the calcining processes generate sulfur dioxide, which is controlled and converted to sulfuric acid as a marketable process by-product.

Electrolytic processing of desulfurized calcine consists of three basic steps; leaching, purification, and electrolysis. Leaching refers to the dissolving of the captured calcine in a solution of sulfuric acid to form a zinc sulfate solution. After leaching, the solution is purified in two or more stages by adding zinc dust, which precipitates the copper and cadmium which are then filtered out.

Zinc electrowinning takes place in an electrolytic cell and involves running an electric current from a lead-silver alloy anode through the aqueous zinc compound solution. This process charges the dissolved zinc ion and deposits it onto an aluminum cathode (a plate with an opposite charge) which is immersed in the solution. Periodically, the zinc-coated cathodes are removed and rinsed, and the zinc mechanically stripped from the aluminum plates. The zinc concentrate is then melted and cast into ingots.

Electrolytic zinc smelters contain as many as several hundred cells. A portion of the electrical energy is converted into heat, which increases the temperature of the electrolyte. During electrowinning a portion of the electrolyte passes through cooling towers to decrease its temperature and to evaporate the water it collects during the process.

The sulfur dioxide generated during the primary zinc refining process is further reacted with oxygen and water to produce sulfuric acid. The wastes from the acid plant may contain sulfur, cadmium, and lead.

During the electrolytic refining of zinc, solid materials in the electrolytic solution that are not captured previously during purification may precipitate out in the electrolytic cell. When the cells undergo their periodic shutdown to recover zinc, this precipitated waste (known as anode slimes/sludges) is collected during cell cleaning.

Primary zinc processing activities generate air emissions, process wastes, and other solid-phase wastes. The material inputs and waste outputs resulting from primary zinc processing are presented by media in Table 3-1. Air emissions are generated during roasting. Sulfur dioxide emissions from the roasting processes at zinc processing facilities are generally recovered at on-site sulfuric acid plants. Much of the particulate matter emitted from primary zinc facilities is also attributable to roasters.

Table 3-1

Process Materials Inputs/Waste Outputs - Zinc

Process	Material Input	Air Emissions	Process Wastes	Other Wastes
Zinc Calcining	Zinc ore, coke	Sulfur dioxide, particulate matter containing zinc and lead		Acid plant blowdown slurry
Zinc Leaching	Zinc calcine, sulfuric acid, limestone, spent electrolyte		Wastewaters containing sulfuric acid	
Zinc Purification	Zinc-acid solution, zinc dust		Wastewaters containing sulfuric acid, iron	Copper cake, cadmium
Zinc Electrowinning	Zinc in a sulfuric acid/aqueous solution, lead-silver alloy anodes, aluminum cathodes, barium carbonate, or strontium, colloidal additives		Dilute sulfuric acid	Electrolytic cell slimes/sludges

Though the amount and composition of particulate varies with operating parameters, the particulate is likely to contain zinc and lead.

Wastewaters may be generated during the leaching, purification, and electrowinning stages of primary zinc processing when electrolyte and acid solutions become too contaminated to be reused again. This wastewater is treated before discharge.

Solid wastes are generated at various stages in primary zinc processing. Blowdown slurry generated during the operation of sulfuric acid plants is generally transferred off site. The solid copper cake generated during purification is generally sent off site to recover the copper.

3.4 Semiconductor Manufacturing

A semiconductor is a material that has an electrical conductivity between that of a conductor and an insulator; its electrical characteristics can be manipulated to behave like either depending on how it is processed. Silicon has traditionally been the substrate used to manufacture semiconductors; recently other materials such as gallium arsenide (GaAs) and indium phosphide (InP) have been used as a substrate material.

The semiconductor manufacturing process is continually evolving. The variety of distinct processing steps involved results in a range of processes that may occur at a single plant. Process designs are not uniform from plant to plant. An average semiconductor manufacturing process consists of hundreds of process steps, of which a significant percentage may be potential sources of EPCRA Section 313 chemicals. Many of the manufacturing steps are repeated several times during the production process. For these reasons, this overview will discuss general manufacturing steps and does not attempt to describe a specific type of plant.

A clean environment is essential to the manufacture of semiconductors. Thus cleaning operations precede and follow many of the manufacturing process steps. Wet processing, during which semiconductor devices are repeatedly immersed in or sprayed with solutions is commonly used to minimize the risk of contamination. Wet processes are the primary source of EPCRA Section 313 chemicals found in semiconductor manufacturing.

The primary component of a semiconductor is the semiconductor wafer, or chip. The manufacture of a semiconductor chip is essentially a six-step process (see Figure 3-4) with the following steps:

- Photolithography;
- Thin Films;
- Etching;
- Cleaning;
- Doping; and
- Chemical Mechanical Planarization.

The following sections discuss each of the processing steps identified above. It should be noted that many of the chemicals used in semiconductor manufacturing are used in more than one process, and some of the chemicals are used as a raw material as well as generated indirectly through the use of other chemicals. For example, hydrochloric acid is used in wet etching processes and is also generated in small quantities during dry etching, where chlorine plasma reacts with a hydrogen carrier to produce hydrochloric acid. Also, regardless of which process a chemical is used in, a general rule is that acid/base streams are treated in an on-site wastewater treatment plant and waste solvents are typically collected and sent off site for waste management (such as recycling or energy recovery).

3.4.1 Photolithography

Photolithography is used in semiconductor manufacturing to form surface patterns on the wafer. These patterns will in turn allow various materials to be deposited on or removed from selected, precise locations. In this process a viscous, solvent-based, light-sensitive photoresist is applied to the wafer on a spin track. On the spin track, a fixed amount of photoresist is metered onto the wafer, which is then spun at high speed on a rotating element to uniformly coat the wafer surface.

After a "soft bake" to remove most of the carrier solvent, a pattern is introduced into the resist by exposing predefined areas of the wafer with specific wavelengths of light, lasers, electron beams, or other means. A template mask, which is a glass plate containing an image of the desired circuit, may be used to introduce the pattern. Depending on the photoresist system, a developer solution is applied to dissolve some of the photoresist, yielding a stencil for further processing. Materials may be added or removed from the unmasked areas, giving a printed circuit. The number of photolithography steps required depends on the type of integrated circuit.

After the subsequent processing steps, residual photoresist is removed by using wet stripping (solvent or acid) or plasma gas stripping.

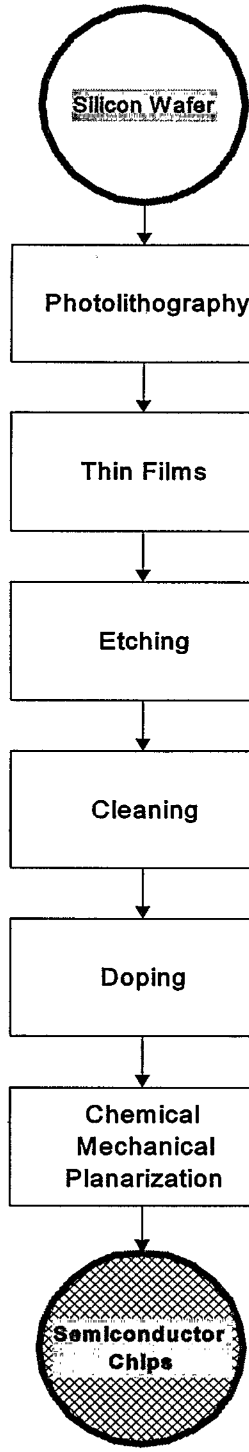


Figure 3-4. Overall Process Flow Diagram - Semiconductor Manufacturing

The most common potential sources of EPCRA Section 313 chemicals from photolithography are photoresist solvents, strippers, and developers. The primary release source is tool exhaust from the photoresist applicators, developing, and stripping stations; spent solvent, developer, and stripping solutions collected and sent either to a POTW or for off-site treatment, disposal, or energy recovery; and container residue. Typical EPCRA Section 313 chemicals include n-methyl-2-pyrrolidone, xylene (mixed isomers), certain glycol ethers, ammonia, and methyl ethyl ketone. Ammonium compounds are commonly used as developers.

Release and other waste management activity types include fugitive and point source emissions to the air from wet chemical and solvent stations and control equipment exhaust, and off-site transfers to POTWs, treatment facilities, and waste management facilities. Vapors from organic solvents found in the photoresist and photoresist strippers are typically sent to an on-site treatment unit, usually some type of concentrator (such as a carbon absorber) followed by thermal destruction.

3.4.2 Thin Films

In thin film deposition, layers of single crystal silicon, polysilicon, silicon nitride, silicon dioxide, and other materials are deposited on the wafer to provide desirable properties on portions of the device or to serve as masks. Deposition of these films is frequently performed in a chemical vapor deposition (CVD) reactor or a high-temperature tube furnace using silicon-containing gases as reactants. The deposition rate can be further enhanced by striking a plasma to overcome kinetic barriers. Selected impurity compounds or dopants may be used in the deposition process to alter the electrical characteristics of the deposited film or layer. Sometimes chlorine gas, hydrochloric acid (acid aerosols), or 1,1,1-trichloroethane is used during oxidation to modify the oxide characteristics.

Typical EPCRA Section 313 chemicals used in these deposition processes are chlorine, anhydrous ammonia, hydrochloric acid (acid aerosols) 1,1,1-trichloroethane, and 1,2-dichloroethylene.

To interconnect electrical devices on an integrated circuit and to provide for external connections, metallic layers are deposited onto the wafer by evaporation, sputtering, or

CVD. Evaporation consists of vaporizing a metal under a vacuum at a very high temperature. Sputtering processes (also called physical vapor deposition or PVD) involve bombarding metallic targets with a plasma gas, which displaces ions from the target and deposits them on the wafer. CVD of metal is similar to the other deposition processes described above except that the reactive gas is a metal-containing vapor. Devices may have a single layer or multiple layers of metal.

Typical EPCRA Section 313 chemicals used in metallization processes are ammonia and compounds of chromium, copper, and nickel.

The most common potential source of EPCRA Section 313 chemicals from application of thin films is ammonia gas used as a nitrogen source in silicon nitride deposition, organics used as chlorine sources and as a cleaner for deposition furnaces, and metals deposited to interconnect electrical devices. The primary point of release is the thin film deposition tool (furnace or oxidation chamber). Exhaust from these tools is typically routed to a scrubber which vents to the atmosphere and also result in wastewater generation. It should be noted that metals are not typically used in amounts that would exceed the reporting threshold. Release and other waste management activity types from thin film deposition processes include point source air, on-site treatment, and off-site disposal.

3.4.3 Etching

Etching is used to chemically remove specific unwanted areas of silicon substrate or deposited film so that an underlying material may be exposed or another material may be deposited in the etched material's place. Etch processes usually occur after a photoresist pattern has been applied, so that the etching is accomplished in specific areas.

Etching may be performed using either solutions of acids, bases, or oxidizers (wet etch), or by using various gases (usually halogenated) excited by striking a plasma (dry etch). In either case, the fluoride ion or radical is almost always introduced if the substrate or film to be etched contains silicon.

Typical examples of chemicals used in etch processes include 1,1-dichloro-l-fluoroethane, chlorine, ethylene glycol, hydrochloric acid (acid aerosols), hydrogen fluoride, nitric acid, phosphoric acid, and sulfuric acid (acid aerosols).

The most common potential source of EPCRA Section 313 chemicals from etching is the etchant material itself, usually inorganic acids used in wet etching processes, and certain halogenated organics used in dry etching processes. Acid gasses from the etching tools are usually vented through a scrubber, which in turn sends spent scrubber water to an on-site treatment plant for neutralization prior to discharge to a receiving stream or POTW. Release and other waste management activity types include stack air, fugitive air, container residue, and discharge to a POTW.

3.4.4 Cleaning

Cleaning of wafers is required to prepare them for each chemical and physical process to ensure that contaminants on the wafer surfaces do not affect the final integrated circuit's electrical performance. Before, and sometimes after, wafers are subjected to any specialized manufacturing processes, they are typically immersed in or sprayed with various aqueous and/or organic solutions. In some cases they are mechanically scrubbed in some manner to remove films, residues, bacteria, or other particles. Fog chambers may also be used for wafer cleaning.

Typical sources of EPCRA Section 313 chemicals from cleaning operations would be cleaning station exhaust vents, waste solvents, and container residue (from "empty" containers of the cleaning solution). Release and other waste management activity types from this process include stack and fugitive air emissions; off-site transfer of the spent cleaning solutions; wastewater discharges (either direct or to a POTW); and transfers of "empty" shipping containers to off-site locations.

3.4.5 Doping

Doping is a process in which specific atoms of impurities are introduced into the silicon substrate to alter the electrical properties of the substrate by acting as charge carriers. Doping is typically accomplished through ion implantation or diffusion processes.

Ion implantation is the most common method used to introduce impurity atoms into the substrate. The dopant atoms are first ionized with a medium-to-high-current filament, then accelerated toward the wafer surface with large magnetic and electrical fields. Because of the high kinetic energy of the ions during bombardment, damage to the substrate's crystalline structure occurs. To restore the substrate's structure to a satisfactory level, slow heating or "annealing" of the amorphous material in various gaseous atmospheres is subsequently performed.

Diffusion is a high-temperature process also used to introduce a controlled amount of a dopant gas into the silicon substrate. The process occurs in a specially designed tube furnace where dopants may be introduced in one of two primary ways: dopant gases may be introduced into the furnace that will diffuse into the exposed areas of the substrate (gaseous diffusion), or dopant atoms may diffuse into the substrate from a previously deposited dopant oxide layer in the areas where the two are in contact (nongaseous diffusion).

Typical EPCRA Section 313 chemicals used in doping processes are boron trifluoride and compounds of antimony, barium, and nickel.

The most common potential source of EPCRA Section 313 chemicals from doping are the dopants themselves, as well as certain organic compounds that may be used as furnace cleaning gases or chlorine sources. The physical release points are tool and control device exhaust vents, spent cleaning solutions, and solid or hazardous waste generated as part of the process.

Organic chemicals may be emitted from furnace exhaust and may also be collected and sent off site for energy recovery or disposal.

3.4.6 Chemical Mechanical Planarization

Chemical Mechanical Planarization (CMP) is used in semiconductor manufacturing to remove the top layer of material from the wafer in a controlled manner, leaving a smooth and flat surface for further processing. This technology is applied in two ways. The first is to selectively remove the top part of a nonconducting layer or film to reduce the topography on the wafer (also called planarization). The second type of CMP is removal of excess material from the surface of conducting layers (metals).

The only notable source of EPCRA Section 313 chemicals from CMP is the planarization process which typically contains ferric nitrate ($Fe(NO_3)_3$), a nitrate compound. Spent slurries containing nitrates are typically sent off site to a POTW.

3.5 Printed Wiring Board Manufacturing

Printed wiring boards (PWBs) are the physical structures on which electronic components such as semiconductors and capacitors are mounted. PWBs are subdivided into single-sided, double-sided, multilayer, and flexible boards. Multilayer boards are manufactured similarly to single and double-sided boards, except that conducting circuits are etched on both the external and internal layers. Multilayer boards allow for increased complexity and density. PWBs are produced using three methods: additive, subtractive, or semi-additive technology. The subtractive process accounts for a significant majority, perhaps 80%, of PWB manufacturing.

The conventional subtractive manufacturing process begins with a board, consisting of epoxy resin and fiberglass, onto which patterns are imaged. In most operations, conducting material, usually copper, is bonded onto the substrate surface to form copper-clad laminate. After drilling holes through the laminate and making those holes conductive, unwanted copper is etched off, leaving copper patterns. The patterns on the board form the electric circuits that conduct electricity. Multilayer boards typically use metals such as platinum, palladium, and copper to form electric circuits. Specialized PWBs may use nickel, silver, or gold.

Additive technology is used less often than subtractive technology because it is a more difficult and costly production process. This capital-intensive technology is used primarily for small interconnection components used in multi-chip devices. The production process begins with a base plate upon which a dielectric material is deposited. An interconnecting layer of copper is plated onto the dielectric layer which connects the layers of dielectric material and copper. Copper posts are plated-up and another layer of dielectric material is deposited exposing the posts. The next interconnect layer is plated and makes contact with the posts. Layers of dielectric material, copper, and copper posts are added to complete the interconnect. A lithographic process, similar to the one used in semiconductor manufacturing, diminishes the spaces and widths of the PWB.

This section provides a simplified discussion of the steps commonly performed during conventional subtractive manufacturing. These steps are outlined below:

- Board preparation;
- Application of conductive coatings (plating);
- Soldering;
- Fabrication; and
- Assembly.

3.5.1 Board Preparation

Board preparation begins with a lamination process. Two-side etched copper dielectric boards (consisting usually of fiberglass and epoxy resin) are separated by an insulating layer and laminated or bonded together, usually by heat and pressure. Photographic tools are used to transfer the circuit pattern to the PWB, and computer control programs are used to control the drilling, routing, and testing equipment. Preparing the copper-clad board involves drilling holes to establish an electrical path between the layers and to mount components. The boards are then mechanically cleaned to remove drilling wastes (i.e., fine particulate contaminants, such as copper). Vapor degreasing, abrasive cleaning, chemical cleaning with alkaline solutions, acid dips, and water rinses are techniques used to clean the boards and prepare them for the next process, electroless plating. Table 3-2 shows materials used during lamination, drilling, and cleaning processes.

Table 3-2

Chemicals Used in Lamination, Drilling, and Cleaning

Lamination	Drilling	Cleaning
Epoxies	Sulfuric acid Potassium permanganate Ammonium bifluoride Oxygen Fluorocarbon gas	Acetone 1,1,1-Trichloroethane Silican (and other abrasives) Sulfuric acid Aqueous ammonia Hydrochloric acid

Source: Based on EPA DfE 1993: *Industry Profile and Description of Chemical Use for the Printed Wiring Board Industry*: Preliminary Draft.

Wastes generated include: airborne particulates, acid fumes, and organic vapors from cleaning, surface preparation, and drilling; spent acid and alkaline solutions; spent developing solutions, spent etchings, and waste rinsewaters in the wastewater; and scrap board materials and sludges from wastewater treatment. Drilling and routing dust (copper, aluminum, and gold) are collected and recycled.

3.5.2 Electroless Plating

The first process in this step is to prepare the surfaces of the drilled holes. The holes are prepared by an etchback process to remove smeared epoxy resin and other contaminants using one of the following: sulfuric or hydrochloric acid; potassium permanganate; or carbon tetrafluoride, oxygen and nitrogen. The holes are then coated with a material such as copper or graphite carbon, by a chemical process called electroless plating.

Electroless plating coats a uniform conducting layer of copper or other material on the entire surface including the barrels of the holes of the prepared board without outside power sources. This coating of copper is not thick enough to carry an electrical current, but provides a base upon which additional copper can be deposited electrolytically. Chemical deposition is the technique used to coat the board. After the electroless plating, the boards are dried to prevent the board from oxidation (e.g., rusting). The board may also be cleaned to prepare for a following electroplating processing. Table 3-3 shows a list of material used. Wastes generated include:

spent electroless copper baths; spent catalyst solutions; spent acid solutions; waste rinsewaters; and sludges from wastewater treatment.

Table 3-3

Materials Used in Copper and Tin-Lead Electro- and Electroless Plating Processes

Type of Plating	Electroplating Chemicals	Electroless Chemicals
Copper	Copper pyrosphate Orthophosphate Pyrophosphate Nitrates Ammonia Acid copper Copper sulfate Sulfuric acid	Hydrochloric acid Palladium chloride Stannous chloride Metallic tin pellets Sodium hydroxide Copper sulfate Formaldehyde
Tin-Lead	Tin-Lead Fluoroboric acid Boric Acid Peptone	Tin chloride Sodium hypophosphite Sodium citrate

Source: Based on EPA DfE 1993: Industry Profile and Description of Chemical Use for the Printed Wiring Board Industry: Preliminary Draft.

3.5.3 Imaging

During imaging, circuit patterns are transferred onto the boards through photolithography or a stencil printing process. Photoresist (i.e., a light sensitive chemical) is applied to the board in areas where the circuit pattern will not be set. The board is exposed to a radiation source and developed to remove the unwanted areas of the resist layer. Stencil printing uses a printing process, such as silk screening, to apply a protective film that forms the circuit pattern.

After photolithography, the boards are subjected to a light etching process, typically using etchants containing ammonia, to remove rust inhibitor or other metals (usually copper). After the stencil printing process, the protective film is dried, and the exposed copper is etched away. Sulfuric acid and hydrogen peroxide are common etchants used during imaging. After plating or etching, the photoresist is removed with a photoresist stripper.

Tables 3-4 and 3-5 present a list of materials used during photolithography and etching process. Wastes generated include organic vapors and acid fumes, spent developing solutions, spent resist material, spent etchant, spent acid solutions, and sludges from wastewater treatment.

Table 3-4

Chemicals Used in Photolithography for Printed Wiring Boards

Resists	Photopolymer Developers	Photopolymer Strippers
Mylar Vinyl Photoresists	Isopropyl alcohol Potassium bicarbonate Sodium bicarbonate 1,1,1-Trichloroethane Amines Glycol ethers	Sodium hydroxide Potassium hydroxide Methylene chloride

Source: Based on EPA DfE 1993: Industry Profile and Description of Chemical Use for the Printed Wiring Board Industry: Preliminary Draft.

Table 3-5

Materials Used During Etching

Ammonia Ammonium chloride Ammonium persulfate Ammonium sulfate Boric acid Carbon tetrafluoride Chlorine	Cupric chloride Hydrochloric acid Hydrofluoric acid Hydrogen peroxide Lead	Nickel Nickel chloride Nickel sulfamate Nitrate Nitric acid Nitrogen Orthophosphate Oxygen Peptone	Permanganates Sodium citrate Sodium hydroxide Stannous chloride Sulfuric acid Tin

Source: Based on EPA DfE 1993: Industry Profile and Description of Chemical Use for the Printed Wiring Board Industry: Preliminary Draft.

3.5.4 Electroplating

Electroplating is a process in which a metal is deposited on a substrate through electrochemical reactions. Electroplating is required to build up the thickness and strength of the conducting layers to provide reliable electrical conductivity between inner layers or from one side of the PWB to the other. Electroplating can also protect against corrosion, wear, or erosion.

This process involves immersing the article to be coated/plated into a bath containing acids, bases, or salts.

The electroplating process for PWBs usually begins with the copper laminate which is coated with a plating resist (photolithography), by stenciling, leaving the area exposed to form the circuit pattern. The resist prevents the conductive material from adhering to other areas of the board and forms the circuit pattern.

The PWB plating process typically uses copper and tin-lead as plating materials, although silver, nickel, or gold can be used. Copper in a plating bath solution is deposited to a sufficient thickness, and a solvent or aqueous solution is applied to remove the plating resist. The copper coating forms interconnections between the layers and provides electrical contact for electronic parts mounted or assembled on the PWB surface. PWB manufacturers then typically electroplate a tin or tin-lead solder on the board to protect the circuit pattern during the following etching or stropping processes. An acid etch solution (ammonia, peroxide solutions, sodium persulfate, cupric chloride, or ferric chloride) removes the exposed copper foil, leaving the thicker copper plating to form the circuit pattern. Ammonia and cupric chloride are the primary etchants used by PWB manufacturers. Fluoroboric acid is used in the tin-lead plating process to keep the metals dissolved in the solution and to ensure a consistent deposition of the tin-lead alloy onto the circuit board.

After the plating bath, the board is rinsed with water, scrubbed, and then dried to remove the copper, spray etch solutions, and other materials. Rinsing ends the chemical reactions during plating and prevents contamination or dragout from being released in the next bath or rinse water (dragout is the plating solution that sticks to parts after taken out of the plating bath). Dragout can occur in any bath step, not just in one plating bath. The tin-lead layer is generally removed and the panel is electrically tested for discontinuities in the electrical pathway and shorts. Table 3-3 presents a list of materials used during the electroplating process.

Wastes generated during plating include: spent acid solutions, waste rinsewaters, spent developing solutions, spent etchant, and spent plating baths in the wastewater; organic vapors from spent developing solution and spent resist removal solution; and acid and ammonia fumes.

3.5.5 Soldering Coating

Solder coating is used to add solder to PWB copper components before component assembly. All methods of solder coating involve dipping the panel into molten solder. The solder, an alloy consisting of 60 percent tin and 40 percent lead, coats the pads and holes not covered by solder mask. The excess solder is removed with a blast of hot oil or hot air. However, the hot oil or hot air does not remove the solder that has formed a chemical (intermetallic) bond with the copper. The most common process is hot-air leveling.

3.5.6 Electrical and Mechanical Testing

A cross section is cut from a sample panel from each lot using a grinding process called routing, and the plated holes are examined with a photomicrograph. Individual circuit boards are cut out of panels that pass quality control. Routing generates dust which may contain copper, lead, or other metals plated to the panel, but the dust is recycled. Electrical tests, dimensional and visual inspections, and quality audits are performed to ensure compliance with customer requirements. Finally, the finished PWBs are packaged, labeled, and shipped to the customer.

3.5.7 Printed Wiring Board Assembly and Soldering

After the PWBs are manufactured, the electrical components are attached during assembly. Adhesives are applied to the boards, and then the components are attached and soldered to the boards. Components are attached to the PWB by a process called soldering. There are several different kinds of soldering processes, including wave, dip, and drag. A type of chemical known as "flux" is used before soldering to facilitate the production of the solder connection. Not only does flux clean the surface and remove oxidized material, it prevents oxidation from occurring during the solder process. After the solder has been applied, flux residue may be removed from the board, and the board may be cleaned and dried.

The wastes generated during assembly include: solder dross, post-solder scrap boards, filters, gloves, rags, and spent gaseous or semi-gaseous solvents from cleaning processes. The wastes that may be generated during soldering, flux application, and cleaning include: organic vapors, copper, lead, spent solvents, and spent deionized water into the wastewater; solder dross; and wastewater treatment sludge. Solder dross is primarily oxidized solder skin that forms on any molten solder exposed to oxygen and can be recycled off site.

3.6 Motor Vehicle Equipment Manufacturing

Motor vehicle parts and accessories include both finished and semi-finished components. Approximately 8,000 to 10,000 different parts are ultimately assembled into approximately 100 major motor vehicle components, including suspension systems, transmissions, and radiators. These parts are eventually transported to an automotive manufacturing plant for assembly.

The manufacturing process used to produce the thousands of discrete parts and accessories vary depending on the end product and materials used. Different processes are employed for the production of metal components versus the production of plastic components. Most processes, however, typically include casting, forging, molding, extrusion, stamping, and welding.

3.6.1 Foundry Operations

Foundries, whether they are integrated with automotive assembly facilities or independent shops, cast metal products which play a key role in the production of motor vehicles and motor vehicle equipment. Iron and steel are currently the major metal components of an automobile with increasing use of aluminum and other metals. The following discussion focuses on iron foundries and associated production processes.

The main steps in producing cast iron motor vehicle products are as follows (see Figure 3-5):

- Pattern design and production;
- Sand formulation;
- Mold and core production;
- Metal heating and alloying;
- Metal molding;
- Mold shakeout;
- Production finishing and heat treating; and
- Inspection.

The process begins with the mixing of moist silica sand with clay and water to produce the "green sand," which forms the basis of the mold. Other additives, including organics such as seacoal or oat hulls, may be added to the green sand to help prevent casting defects. The core is then created using molded sand and often includes binders, such as resins, phenol, and/or formaldehyde. The core is the internal section of a casting used to produce the open areas needed inside such items as an engine or a drive train. After the core has been molded, it is baked to ensure its shape, and then combined with the rest of the casting mold in preparation for casting. At the same time the core is being created, iron is being melted. The iron charge, whether it be scrap or new iron, is combined with coal (as a fuel) and other additives such as calcium carbide and magnesium, and fed into a furnace, which removes sulfur (usually an electric arc, an electric induction, or a cupola furnace).

Calcium carbide may be added for certain kinds of iron casting, and magnesium is added to produce a more ductile iron. Once the iron reaches the appropriate temperature, it is poured into the prepared mold. The mold then proceeds through the cooling tunnel and is placed on a grid to undergo a process called "shakeout." During shakeout the grid vibrates, shaking loose the mold and core sand from the casting. The mold and core are then separated from the product which is ready for finishing.

The finishing process is made up of many different steps depending upon the final product. The surface may be smoothed using an oxygen torch to remove any metal snags or chips, it may be blast-cleaned to remove any remaining sand, or it may be pickled using acids to achieve the correct surface. If necessary, the item may be welded to ensure the tightness of any

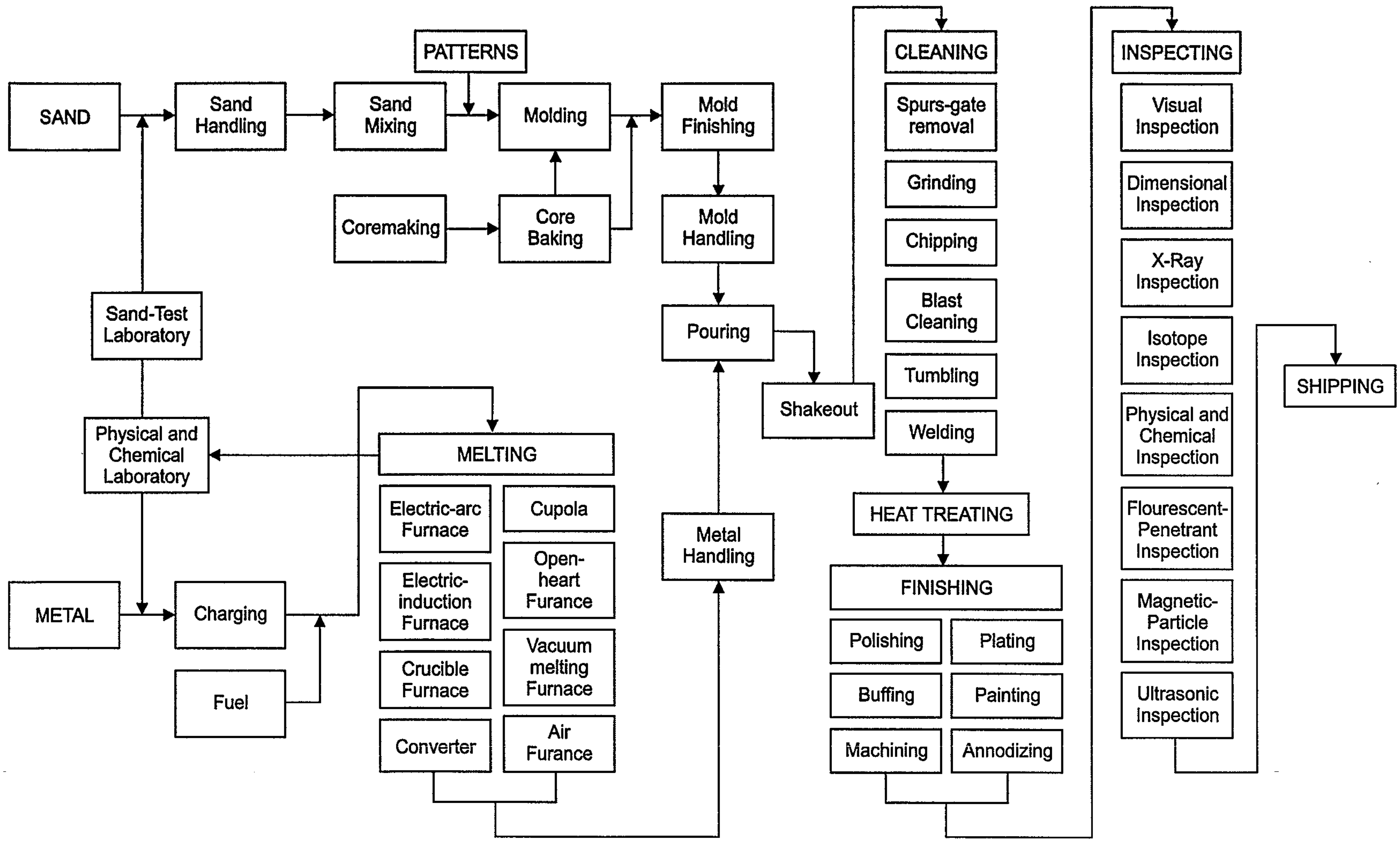


Figure 3-5. General Foundry Flow Diagram

seams or seals. After finishing, the item undergoes a final heat treatment to ensure it has the proper metallurgical properties. The item is then ready for inspection. Inspection may take place in any number of ways, be it visually, by x- or gamma ray, ultrasonic, or magnetic particle. Once an item passes inspection, it is ready to be shipped to the assembly area.

Iron foundries create a number of air emissions, process wastewaters, and solid wastes. Gas and particulate emissions occur throughout the casting process. Dust created during sand preparation, molding, and shakeout is prevalent. Gases containing lead and cadmium and other particulate matter and sulfur dioxide are also created during foundry operation, especially during the melting of the iron.

The wastewaters generated during foundry operations are primarily from slag quenching operations (water is sprayed on the slag to both cool it as well as pelletize it) and by the wet scrubbers employed as air pollution control devices connected to furnaces and sand and shakeout operations. Due to the presence of cadmium and lead in iron, these metals may both be present in wastewaters.

3.6.2 Metal Fabricating

Another major process in the manufacturing of automotive parts is metal fabrication. Metal fabrication involves the shaping of metal components. Many automotive parts, including fenders, hubcaps, and body parts are manufactured in metal fabricating shops. Typical large-scale production of these items starts with molten metal (ferrous or nonferrous) containing the correct metallurgical properties. Once the metal has been produced, it is cast into a shape that can enter the rolling process. Shearing and forming operations are then performed to cut materials into a desired shape and size and bend or form materials into specified shapes.

Shearing (or cutting) operations include punching, piercing, blanking, cutoff, parting, shearing, and trimming. Basically, these are operations that produce holes or openings, or that produce blanks or parts. Forming operations shape parts by forcing them into a specified configuration, and include bending, forming, extruding, drawing, rolling, spinning, coining, and forging.

Once shearing and forming activities are complete, the material is machined. This entails shaping or forming a workpiece by removing material from pieces of raw stock with machine tools. The principal processes involved in machining are hole-making, milling, turning, shaping/planing, broaching, sawing, and grinding.

Each of the metal shaping processes can result in wastes containing EPCRA Section 313 chemicals. In general, there are two categories of waste generated in metal shaping operations: scrap metal and metalworking fluids/oils.

Scrap metal may consist of metal removed from the original piece (e.g., steel or aluminum). Quite often, scrap is reintroduced into the process as feedstock.

In general, metalworking fluids can be petroleum-based, oil-water emulsions, or synthetic emulsions that are applied to either the tool or the metal being tooled to facilitate the shaping operation. Metalworking fluids typically become contaminated and spent with extended use and reuse. When disposed, these fluids may contain contaminants, including chlorine, sulfur an phosphorous compounds, phenols, cresols, and alkalines, as well as metals. Air emissions may result through volatilization during storage, fugitive losses during use, and direct ventilation of fumes.

3.6.3 Metal Finishing/Electroplating

The final process in manufacturing motor vehicle parts is metal finishing and electroplating. Numerous methods are used to finish metal products. However, prior to applying the finishing application, the surface must be prepared. One of the most important aspects of a finished product is the surface cleanliness and quality. Without a properly cleaned surface, even the most expensive coatings will fail to adhere or prevent corrosion. The steel motor vehicle parts are generally cleaned with nitric, hydrochloric, and hydrofluoric acid, as well as alkaline cleaning agents.

Metal finishing and electroplating activities are performed on a number of metals and serve a variety of purposes; the primary purpose being protection against corrosion. This is particularly important to the automotive industry because of the harsh weather and road conditions to which automobiles may be subject. Metal finishing and electroplating can also be performed for decorative purposes. These plating processes involve immersing the article to be coated/plated into a bath consisting of acids, bases, salts, etc.

The metals used in electroplating operations (both common and precious metal plating) include cadmium, lead, chromium, copper, nickel, zinc, gold, and silver. Cyanides are also used extensively in electroplating solutions and in some stripping and cleaning solutions.

Electroless plating is the chemical deposition of a metal coating onto a metal object, by immersion of the object in an appropriate plating solution. In electroless nickel plating, the source of nickel is a salt, and a reducer is used to reduce the nickel to its base state. A complexing agent is used to hold the metal ion in the solution. Immersion plating produces a metal deposit by chemical displacement. Immersion plating baths are usually formulations of metal salts, alkalies, and complexing agents (typically cyanide or ammonia).

Etching is the process used to produce specific design configurations or surface appearances on parts by controlled dissolution with chemical reagents or etchants. Etching solutions are commonly made up of strong acids or bases with spent etchants containing high concentrations of spent metal. The solutions include ferric chloride, nitric acid, ammonium persulfate, chromic acid, cupric chloride, and hydrochloric acid.

Anodizing uses the piece to be coated, generally with an aluminum surface, as an anode in an electrolytic cell. Anodizing provides aluminum parts with a hard abrasion- and corrosion-resistant film. This coating is porous, allowing it to be dyed or to absorb lubricants. This method is used both in decorative applications, including automotive trim and bumper systems, and in engineering applications such as aircraft landing gear struts. Anodizing is usually performed using either sulfuric or chromic acid often followed by a hot water bath, though nickel acetate or sodium potassium dichromate seal may also be used.

Surface preparation operations generate wastes contaminated with solvents and/or metals depending on the type of cleaning operation. Concentrated solvent-bearing wastes and releases may arise from degreasing operations. Degreasing operations may result in solvent-bearing wastewaters, air emissions, and materials in solid form.

Surface finishing and related washing operations account for a large volume of wastes associated with automotive metal finishing. Metal plating and related waste account for the largest volumes of metal (e.g., cadmium, chromium, copper, lead, mercury, and nickel) and cyanide-bearing wastes.

Electroplating operations can result in solid and liquid wastestreams that contain EPCRA Section 313 chemicals. Liquid wastes result from workpiece rinses and process cleanup waters. Most surface finishing (and many surface preparation) operations result in liquid wastestreams. Centralized wastewater treatment systems are common, and can result in solid-phase wastewater treatment sludges. In addition to these wastes, spent process solutions and quench baths are discarded periodically when the concentrations of contaminants inhibit proper function of the solution or bath. When discarded, process baths usually consist of solid- and liquid-phase wastes that may contain high concentrations of acids, bases, and cyanide wastes.

3.7 Motor Vehicle Painting/Finishing

Automotive finishing is a multi-step process subdivided into four categories: 1) anti-corrosion operations, consisting of cleaning applications, a phosphate bath, and a chromic acid bath; 2) priming operations, consisting of an electrodeposition primer bath, an anti-chip application, and a primer-surfacer application; 3) joint sealant application; and 4) finishing operations, consisting of a color coat application, a clear coat application, and any painting necessary for two-tone color or touch-up applications. The stages of the automotive finishing process are illustrated in Figure 3-6

After the automobile body has been assembled, anti-corrosion operations prepare the body for the painting/finishing process. Initially, the body is sprayed with or immersed in a cleaning agent, typically consisting of detergents, to remove residual oils and dirt. The body is then dipped into a phosphate bath, typically zinc phosphate, to prevent corrosion. The phosphate process also improves the adhesion of the primer to the metal. The body is then rinsed with chromic acid, further enhancing the anti-corrosion properties of the zinc phosphate coating. The anti-corrosion operations conclude with another series of rinsing steps.

Priming operations further prepare the body for finishing by applying various layers of coatings designed to protect the metal surface from corrosion and assure good adhesion of subsequent coatings. Prior to the application of these primer coats, however, plastic parts to be painted and finished with the body are installed.

A primer coating is applied to the body using an electrodeposition method, creating a strong bond between the coating and the body to provide a more durable coating. In electrodeposition, a negatively-charged auto body is immersed in a positively-charged bath of primer. The coating particles, insoluble in the liquid and positively-charged, migrate toward the body and are, in effect, "plated" onto the body surface.

Although the primer bath is mostly water-based with only small amounts of organic solvent (less than five percent to ten percent), fugitive emissions consisting of volatile organic compounds (VOCs) can occur. However, the amount of these emissions is quite small. In addition to solvents and pigments, the electrodeposition bath contains small amounts of lead.

Prior to baking, excess primer is removed through several rinsing stages. The rinsing operations use various systems to recover excess electrodeposited primer. Once the body is thoroughly rinsed, it is baked. VOC emissions resulting from the baking stage are generally incinerated.

Next, the body is further water-proofed by sealing spot-welded joints of the body. Water-proofing is accomplished through the application of a paste or putty-like substance. This sealant usually consists of polyvinyl chloride and small amounts of solvents. The body is again baked to ensure that the sealant adheres thoroughly to the spot-welded areas.

After water-proofing, the automobile body proceeds to the anti-chip booth. Here, a substance usually consisting of a urethane or an epoxy ester resin, in conjunction with solvents, is applied locally to certain areas along the base of the body, such as the rocker panel or the front of the car. This anti-chip substance protects the lower portions of the automobile body from small objects, such as rocks, which can fly up and damage automotive finishes.

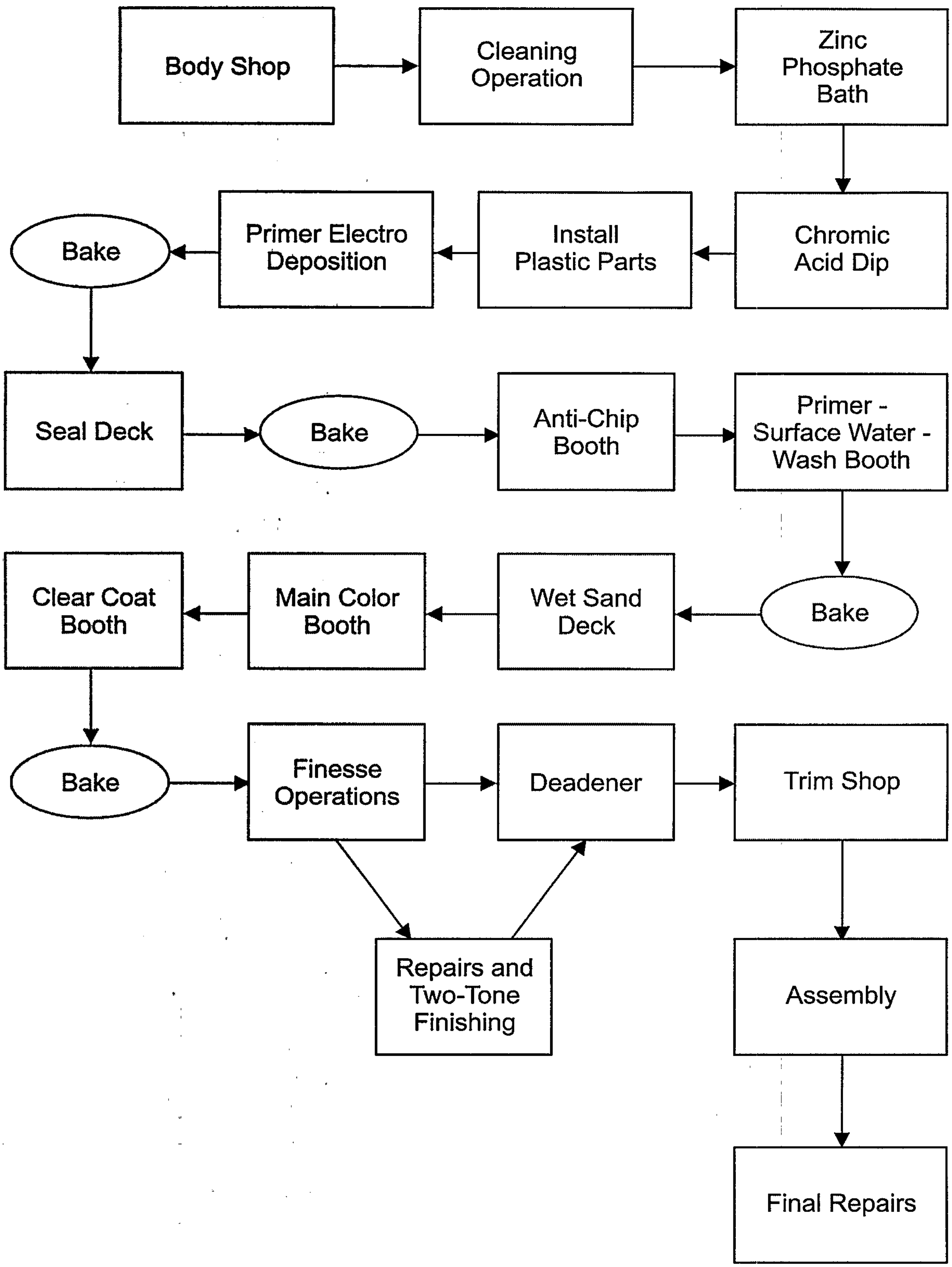


Figure 3-6. Car Painting Process

The primer-surfacer coating, unlike the initial electrodeposition primer coating, is applied by spray application in a water-wash spray booth. The primer-surfacer consists primarily of pigments, polyester or epoxy ester resins, and solvents. Due to the composition of this coating, the primer-surfacer creates a durable finish which can be sanded. The pigments used in this finish provide additional color layers in case the primary color coating is damaged. A continuous stream of air, usually from ceiling to floor, is used to transport airborne particulates and solvents from the primer-surfacer overspray. The air passes through a water curtain which captures a portion of the airborne solvents for reuse or treatment at a waste water facility. Efforts have been made at certain facilities to recycle this air to reduce VOC emissions.

After the primer-surfacer coating is baked, the body is then sanded, if necessary, to remove any dirt or coating flaws. This is accomplished using a dry sanding technique. Particulate matter is generated during this process.

The next step of the finishing process is the application of the primary color coating. This is accomplished in a manner similar to the application of primer-surfacer. One difference between these two steps is the amount of pigments and solvents used in the application process. VOC emissions from primary color coating operations can be double that released from primer-surfacer operations. In addition to the pigments and solvents, aluminum or mica flakes can be added to the primary color coating to create a finish with unique reflective qualities. Instead of baking, the primary color coat is allowed to "flash off," in other words, the solvent evaporates without the application of heat. This evaporation contributes to significant air emissions.

After the primary color coating is allowed to air-dry briefly, the final coating, a clear coat, is applied. The clear coat adds luster and durability to the automotive finish. This coating generally consists of a modified acrylic or a urethane and is baked on. Following the baking of the clear coat, the body is inspected for imperfections in the finish. Operators finesse minor flaws through light sanding and polishing and without any repainting.

Once the clear coat is baked, a coating known as deadener is applied to certain areas of the automobile underbody. Deadener, generally a solvent-based resin of tar-like consistency, is applied to areas such as the inside of wheel wells to reduce noise. In addition, anti-corrosion wax is applied to other areas, such as the inside of doors, to further seal the automobile body and prevent moisture damage. This wax contains aluminum flake pigment and is applied using a spray wand.

The finished vehicle is then inspected to ensure that no damage has occurred as a result of the final assembly stages. If there is major damage, the entire body part is replaced. However, if the damage is minor, such as a scratch, paint is taken to the end of the line and applied using a hand-operated spray gun.

Many of the wastes generated during automotive production are the result of painting and finishing operations. These operations result in air emissions as well as the generation of solid and liquid wastes.

Air emissions, primarily VOCs, result from the painting and finishing application processes (paint storage, mixing, applications, and drying) as well as cleaning operations. These emissions are composed mainly of organic solvents containing EPCRA Section 313 chemicals which are used as carriers for the paint. Solvents are also used during cleanup processes to clean spray equipment between color changes, and to clean portions of the spray booth. Solvents are often composed of a mixture of dimethyl-benzene, acetone, 4-methyl-2-pentanone, butyl ester acetic acid, light aromatic solvent naphtha, ethyl benzene, hydrotreated heavy naphtha, 2-butanone, toluene, and 1-butanol.

Various solid and liquid wastes may be generated throughout painting operations. These wastes generally contain the solvents with EPCRA Section 313 chemicals listed above. Solid and liquid wastes may also contain metals from paint pigments and organic solvents.

4.0 THRESHOLD DETERMINATIONS

This section reviews how accurately facilities determined whether EPCRA Section 313 chemicals exceeded TRI reporting thresholds and the extent to which incorrect threshold determinations ultimately affect the quality of the TRI database. Threshold determinations are a critical element in determining whether facilities must report the release and other waste management quantities of EPCRA Section 313 chemicals. More specifically, errors in threshold determinations can cause facilities to fail to submit Form Rs for chemicals that meet the reporting criteria, which may cause the TRI database to understate the magnitude of release and other waste management quantities. This section considers the following topics when evaluating how threshold determinations affect the quality of TRI data:

- Approaches commonly used to calculate thresholds (Section 4.1)
- Frequency of incorrect threshold determinations (Section 4.2)
- Reasons for making incorrect threshold determinations (Section 4.3)

The section concludes by reviewing key findings and offering several recommendations for improving future reporting practices.

This section does not differentiate facilities that submitted Form R reports from those facilities that submitted Form A reports (i.e., alternate certification statements). Section 7 of this report provides specific details on the frequency with which facilities choose to submit Form As.

4.1 Approaches Used for Determining Thresholds

This subsection summarizes the approaches that the surveyed facilities used to calculate thresholds and correlates selected approaches with the accuracy of threshold determinations. For every EPCRA Section 313 report reviewed during the site visits, surveyors documented the approach used to determine thresholds using the following categories:

- Purchasing data and inventory records;
- Emission factors;

- Mass balance;
- Assumed a threshold was exceeded;
- Process recipes;
- Monitoring data;
- Production data; and/or
- Other.

During each site visit, surveyors reviewed information in the facility's supporting documentation to identify which approach, or which combination of approaches, was used to calculate thresholds. In cases where a facility's documentation was incomplete, site surveyors identified an approach that could reasonably have been used to estimate thresholds. Figure 4-1 summarizes the approaches that facilities in SIC Codes 33, 36, and 37 most commonly used to estimate thresholds for the chemicals that were reported to the TRI database. The figure indicates some notable trends:

- For all industries considered, facilities most often used purchasing data, inventory records, and process recipes to calculate thresholds for chemicals during RY 1996. Site surveys conducted following RYs 1987, 1988, 1994, and 1995 also found facilities frequently used these same approaches to calculate thresholds. The site surveyors generally agreed that facilities' use of purchasing data, inventory data, and process recipes was an appropriate approach for estimating thresholds, particularly for raw materials.

- Facilities in the primary metals industry (SIC Code 33) and the electronic and other electrical equipment industry (SIC Code 36) were twice as likely to assume that a threshold was exceeded than facilities in the transportation equipment industry (SIC Code 37). Previous analyses of site visit data found facilities that assume thresholds are exceeded are more likely to make incorrect threshold determinations than facilities that calculate actual quantities of chemicals manufactured, processed, and otherwise used. Sections 4.2 through 4.4 revisit the effect of assuming thresholds are exceeded on the quality of the TRI database.

4.2 Frequency of Incorrect Threshold Determinations

The following analyses indicate the frequency and type of incorrect threshold determinations made by facilities and project how erroneous determinations ultimately affect the quality of the TRI database. During site visits, surveyors used information provided by facility contacts to calculate thresholds for all EPCRA Section 313 chemicals that were manufactured, processed, or otherwise used. Based on these calculations and the required reporting threshold quantities, surveyors then listed the chemicals for which the facilities should have submitted EPCRA Section 313 reports. Errors in threshold determinations were identified by comparing the list of chemicals that the surveyor determined had exceeded thresholds to the list of chemicals for which facilities actually submitted EPCRA Section 313 reports. These comparisons yielded four possible outcomes:

- The facility submitted an EPCRA Section 313 report (i.e., either a Form R or a Form A) for a chemical that exceeded a threshold;
- The facility did not submit an EPCRA Section 313 report for a chemical that did not exceed a threshold;
- The facility submitted an EPCRA Section 313 report for a chemical that did not exceed a threshold; or
- The facility did not submit an EPCRA Section 313 report for a chemical that exceeded a threshold.

In the first two outcomes, the facilities correctly determined thresholds. The third outcome represents an incorrect threshold determination that causes facilities to unnecessarily submit Form Rs or Form As. The fourth outcome represents an incorrect threshold determination, and therefore causes facilities to fail to meet their statutory requirement of reporting environmental release and other waste management quantities to the TRI database. Important "right-to-know" information is then unavailable to the public.

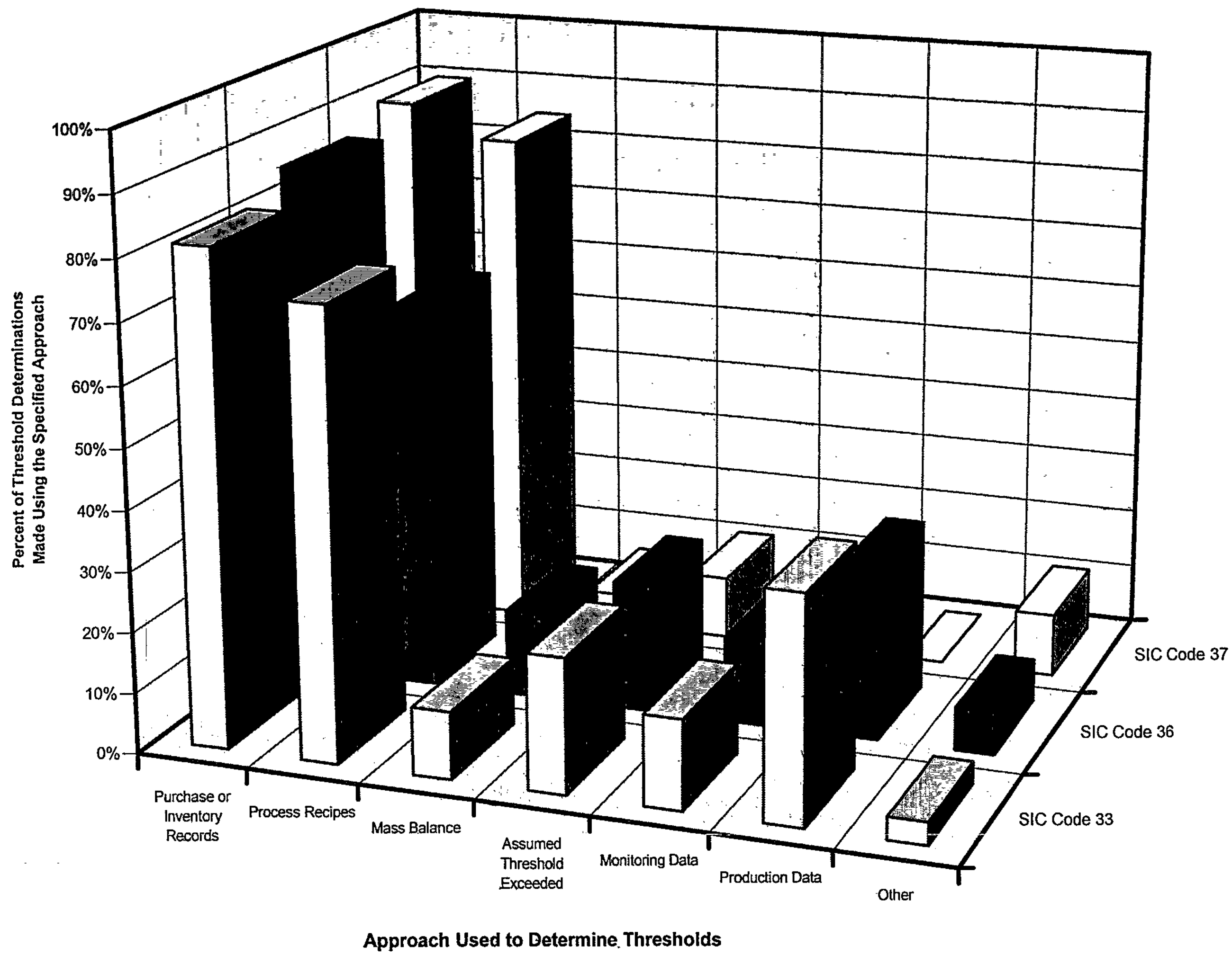


Figure 4-1. Approaches Used by Facilities to Make Threshold Determinations

Using the four possible outcomes, Tables 4-1, 4-2, and 4-3 and Figure 4-2 summarize the frequency that facilities made correct and incorrect threshold determinations during RY 1996. The tables and figure suggest several important observations:

- Over all SIC Codes considered, facilities determined thresholds correctly for over 90% of the EPCRA Section 313 chemicals used at their respective plants. According to a trend analysis of threshold determinations (see Table 4-3), the site survey project has found that the percentage of making correct threshold determinations has remained relatively constant over RYs 1987, 1988, 1994, 1995, and 1996.

- Facilities visited in the primary metals industry (SIC 33) had the highest frequency (8.3%) of incorrect threshold determinations, and most of the incorrect determinations were made for metals and metal compounds. The incorrect determinations were nearly evenly split between failing to submit EPCRA Section 313 reports for chemicals that exceeded thresholds (4.3% of errors) and submitting EPCRA Section 313 reports for chemicals that did not exceed thresholds (4.0% of errors). The impact of incorrect threshold determinations on the quality of the entire TRI database can be estimated by scaling the results of the current site visits up to the 6,603 EPCRA Section 313 reports that were submitted for RY 1996 for all facilities in SIC 33.[1] For example, the site surveyors concluded that 11 EPCRA Section 313 reports out of the 75 reports that were submitted by the selected facilities were actually for chemicals that did not exceed thresholds (see Table 4-1). This fact suggests that 970 of the 6,603 EPCRA Section 313 reports filed by facilities in SIC 33 for reporting year 1996 also were filed for chemicals that did not exceed thresholds. Similarly, the site surveyors concluded that the selected facilities should have submitted 12 EPCRA Section 313 reports in addition to the 75 that were reviewed, which suggests that facilities in SIC 33 should have submitted an additional 1,100 reports to TRI (see Table 4-2).

[1] These extrapolations assume the reporting practices of the facilities visited are representative of the reporting practices of the industry as a whole.

Table 4-1

Accuracy of Threshold Determinations for Reporting Year 1996, by SIC Code

Threshold Determination Outcome		Number of EPCRA Section 313 Chemicals Reviewed, by SIC Code *(Percent of Total Chemicals Reviewed in the SIC Code Is Shown in Parentheses)*		
		SIC Code 33 (primary metals)	**SIC Code 36 (electronic equipment)**	**SIC Code 37 (transportation equipment)**
Total number of EPCRA Section 313 reports submitted by facilities that were visited		75	41	75
Correct threshold determinations	Facility submitted an EPCRA Section 313 report for a chemical that exceeded a threshold	64 *(23.2%)*	41 *(24.1%)*	68 *(18.2%)*
	Facility did not submit an EPCRA Section 313 report for a chemical that did not exceed a threshold	189 *(68.5%)*	122 *(71.8%)*	294 *(78.8%)*
Incorrect threshold determinations	Facility submitted an EPCRA Section 313 report for a chemical that did not exceed a threshold	11 *(4.0%)*	0 *(0.0%)*	7 *(1.9%)*
	Facility did not submit an EPCRA Section 313 report for a chemical that exceeded a threshold	12 *(4.3%)*	7 *(4.1%)*	4 *(1.1%)*

Table 4-2

Estimated Impact of Incorrect Threshold Determinations on the Number of EPCRA Section 313 Reports Submitted to EPA

SIC Code (industry)	Total number of EPCRA Section 313 reports filed by facilities in the industry for RY 1996	Estimated number of EPCRA Section 313 reports that were filed in RY 1996 for chemicals that did not exceed thresholds	Estimated number of additional EPCRA Section 313 reports that should have been filed in RY 1996
33 (Primary metals)	6,603	970	1,100
36 (Electronics equipment)	3,121	0	530
37 (Transportation equipment)	4,331	400	230

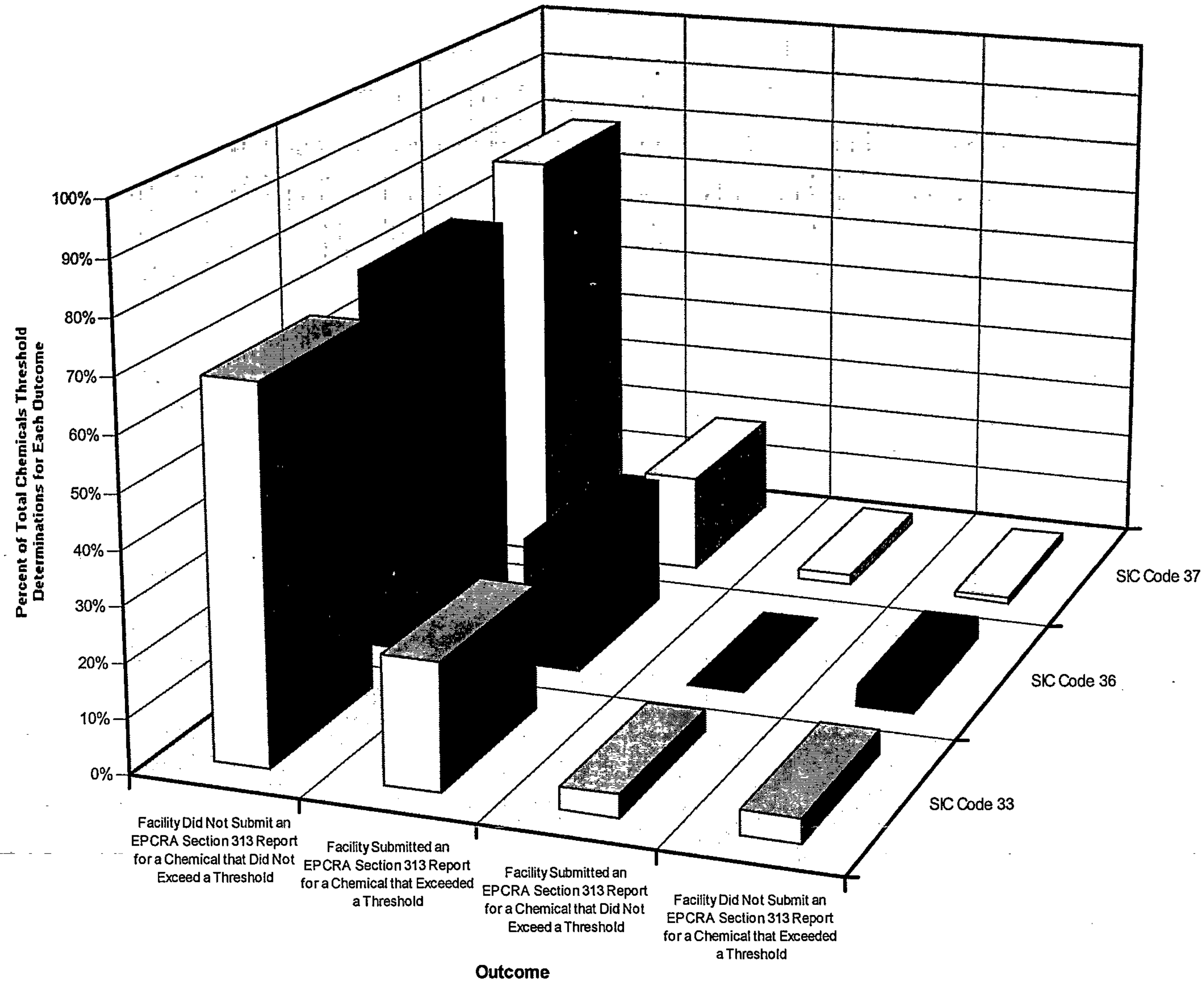
Note: Projections in this table were calculated from the data presented in Section 1 and assume that the reporting practices of the facilities visited during the site survey program are representative of the reporting practices of the facilities in the entire industry.

Table 4-3

Accuracy of Threshold Determinations by Reporting Year

Reporting Year	SIC Codes	Percent of Correct Threshold Determinations
1987	20-39	93.0%
1988	28, 291, 34-36	94.5%
1994	25, 281, 285, 30	93.3%
1995	26, 286	93.0%
1996	33, 36, 37	95.0%

Note: Refer to 1994 and 1995 Toxic Release Inventory Data Quality Report, USEPA, March 1998 for threshold determination data for reporting years 1987, 1988, 1994, and 1995.



Data for this figure can be found in Table 4-1.

Figure 4-2. Accuracy of Threshold Determinations by SIC Code

- Facilities visited in the electronics equipment industry (SIC Code 36) made incorrect threshold determinations less frequently than facilities in the primary metals industry (SIC Code 33); however, every incorrect threshold determination observed for facilities manufacturing electronics equipment resulted in the facilities failing to submit EPCRA Section 313 reports for chemicals that actually exceeded thresholds. Most of the incorrect threshold determinations were made for inorganic acids. Using the same extrapolation scheme presented in the previous bulleted item, the frequency of incorrect threshold determinations suggest that, on average, facilities in SIC Code 36 should have filed 530 EPCRA Section 313 reports in reporting year 1996, beyond the 3,121 reports actually filed (see Table 4-2).

- Facilities visited in the transportation equipment industry (SIC Code 37) made the fewest incorrect threshold determination errors of the three industries considered in the latest site survey program. The incorrect threshold determinations for this industry included metals, inorganic acids, and organic compounds. Of the 75 EPCRA Section 313 reports that site surveyors reviewed for facilities in this industry, seven were filed for chemicals that did not exceed thresholds. Further, site surveyors concluded that facilities did not submit EPCRA Section 313 reports for an additional four chemicals. Extrapolating the frequency of incorrect threshold determinations to the entire industry, the site survey results suggest that 400 of the 4,331 EPCRA Section 313 reports filed by facilities in SIC Code 37 for reporting year 1996 were for chemicals that did not exceed thresholds, and that an additional 230 reports should have been filed by facilities in this industry (see Table 4-2).

In summary, site surveyors found that in the industries surveyed, 95% of threshold determinations are made correctly, considering chemicals that both exceed and do not exceed thresholds. When only chemicals that actually exceed thresholds are considered, surveyors found that they were correctly reported as exceeding thresholds 88% of the time. Consistent with findings from previous years, the industry that had the fewest errors (SIC Code 37) was also the industry that was least likely to assume that thresholds were exceeded.

4.3 Reasons for Making Incorrect Threshold Determinations

This section summarizes why facilities made incorrect threshold determinations. During the site visits, surveyors classified the reasons for making each incorrect threshold determination into several general categories. The site surveyors identified the reasons for erroneous threshold calculations from discussions with facility personnel and from information in supporting documentation kept at the facility. The following discussion first explains why facilities failed to submit EPCRA Section 313 reports for chemicals that exceeded thresholds, then explains why facilities submitted reports for chemicals that did not exceed thresholds.

4.3.1 Reasons Why Facilities Failed to Submit EPCRA Section 313 Reports for Chemicals That Exceeded Thresholds

Table 4-4 summarizes the reasons why facilities failed to submit EPCRA Section 313 reports for chemicals that exceeded thresholds during reporting year 1996. As shown in the table, the most common reason why facilities did not identify chemicals used above threshold levels was because facilities simply overlooked the use of EPCRA Section 313 chemicals. Only two of the facilities visited made calculation errors that led to the erroneous conclusion that a chemical was not used at reportable levels. None of the facilities visited failed to submit reports due to misclassifying a chemical activity between "manufacture," "process," or "otherwise use." Other reasons for making incorrect threshold determinations all represent cases where facilities misinterpreted reporting exemptions or some other aspect of the reporting instructions. The following lists provide further insight into why facilities made incorrect threshold determinations, and indicate specific examples of errors documented during site visits:

Overlooking a chemical activity:

- To determine which chemicals exceed reporting thresholds, representatives from a steel mill calculated annual usage of metal alloys that are added to an electric arc furnace. The site surveyor noted that scrap metal used at the facility probably included other metal alloys that were not accounted for by the facility's calculations. Analytical data for baghouse dusts and hazardous waste manifests suggested that the steel mill "processed" two additional metal compounds at levels exceeding 25,000 pounds.

- A manufacturer of transportation equipment was aware that the painting operations at the facility used glycol ethers but assumed that the usage could not possibly have exceeded threshold quantities. Review of purchasing data indicated that total annual usage was significantly greater than threshold amounts.

Table 4-4

Reasons Why Facilities Failed to Submit EPCRA Section 313 Reports for Chemicals That Exceeded Thresholds

Reason for not submitting a report for a chemical that exceeded a threshold	**Number of chemicals that were not reported for the listed reason, by SIC Code** *(percent of total shown in parentheses)*		
	SIC Code 33	**SIC Code 36**	**SIC Code 37**
Chemical was overlooked	10 *(83%)*	2 *(29%)*	3 *(75%)*
Chemical activity was misclassified	0 *(0%)*	0 *(0%)*	0 *(0%)*
Threshold quantity was miscalculated	0 *(0%)*	2 *(29%)*	0 *(0%)*
Other	2 *(17%)*	3 *(42%)*	1 *(25%)*
Total number of errors	12	7	4

Misinterpreting reporting instructions:

- A semiconductor manufacturer used hydrochloric acid and sulfuric acid in a series of enclosed spray-cleaning operations. The facility thought that the "acid aerosols" activity qualifier for these chemicals applied only to "acid aerosols" found in ambient air, and not enclosed equipment. The site surveyor noted that any hydrochloric or sulfuric acid in aerosol form—even aerosols present in enclosed spray-cleaning operations—should be counted towards thresholds.

- A metals processing facility was aware that it "processed" over 25,000 pounds of copper, but thought the copper wire was used only as an article. Noting that the facility's processes cause releases of some copper and change the original size of the wire, the site surveyor concluded that the article exemption did not apply.

4.3.2 Reasons Why Facilities Submitted EPCRA Section 313 Reports for Chemicals That Did Not Exceed Thresholds

Table 4-5 summarizes why facilities submitted EPCRA Section 313 reports for chemicals that did not exceed thresholds during reporting year 1996. Clearly, there were many different reasons why facilities made incorrect threshold determinations, with no single reason dominating the site survey results. (The "other" category included several different reasons for making incorrect threshold determinations.) The following list provides further insight into why facilities made incorrect threshold determinations and describes specific instances when site surveyors concluded that facilities submitted an EPCRA Section 313 report for a chemical that did not exceed a threshold:

- A metals processing facility calculated a 35,000-pound threshold for aluminum, but did not account for the "fume or dust" activity qualifier. The site surveyor noted that the facility actually "processed" less than 2,000 pounds of aluminum "fume or dust."

- A facility submitted reports for all chemicals that were "manufactured," "processed," or "otherwise used" in quantities greater than 10,000 pounds per year, including for N,N-dimethylformamide, of which the facility "processed" approximately 15,000 pounds. The site surveyor noted that the 10,000 pound threshold applies only to chemicals that are "otherwise used" and that a 25,000 pound threshold applies to chemicals that are "manufactured" or "processed." As a result, the surveyor concluded that the facility should not have reported for N,N-dimethylformamide.

Table 4-5

Reasons Why Facilities Submitted EPCRA Section 313 Reports for Chemicals That Did Not Exceed Thresholds

Reason for submitting a report for a chemical that did not exceed a threshold	Number of chemicals that were reported for the listed reason, by SIC Code *(percent of total shown in parentheses)*		
	SIC Code 33	SIC Code 36	SIC Code 37
Decided to report, even though aware that the chemical usage was below threshold levels	2 *(18%)*	NA	2 *(29%)*
Chemical activity misclassified	0 *(0%)*	NA	3 *(43%)*
Miscalculated the threshold quantity	1 *(9%)*	NA	0 *(0%)*
Chemical was delisted or modified	2 *(18%)*	NA	0 *(0%)*
Other	6 *(55%)*	NA	2 *(29%)*
Total number of errors	11	0	7

NA: Not applicable. None of the facilities in SIC 36 that were visited submitted an EPCRA Section 313 report for a chemical that did not exceed a threshold.

- A smelting facility kept a detailed materials inventory which indicated that the facility "processed" over 25,000 pounds of chromium and manganese. The site surveyor noticed that these metals were trace impurities in the facility's processes and probably were never present at concentrations exceeding *de minimis* levels. Based on a detailed review of Material Safety Data Sheets (MSDS)s, laboratory analytical data, and usage records, the site surveyor concluded that the *de minimis* exemption applied to the metals and that the facility should not have filed the corresponding EPCRA Section 313 reports.

- A facility submitted a Form R for phosphoric acid in every reporting year since 1987. In RY 1996, however, the facility noted that usage of phosphoric acid was below the corresponding thresholds. Fearing that not submitting a Form R for a chemical that was previously reported might somehow trigger an audit or enforcement response, the facility reported for phosphoric acid anyway.

As noted previously, Section 4.4 lists several recommendations to help facilities avoid making similar errors in future reporting years when determining which chemicals exceed thresholds.

4.3.3 Chemical Activity Classification

Because appropriate TRI reporting thresholds (e.g., 10,000 or 25,000 pounds) depend on how facilities use EPCRA Section 313 chemicals, it is important that facilities correctly classify chemical activities as either "manufacture," "process," or "otherwise use." Table 4-5 indicates that facilities in SIC Code 37 incorrectly submitted EPCRA Section 313 reports for three chemicals that exceeded thresholds as a result of misclassifying the chemical activities. To evaluate how accurately facilities classify chemicals, site surveyors documented activities for all EPCRA Section 313 chemicals based on information provided by facility contacts and on observations made during facility tours. Figure 4-3, which compares chemical activity classifications made by facilities to those made by site surveyors for RY 1996, suggests that the site surveyors generally agreed with the chemical activity classifications that facilities indicated on their EPCRA Section 313 reports. Site surveyors did not notice consistent reasons why facilities misclassified chemical usage.

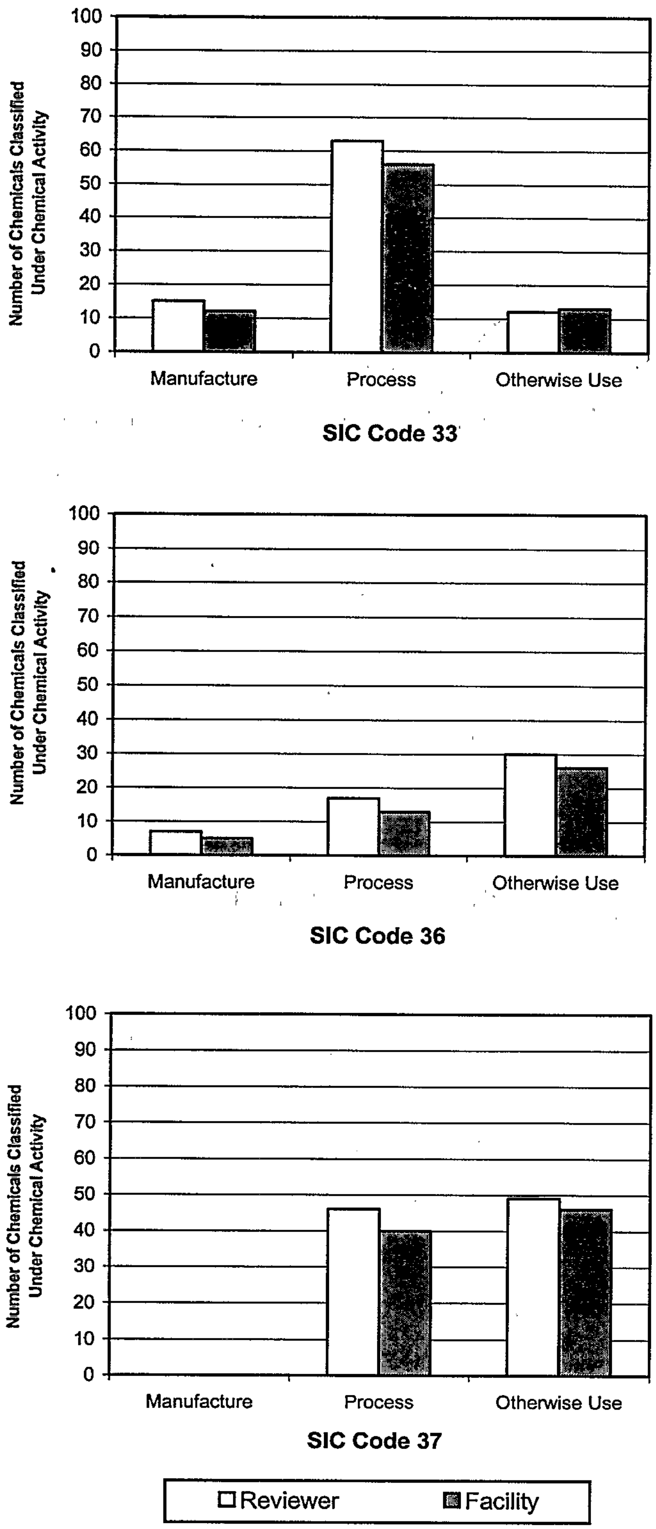


Figure 4-3. Comparison of Chemical Activity Classifications Made by Facilities to Those Made by Reviewers

4.3.4 Impact of Not Calculating Thresholds

An important factor to consider in the accuracy of threshold determinations is whether facilities actually calculated threshold levels for EPCRA Section 313 chemicals or whether they just assumed that thresholds were or were not exceeded. At each facility visited, site surveyors used feedback from facility contacts and data in supporting documentation to determine which method was adopted to make threshold determinations. For EPCRA Section 313 chemicals found to exceed reporting thresholds, Table 4-6 summarizes the frequency with which facilities in the selected industries actually calculated annual usages. Not surprisingly, facilities in the industries that calculated thresholds least often (SIC Code 33 and SIC Code 36) made more errors when determining thresholds than facilities in the industry that calculated thresholds more frequently (SIC Code 37). This observation, which is consistent with findings from site visits for reporting year 1994 and 1995[1], suggests that errors in threshold determinations may be significantly reduced if facilities actually calculate annual usages for EPCRA Section 313 chemicals, as opposed to assuming that chemicals are below or above reporting thresholds. Section 4.4 further discusses this issue.

4.3.5 Other Factors Correlating with the Frequency of Incorrect Threshold Determinations

As noted on the Survey Instrument (see Appendix A), site surveyors collected additional data from facilities on factors that are suspected to affect the quality of TRI reporting. These additional data include, but are not limited to, the amount of time facilities spend to prepare EPCRA Section 313 reports, the frequency with which facilities call the EPCRA hotline, and the title or position of the persons who completed a facility's EPCRA Section 313 reports. Comparing the frequency of making incorrect threshold determinations with these additional data revealed two interesting trends:

Table 4-6

Frequency with Which Facilities Calculated Thresholds for EPCRA Section 313 Chemicals, by SIC Code

SIC Code	Percent of Chemicals Reviewed by Site Surveyors for Which Facilities Calculated Thresholds
33	58.6%
36	81.3%
37	93.7%

Note: Data based on (1) chemicals that facilities submitted Form Rs or Form As and (2) chemicals that were "incorrectly not reported" (see Section 4.2 for definition).

- Industries in which "facility environmental staff" prepared EPCRA Section 313 reports tended to make the least amount of incorrect threshold determinations. More specifically, 68% of facilities in SIC Code 37 had "facility environmental staff" prepare EPCRA Section 313 reports, compared to 57 percent of facilities in SIC Code 36 and just 33% of facilities in SIC Code 33. (See Section 7 for further information on these distributions.)

- Industries in which the EPCRA Section 313 report preparers call the EPCRA hotline most frequently were found to make the least number of incorrect threshold determinations. More specifically, 68% of the facilities visited in SIC Code 37 called the EPCRA hotline, while 57% of the facilities visited in SIC Code 36 and only 48% of facilities visited in SIC Code 33 called the EPCRA hotline. (Again, see Section 7 for further information on these distributions.)

Although the previous associations between the type of staff completing EPCRA Section 313 reports and the frequency with which staff consult the EPCRA hotline appear to correlate with the accuracy of threshold determinations, further study is needed to determine whether this trend is statistically significant and applicable to other industries.

4.4 Lessons Learned

In summary, site surveyors found that facilities in the transportation equipment industry (SIC Code 37) determined thresholds more accurately than facilities in the primary metals and electronic equipment industries (SIC Codes 33 and 36). Although many factors likely contribute to this trend, the survey results suggest that facilities that calculate thresholds for EPCRA Section 313 chemicals make fewer incorrect threshold determinations than facilities that assume thresholds are exceeded.

Overall, facilities correctly calculated thresholds for 95% of the EPCRA Section 313 chemicals used at the selected industries. However, the frequency of incorrect threshold determinations suggests that the TRI database might not account for a significant quantity of chemicals used at reportable levels. More specifically, the site survey results suggest that for RY 1996, facilities correctly reported for 88% of the chemicals that actually exceeded thresholds.

Although the nature and extent of threshold determinations varies from one industry to the next, some general lessons can be learned from the mistakes identified by the site surveyors. Section 8 further discusses this issue.

5.0 SOURCES AND TYPES OF RELEASE AND OTHER WASTE MANAGEMENT ACTIVITIES

This section provides an overview of the sources of on-site releases and both on-site and off-site waste management activities. It also discusses corresponding release and other waste management activity types as they pertain to the RY 1996 Form R. Errors and oversights in identifying potential sources of chemical usage can result in significant errors when estimating the quantity released and otherwise managed as waste. Similarly, misidentifying the type of release or other waste management activity can result in data being misclassified in the TRI database. This section analyzes the frequency and types of errors facilities have made in identifying the sources and types of release and other waste management activities. The analysis can help identify the reasons for certain systematic errors made by the regulated community, in general, and by the specific industries visited, in particular. Once the reasons are identified, EPA can take appropriate action to help facilities reduce the frequency of errors, and thereby increase the accuracy of the estimates.

This section considers the following topics when evaluating how release and other waste management estimates affect the quality of TRI data:

- Distribution of release and other waste management activity sources and release and other waste management activity types within each SIC Code (Section 5.1);
- Incorrectly reported release and other waste management activity types (Section 5.2);
- Overlooked release and other waste management activities (Section 5.3);
- Calculation methodologies (Section 5.4); and
- On-site waste management activities (Section 5.5).

Trends and corresponding qualitative discussions regarding observations made during the site visits are presented as applicable, and issues that are specific to individual industries or unit operations are discussed whenever possible. The information combined with the quantitative data presented in Section 6 will help determine the primary sources of error in data entered in the TRI database.

For the purposes of this report, "sources" mean the streams or unit operations that generate the potential release or other waste management activity (such as process vents, container residue, or spills) and "types" mean the ultimate disposition of the release or other waste management activity corresponding to elements in Sections 5 through 7 of the RY 1996 Form R (such as releases to fugitive air, releases to stack air, discharges to a publicly owned treatment works (POTW), releases to land, and transfers to off-site disposal). In most cases, this section presents data both in a tabular form for quantitative analysis and in a graphical format for qualitative trend analyses. Data are presented for RY 1996 for each of the three major SIC Codes visited (33, 36, and 37). A trend analysis between these SIC Codes has been conducted and a general comparison to the findings from previous survey efforts is made when applicable (see *1994 and 1995 Toxic Chemical Release Inventory Data Quality Report,* EPA 745-R-98-002, for details on results of surveys in SIC Codes 25, 26, 281, 285, 286, and 30).

5.1 Observed Release and Other Waste Management Activities

Table 5-1 presents the distribution of sources and the corresponding types of release or other waste management activity that was observed during the site visits for SIC Codes 33, 36, and 37. One facility may have multiple sources for a given type. Therefore, a "total" row is included to show the percent of facilities that had at least one source for the given type. Note that, for on-site energy recovery, on-site treatment, and on-site recycling, data were not available for distribution from specific sources. Figure 5-1a presents the "totals" by type of release and other waste management activity and Figures 5-1b through 5-1g present the data graphically by source for each release type and management activity. No transfers to underground injection were reported or observed; therefore, no corresponding figure is presented.

Site surveyors identified fugitive air releases at most facilities in these SIC Codes (59% to 74%). However, the percent of facilities with fugitive air releases was less than the percent observed in site visits conducted in RYs 1994 and 1995, when nearly all facilities had fugitive air releases. (Releases of 67% in SIC Code 30 and 80% to 100% in SIC Codes 286, 26, 25, 281, and 285.) A lower percentage was expected for the RY 1996 study, because fewer volatile organic chemicals and significantly more inorganic chemicals are processed and used in SIC Codes 33,

Table 5-1

Distribution of Sources and Types of Release and Other Waste Management Activities

Release or Other Waste Management Activity Type	Source	Percent of Facilities with Releases or Waste Management Activities		
		SIC Code 33	SIC Code 36	SIC Code 37
Fugitive	Volatilization from process areas	51.9%	64.3%	68.4%
	Pumps/valves/flanges	7.4%	21.4%	15.8
	Storage tank/stock pile losses	3.7%	28.6%	15.8%
	Housekeeping practices/waste cleanup	11.1%	21.4%	5.3%
	Accidental spills/releases	11.1%	14.3%	5.3%
	Volatilization from treatment areas	3.7%	0.0%	5.3%
	Other[a]	11.1%	0.0%	0.0%
	TOTAL Reporting Release from at Least One Source[b]:	**59.3%**	**64.3%**	**73.7%**
Stack	Volatilization from process areas	59.3%	85.7%	68.4%
	Pumps/valves/flanges	0.0%	21.4%	5.3%
	Storage tank/stock pile losses	3.7%	21.4%	15.8%
	Housekeeping practices/waste cleanup	0.0%	14.3%	5.3%
	Accidental spills/releases	0.0%	7.1%	0.0%
	Volatilization from treatment areas	7.4%	28.6%	15.8%
	Process discharge streams	0.0%	0.0%	5.3%
	Other[a]	18.5%	0.0%	0.0%
	TOTAL Reporting Release from at Least One Source[b]:	**63.0%**	**85.7%**	**68.4%**
Receiving Stream/ Surface Water	Housekeeping practices/waste cleanup	3.7%	0.0%	0.0%
	Accidental spills/releases	0.0%	7.1%	5.3%
	Waste treatment discharge streams	7.4%	0.0%	0.0%

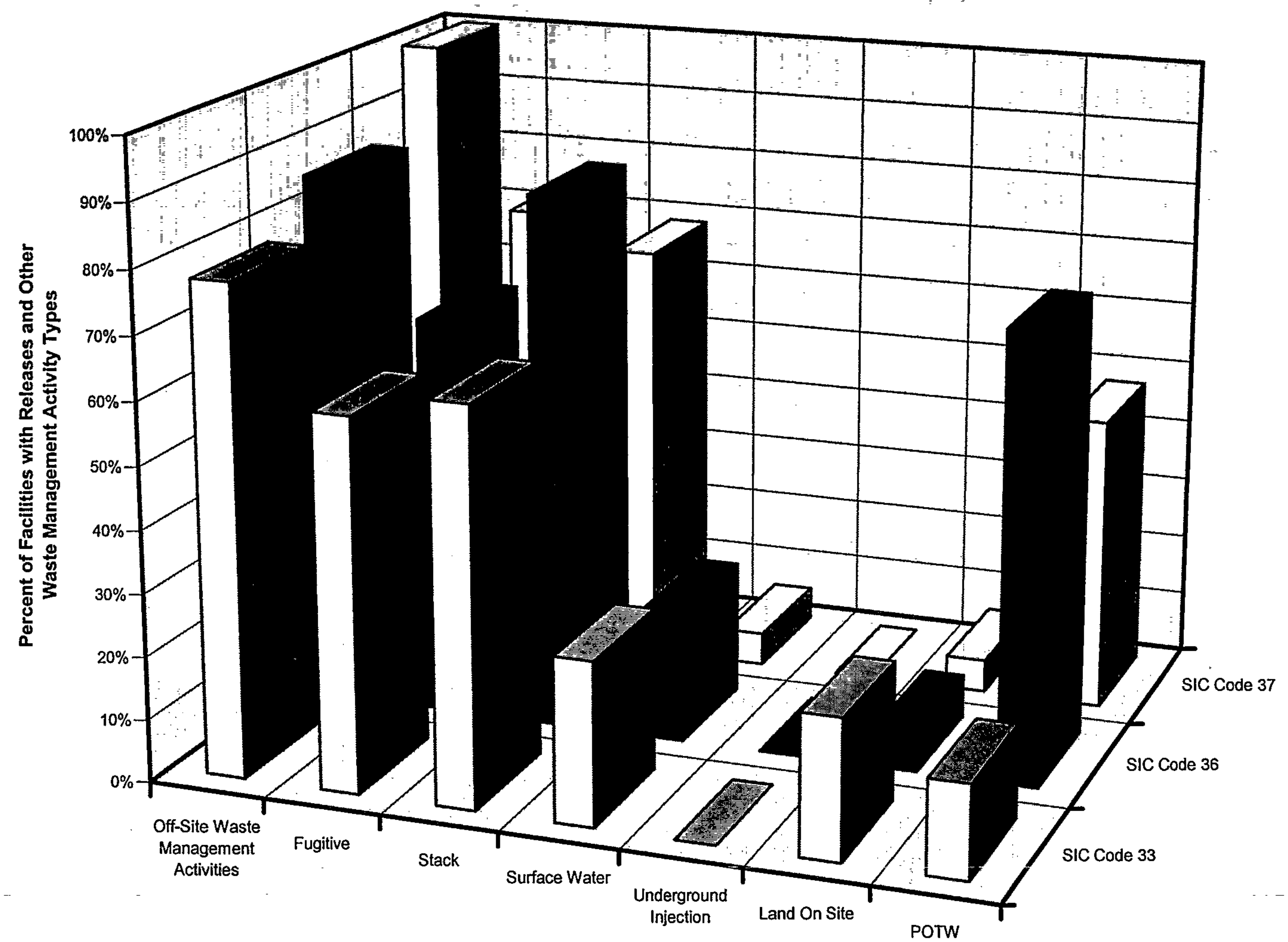
Table 5-1 (Continued)

Release or Other Waste Management Activity Type	Source	Percent of Facilities with Releases or Waste Management Activities		
		SIC Code 33	SIC Code 36	SIC Code 37
Receiving Stream/ Surface Water (Cont.)	Stormwater runoff	22.2%	21.4%	5.3%
	Process discharge streams	3.7%	0.0%	0.0%
	TOTAL Reporting Release from at Least One Source[b]:	**25.9%**	**21.4%**	**5.3%**
Underground Injection	**TOTAL Reporting Release from at Least One Source[b]:**	**0.0%**	**0.0%**	**0.0%**
Land On Site	Accidental spills/releases	11.1%	7.1%	5.3%
	Process discharge streams	3.7%	0.0%	0.0%
	Treatment sludges, recycling or energy recovery by-products	3.7%	0.0%	0.0%
	Other[a]	3.7%	0.0%	0.0%
	TOTAL Reporting Release from at Least One Source[b]:	**22.2%**	**7.1%**	**5.3%**
POTW	Housekeeping practices/waste cleanup	0.0%	14.3%	0.0%
	Accidental spills/releases	0.0%	21.4%	5.3%
	Waste treatment discharge streams	3.7%	64.3%	36.8%
	Stormwater runoff	3.7%	0.0%	0.0%
	Process discharge streams	7.4%	28.6%	26.3%
	TOTAL Reporting Release from at Least One Source[b]:	**14.8%**	**71.4%**	**47.4%**
Off-Site Transfer	Housekeeping practices/waste cleanup	33.3%	35.7%	31.6%
	Accidental spills/releases	11.1%	7.1%	10.5%
	Waste treatment discharge streams	25.9%	21.4%	10.5%
	Process discharge streams	70.4%	85.7%	84.2%
	Container residue	3.7%	7.1%	26.3%

Table 5-1 (Continued)

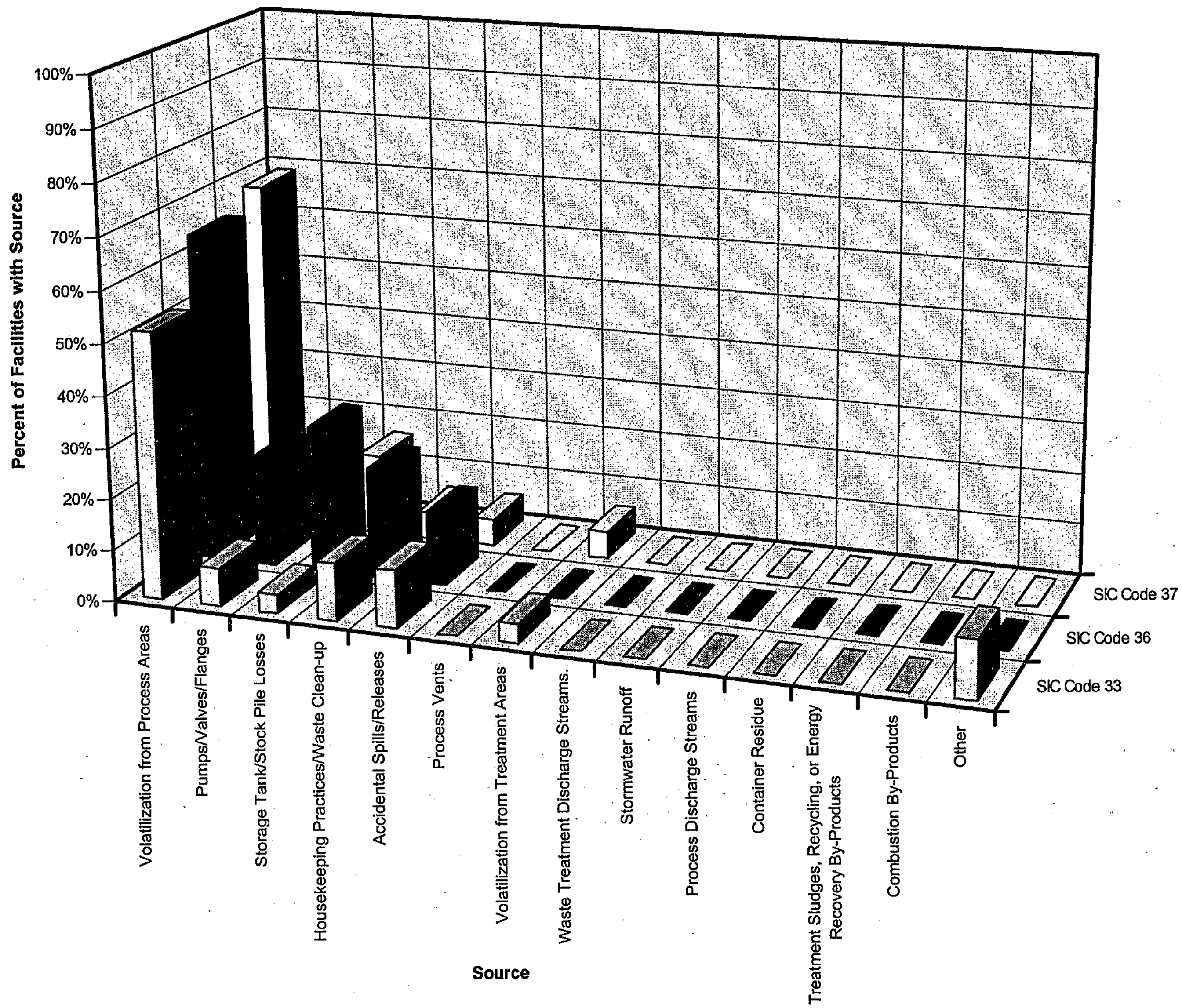
Release or Other Waste Management Activity Type	Source	Percent of Facilities with Releases or Waste Management Activities		
		SIC Code 33	SIC Code 36	SIC Code 37
Off-Site Transfer (Cont.)	Treatment sludges, recycling or energy recovery by-products	33.3%	42.9%	31.6%
	Other[a]	0.0%	0.0%	21.1%
	TOTAL Reporting Release from at Least One Source[b]:	**77.8%**	**85.7%**	**100.0%**
On-Site Energy Recovery[c]	**TOTAL Reporting Releases from at Least One Source:**	**0.0%**	**14.3%**	**10.5%**
On-Site Treatment[c]	**TOTAL Reporting Releases from at Least One Source:**	**54.2%**	**71.4%**	**36.8%**
On-Site Recycle[c]	**TOTAL Reporting Releases from at Least One Source:**	**12.5%**	**7.1%**	**0.0%**

[a]Sources listed as "other" include: dust releases from air pollution control devices (baghouses, electrostatic precipitators, and rotoclones), off-spec product, and remedial actions.
[b]Total is not additive. Facilities may report a release type from multiple sources.
[c] Data not available for distribution from individual sources.



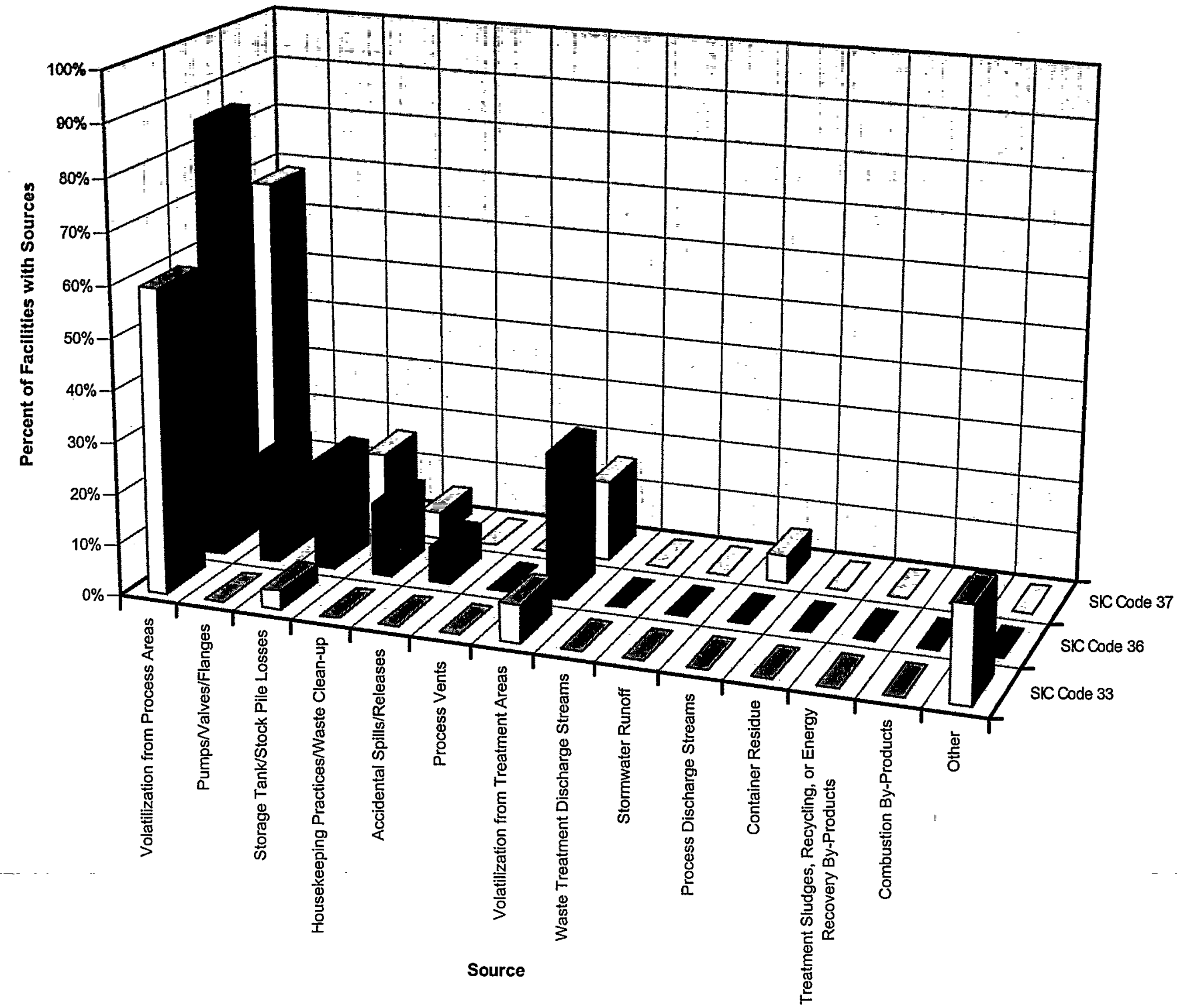
Data for this figure can be found on Table 5-1.

Figure 5-1a. Distribution of Release and Other Waste Management Activity Types (RY 1996)



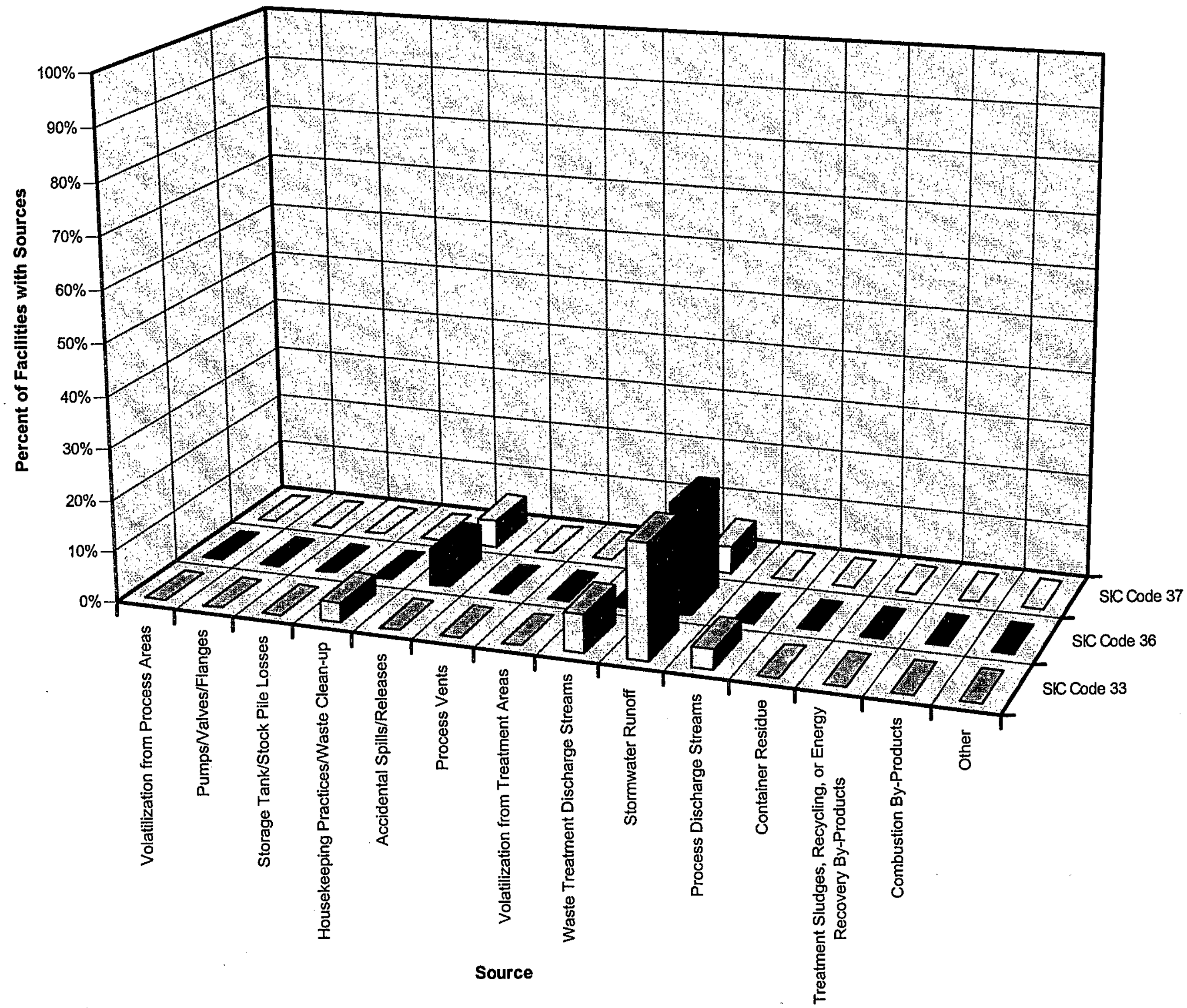
Data for this figure can be found on Table 5-1.

Figure 5-1b. Distribution of Sources for Fugitive Releases



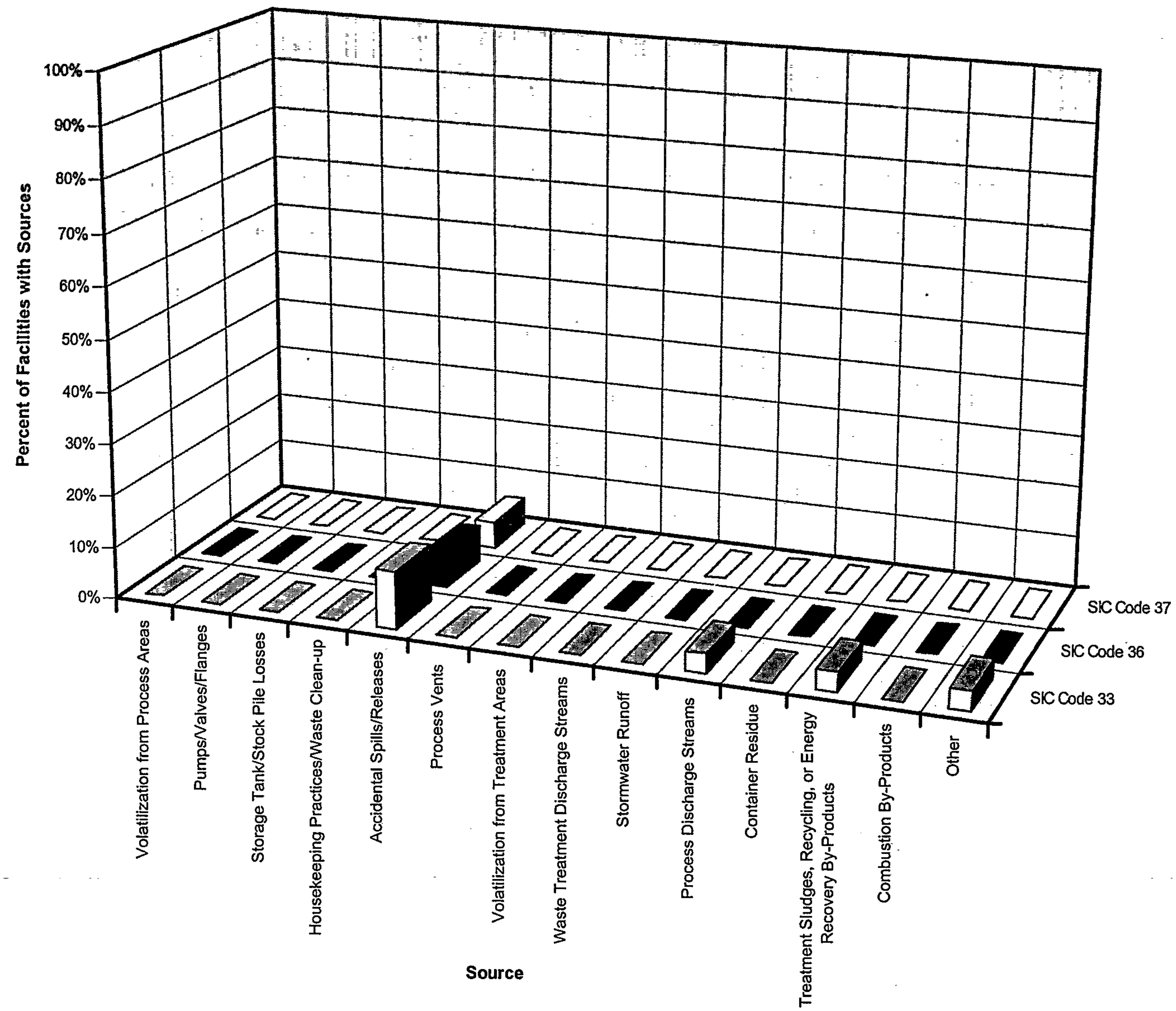
Data for this figure can be found on Table 5-1.

Figure 5-1c. Distribution of Sources for Stack Releases (RY 1996)



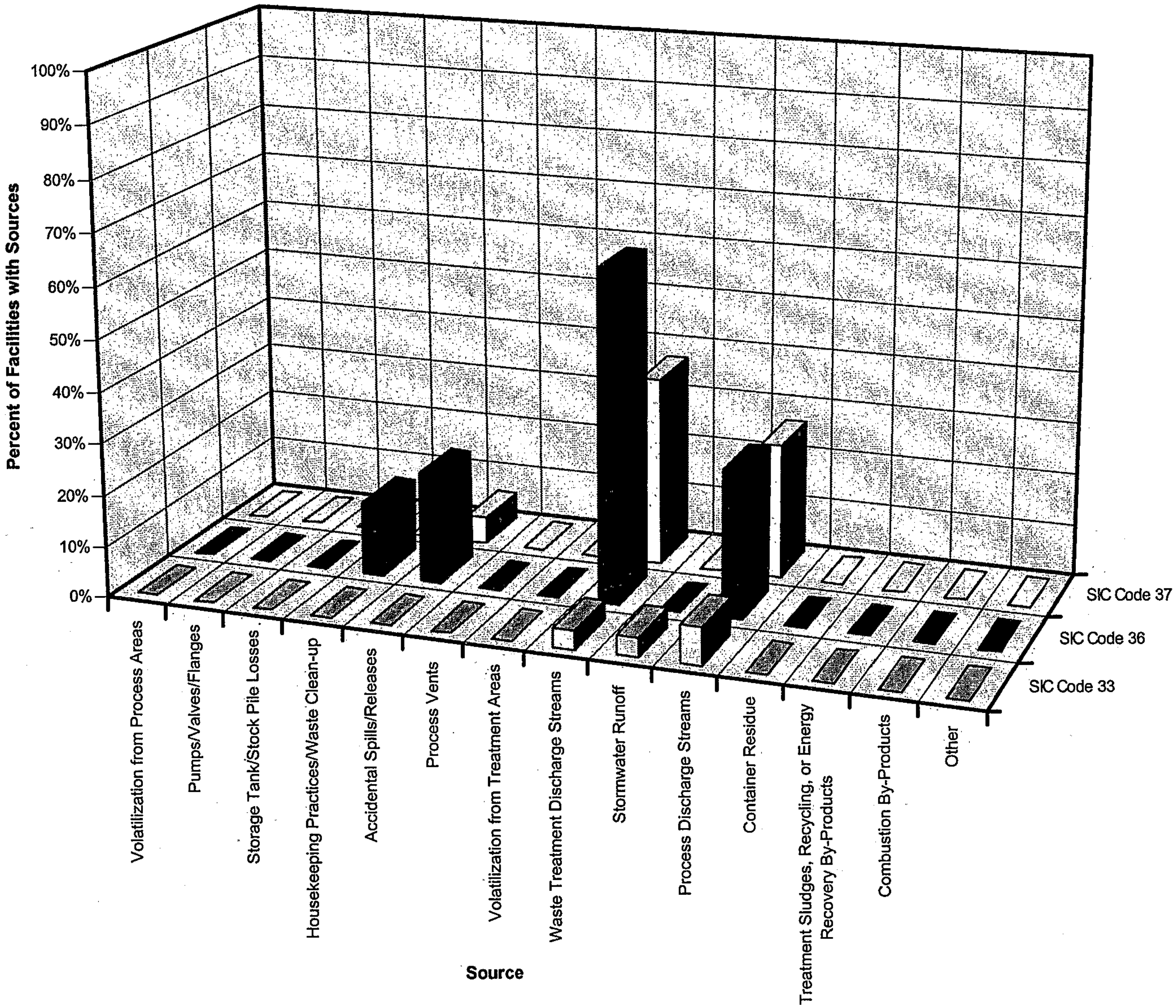
Data for this figure can be found on Table 5-1.

Figure 5-1d. Distribution of Sources for Surface Water Discharges (RY 1996)



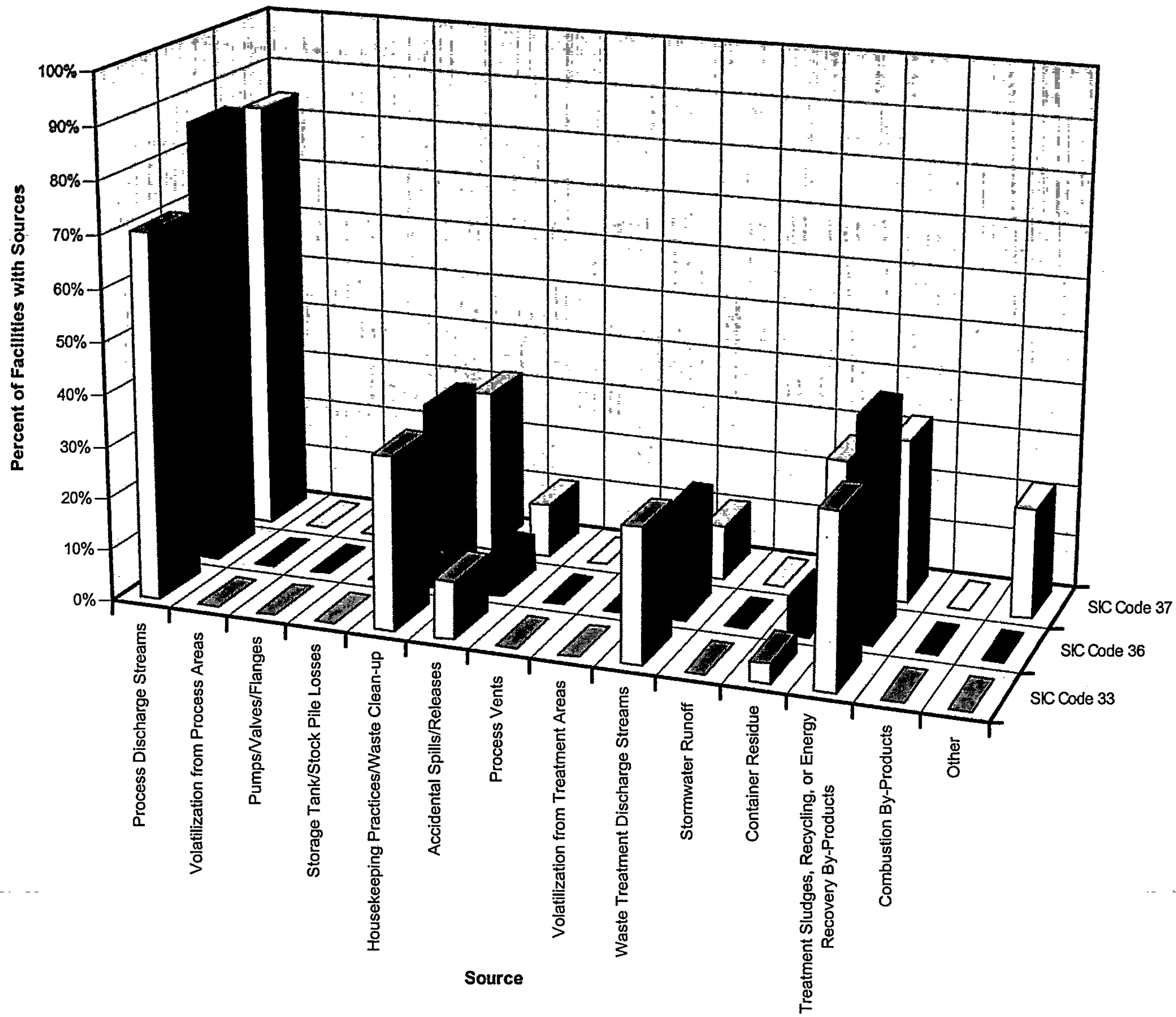
Data for this figure can be found on Table 5-1.

Figure 5-1e. Distribution of Sources for Land On-Site (RY 1996)



Data for this figure can be found on Table 5-1.

Figure 5-1f. Distribution of Sources for Discharges to POTWs (RY 1996)



Data for this figure can be found on Table 5-1.

Figure 5-1g. Distribution of Sources from Off-Site Transfers for Release and Other Waste Management Activities

36, and 37 than in the previously studied SIC Codes. A similar trend is seen when comparing stack air releases.

Site surveyors observed at least one type of off-site transfer for release and other waste management activities at nearly all facilities (78%, 86%, and 100% in SIC Codes 33, 36, and 37, respectively). In RYs 1994 and 1995, site surveyors observed a significantly smaller percent of facilities with off-site transfers for release and other waste management activities (90% in SIC Code 25 and 55% to 70% for all other SIC Codes). The number of off-site transfers for release and other waste management activities increased for the RY 1996 study, because facilities in SIC Codes 33, 36, and 37 generally collect a large quantity of "scrap" or "unusable" material containing metals and send it off site for waste management activities.

Many facilities also discharged EPCRA Section 313 chemicals to water, both indirectly discharged to a POTW and directly discharged to surface water. The percent of discharges to water is slightly higher than that observed during site visits to facilities in RY 1994 and RY 1995. Underground injection was never observed during site visits to facilities, in contrast to what was seen in RY 1994 and RY 1995.

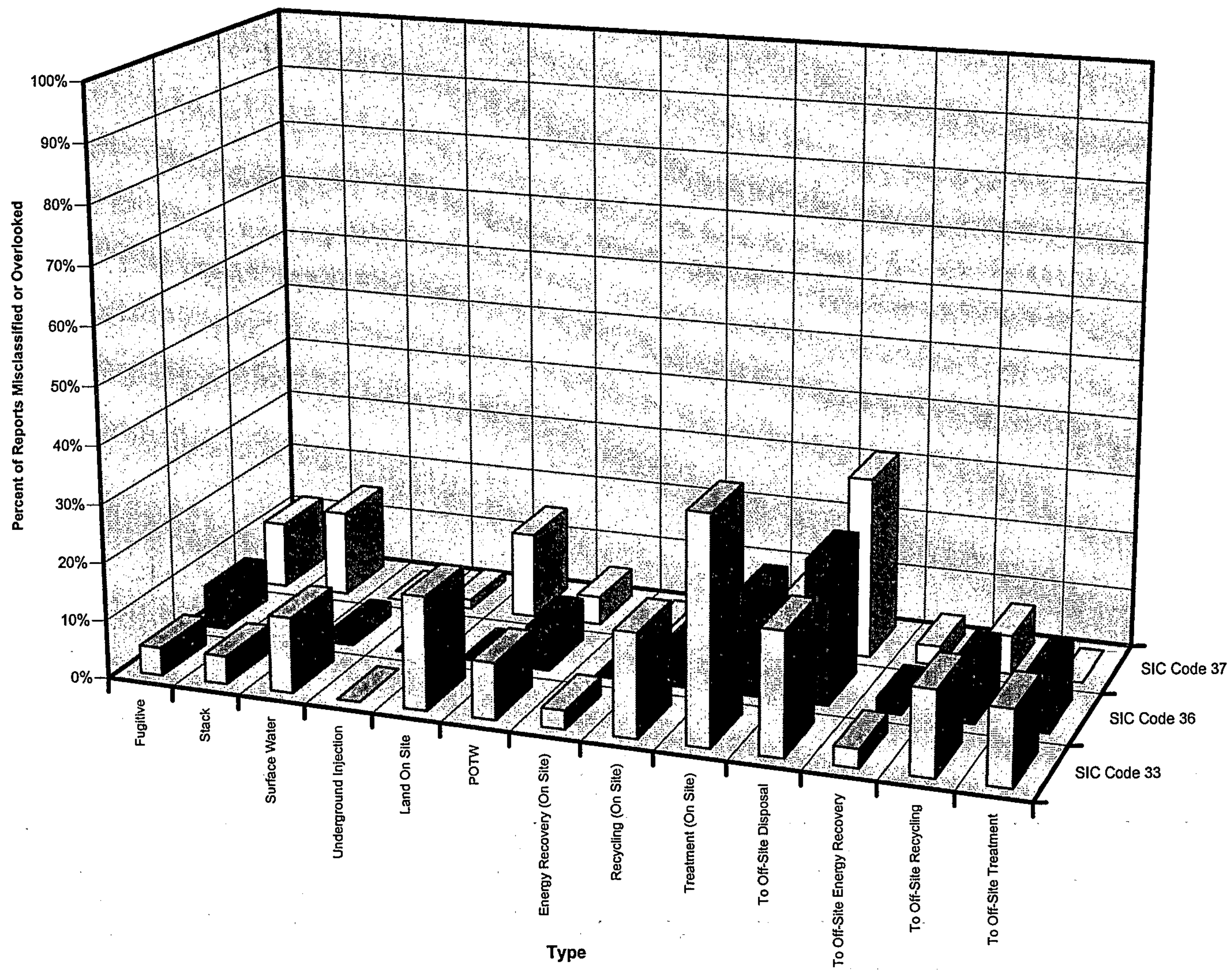
5.2 Incorrectly Reported Release and Other Waste Management Activity Types

This section presents the release and other waste management activity types that facilities misclassified and overlooked. An analysis of these results can help identify the sections of the RY 1996 Form R that cause confusion for the regulated community. A comparison with site surveys conducted in individual SIC Codes can help identify areas of confusion that are specific to various industries. These data alone cannot be used to quantitatively assess the accuracy of data in the TRI database because the magnitude of errors in estimates is not considered. Section 6 presents a detailed quantitative analysis. Table 5-2 and Figure 5-2 presents the percent of misclassified or overlooked release and other waste management activities.

Table 5-2

Misclassified and Overlooked Types of Release and Other Waste Management Activities

Release or Other Waste Management Activity Type	Percent of Reports Misclassified or Overlooked		
	SIC Code 33	SIC Code 36	SIC Code 37
Fugitive	4.8%	7.3%	11.5%
Stack	4.8%	2.4%	14.8%
Receiving Stream	12.9%	2.4%	0.0%
Underground Injection	0.0%	0.0%	1.6%
Land On Site	19.4%	0.0%	14.8%
POTW	9.7%	7.3%	4.9%
Energy Recovery (On Site)	3.2%	0.0%	0.0%
Recycling (On Site)	17.7%	7.3%	0.0%
Treatment (On Site)	38.7%	17.1%	8.2%
To Off-Site Disposal	21.0%	24.4%	31.1%
To Off-Site Energy Recovery	3.2%	2.4%	3.3%
To Off-Site Recycle	14.5%	9.8%	6.6%
To Off-Site Treatment	12.9%	9.8%	0.0%



Data for this figure can be found in Table 5-2.

Figure 5-2. Misclassified or Overlooked Types of Release and Other Waste Management Activities

A comparison of the release and other waste management activities reported by facilities with those identified by site surveyors showed that a large number of facilities reported the wrong release or other waste management activity type. This section discusses those types that were incorrectly reported and presents a qualitative discussion regarding the corresponding error.

5.2.1 Air Releases

A small number of facilities misclassified air emissions or overlooked them entirely. Although facilities often had difficulty in quantifying their releases, most recognized they existed and made attempts to calculate release estimates from most sources. The facilities' most common source of error was their failure to identify fugitive emissions of metals or metal compounds when processes were conducted at extremely high temperatures. Facilities also commonly failed to report EPCRA Section 313 chemicals in particulate matter that escaped from baghouses or other dust collection systems. The number of facilities in SIC Codes 33, 36, and 37 that misclassified or overlooked air emissions is lower than that observed in RYs 1994 and 1995. A primary reason is that many facilities visited in RYs 1994 and 1995 misclassified releases to general room air. Facilities in SIC Codes 33, 36, and 37 were likely to have process air releases to large, open areas rather than in an enclosed room. Therefore, the potential for this mistake did not occur. Another common error in RYs 1994 and 1995 was overlooking stack releases from storage tanks. However, this error was not detected in facilities in SIC Codes 33, 36, and 37 as these facilities were less likely to have storage tanks.

5.2.2 Off-Site Transfers for Recycling and Disposal, and On-Site Recycling

Many facilities in RY 1996 misclassified or overlooked off-site transfers for release and other waste management activities. In particular, transfers off-site for disposal and off-site transfers for recycling were often misreported, in addition to on-site recycling.

A primary reason for misclassified release and other waste management activities is confusion over "direct reuse" (which is not reportable) and "recycling" (which is reportable). For example, facilities often reported large quantities of off-specification products containing metals that were directly reused in secondary smelting operations (without further waste management) as sent off-site for recycling. Other facilities reported scrap, slag, and dust even though it was directly reused in the production of asphalt as either off-site or on-site recycling. Similarly, facilities misclassified on-site recycling when various process streams were directly reused.

A frequently observed error for transfers off-site for disposal was overlooking large quantities of EPCRA Section 313 chemicals (typically metals) that were present in dust collected in baghouses, electrostatic precipitators, and rotoclones. This dust is often disposed to landfills. Finally, some facilities reported transfers off-site for recycling without knowledge of how the waste was actually handled. In these instances, most facility contacts could not provide a basis for claiming recycling and indicated that the material may actually be disposed.

Many of these facilities recognized that they may have been misreporting and expressed a desire for clarification on the reuse/recycling issue in general and its applicability, specifically to typical operations in SIC Codes 33, 36, 37. A comparison to previous data shows that many facilities in RYs 1994 and 1995 also frequently misclassified off-site transfers for release and other waste management activities. However, those facilities did not typically have "recycling" vs. "direct reuse" concerns.

5.2.3 On-Site Treatment and Land Disposal

On-site treatment and on-site land disposal were overlooked at a large number of facilities (not misclassified), in particular in the primary metals industry (SIC Code 33). Most facilities failed to consider the removal of dust from an air stream as "treatment or removal" when it applies to metals and metal compounds. Some facilities felt that because the metal was not destroyed, it should not be reported in Section 7A as being treated. *[The 1996 TRI instructions say that the waste treatment efficiency reported must represent physical removal of the parent metal from the waste stream, p.41]* Other facilities entirely overlooked the dust being treated and its subsequent disposal to land. This situation was observed more frequently in facilities that employed large dust collection systems and when metals were present in the process.

5.2.4 Water Discharges

Discharges containing EPCRA Section 313 chemicals from facilities in SIC Codes 33, 36, and 37 to POTWs and receiving streams were less prevalent than observed at site visits for RYs 1994 and 1995. However, there were some instances where discharges were overlooked.

5.3 Overlooked Release and Other Waste Management Activities

Section 5.2 discussed the release and other waste management activity types that were either misclassified or overlooked. This section identifies the process or unit operation sources that were overlooked. An analysis of this information may be used to identify specific unit operations or processes that are problematic for EPCRA Section 313 reporting. Additional guidance and a focussed effort to analyze the fate of EPCRA Section 313 chemicals from these sources will increase the accuracy of data in the TRI database. Again, these data do not reflect a quantitative measurement of the estimates associated with release and other waste management activities, but a quantitative analysis of the estimates is presented in Section 6.

In general, fewer facilities in SIC Codes 33, 36, and 37 completely overlooked release and other waste management activity sources compared to those visited in RYs 1994 and 1995 (although the magnitude of the associated errors may be greater).

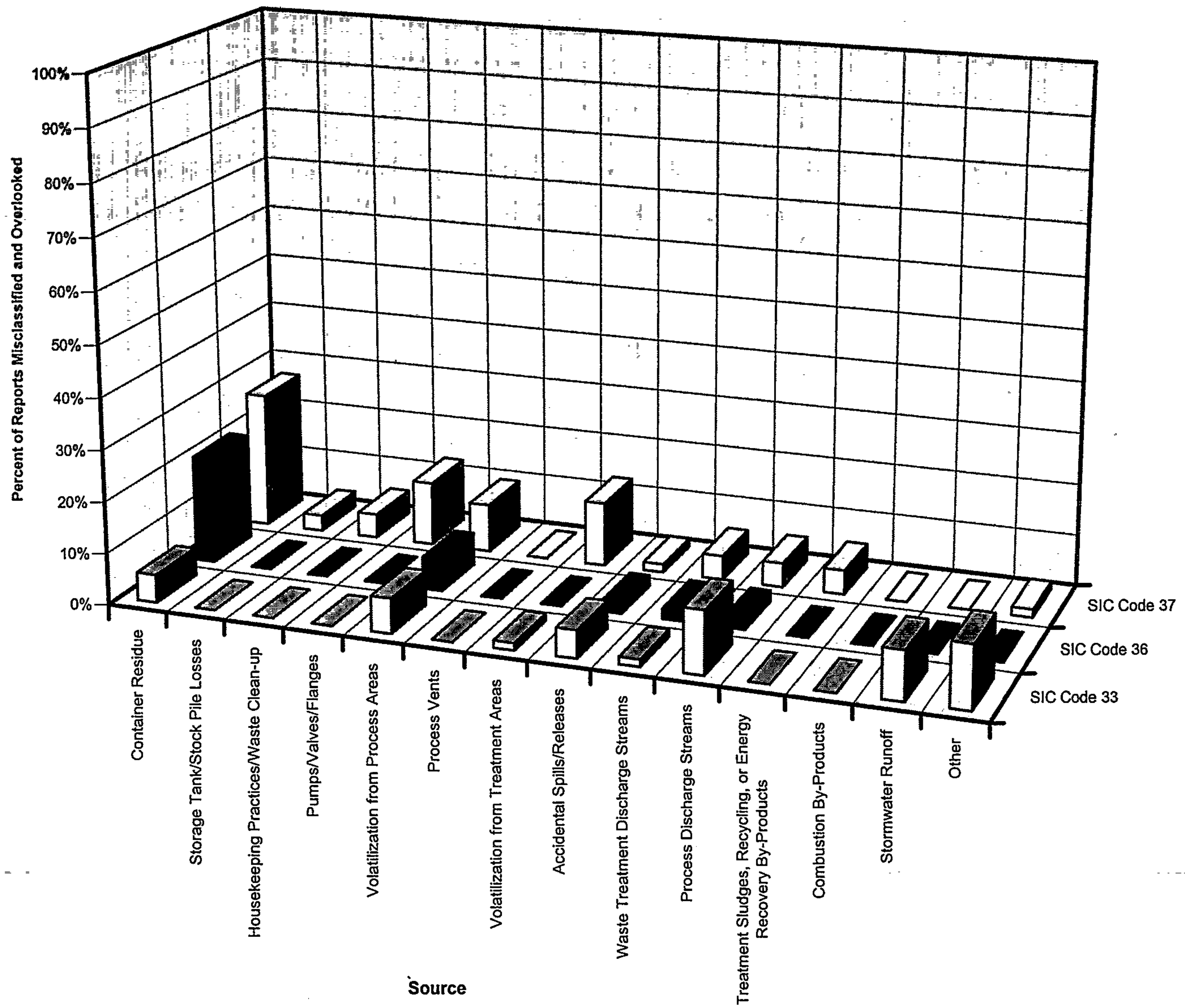
As shown on Table 5-3 and Figure 5-3, several facilities overlooked some sources of release and other waste management activities entirely. In some cases, the result was an underestimation of the overall quantity of the toxic chemical managed as waste by the facility. However, in cases where a mass balance was used as the method to determine the quantity of the toxic chemical managed as waste, the facility may have included the quantity that was overlooked in another source. For example, a facility may have overlooked a 1% stack air release from a dust collection system that is 99% efficient. However, after conducting a material balance and analyzing the total throughput, the facility may have assumed this quantity was released from process areas as fugitive emissions. In this case, the stack release to air would have been under reported, while the fugitive air emissions would have been over reported.

Table 5-3

Misclassified and Overlooked Sources of Release and Other Waste Management Activities

Source	Percent of Reports Identified (weighted)		
	SIC Code 33	SIC Code 36	SIC Code 37
Container residue	5.4%	20.8%	26.6%
Storage tank/stock pile losses	0.0%	0.0%	3.1%
Housekeeping practices/waste cleanup	0.0%	0.0%	4.7%
Pumps/valves/flanges	0.0%	0.0%	12.5%
Volatilization from process areas	6.8%	6.3%	9.4%
Process vents	0.0%	0.0%	0.0%
Volatilization from treatment areas	1.4%	0.0%	12.5%
Accidental spills/releases	5.4%	2.1%	1.6%
Waste treatment discharge streams	1.4%	2.1%	4.7%
Process discharge streams	12.2%	2.1%	4.7%
Treatment sludges, recycling or energy recovery by-products	0.0%	0.0%	4.7%
Combustion by-products	0.0%	0.0%	0.0%
Stormwater runoff	9.5%	0.0%	0.0%
Other[a]	12.2%	0.0%	1.6%

[a]Sources of "other" include: baghouse dust, over spray, remedial actions, and repackaging losses.



Data for this figure can be found in Table 5-3.

Figure 5-3. Misclassified and Overlooked Sources of Release and Other Waste Management Activities

This error was observed on a site-specific basis, typically when a mass balance was used for facility-wide estimates. Many facilities overlooked sources entirely and did not account for the associated EPCRA Section 313 chemicals when reporting for any types of release and other waste management activities on the Form R. The sources most often overlooked were container residue (typically as liquid residue in "empty" drums), stack emissions of particulate matter, transfers and disposal of collected particulate matter, and transfers or management of off-specification product.

5.3.1 Container Residue

In RY 1996, the largest source of overlooked release and other waste management activities (considering frequency, not overall quantity) was from container residue, as was the case in RYs 1994 and 1995; however, both the frequency and magnitude were considerably less in SIC Codes 33, 36, and 37. A main reason for the decrease in errors is that fewer facilities in these SIC Codes purchase or use drums of organic liquids, which decreases the opportunity to overlook container residue. Although the EPCRA Section 313 instructions specify that container residue should be considered as a release or other waste management quantity, facilities assumed that all used drums, totes, or small containers were completely empty and the subsequent transfer of the empty containers off site for disposal (disposal on site was rarely observed in SIC Codes 33, 36, and 37) did not result in any release or other waste management activities of EPCRA Section 313 chemicals. Many facilities did not consider the potential for reportable quantities of residual chemicals in these containers. Other facilities considered this potential release or other waste management quantity but felt it was negligible (and did not report it) if drums were shipped as "empty", as defined by federal and/or state shipping regulations.

In practice, liquids are often removed from drums by gravity draining or by pumping. Neither of these methods removes all material from the drum and an appreciable quantity may remain. Hazardous Materials Transportation Act (HMTA), Hazardous Materials Transportation Uniform Safety Act (HMTUSA), and Resource Conservation Recovery Act (RCRA) regulations require special handling precautions when transporting drums containing hazardous materials (drums are often defined as "RCRA empty" for shipping purposes if they contain less than one inch of a liquid substance). Therefore, facilities often remove the materials in the containers to levels which are below state or federal regulations, but they do not completely empty them. It should be noted that some facilities (less than was observed in RYs 1994 and 1995) sent hundreds of "empty" drums off-site that potentially contained some residual EPCRA Section 313 chemical. This transfer results in a significant quantity released or otherwise managed as waste that was overlooked.

Some facilities also overlooked release and other waste management quantities due to residual powdered EPCRA Section 313 chemicals in empty bags. This quantity was significantly less than observed in previous reporting years, primarily because pigments in the form of solids are commonly used in painting operations (SIC Code 285, RY94), while polymer beads were the only solid material that result in container residue observed at more than one site in SIC Codes 33, 36, and 37. Note that most facilities that add powdered metal alloys to molten processes do so by dumping the alloy, including its container, to the kettle. Therefore, in this instance there is no container residue.

Most of the liquid release and other waste management quantities from overlooked container residue should have been reported as off-site transfers for disposal. However, some should have been reported to off-site recycling, off-site treatment, or off-site energy recovery. Other overlooked liquid discharges should have been reported as discharged to either POTWs or to surface water streams because the drums were rinsed on site and the rinsewater was collected and sent to the local POTW or receiving stream. Most overlooked solid releases from bag residue should have been reported as being disposed to on-site landfills or to off-site disposal.

5.3.2 Process Areas and Discharge Streams

The next most overlooked sources were volatilization from process areas and process discharge streams. Many facilities in the primary metals industry (SIC Code 33) overlooked significant quantities of metals that volatilize during smelting and foundry operations. Metals and metal compounds often volatilize or become entrained as fumes or dust during these operations. The concentration of these metals in the air stream is often small (in the parts per million range); however, the throughput is so high that a significant quantity may be overlooked. Facilities often failed to apply metals with the "fume or dust" qualifier to the manufacturing threshold. Similar oversights were observed, although less frequently, in SIC Codes 36 and 37.

Overlooking EPCRA Section 313 chemicals in air streams also resulted in underestimating or overlooking the quantity from other sources, such as dust that is ultimately released or disposed in stormwater, other process discharge streams, and waste treatment discharge streams.

5.3.3 Other Treatment Areas

Facilities rarely overlooked volatilization from treatment areas, most likely because most treatment chemicals are either non-volatile or are completely destroyed during the treatment process. This observation is consistent with RYs 1994 and 1995 surveys. Similarly, release and other waste management quantities from storage tank losses; releases from process vents, pumps, valves, and flanges; and housekeeping wastes were rarely overlooked.

5.3.4 Combustion

Site surveyors did not identify any overlooked release or other waste management activities from combustion by-products at facilities in SIC Codes 33, 36, or 37. In contrast to the facilities visited for RYs 1994 and 1995 survey programs, very few of the facilities visited for the RY 1996 survey used on-site boilers, industrial furnaces, or incinerators.

5.4 Calculation Methodologies

EPA requires facilities to designate one of four calculation methodology categories used for each release or other waste management activity estimate (monitoring data, mass balances, emission factors, and engineering judgment or calculations). Table 5-4 presents the distribution of calculation methodologies that were used to determine estimates for each release or other waste management activity type. An analysis of the methodologies used and how frequently facilities used the best available methodology provides insight on the accuracy of some estimates and on the reason for some errors.

It was observed during the review of facility notes that facilities often used multiple methods or reported a method that was inconsistent with the method actually used. Therefore, the data reported in Table 5-4 represents the site surveyor's opinion as to the primary method actually used by the facility, not necessarily the method reported on the facility's Form R (and entered in the TRI database). Using the surveyor's opinion allows for a better analysis of data accuracy when compared to the actual methods used. Additionally, a significant number of facilities used hazardous waste manifests to calculate estimates of off-site transfers. Site surveyors noted these occurrences, when applicable. Their frequency of use is presented along with the four EPA-accepted methods. It should be noted that few or no release or other waste management activity quantities were reported for several release or other waste management activity types. In these circumstances the table shows zero percent.

5.4.1 Air Releases

For RY 1996, nearly all facilities reported at least one fugitive release. As in RYs 1994 and 1995, site surveyors observed that fugitive releases were typically the most difficult for facilities to estimate. Engineering calculations were the predominant method used by most facilities. Site surveyors observed that many facilities actually used one or more of the methods to estimate fugitive emissions, and then applied engineering judgment to total the emissions from all sources. They used engineering judgment for partitioning releases between stack and fugitive if monitoring data were not available. Mass balances, monitoring data, and emission factors are presented in Table 5-4 only when they were the predominant method used.

It was uncommon for facilities to have access to monitoring data for fugitive releases. However, facilities did use it when available (typically in the form of periodic leak tests). Only a few facilities used emission factors, a contrast to survey results from RYs 1994 and 1995 when several facilities used emission factors. Many facility contacts inquired whether emission factors that were relevant to their processes existed (for fugitive or stack emissions). They were not aware of EPA-published factors or any relevant trade association factors and very few had conducted testing to develop facility-specific emission factors. The type of emission factors used and a subsequent discussion is presented below.

Table 5-4

Distribution of Calculation Methodologies

Release or Other Waste Management Activity Type	Calculation Methodology	Percent of Facilities using Methodology		
		SIC Code 33	SIC Code 36	SIC Code 37
Fugitive	Engineering calculations	83.3%	90.5%	60%
	Mass balance	0.0%	4.8%	31.4%
	Monitoring data	11.1%	0.0%	5.7%
	Emission factors	5.6%	4.8%	2.9%
Stack	Engineering calculations	60.5%	69.9%	42.9%
	Mass balance	7.9%	24.2%	48.6%
	Monitoring data	26.3%	3.0%	5.7%
	Emission factors	5.3%	3.0%	2.9%
Receiving Stream	Engineering calculations	16.7%	12.5%	0.0%
	Mass balance	0.0%	12.5%	0.0%
	Monitoring data	83.3%	75.0%	100.0%
Underground Injection	Underground injection was not claimed or observed	0.0%	0.0%	0.0%
On-Site Land Disposal	Engineering calculations	0.0%	100.0%	100.0%
	Monitoring data	100.0%	0.0%	0.0%
POTW	Engineering calculations	50.0%	28.0%	45.5%
	Mass balance	0.0%	16.0%	4.5%
	Monitoring data	50.0%	56.0%	50.0%
To Off-Site Disposal	Engineering calculations	34.6%	16.7%	28.5%
	Monitoring data	61.5%	83.3%	64.3%
	Hazardous waste manifests	3.8%	0.0%	7.1%

Table 5-4 (Continued)

Release or Other Waste Management Activity Type	Calculation Methodology	Percent of Facilities using Methodology		
		SIC Code 33	SIC Code 36	SIC Code 37
To Off-Site Treatment	Mass balance	25.0%	25.0%	0.0%
	Monitoring data	75.0%	75.0%	100.0%
To Off-Site Recycle	Engineering calculations	17.4%	28.6%	63.0%
	Mass balance	0.0%	14.3%	10.5%
	Monitoring data	82.6%	42.9%	26.3%
	Hazardous waste manifests	0.0%	14.3%	0.0%
To Off-Site Energy Recovery	Engineering calculations	100.0%	0.0%	55.1%
	Mass balance	0.0%	9.1%	0.0%
	Monitoring data	0.0%	63.6%	27.6%
	Hazardous waste manifests	0.0%	27.3%	17.2%
On-Site Treatment	Engineering calculations	100.0%	47.1%	92.3%
	Mass balance	0.0%	47.1%	7.7%
	Monitoring data	0.0%	5.9%	0.0%
On-Site Energy Recovery	Mass balance	0.0%	100.0%	0.0%
On-Site Recycling	Engineering calculations	50.0%	50.0%	100.0%
	Monitoring data	50.0%	50.0%	0.0%

[1]"Other" methodologies according to facility notes include: off-site facility test reports, facility or trade association computer modeling, air permit limits, and "undocumented".

Due to a lack of monitoring data and relevant emission factors, facilities used mass balances to determine fugitive releases from at least one process line or unit operation when a material balance around the entire facility resulted in a chemical quantity that was unaccounted for.

Most facilities also reported a stack release. Although facilities had difficulty in estimating these releases, they typically indicated less difficulty in identifying and quantifying these releases than observed with fugitives. Engineering calculations and mass balances were the most often used methods. However, surveyors also observed the use of emission factors and monitoring data (actual releases from stack tests). As with fugitive emissions, few facilities were aware of published emission factors that applied to their processes. However, some had conducted stack testing and used the appropriate monitoring data to develop site-specific factors accordingly.

5.4.2 Water Discharges

Many facilities reported discharges to POTWs and/or surface water. Using monitoring data was the primary method to calculate POTW and surface water discharges. Typically, discharges were monitored for compliance with various local, state, or other federal regulations, resulting in an accurate estimate. If monitoring data were not available, facilities typically used a mass balance around processes involving contact water to determine the quantity of EPCRA Section 313 chemical that could not be accounted for. Then, engineering judgment (usually based on knowledge of chemical volatility and solubility) was used to estimate a partition factor between releases of the unaccounted quantity that would be lost to fugitive air versus the quantity discharged to water.

5.4.3 Off-Site Transfers for Release and Other Waste Management Activities

Table 5-4 shows that most facilities used monitoring data and/or hazardous waste manifests to estimate off-site transfers for release or other waste management. Monitoring data came from two main sources: (1) periodic facility sampling of the process waste streams that were collected prior to shipment, and (2) sampling conducted by the receiving facility. Documentation for this data was typically more prevalent and more complete than methods used to estimate release and other waste management activities to most other sources. However, in contrast to data observed in RYs 1994 and 1995, test data often provided only the concentration of EPCRA Section 313 chemicals. Facilities often made mistakes in calculating the throughput of material sent off site. Also, many sources were overlooked and some transfers were reported when they were actually directly reused (and not reportable). Therefore, the accuracy of the overall off-site transfer estimates is questionable.

5.4.4 Correct Methodology Usage

Figure 5-5 presents the frequency with which the site surveyors felt the method used by the facility would result in the most accurate estimate, based on information and data available to the surveyor at the time of the site visit. It does not present the frequency that the facilities correctly calculated the quantity of release or other waste management activity. This figure shows concurrence with the selected method in most cases.

As observed during surveys from RYs 1994 and 1995, it should be noted that during many visits the surveyor identified another, more accurate method that could have been used to estimate release and other waste management quantities, if a particular variable had been tracked for RY 1996. In many cases, the facility contact indicated that it would have been fairly easy for the facility to implement the suggestion and that they planned to take the surveyors' advice for subsequent years. However, it was not always possible to recreate the required variable. Another limitation to this analysis is the fact that surveyors often identified a more accurate method that could be used based on data the facility claimed to have, but the facilities were unable to gather the information immediately for use by the site surveyor.

Table 5-5

Frequency the Best Methodology was Used by Facilities to Estimate Release and Otherwise Waste Managed Quantities

SIC Code	Frequency
33	85.9%
36	99.3%
37	87.7%

5.4.5 Emission Factors

Chemical-specific emission factors were sometimes used to estimate fugitive and stack releases. EPA instructed site surveyors to determine the type of chemical-specific emission factors used, when applicable. The potential types were designated as facility-derived, EPA-approved or published, trade association-derived, and other. Table 5-6 presents the percentage of use for each type of chemical-specific emission factor.

These factors were typically employed to estimate fugitive releases of volatile chemicals from process areas or piping (leaks from pumps, valves, flanges, etc.) or to estimate stack releases from storage tanks and stack releases from gasses generated by unit operations that were channeled through air pollution control devices (typically baghouses). Non-chemical-specific factors in trade association guidance or derived by the facility were treated as engineering calculations.

Table 5-6

Types of Emission Factors Used for Fugitive and Stack Air Releases

Release Type	Release Source	Percent (by report)		
		SIC Code 33	SIC Code 36	SIC Code 37
Fugitive	Facility derived	83.3%	100.0%	25.0%
	EPA derived	0.0%	0.0%	25.0%
	Trade Association derived	16.7%	0.0%	25.0%
	Other	0.0%	0.0%	25.0%
Stack	Facility derived	100.0%	100.0%	75.0%
	EPA derived	0.0%	0.0%	0.0%
	Trade association derived	0.0%	0.0%	25.0%
	Other	0.0%	0.0%	0.0%

5.5 On-Site Recycling, Treatment, and Energy Recovery

With the exception of gases routed through dust collection systems, the RY 1996 survey finds that EPCRA Section 313 chemicals were rarely managed on site (recycling, treatment, or energy recovery). Table 5-2 and Figure 5-2 show that some facilities incorrectly identified these waste management activities. Additionally, EPA recognized the potential confusion in reporting requirements for on-site treatment in Section 7A and Section 8.6 of the EPCRA Section 313 report. Therefore, site surveyors specifically determined whether the quantities reported were sent to treatment versus actually treated. Facilities typically correctly identified on-site treatment activities when they existed (with the exception of significant confusion regarding whether to report dust collection systems, particularly for metals entrained in the dust). Only a few facilities incorrectly reported, as shown in Table 5-7.

Table 5-7

Facilities Incorrectly Reporting the Quantity Sent to Treatment Rather than Actually Treated

SIC Code	Percent Incorrectly Reported
33	7.4%
36	14.3%
37	5.3%

It should be noted that the quantitative values presented in Figure 5-2 and Table 5-2 regarding on and off-site recycling may not be accurate because most facilities were confused by the definition of "recycling". EPA recognized that this potential might exist and instructed site surveyors only to analyze release and other waste management activities to recycling activities if the facility reported them. Therefore, site surveyors only recorded on-site recycling as incorrect if such activities were claimed but did not exist.

Site surveyors discussed on-site management issues and acquired feedback from facility contacts. The primary concern raised was that definitions of the terms "recycling", "direct reuse", and "waste management" are generally unclear. Additionally, facilities felt that these terms were particularly confusing when applied to large quantities of off-specification material that was "recycled", either on site or off site. Tens of thousands of pounds of metals could be involved in these processes.

Facilities also expressed confusion about how to report on-site treatment of metals or metal compounds. Many realized that metals cannot be treated for destruction; however, they can be removed from a process waste stream. Facilities questioned whether this removal should be considered "treatment" in Section 7A, and whether the removal efficiency (opposed to the destruction efficiency) should be reported. *[Facilities should report the removal efficiency of metals in the waste stream.]*

Very few facilities were confused or concerned regarding when to report EPCRA Sections 313 chemicals sent to treatment versus those chemicals sent to energy recovery, perhaps because relatively few EPCRA Section 313 chemicals in these SIC Codes were incinerated.

On-site recycling was rarely claimed at these facilities. Typically recycle streams included off-specification product, process solvents, or waste dust collected in a baghouse. Tables 5-8 and 5-9 summarize data that were collected for on-site recycling that was observed during site visits. Table 5-9 presents the frequency that each EPCRA Section 313 chemical or chemical category was recycled, as reported by these facilities.

Table 5-8

Observed On-Site Recycling Activities

# Of Facilities Reporting	Type of Recycling Claimed	Description of Recycling Stream	SIC Code
1	Other	By-product	33
2	Other	Polymer remelt or "reshred"	33
1	Metals Recovery, Electrolytic, and Ion Exchange	Spent metal plating bath	36
1	Other (Process Discharge Stream)	Product grinding-back to process stream	37
1	Spent Process Solvent	Solvents/organics recovery batch still	37

Table 5-9

Chemicals For Which On-Site Recycling Was Claimed (SIC Codes 33, 36, and 37 Combined)

EPCRA Section 313 Chemical or Chemical Category	Number of Facilities Reporting
Copper or copper compounds	2
Lead compounds	2
Antimony compounds	1
Hydrogen fluoride	1
Methyl ethyl ketone)	1
Phenol	1
Toluene	1
Xylene (mixed isomers)	1

6.0 RELEASE AND OTHER WASTE MANAGEMENT ACTIVITIES

Release and other waste management estimates are the most highly scrutinized and publicized data in the TRI program. Thus, comparing the facility estimates to the surveyor estimates gives an indication of how accurately the facilities in the three SIC Codes have reported. This section discusses release and other waste management estimates made by facilities and site surveyors. Major differences in release and other waste management estimates between the facilities and site surveyors are noted, and the reasons for the differences are explained. The following topics are discussed in each subsection:

- On-site release and other waste management estimates, as reported in Section 5 of the Form R (Section 6.1)
- Off-site transfers for release and other waste management quantities, as reported in Section 6 of the Form R (Section 6.2)
- On-site release and other waste management activities as reported in Section 7 of the Form R (Section 6.3)
- Production ratio/activity index (Section 6.4)
- Source reduction (Section 6.5)

A discussion of the methodology used by the site surveyors to gather the data necessary to estimate the release and other waste management quantities is contained in Section 2. A discussion of the specific techniques used by the facilities and by the site surveyors when estimating release and other waste management quantities is presented in Section 5.

Facilities are required to report estimates of release and other waste management by chemical for each release and other waste management activity type. On-site release and other waste management activities (as reported in Section 5 and Section 8.1 of the Form R) must be apportioned among the following five categories:

— Fugitive or non-point air emissions;
— Stack or point air emissions;
— Discharges to receiving streams or water bodies;
— Underground injection on site; or
— Releases to land on site.

Off-site transfers for release and other waste management activities (as reported in Section 6 and Sections 8.3, 8.5, and 8.7 of the Form R) are categorized according to how the waste is managed:

- Discharges to POTWs;
- Off-site transfer for disposal;
- Off-site transfer for treatment;
- Off-site transfer for recycling; and
- Off-site transfer for energy recovery.

Facilities also report on their on-site waste management activities in Sections 7, 8.2, 8.4, and 8.6 of the Form R according to these type categories:

- On-site treatment;
- On-site recycling; and
- On-site energy recovery.

6.1 Estimates of On-Site Release and Other Waste Management Quantities as Reported in Section 5 of the Form R

Section 6.1.1 compares the estimates of on-site release and other waste management quantities between the facilities and surveyors. Section 6.1.2 compares the scaled up facility estimates to the TRI database.

6.1.1 Comparison of the Facility Estimates to the Surveyor Estimates

To assess the accuracy of the estimates reported by the facilities, the facility estimates for each medium were compared to those calculated by the site surveyors. First, the chemical-specific estimates were summed at the facility level for each release and transfer medium. Next, the estimates were totaled by type for facilities in the SIC Codes 33, 36, and 37. These totals for each of the SIC Codes were compared to evaluate overall accuracy within and among the industries. Because the chemical-specific estimates are combined by type, the accuracy of site-specific estimates for each chemical at each facility is not evaluated in this report. Such information was provided to the facility at the time of the site visit.

Tables 6-1a through 6-1c show the percent difference between the facility estimates and the site surveyor estimates for each release and transfer medium in Section 5 of the Form R for SIC Codes 33, 36, and 37. The percent difference is calculated as:

$$\text{Percent Difference} = (Fa - SS)/(SS) \times 100$$

where: Fa = Facility Estimate
SS = Site Surveyor Estimate

The site surveyor estimates were used as the basis for comparison as they are a more accurate representation of "true value" than the facility estimates. Negative percent difference values indicate that, overall, the facilities surveyed underestimated the release or other waste management activity, while positive values indicate an overestimate. These differences are depicted graphically in Figures 6-1a through 6-1c. Note that none of the surveyed facilities had transfers to underground injection.

Figures 6-2a through 6-2c illustrate the percentage of facility estimates which were greater than, equal to within 5%, or less than the surveyor estimates for SIC Codes 33, 36, and 37, respectively. The number of facilities with each type is given in parentheses below each release and other waste management activity type.

Release and Other Waste Management Estimates in the Primary Metals Industry, SIC Code 33

For the primary metals industry, SIC Code 33, 27 facilities were surveyed and estimates for 74 EPCRA Section 313 chemicals were reviewed. Comparing the facility estimates to the site surveyor estimates (Table 6-1a), the largest discrepancies in total pounds are for on site land disposal (480%). For on-site land disposal, the large difference can be attributed to one facility. This facility completed the wrong column on the Form R and should have reported the chemical as sent off-site for disposal. The closest agreement is for discharges to receiving streams or other bodies of water at 0.5% (based on five facilities). The total percent difference for all on-site release and other waste management activities in this SIC Code is 0.22%.

Release and Other Waste Management Estimates in the Electronic and Other Electrical Equipment Industry, SIC Code 36

In the electronic and other electrical equipment industry, SIC Code 36, a total of 14 facilities were surveyed. Site surveyors reviewed and estimated release and other waste management activities for 48 EPCRA Section 313 reports. The range of the percent differences in the estimates in SIC Code 33, is 1.5 to 53.1% (see Table 6-1b). The total percent difference for all on-site release and other waste management activities in the SIC Code is -24.5%.

Release and Other Waste Management Estimates in the Transportation Equipment Industry, SIC Code 37

A total of 19 facilities were surveyed in the transportation equipment industry, SIC Code 37, and 64 EPCRA Section 313 reports reviewed. Total estimates for each type by facility are within 10% of the site surveyor estimates, with the exception of on-site land disposal which differed by 212% (see Table 6-1c). Note, however, that total releases of this type were only 255 pounds at the facilities visited.

Table 6-1a

Summary of SIC Code 33 On-Site Release and Other Waste Management Quantities as Reported in Section 5 of the Form R[a]

Type[b]	Release and Other Waste Management Quantities Reported by the Facilities (million pounds)	Release and Other Waste Management Quantities Estimated by the Surveyors (million pounds)	Percent Difference[c]
Fugitive air	0.112	0.121	-7.75%
Stack air	0.784	0.797	-1.63%
Receiving stream	4.55E-03	4.53E-03	0.541%
Land on site	0.029	0.005	480%
Total	0.930	0.928	0.22%

[a]Number of facilities = 27; number of EPCRA Section 313 reports represented = 74.
[b]No underground injection was reported.
[c]Percent Difference = (Fa - SS)/(SS) x 100, where Fa = Facility Estimate and SS = Site Surveyor Estimate.
Note: Due to rounding, calculated values may not yield exact numbers.

Table 6-1b

Summary of SIC Code 36 On-Site Release and Other Waste Management Quantities as Reported in Section 5 of the Form R[a]

Type[b]	Release and Other Waste Management Quantities Reported by the Facilities (million pounds)	Release and Other Waste Management Quantities Estimated by the Surveyors (million pounds)	Percent Difference[c]
Fugitive air	0.027	0.022	22.9%
Stack air	0.045	0.074	-39.4%
Receiving stream	6.36E-04	6.26E-04	1.52%
Land on site	1.35E-03	8.80E-04	53.1%
Total	0.074	0.098	-24.5%

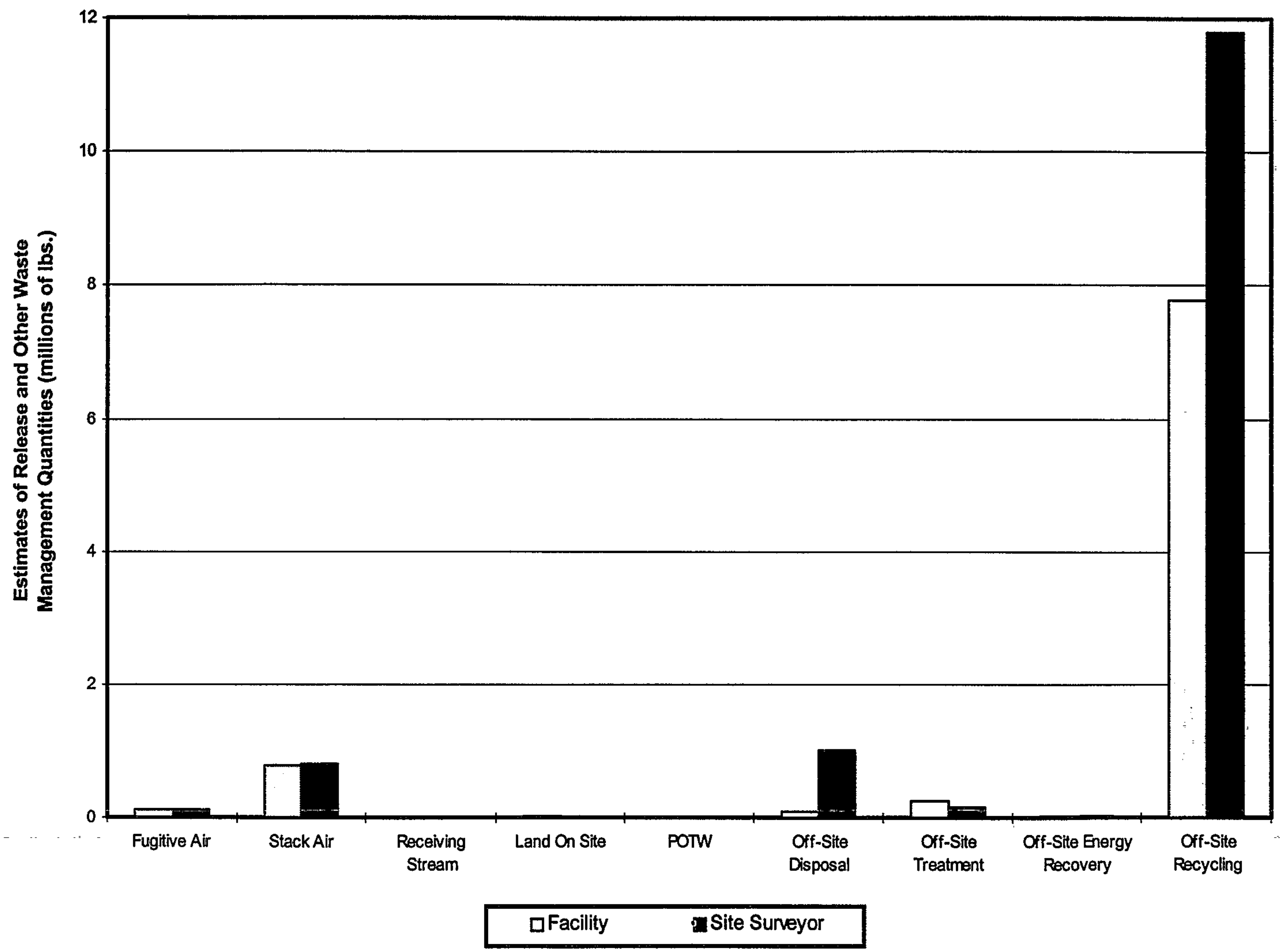
[a]Number of facilities = 14; number of EPCRA Section 313 reports represented = 48.
[b]No underground injection was reported.
[c]Percent Difference = (Fa - SS)/(SS) x 100, where Fa = Facility Estimate and SS = Site Surveyor Estimate.
Note: Due to rounding, calculated values may not yield exact numbers.

Table 6-1c

Summary of SIC Code 37 On-Site Release and Other Waste Management Quantities as Reported in Sections 5 of the Form R[a]

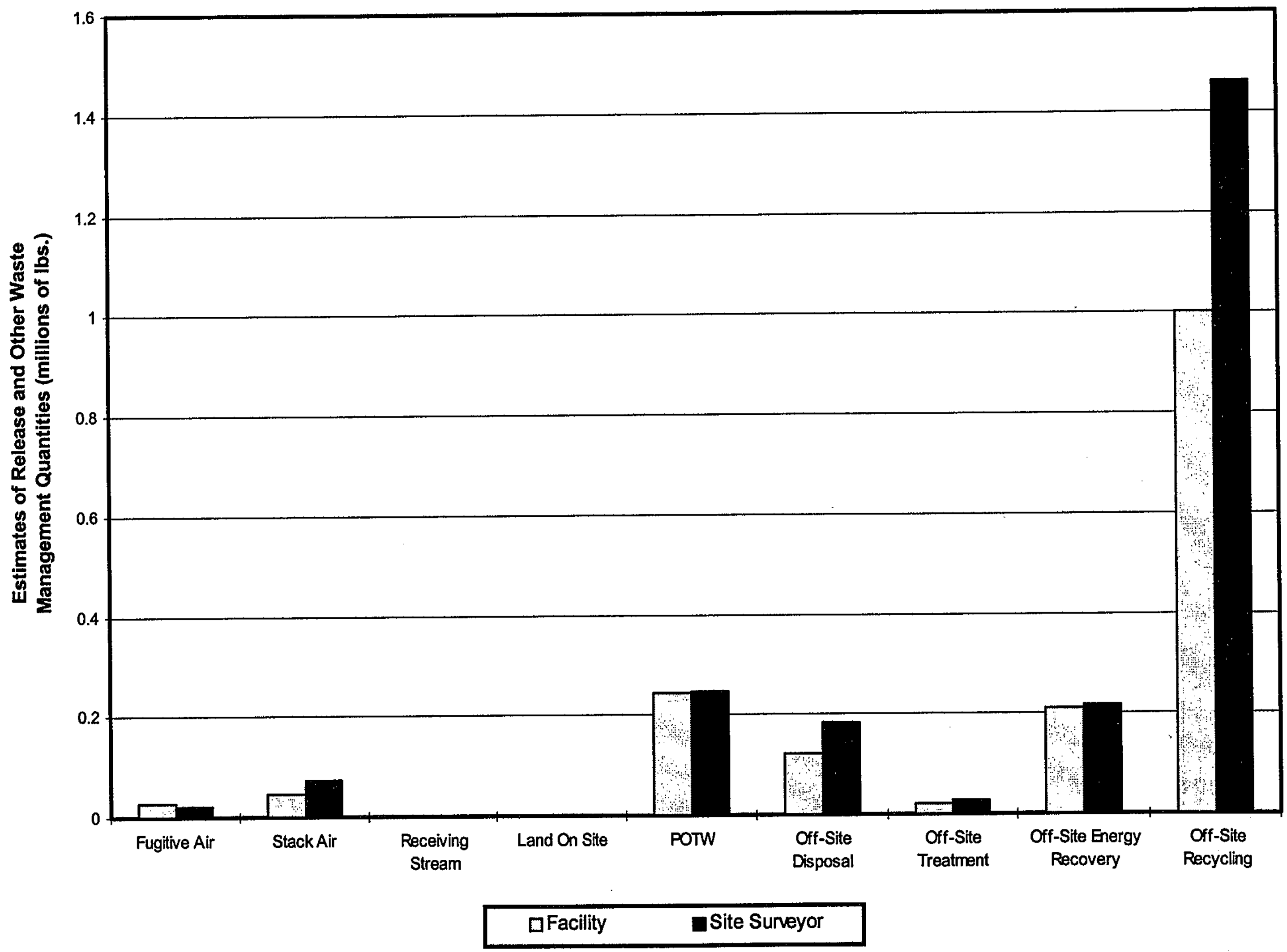
Type[b]	Release and Other Waste Management Quantities Reported by the Facilities (million pounds)	Release and Other Waste Management Quantities Estimated by the Surveyors (million pounds)	Percent Difference[c]
Fugitive air	0.268	0.297	-9.96%
Stack air	1.08	1.11	-2.78%
Receiving stream	0.0	0.0	0%
Land on site	7.96E-04	2.55E-04	212%
Total	1.35	1.41	-4.26%

[a]Number of facilities = 19; number of EPCRA Section 313 reports represented = 64.
[b]No underground injection was reported.
[c]Percent Difference = (Fa - SS)/(SS) x 100, where Fa = Facility Estimate and SS = Site Surveyor Estimate.
Note: Due to rounding, calculated values may not yield exact numbers.



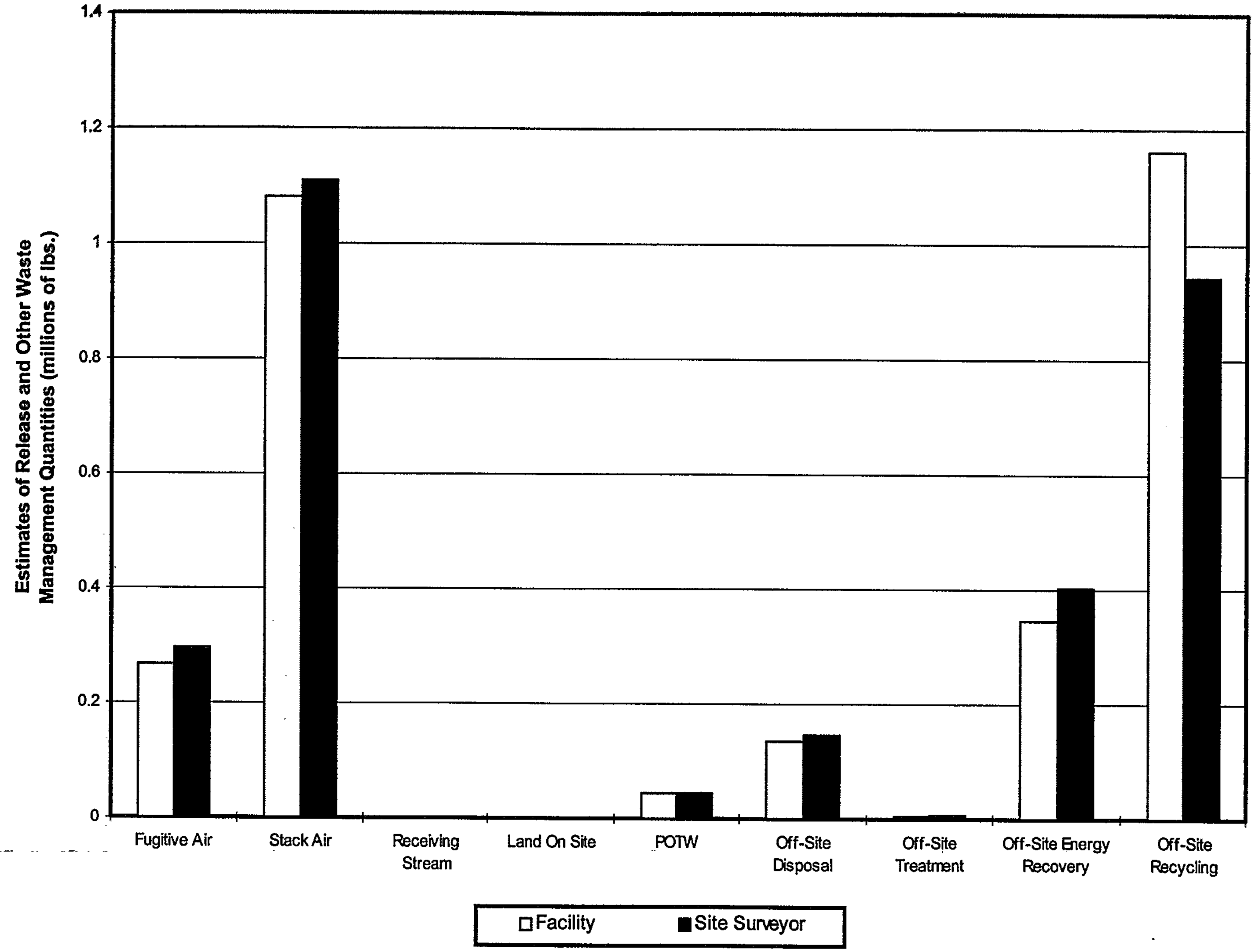
Data for this figure can be found on Tables 6-1a and 6-4a.

Figure 6-1a. Comparison of Estimates of Total Release and Other Waste Management Quantities as Reported in Sections 5 and 6 of the Form R in SIC Code 33



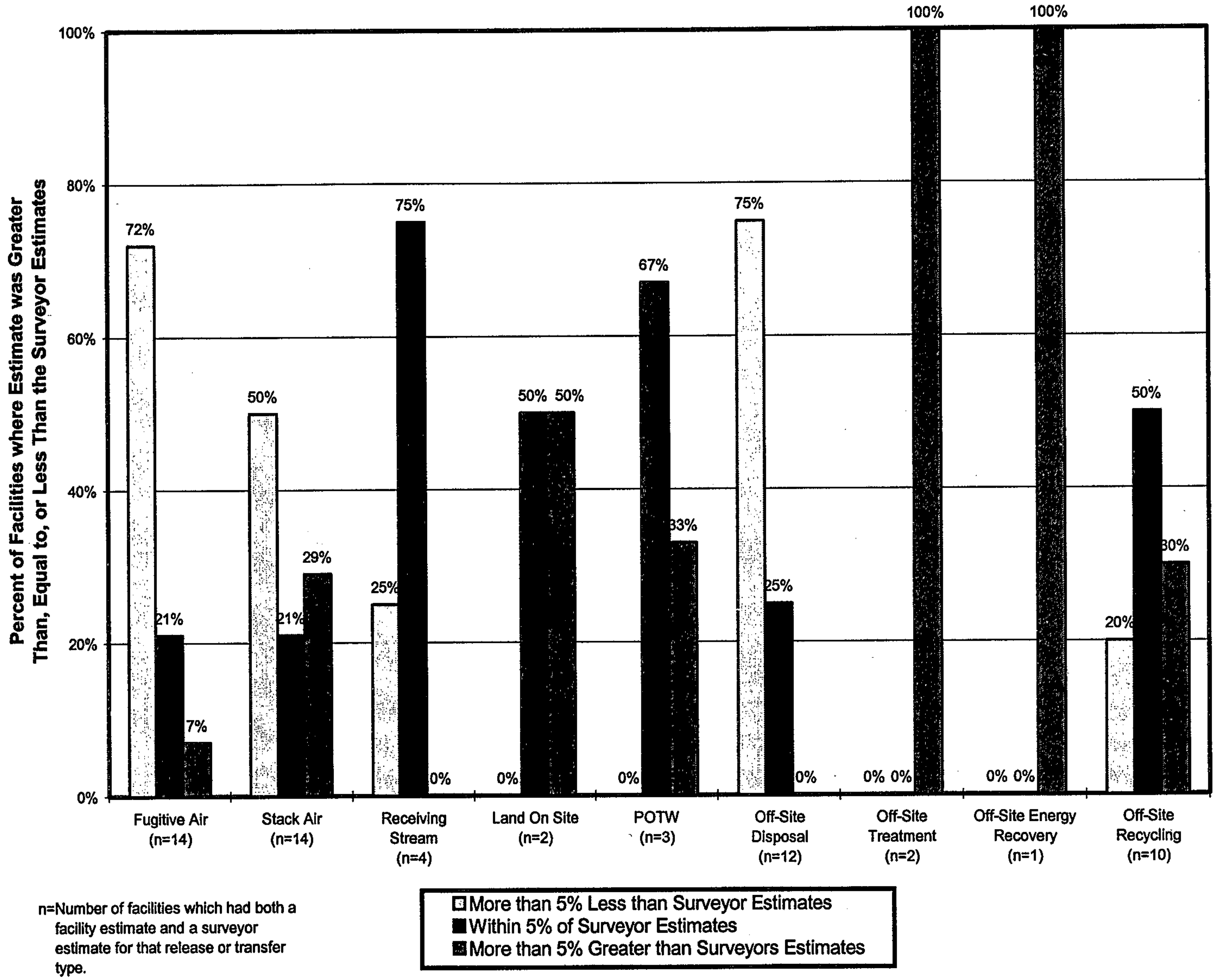
Data for this figure can be found on Tables 6-1b and 6-4b.

Figure 6-1b. Comparison of Estimates of Total Release and Other Waste Management Quantities as Reported in Sections 5 and 6 of the Form R in SIC Code 36



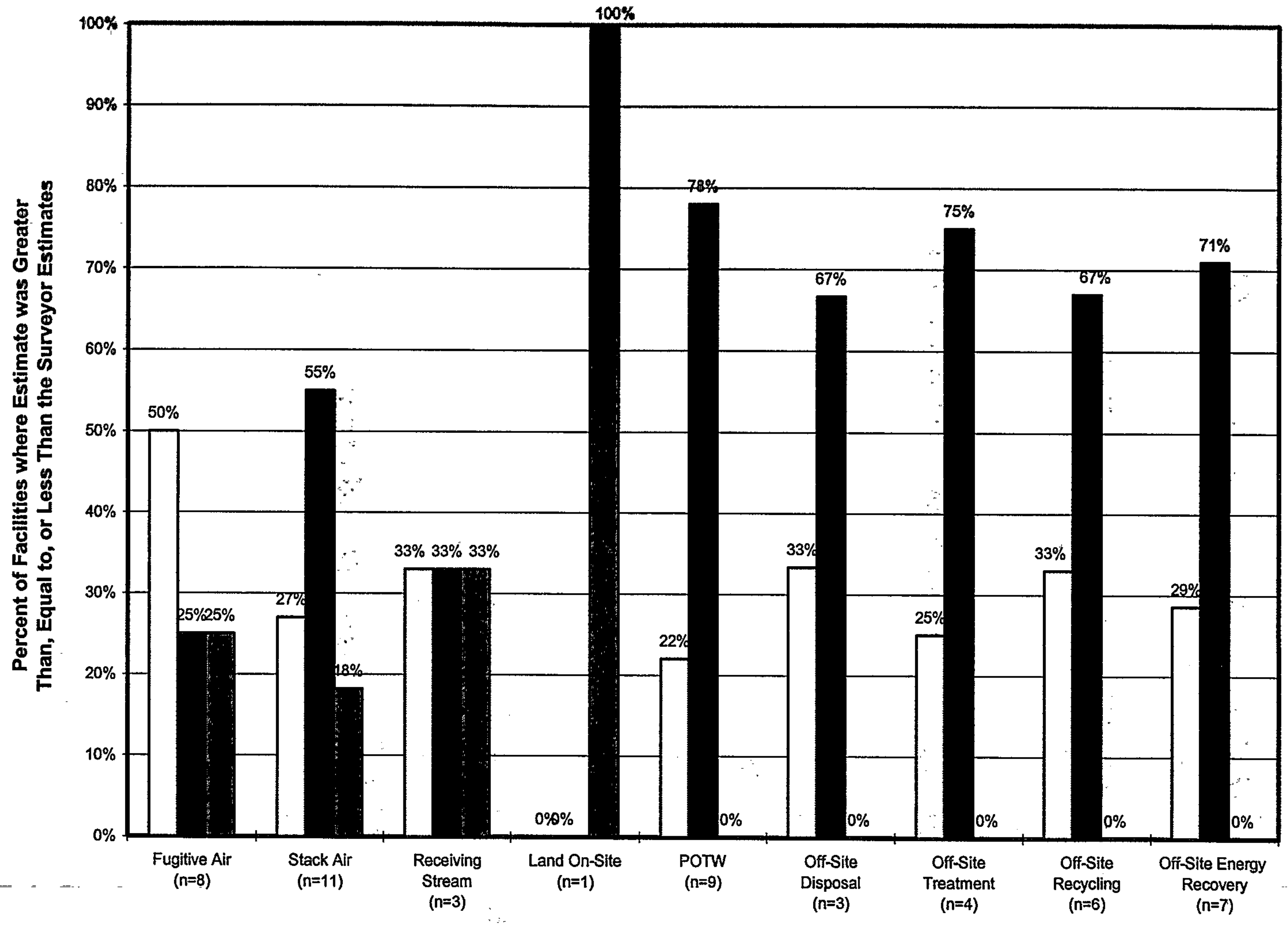
Data for this figure can be found on Tables 6-1c and 6-4c.

Figure 6-1c. Comparison of Estimates of Total Release and Other Waste Management Quantities as Reported in Sections 5 and 6 of the Form R in SIC Code 37



n=Number of facilities which had both a facility estimate and a surveyor estimate for that release or transfer type.

Figure 6-2a. Frequency of Agreement Between Facility and Surveyor Estimates by Release and Other Waste Management Activity Type for SIC Code 33



n= Number of facilities which had both a facility estimate and a surveyor estimate for that release or transfer type.

Figure 6-2b. Frequency of Agreement Between Facility and Surveyor Estimates by Release and Other Waste Management ActivityType for SIC Code 36

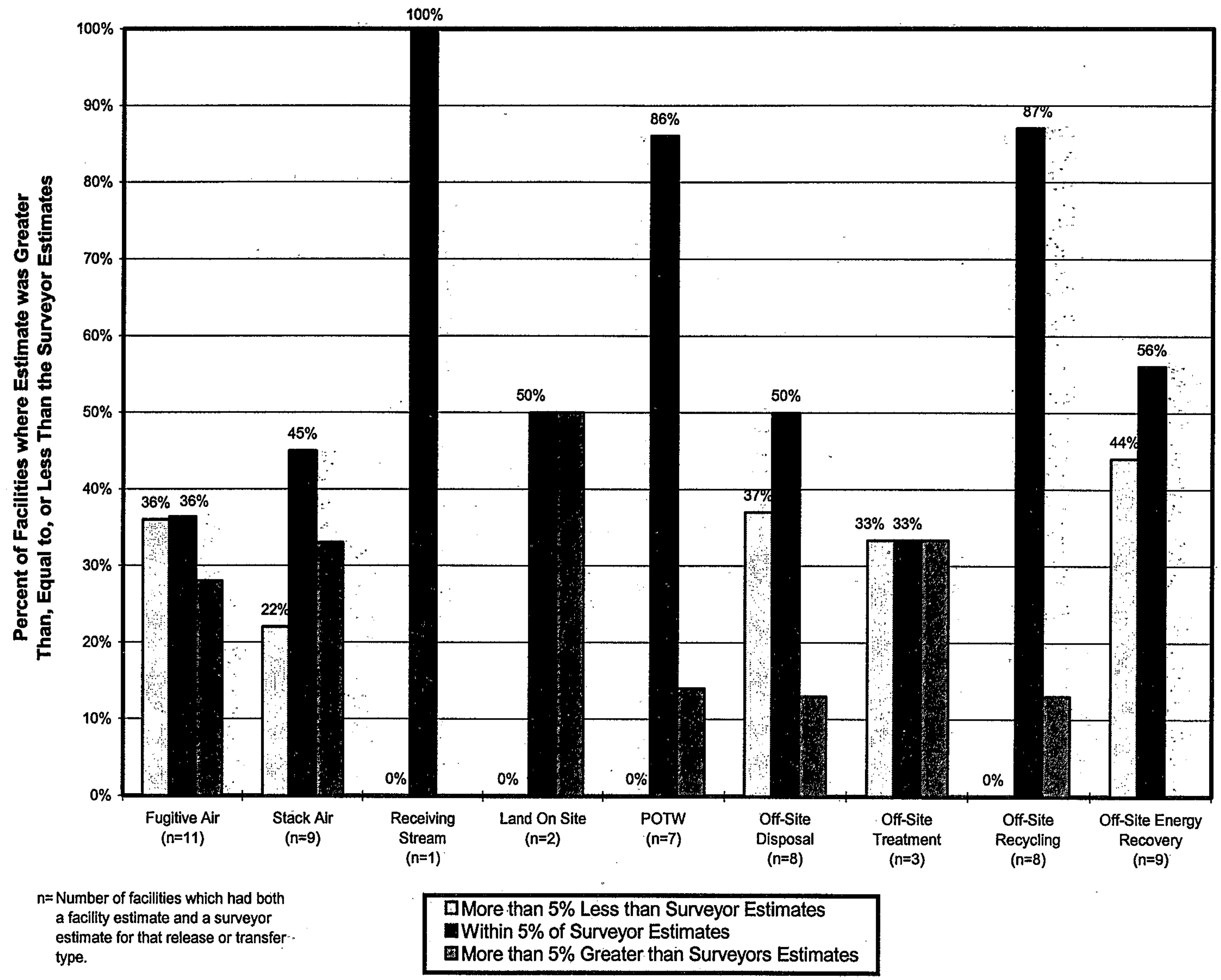


Figure 6-2c. Frequency of Agreement Between Facility and Surveyor Estimates by Release and Other Waste Management Activity Type for SIC Code 37

Summary of On-Site Release and Other Waste Management Estimates in all Three SIC Codes

Table 6-2 summarizes the differences in on-site release and other waste management quantities for all three SIC Codes. The high percent differences for on-site disposal to land are due to errors from a few facilities, as explained above. The overall magnitude of these errors is small, and does not contribute significantly to the total release and other waste management quantities.

Table 6-2

Comparison of Differences Between Facility Estimates and Site Surveyor Estimates Across the SIC Codes

Medium	Percent Difference for SIC Code 33	Percent Difference for SIC Code 36	Percent Difference for SIC Code 37
Fugitive air	-7.75%	22.9%	-9.96%
Stack air	-1.63%	-39.4%	-2.78%
Receiving stream	0.54%	1.52%	0.0%
Land on site	432%	53.1%	212%
Total	0.22%	-24.5%	-4.26%

Note: Percent Difference = (Fa - SS)/(SS) x 100, where Fa = Facility Estimate and SS = Site Surveyor Estimate.

6.1.2 Comparison of the Facilities Surveyed to the National TRI Database

Estimates made by surveyed facilities were compared to national estimates in the TRI database to determine how closely the release and other waste management quantities reported by the surveyed population matched the national population. To make this comparison, the estimates of the surveyed facilities were scaled-up to place them on the same basis as the national estimates. The scale-up factor used is the ratio of the number of Form Rs reported by the surveyed facilities to the number of Form Rs submitted to the TRI database by all the facilities in the SIC Codes visited. Only release and other waste management quantities from facilities with 15 or fewer Form Rs were included in the national estimates, since this was also a selection criteria when identifying facilities to visit (see discussion in Section 2). Tables 6-3a through 6-3c show this comparison and the percent differences for SIC Codes 33, 36, and 37, respectively. A comparison of transfers to underground injection has not been made since none of the facilities surveyed used underground injection systems. The percent difference is calculated as:

$$\text{Percent Difference} = (Fa - TRI)/(TRI) \times 100$$

where: Fa = Scaled Facility Estimate
TRI = Total Releases and Transfers Reported in TRI database

The TRI database values have been used as the basis for comparison as these data are being used nationwide.

Table 6-3a

Comparison of Scaled On-Site Release and Other Waste Management Quantities as Reported in Section 5 of the Form R for the Facilities Surveyed to the TRI Database, SIC Code 33

Type[a]	Scaled Release and Other Waste Management Quantities Reported by Surveyed Facilities (million pounds)	Total Reported Nationwide (SIC Codes 331, 332, 333, 334, 335) (million pounds)	Percent Difference[b] Facility: TRI
Fugitive Air	7.22	39.9	-81.9%
Stack Air	50.6	108	-53.2%
Receiving Stream	0.294	32.3	-99.1%
On Site Disposal	1.89	215	-99.1%
Total	60	395	-84.8%

[a]No underground injection was reported.
[b]Percent difference = (Fa-TRI)/(TRI) x 100, where Fa=Scaled Facility Estimate and TRI=Total Release Estimate as Reported in the TRI database.

Overall, there are substantial differences between the scaled-up release and other waste management quantities from the surveyed facilities compared to national estimates in the TRI database. We believe this finding relates to the voluntary nature of the program. Anecdotal evidence suggests that smaller companies and facilities have been more willing to participate in the survey program, and larger companies and facilities have a greater tendency to decline to participate. Further examination of the TRI database records of facilities that declined to participate in the site survey program for RY 1996 indicates they had approximately five times the amount of release and other waste management quantities per Form R than those that volunteered to participate in the survey. Thus, the difference in the release and other waste management estimates between the surveyed facilities and the national estimates reflect that surveyed facilities tended to have lower throughput, on average, than the industry as a whole.

Table 6-3b

Comparison of Scaled On-Site Release and Other Waste Management Quantities as Reported in Section 5 of the Form R for the Facilities Surveyed to the TRI Database, SIC Code 36

Type[a]	Scaled Release and Other Waste Management Quantities Reported by Surveyed Facilities (million pounds)	Total Reported Nationwide (SIC Codes 367 and 369) (million pounds)	Percent Difference[b] Facility: TRI
Fugitive air	1.73	3.22	-46.2%
Stack air	2.90	7.91	-63.4%
Receiving stream	0.041	1.39	-97.1%
On Site disposal	0.087	0.299	-70.9%
Total	4.76	12.8	-62.8%

[a]No underground injection was reported.
[b]Percent difference = (Fa-TRI)/(TRI) x 100, where Fa=Scaled Facility Estimate and TRI=Total Release Estimate as Reported in the TRI database.

Table 6-3c

Comparison of Scaled On-Site Release and Other Waste Management Quantities as Reported in Section 5 of the Form R for the Facilities Surveyed to the TRI Database, SIC Code 37

Type[a]	Scaled Release and Other Waste Management Quantities Reported by Surveyed Facilities (million pounds)	Total Reported Nationwide (SIC Codes 371 and 372) (million pounds)	Percent Difference[b] Facility: TRI
Fugitive air	17.3	16.2	6.55%
Stack air	69.6	66.6	4.53%
Receiving stream	0.0	0.275	-100%
On site disposal	0.051	0.69	-92.6%
Total	87.0	83.8	3.82%

[a]No underground injection was reported.
[b]Percent difference = (Fa-TRI)/(TRI) x 100, where Fa=Scaled Facility Estimate and TRI=Total Release Estimate as Reported in the TRI database.

6.2 Estimates of Off-Site Release and Other Waste Management Quantities as Reported in Section 6 of the Form R

Section 6.2.1 compares the estimates of off-site release and other waste management quantities between the facilities and surveyors. Section 6.2.2 compares the scaled up facility estimates to the TRI database.

6.2.1 Comparison of the Facility Estimates to the Surveyor Estimates

To assess the accuracy of the estimates reported by the facilities, the facility estimates for each medium were compared to those calculated by the site surveyors. This was done in the same manner that the on-site releases and waste management quantities were tabulated.

Tables 6-4a through 6-4c show the percent difference between the facility estimates and the site surveyor estimates for each off-site release and transfer medium in Section 6 of the Form R for SIC Codes 33, 36, and 37. The percent difference is calculated as:

$$\text{Percent Difference} = (Fa - SS)/(SS) \times 100$$

where: Fa = Facility Estimate
SS = Site Surveyor Estimate

The site surveyor estimates were used as the basis for comparison as they are a more accurate representation of "true value" than the facility estimates. Negative percent difference values indicate that, overall, the facilities surveyed underestimated the release or other waste management activity, while positive values indicate an overestimate. These differences are depicted graphically in Figures 6-1a through 6-1c. Note that none of the surveyed facilities had transfers to underground injection.

Figures 6-2a through 6-2c illustrate the percentage of facility estimates which were greater than, equal to within 5%, or less than the surveyor estimates for SIC Codes 33, 36, and 37, respectively. The number of facilities with each type is given in parentheses below each release and other waste management activity type.

Release and Other Waste Management Estimates in the Primary Metals Industry, SIC Code 33

For the primary metals industry, SIC Code 33, 27 facilities were surveyed and estimates for 74 EPCRA Section 313 chemicals were reviewed. Comparing the facility estimates to the site surveyor estimates (Table 6-4a), the largest discrepancies in total pounds are for transfers off site disposal (-91.4%), transfers off site for treatment (73.4%), and discharges to POTWs (50%). The total percent difference for all off-site release and other waste management activities in this SIC Code is -37.3%.

In the case of off-site disposal, estimates were reported by 12 facilities from all five of the three-digit SIC Code 33 facilities surveyed; nine of these facilities underestimated the quantity sent off site for further waste management. Two facilities account for much of the difference. One incorrectly thought copper qualified for the article exemption; this facility disposed of large amounts of copper at an off-site landfill, negating the exemption. The second miscalculated the percent of a metal sent to an off-site landfill. Because the total amount of waste landfilled was high in both cases, the amount underestimated was large. An additional seven should have reported greater release quantities to this type, which results in a large discrepancy between the totals for the facility and surveyor estimates.

In the case of chemicals sent off site for treatment, one facility greatly overestimated its transfers for two reasons: the facility incorrectly assumed the metals in waste transferred off site were treated instead of being disposed, and they miscalculated the amount of nitric acid produced, thus overestimating the quantity treated. For discharges to POTWs, one facility accounts for the discrepancy by reporting releases (Code A, 1-10 pounds) where they should not have. The chemical was zinc which in this case would not be released as a dust or fume to the POTW. Note that although this contributes a 50% error in the quantity sent to POTWs, the size of the error is orders of magnitude smaller than that of other types.

Figure 6-1a shows the impact of the estimating differences on the amounts of chemicals released and otherwise managed as waste. The errors in the estimates of off-site transfers are the most significant. The 4 million pound difference in off-site recycling estimates between the facilities and surveyors accounts for 83% of the difference in the total off-site release and other waste management quantities in SIC Code 33. The difference can be attributed to one facility overlooking 4 million pounds of metal in slag that was sent to an off-site recycler for further use in road maintenance.

As presented in Figure 6-2a, the majority of the air releases and off-site transfers for disposal were underestimated. Transfers for off-site treatment and off-site energy recovery tended to be overestimated.

Table 6-4a
Summary of SIC Code 33 Off-Site Release and Other Waste Management Quantities as Reported in Section 6 of the Form R[a]

Type[b]	Release and Other Waste Management Quantities Reported by the Facilities (million pounds)	Release and Other Waste Management Quantities Estimated by the Surveyors (million pounds)	Percent Difference[c]
POTW	1.65E-05	1.10E-05	50%
Off-site disposal	0.086	1.005	-91.4%
Off-site treatment	0.261	0.150	73.4%
Off-site energy recovery	0.030	0.022	37.5%
Off-site recycling	7.77	11.8	-34.1%
Total	8.15	13.0	-37.3%

[a]Number of facilities = 27; number of EPCRA Section 313 reports represented = 74.
[b]No underground injection was reported.
[c]Percent Difference = (Fa - SS)/(SS) x 100, where Fa = Facility Estimate and SS = Site Surveyor Estimate.
Note: Due to rounding, calculated values may not yield exact numbers.

Table 6-4b
Summary of SIC Code 36 Off-Site Release and Other Waste Management Quantities as Reported in Section 6 of the Form R[a]

Type[b]	Release and Other Waste Management Quantities Reported by the Facilities (million pounds)	Release and Other Waste Management Quantities Estimated by the Surveyors (million pounds)	Percent Difference[c]
POTW	0.243	0.246	-1.23%
Off-site disposal	0.121	0.182	-33.3%
Off-site treatment	0.020	0.026	-21.7%
Off-site energy recovery	0.211	0.215	-2.16%
Off-site recycling	1.00	1.46	-31.5%
Total	1.60	2.13	-24.9%

[a]Number of facilities = 14; number of EPCRA Section 313 reports represented = 48.
[b]No underground injection was reported.
[c]Percent Difference = (Fa - SS)/(SS) x 100, where Fa = Facility Estimate and SS = Site Surveyor Estimate.
Note: Due to rounding, calculated values may not yield exact numbers.

Table 6-4c
Summary of SIC Code 37 Off-Site Release and Other Waste Management Quantities as Reported in Section 6 of the Form R[a]

Type[b]	Release and Other Waste Management Quantities Reported by the Facilities (million pounds)	Release and Other Waste Management Quantities Estimated by the Surveyors (million pounds)	Percent Difference[c]
POTW	0.045	0.045	0%
Off-site disposal	0.136	0.146	-6.57%
Off-site treatment	0.006	0.007	-10.82%
Off-site energy recovery	0.346	0.403	-14.1%
Off-site recycling	1.16	0.942	22.9%
Total	1.69	1.54	9.74%

[a]Number of facilities = 19; number of EPCRA Section 313 reports represented = 64.
[b]No underground injection was reported.
[c]Percent Difference = (Fa - SS)/(SS) x 100, where Fa = Facility Estimate and SS = Site Surveyor Estimate.
Note: Due to rounding, calculated values may not yield exact numbers.

Release and Other Waste Management Estimates in the Electronic and Other Electrical Equipment Industry, SIC Code 36

In the electronic and other electrical equipment industry, SIC Code 36, a total of 14 facilities were surveyed. Site surveyors reviewed and estimated release and other waste management quantities for 48 EPCRA Section 313 reports. The total percent difference for all off-site release and other waste management activities in this SIC Code is -24.9% (see Table 6-4b).

As with the primary metals industry, errors in the off-site transfers have the greatest consequence on the total estimate of release and other waste management quantities (see Figure 6-1b). Two facilities underestimated off-site recycling by a significant amount. One facility failed to report for copper (overlooking the chemical entirely), accounting for 25,000 pounds of the difference. The other facility assumed all metals were directly reused when taken off site when some were managed and then recycled. Similar to the primary metals industry, the 460,000 pound difference in off-site recycling between the facility and surveyors estimates accounts for 87% of the difference in the total off-site release and other waste management quantities in SIC Code 36.

Release and Other Waste Management Estimates in the Transportation Equipment Industry, SIC Code 37

A total of 19 facilities were surveyed in the transportation equipment industry, SIC Code 37, and 64 EPCRA Section 313 reports reviewed. Total estimates for each type by facility are within 25% of the site surveyor estimates (see Table 6-4c). Of the three SIC Codes surveyed, this SIC Code shows the best overall agreement with a total percent difference of off-site releases and waste management quantities of 9.7%. The most significant impact in terms of the error in the overall amount of release and other waste management activities is again due to the inaccuracies in estimating the off-site transfers to recycling (see Figure 6-1c). One facility significantly overestimated off-site recycling of metals due to the fact that most of this metal was directly reused.

Summary of Off-Site Release and Other Waste Management Estimates in all Three SIC Codes

Table 6-5 summarizes the differences in off-site release estimates and waste management quantities for all three SIC Codes. Figure 6-3 presents the sum of the total (on-site and off-site) release and waste management quantities for each SIC Code graphically.

Overall, off-site transfers to recycling, disposal, and treatment were the most problematic to estimate for all the SIC Codes. Because these transfer types account for a large portion of the total quantity of release and other waste management activities, improving on these estimates would improve the accuracy of the total estimates reported.

The main reason for the difficulty facilities had estimating off-site transfers to recycling relates to differentiating between "reuse" and "recycle". Facilities felt that definitions for these were not clearly stated in the reporting instructions in general, nor do they address specific concerns that are unique to these SIC Codes. In particular, these definitions were perceived to be unclear as they apply to metals and metal compounds present in scrap, off-specification product, dust, slag, and other spent process streams that are subsequently used by other facilities.

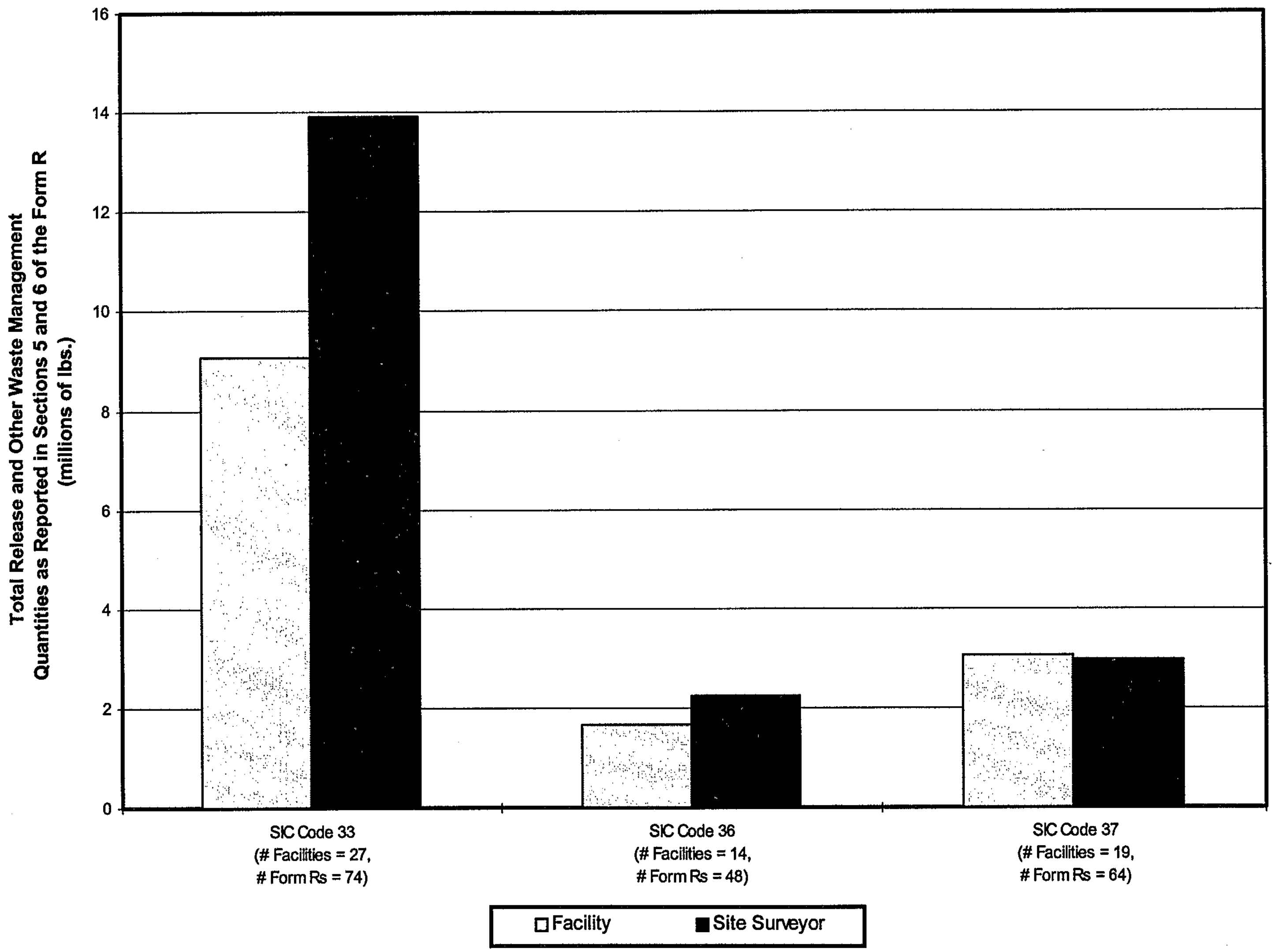
Some facilities reported confusion based on the EPA issue paper, *Clarification and Guidance for the Metal Fabrication Industry, January 1990*. This guidance was issued prior to inclusion of Section 8 of the Form R and states that amounts sent off site for recycling should not be reported, which is incorrect under current reporting requirements. The document also references EPA's *Toxic Chemical Release Inventory Questions and Answers: 1990 Update*, which also contains some outdated information. Efforts are currently underway to revise the metal fabrication and electroplating guidance documents, and updated guidance should be available within the next year.

Table 6-5

Comparison of Differences Between Facility Estimates and Site Surveyor Estimates Across the SIC Codes

Medium	Percent Difference for SIC Code 33	Percent Difference for SIC Code 36	Percent Difference for SIC Code 37
POTW	50.0%	-1.23%	0%
Off-site disposal	-91.4%	-33.3%	-6.57%
Off-site treatment	73.4%	-21.7%	-10.8%
Off-site energy recovery	37.5%	-2.16%	-14.1%
Off-site recycling	-34.1%	-31.5%	22.9%
Total	-37.3%	-24.9%	9.74%

Note: Percent Difference = (Fa - SS)/(SS) x 100, where Fa = Facility Estimate and SS = Site Surveyor Estimate.



Data for this figure can be found on Tables 6-1a through 6-1c.

Figure 6-3. Comparison of Facility and Site Surveyor Estimates of Total Release and Other Waste Management Quantities as Reported in Sections 5 and 6 of the Form R.

A secondary reason for inaccuracies in the estimates of off-site transfers is due to facilities mistakenly assuming metals sent off site in waste that are treated rather than disposed. This assumption causes some treatment estimates to be overestimated, and the corresponding disposal to be underestimated. Another discrepancy is that facilities did not always know the fate of waste removed from the site and incorrectly assumed recycling. Unless facilities had supporting documentation of these waste management practices, the site surveyors considered these transfers to be sent for disposal. Again, disposal would be underestimated and off-site transfers for recycling would be overestimated when this occurred.

As an indication of how industries surveyed this year compare to those surveyed in previous years, the overall percent differences are presented in Table 6-6. (These percent differences account for all on-site and off-site release and other waste management quantities.) This comparison suggests that industries in SIC Codes 33, 36, and 37 have less accurate reporting. On closer evaluation, industries in SIC Code 33 account for much of the 28% difference, and SIC Code 36 to a lesser extent. Industries in SIC Code 37 at 3% difference are comparable to the facilities in the SIC Codes from previous years.

Industry confusion over the definitions of recycling and reuse is the main reason for the 28% difference in facility and surveyor estimates in SIC Code 33. The magnitude of the difference in estimates is due to the large amount of throughput, use, and reuse of metals in this industry. In addition to providing guidance on recycling and reuse, industry-specific guidance appears warranted.

Table 6-6

Percent Difference of Facility and Site Surveyor Estimated Total Release and Other Waste Management Quantities as Reported in Sections 5 and 6 of the Form R for Reporting Years 1996, 1995, 1994, 1988, and 1987

Reporting Year	SIC Codes Surveyed	Percent Difference
1996	331, 332, 333, 334, 335, 367, 369, 371, 372	-28%
1995	26, 286	-1.2%
1994	25, 281, 285, 30	-6.7%
1988	28, 291, 34 through 38	1.1%
1987	20 through 39	-2.2%

6.2.2 Comparison of the Facilities Surveyed to the National TRI Database

Estimates made by surveyed facilities were compared to national estimates in the TRI database to determine how closely the release and other waste management quantities reported by the surveyed population matched the national population. To make this comparison, the estimates of the surveyed facilities were scaled-up to place them on the same basis as the national estimates. The scale-up factor used is the ratio of the number of Form Rs reported by the surveyed facilities to the number of Form Rs submitted to the TRI database by all the facilities in the SIC Codes visited. Only release and other waste management quantities from facilities with 15 or fewer Form Rs were included in the national estimates, since this was also a selection criteria when identifying facilities to visit (see discussion in Section 2). Tables 6-7a through 6-7c show this comparison and the percent differences for SIC Codes 33, 36, and 37, respectively.

$$\text{Percent Difference} = (Fa - TRI)/(TRI) \times 100$$

where: Fa = Scaled Facility Estimate
TRI = Total Release and Other Waste Management Quantities Reported in TRI database

The TRI database values have been used as the basis for comparison as these data are being used nationwide.

Table 6-7a

Comparison of Scaled Off-Site Release and Other Waste Management Quantities as Reported in Section 6 of the Form R by the Facilities Surveyed to the TRI Database, SIC Code 33

Type[a]	Scaled Release and Other Waste Management Quantities Reported by Surveyed Facilities (million pounds)	Total Reported Nationwide (SIC Codes 331, 332, 333, 334, 335) (million pounds)	Percent Difference[b] Facility: TRI
POTW	0.001	5.49	-100%
Off-Site Transfers	526	1,067	-50.7%
Total	526	1,072	-50.9%

[a]No underground injection was reported.
[b]Percent difference = (Fa-TRI)/(TRI) x 100, where Fa=Scaled Facility Estimate and TRI=Total Release Estimate as Reported in the TRI database.

Overall, there are substantial differences between the scaled-up release and other waste management quantities from the surveyed facilities compared to national estimates in the TRI database. We believe this finding relates to the voluntary nature of the program. Anecdotal evidence suggests that smaller companies and facilities have been more willing to participate in the survey program, and larger companies and facilities have a greater tendency to decline to participate. Further examination of the TRI database records of facilities that declined to participate in the site survey program for RY 1996 indicates they had approximately five times the amount of release and other waste management quantities per Form R than those that volunteered to participate in the survey. Thus, the difference in the release and other waste management estimates between the surveyed facilities and the national estimates reflect that surveyed facilities tended to have lower throughput, on average, than the industry as a whole.

Table 6-7b

Comparison of Scaled Off-Site Release and Other Waste Management Quantities as Reported in Section 6 of the Form R for the Facilities Surveyed to the TRI Database, SIC Code 36

Type[a]	Scaled Release and Other Waste Management Quantities Reported by Surveyed Facilities (million pounds)	Total Reported Nationwide (SIC Codes 367 and 369) (million pounds)	Percent Difference[b] Facility: TRI
POTW	15.7	12.0	30.1%
Off-site transfers	87.3	324	-73.1%
Total	103	336	-69.3%

[a]No underground injection was reported.
[b]Percent difference = (Fa-TRI)/(TRI) x 100, where Fa=Scaled Facility Estimate and TRI=Total Release Estimate as Reported in the TRI database.

Table 6-7c

Comparison of Scaled Off-Site Release and Other Waste Management Quantities as Reported in Section 6 of the Form R for the Facilities Surveyed to the TRI Database, SIC Code 37

Type[a]	Scaled Release and Other Waste Management Quantities Reported by Surveyed Facilities (million pounds)	Total Reported Nationwide (SIC Codes 371 and 372) (million pounds)	Percent Difference[b] Facility: TRI
POTW	2.91	6.99	-58.4%
Off-site transfers	106	193	-45.1%
Total	109	200	-45.5%

[a]No underground injection was reported.
[b]Percent difference = (Fa-TRI)/(TRI) x 100, where Fa=Scaled Facility Estimate and TRI=Total Release Estimate as Reported in the TRI database.

6.3 Estimates of On-Site Waste Management Quantities as Reported in Sections 7, 8.2, 8.4, and 8.6 of the Form R

In addition to evaluating the accuracy of the on-site releases and off-site transfers to disposal, treatment, energy recovery, and recycling. Site surveyors also reviewed facility estimates for EPCRA Section 313 chemicals in on-site waste management activities. Comparisons of the percent differences are made between the facility and the surveyor estimates for each of the three SIC Codes and each of the three waste management types: treatment, energy recovery, and recycling.

To calculate the percent difference, the amounts of EPCRA Section 313 chemicals in waste managed on site estimated by the facilities and the site surveyors were summed to determine totals for each waste management type at each facility. Totals for each facility were then summed for all facilities in each SIC Code. These totals are presented in Tables 6-8a through 6-8c. The percent difference is calculated as:

$$\text{percent difference} = (Fa - SS)/(SS) \times 100$$

where: Fa = facility estimate
SS = site surveyor estimate

The site surveyor estimates were used as the basis for comparison as they are a more accurate representation of "true value" than the facility estimates.

6.3.1 Comparison of the Facility Estimates to the Surveyor Estimates

In general, most facilities in SIC codes 33 and 36 expressed considerable confusion over reporting for on-site waste management activities. This resulted in significant quantitative errors on a facility basis. However, the total amount of EPCRA Section 313 chemicals managed as waste on site is relatively small compared to quantities released and transferred off site for further waste management. Therefore, these errors do not significantly affect the overall estimates in the TRI database. Facilities in SIC code 37 also expressed confusion, but to a much lesser degree.

Of the 27 facilities surveyed, only one reported a quantity greater than zero for on-site treatment (some correctly reported a quantity of zero). Site surveyors found this facility significantly underestimated the quantity treated (destroyed) and that three other facilities overlooked significant quantities. Additionally, as discussed in Section 4, several facilities failed to report on-site treatment or removal of metals in Section 7A of the Form R due to confusion regarding whether removal of metals from a process wastestream should be considered. Most of these facilities also expressed confusion regarding the percent efficiency that should be entered in these situations; destruction efficiency (0%) or removal efficiency (typically 99%). *[The 1996 TRI instructions say that the waste treatment efficiency reported must represent physical removal of the parent metal from the waste stream, p.41. It should be noted, however, that Section 8.6 of the Form R asks for the amount destroyed in on-site treatment. Therefore, the correct amount for metals treatment in this Section 8.6 is zero.]*

Only one facility reported a quantity sent to energy recovery. This was expected because facilities in the primary metals industry rarely employ energy recovery systems for EPCRA Section 313 chemicals, partly because most recycle or reuse activities relate to metals and metal compounds, which do not have a heat content high enough to sustain combustion. In this particular case, the site surveyor determined that the EPCRA Section 313 chemicals were directly reused, not sent to energy recovery.

Four facilities reported on-site recycling, two of which account for the majority of the total amount reported. One of these reported on-site recycling for a direct reuse activity and the second considerably overestimated the quantity recycled. A fifth facility overlooked a recycling activity entirely.

Table 6-8a

On-Site Waste Management for SIC Code 33[a]

Type	Number of Facilities with On-Site Waste Management	Amount Reported by the Facility (million pounds)	Amount Estimated by the Surveyor (million pounds)	Percent Difference[b]
On-site treatment	4	0.002	0.040	-94.8%
On-site energy recovery	0	0.950	0	--
On-site recycling	4	21.2	6.12	246%
Total		22.2	6.16	260%

[a]Number of facilities = 27, number of EPCRA Section 313 reports represented = 74.
[b]Percent Difference = (Fa - SS)/(SS) x 100, where Fa = Facility Estimate and SS = Site Surveyor Estimate.

Table 6-8b

On-Site Waste Management for SIC Code 36[a]

Type	Number of Facilities with On-Site Waste Management	Amount Reported by the Facility (million pounds)	Amount Estimated by the Surveyor (million pounds)	Percent Difference[b]
On-site treatment	7	0.575	1.40	-59%
On-site energy recovery	2	0.486	0.468	3.81%
On-site recycling	2	12.7	0.065	19,416%
Total		13.7	1.94	610%

[a]Number of facilities = 14, number of EPCRA Section 313 reports represented = 48.
[b]Percent Difference = (Fa - SS)/(SS) x 100, where Fa = Facility Estimate and SS = Site Surveyor Estimate.

Table 6-8c

On-Site Waste Management for SIC Code 37[a]

Type[b]	Number of Facilities with On-Site Waste Management	Amount Reported by the Facility (million pounds)	Amount Estimated by the Surveyor (million pounds)	Percent Difference[c]
On-site treatment	3	0.296	0.302	-2.13%
On-site recycling	2	0.016	0.016	0%
Total		0.311	0.318	-2.02%

[a]Number of facilities = 19, number of EPCRA Section 313 reports represented = 64.
[b]No on-site energy recovery was reported.
[c]Percent Difference = (Fa - SS)/(SS) x 100, where Fa = Facility Estimate and SS = Site Surveyor Estimate.

Electronic and Other Electrical Equipment Industry, SIC Code 36

Fourteen facilities from this SIC Code were surveyed. Five of these reported a quantity greater than zero for on-site treatment. Site surveyors determined that four of these underestimated the quantity treated and identified two additional facilities that employed some type of system that resulted in the destruction of an EPCRA Section 313 chemical. The primary reason for the quantitative errors was not confusion about how to report. Rather, site surveyors identified a number of chemicals that were overlooked entirely. Facilities in the electronic and other electrical equipment industry expressed confusion regarding on-site treatment of metals, similar to the confusion in the primary metals industry. However, the "treatment or removal" of metals (dust removal systems in particular) was less prevalent. Therefore, the percent difference is lower. These facilities were more likely to treat mineral acids (via neutralization) or organic chemicals.

Two of the 14 facilities reported on-site energy recovery. Site surveyors did not identify additional energy recovery operations and quantitative estimates were in close agreement. On-site energy recovery is not an area of confusion for SIC code 36.

Three facilities reported on-site recycling activities. These activities resulted in approximately 12.7 million pounds reported in the TRI database. The site surveyors concluded that two of these facilities correctly reported (both the recycling activity and the quantity). However, the third facility incorrectly reported over 12.6 million pounds for recycling that were actually directly reused. As with SIC code 33, this indicates that clarification of the terms "recycle" versus "reuse" will greatly increase the accuracy of the TRI database. It also shows that due to extremely high throughputs, an error by one facility may significantly affect the total estimates for the entire SIC code.

Transportation Equipment Industry, SIC Code 37

Results indicate that on-site waste management is rarely conducted in this industry. Also, when employed, facility estimates generally agreed with surveyor estimates, indicating that both the processes used and the chemicals managed cause less confusion than observed in SIC Codes 33 and 36.

Three of the 19 facilities surveyed reported a quantity greater than zero to on-site treatment. Site surveyors agreed within two percent of the estimated value and identified an additional facility that employed on-site treatment activities, but the quantity destroyed was less than 0.5 pounds.

On-site energy recovery was not reported or observed at these facilities.

On-site recycling was reported, and observed at two facilities. Site surveyors agreed with facility estimates in both cases.

6.4 Production Ratio/Activity Index

The production ratio/activity index is a chemical-specific measure of the changes in business activity between subsequent reporting years. The production ratio/activity index can be determined using the following methods:

- TCM - the ratio of the amount of the chemical manufactured in the current reporting year to the previous reporting year;
- TCPV - the ratio of production volume in the current reporting year to the previous reporting year;
- TCU - an activity index of the amount of the toxic chemical used in the current reporting year to the previous reporting year;
- HR - an activity index of the amount of operating hours for an activity in the current reporting year to the previous reporting year;
- WT - an activity index or production ratio based on a weighted average of data from several processes; and
- OTH - any other estimation method.

The site surveyors reviewed the method used by each facility for each Form R, and determined whether it was the most appropriate method to use based on the facility's available data. Figure 6-4 and Table 6-9 present by SIC code the distribution of the use of each method as reported by the facilities and by the site surveyors. The site surveyors recommended changes to the reported method for 25 of 157 (16%) Form Rs. The predominant method used by the facilities and the surveyors for each SIC Code is TCPV followed by TCU. The RY 1996 result is consistent with the results of the data quality surveys previously conducted by EPA.

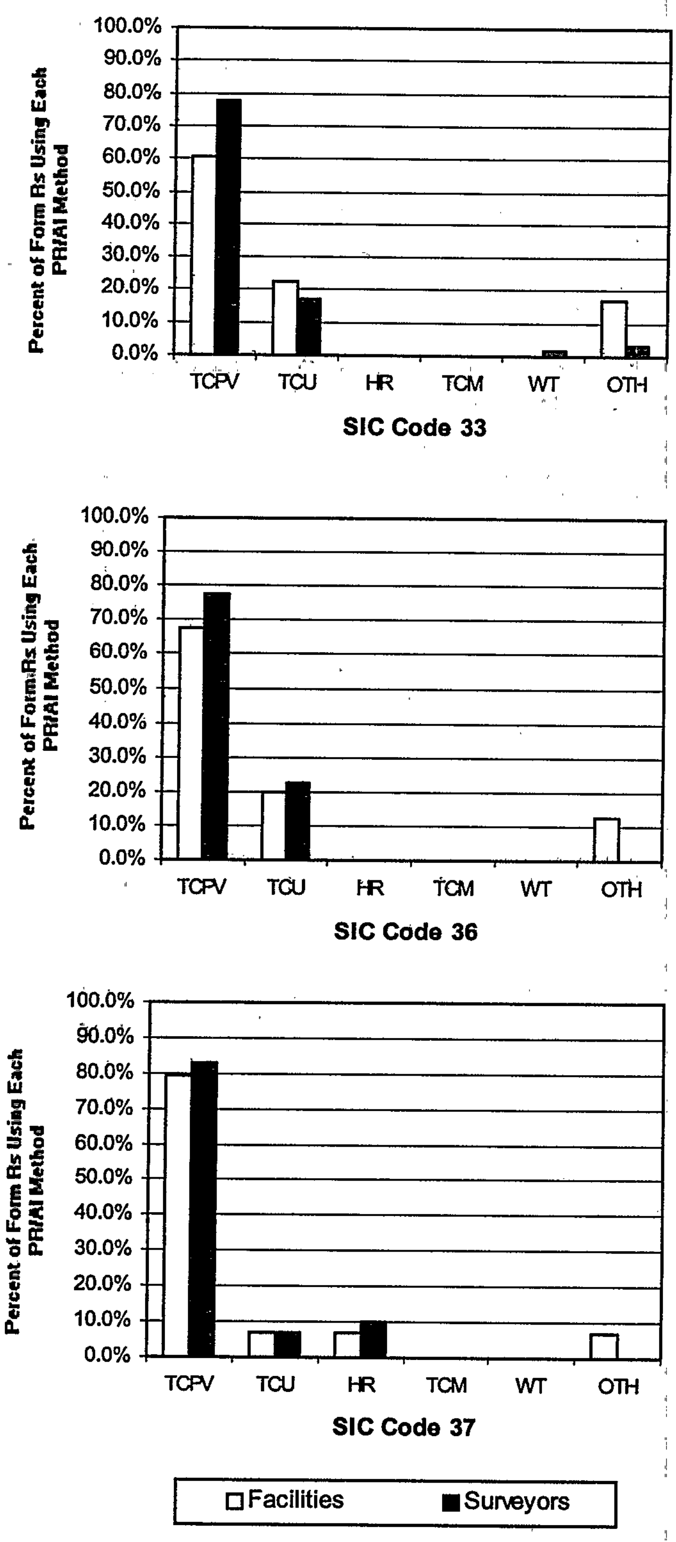
Table 6-9

Estimation Method Used by Facilities and Surveyors to Calculate Production Ratio/Activity Index

Method of Estimate	Percent of Form Rs Reviewed Using Each Method of Estimate					
	SIC Code 33		SIC Code 36		SIC Code 37	
	Facilities	Surveyors	Facilities	Surveyors	Facilities	Surveyors
TCM	0	0	0	0	0	0
TCPV	59	78	68	78	79	83
TCU	22	17	20	22	7	7
HR	0	0	0	0	7	10
WT	0	2	0	0	0	0
OTH	19	3	12	0	7	0

TCM - the ratio of the amount of the chemical manufactured in the current reporting year to the previous reporting year.
TCPV - the ratio of production volume in the current reporting year to the previous reporting year.
TCU - an activity index of the amount of the toxic chemical used in the current reporting year to the previous reporting year.
HR - an activity index of the amount of operating hours for an activity in the current reporting year to the previous reporting year.
WT - an activity index or production ratio based on a weighted average of data from several processes.
OTH - any other estimation method.

Table 6-10 shows the frequency which the surveyors agreed with the facility's choice of method. It also provides explanations for the Form Rs where the surveyors disagreed with the facility's choice of method, and shows that the surveyors disagreed most often with the "other" basis of estimate. For only eight Form Rs (from four facilities), the surveyors thought that a defined method not used by the facility was more appropriate and/or accurate for determining the production ratio/activity index from the data available at the facility.



Data for this figure can be found on Table 6-6.

Figure 6-4. Estimation Method Used by Facilities and Surveyors to Calculate PR/AI

Table 6-10

Percent of Time Surveyor Agreed with Facility Basis of Production Ratio Estimate

SIC Code	Facility Basis of Estimate	Percent of Time Surveyor Agreed with Basis	Changes Made by Surveyor
33	TCPV	97	1 TCPV changed to WT
	TCU	77	3 TCU changed to TCPV
	OTH	18	2 OTH changed to TCPV because the facilities did not know how to calculate this value 5 OTH changed to TCPV because the facilities reported chemical release ratio of 1996 to 1995 1 OTH changed to TCPV because the facility reported the production ratio from 1995 to 1996
36	TCPV	100	Not applicable
	TCU	100	Not applicable
	OTH	0	4 OTH changed to TCPV because the facilities reported a ratio of projected sales for 1997 to 1996 sales 1 OTH changed to TCPV because the facility reported a ratio of sales for 1996 to sales for 1995
37	TCPV	100	Not applicable
	TCU	25	3 TCU changed to HR
	HR	75	1 HR changed to TCPV
	OTH	0	2 OTH changed to TCPV because the facilities reported a ratio of sales for 1996 to sales for 1995 1 OTH changed to TCU because the facility did not know how to calculate this value 1 OTH changed to TCPV because the facility did not know how to calculate this value

TCM - the ratio of the amount of the chemical manufactured in the current reporting year to the previous reporting year.
TCPV - the ratio of production volume in the current reporting year to the previous reporting year.
TCU - an activity index of the amount of the toxic chemical used in the current reporting year to the previous reporting year.
HR - an activity index of the amount of operating hours for an activity in the current reporting year to the previous reporting year.
WT - an activity index or production ratio based on a weighted average of data from several processes.
OTH - any other estimation method.

Most (14 of 19) of the "other" responses were actually errors on the part of the facility, or their lack of knowledge of what this ratio was supposed to represent. Three of the "other" responses were based on the ratio of the facility's sales from 1996 to 1995. In each case these facilities had data available to calculate an activity index (the TCPV method), which the surveyors thought was more appropriate. Surveyors recommended changing all of the "other" responses except two. These two Form Rs (from the same facility) also used the ratio of the facility's sales from 1996 to 1995, but this ratio approximated the production volume for both chemicals.

A common error was that facilities used an activity index that was not specific to the processes involving the EPCRA 313 chemical. This was often seen when facilities based the ratio on total revenue, sometimes even including revenue from foreign sources.

Because many of the reporting errors for the production ratio/activity index were due to facilities not understanding the value or by calculating it using sales data, EPA can improve the accuracy of these values by preparing TRI reporting instructions that more clearly explain the ratio, including a numerical equation example, and by emphasizing that production-based data measures are preferred over sales data when available.

6.5 Source Reduction Activities

The following discussion reviews how accurately facilities report source reduction activities on Form Rs. Starting in RY 1991, EPA requested that facilities include on their Form Rs information describing source reduction activities implemented to reduce the quantity of EPCRA Section 313 chemicals in waste. This information provides the users of the data insight into the types and frequency of source reduction activities by industrial facilities. To assess the accuracy of source reduction entries in the TRI database, analyses in this section address the following three questions:

- Are the source reduction activities that facilities indicate on Form Rs legitimate?
- Why do facilities make errors when claiming source reduction?
- Do all facilities report source reduction activities on Form Rs?

Section 6.5.1 describes the source reduction activities reported for SIC Codes 33, 36, and 37. Section 6.5.2 presents the errors found by the surveyors and answers the preceding questions. Section 6.5.3 summarizes the findings and recommends ways to improve the accuracy of source reduction activity reporting. It should be noted that this section focuses only on source reduction activities that facilities indicate on Form Rs. Form As do not contain source reduction information.

6.5.1 Source Reduction Reporting

Table 6-11 summarizes how often source reduction activities were reported for EPCRA Section 313 chemicals. The data indicate that more source reduction was reported in the electronic and other electrical equipment industry (SIC Code 36) than the transportation equipment industry (SIC Code 37) or the primary metals industry (SIC Code 33). Compared to similar data from previous years, the RY 1996 results for the electronic and other electrical component industry was the largest value of reported source reduction on Form Rs surveyed (39%) of any SIC code previously included in an EPA data quality survey. The results for source reduction reporting in SIC Codes 33 and 37 (13% and 28%, respectively) were similar to the values reported for other SIC codes in other years.

Table 6-11

Frequency With Which Facilities Claimed Source Reduction Activities

SIC Code	Number of Facilities	Percent of Facilities Visited	Percent of Form Rs Submitted[a]	Total Number of Source Reduction Activities Claimed by Facilities
33	6	22	13	8
36	8	57	39	26
37	4	21	28	22

[a]Percents in this column were calculated using the weighting factors discussed in Section 2.6.

Table 6-12 shows the source reduction activities most commonly reported for each SIC code. A variety of responses were received for each SIC code, although raw material substitutions and process modifications account for most of the source reduction activities reported for each SIC code.

6.5.2 Errors Made When Claiming Source Reduction

To identify errors commonly made by facilities and reasons why facilities made these errors, site surveyors determined whether facilities indicated source reduction activities that were consistent with definitions of source reduction presented in the EPCRA Section 313 reporting instructions. In cases where facilities did not claim source reduction activities, site surveyors attempted to determine whether facilities overlooked source reduction activities. The rate of occurrence of errors in reporting source reduction activities and of not reporting source reduction activities is shown in Table 6-13. Only a few errors were identified in reporting source reduction activities. The percentage of errors found was lower than those found in previous EPA data quality surveys. This EPA data quality survey is the first that attempted to identify overlooked source reduction activities. Surveyors did find several overlooked source reduction activities.

Site surveyors disagreed with the source reduction activities reported for only five Form Rs (from two facilities). Three Form Rs, from one SIC Code 369 facility, reported a "change in operating practice" (Code W19) for three metal compound categories because they started re-melting scrap metal. This process is not source reduction because the facility is still processing the same amounts of metals, but now are just receiving some of them from a different source. Another Form R, from an SIC Code 371 facility, reported "other changes in inventory control" (Code W29) for dichloromethane because they improved their drum reconditioning activities. This same facility also reported "other spill and leak protection" (Code W39) because they added a vapor collection system above a process area to capture methanol fumes. This facility may be reducing the amount of dichloromethane and methanol in their waste, but not because of source reduction activities. The errors made by both of these facilities resulted from their not understanding exactly what activities constitute source reduction.

Table 6-12

Source Reduction Activities Claimed by the Surveyed Facilities

SIC Code	Source Reduction Code	Description	Percent of Form Rs That Correctly Used This Code
33	W14	Changed production schedule to minimize equipment changeovers	25.0
	W52	Modified manufacturing equipment and layout	25.0
	W13	Added a recordkeeping system for chemical additions to a bath	12.5
	W41	Increased purity of raw materials	12.5
	W55	Changed from small volume containers to bulk containers	12.5
	W82	Changed composition of raw materials	12.5
36	W58	Other process modifications	26.1
	W42	Substituted raw materials	21.6
	W52	Modified equipment, layout, or piping	21.6
	W19	Other changes in operating practices	8.7
	W13	Improved maintenance scheduling, recordkeeping, or procedures	4.4
	W41	Increased purity of raw materials	4.4
	W73	Substituted coating materials used	4.4
	W78	Other surface preparation and finishing modifications	4.4
	W82	Modified design or composition of product	4.4
37	W42	Reduced concentrations of reportable chemicals in raw materials	35.0
	W72	Modified spray systems	15.0
	W73	Substituted coating materials used	15.0
	W74	Improved application technique	15.0
	W19	Use fewer storage tanks and transfers for fewer emissions	5.0
	W49	Raw material modifications	5.0
	W52	Modified equipment layout or piping	5.0
	W58	Other process modifications	5.0

Table 6-13

Errors in Source Reduction Activity Classifications

SIC Code	Number of Errors in Source Reduction Activity Claims	Estimated Percent of Source Reduction Activities that are Claimed In error[a]	Approximate Number of Source Reduction Activities not Reported by the Selected Facilities	Estimated Percent of Source Reduction Activities that are not Reported[a]
33	0	0	7	11
36	3	12	0	0
37	2	9	4	7

[a] Percents in this column were calculated using the weighting factors discussed in Section 2.6.

The source reduction activities that the surveyors identified as not having been reported are summarized as follows:

- One SIC Code 33 facility had an ongoing effort to increase aluminum yield, and could have reported administrative source reduction activities (Code W13) for two chemicals;
- Two SIC Code 33 facilities modified their equipment (Code W52) and made other changes (Code W58), affecting several chemicals at each site;
- One SIC Code 37 facility could have reported source reduction for one chemical through use of a higher purity raw material (Code W41); and
- Three SIC Code 37 facilities replaced or closed a particular process and stopped using a particular chemical altogether, or eliminated a waste stream to a particular media (Codes W52, W58, or W61).

6.5.3 Overall Accuracy of Source Reduction Data

Site surveyors found that some facilities in the selected industries misinterpreted definitions of source reduction and should not have claimed all the source reduction activities that they did for RY 1996. Observations made by site surveyors suggest that some facilities did not claim legitimate source reduction activities on their Form Rs, but the current site survey data are insufficient for evaluating how often it occurs. The source reduction data in the TRI database may not be completely accurate, however it does indicate that pollution prevention efforts are being considered by industries, and that the reporting of these activities is increasing.

Because the reporting errors of source reduction activities seem to be due to facilities misinterpreting definitions, EPA can help improve the accuracy of source reduction data by preparing TRI reporting instructions and guidance manuals that clearly define which activities are and are not considered to be source reduction.

7.0 PREPARATION OF THE FORM R

Site surveyors interviewed facility personnel during each site visit to obtain general information regarding completion of the EPCRA Section 313 reports (Form Rs or Form As) and to identify trends among the surveyed facilities. The information obtained during these interviews included quantitative information such as facility size (the number of employees at the facility), estimated time to complete the Form Rs, the types of personnel primarily responsible for preparing the Form Rs, and the types of references used by these personnel. In addition, the surveyors obtained qualitative feedback on the Form R Instructions, the Automated Form R (AFR), the TRI Hotline, use of the Form A, and suggestions for additional guidance that EPA should develop to assist facilities in estimating release and other waste management quantities and in preparing the Form Rs. Each of these topics is discussed in a subsection as follows:

- Section 7.1 - Facility Personnel and References;
- Section 7.2 - Amount of Time Needed to Prepare Form R Reports;
- Section 7.3 - Use of the Hotline;
- Section 7.4 - Comments on the Form R Instructions;
- Section 7.5 - Comments on the Automated Form R; and
- Section 7.6 - Comments on Use of the Form A.

7.1 Facility Personnel and References

Table 7-1 identifies the percentage of surveyed facilities by size (based on number of employees) for each SIC Code. The table indicates that most of the primary metals facilities (SIC Code 33) had fewer than 500 employees (an average of 190), while the electronic and other electrical equipment (SIC Code 36) and transportation equipment (SIC Code 37) facilities were evenly split between facilities with 50 to 499 employees and facilities with more than 500 employees.

Table 7-1

Number of Employees at Visited Facilities

Employee Range	Percentage of Visited Facilities with a Given Number of Employees		
	SIC Code 33	SIC Code 36	SIC Code 37
10-49 employees	22	0	11
50-499 employees	74	50	47
>500 employees	4	50	42
Number of Sites	27	14	19
Average Employees	190	690	710

Each facility was asked to identify the type of personnel responsible for completing the Form Rs from among the following choices:

- Facility Environmental - A full-time, on-site employee whose primary responsibility is dealing with environmental issues.
- Corporate Environmental - A person with environmentally-related responsibilities for more than one individual facility and may or may not be physically located at the visited facility.
- Facility Staff - An on-site employee whose responsibilities extend beyond the environmental area.
- Consultant/Contractor - Personnel contracted outside the company to prepare the facility's Form Rs.
- Safety Personnel - Similar employee to Facility Environmental but includes safety issues. This person may have responsibilities dealing with Environmental Health and Safety issues.
- Other - Anyone who completed the Form R that does not belong to one of the previously described staff types.

Table 7-2 lists the types of personnel responsible for preparing the Form Rs for each SIC Code. Both facility staff and facility environmental staff were common responses for SIC Code 33, while facility environmental staff (alone) was the most common response for SIC Codes 36 and 37. Consultants/contractors and facility staff were typically reported by smaller facilities (based on number of employees) across each SIC Code, while facility environmental staff was typically reported by larger facilities.

Table 7-2

Types of Personnel Completing the Form Rs

Staff Type	Percentage of Facilities Using Each Staff Type to Prepare The Form Rs[a]		
	SIC Code 33	SIC Code 36	SIC Code 37
Facility environmental	33	57	68
Corporate environmental	19	7	16
Facility staff	37	14	0
Consultant/contractor	15	29	16
Safety personnel	4	14	5
Other	7	0	5

[a]Totals may equal more than 100 percent due to facility personnel identifying themselves as more than one staff type.

Table 7-3 identifies the reference materials facilities most commonly used to prepare their Form Rs. All but two of the facilities visited used the TRI Reporting Form R instructions for RY 1996 and MSDSs to prepare their Form Rs. Many of the facility contacts had attended EPA-sponsored training workshops. The number of respondents that attended EPA-sponsored training workshops was much greater than reported in EPA's previous surveys. Facility use of other references is similar among the three SIC Codes. One difference between the SIC Codes is that SIC Code 36 commonly reported using EPA's *Estimating Releases and Waste Treatment Efficiencies for TRI (Green Book)* and *Industry Trade Association Materials,* while SIC Code 37 commonly reported the use of EPA's *Compilation of Air Pollutant Emission Factors Document (AP-42),* use of privately sponsored seminar materials, and other resources.

Table 7-3

Common References Used to Complete the Form Rs

Reference	Percentage of Facilities Using a Particular Reference[a]		
	SIC Code 33	SIC Code 36	SIC Code 37
TRI reporting Form R instructions	93	100	100
Material safety data sheets	93	100	100
Estimating Releases and Waste Treatment Efficiencies for TRI (Green Book)	22	29	16
EPCRA Section 313 Release Reporting Guidance, Estimating Chemical Releases	7	7	16
Compilation of Air Pollution Emission Factors, AP-42	19	14	42
Industry trade association materials	19	29	16
Privately sponsored seminar materials	7	7	37
EPA-sponsored training workshop	33	29	53
Computer programs	15	21	37
Other references	22	7	32

[a]Totals may equal more than 100% as facilities often used more than one reference.

Eight facilities reported the use of other references that were not specifically identified in Table 7-3. These sources included supplier data, manufacturer's control efficiencies, hazardous waste manifests, non-AP-42 emission factors, Occupational Safety and Health Administration (OSHA) air sampling data, internal guidance from a corporate office, corporate seminars, EPA's TRI Question and Answer Document, and various software packages. Some of the software packages included MSDS tracking software, purchasing tracking software, chemical tracking software, internal spreadsheets, and named software packages such as OSHA-Soft, Wixel, HMMIS System, Reg Master, and Environmental Management Information System.

7.2 Amount Of Time Needed To Prepare Form Rs

Table 7-4 and Figure 7-1 show the number of hours required to collect the necessary data and complete all the Form Rs as reported by the facilities surveyed in RY 1996. Surveyors requested that the facility select one of five time period ranges (shown in Table 7-4). The time range reported by each facility was then divided by the total number of Form Rs filed by each facility to estimate the time required per Form R as shown in Table 7-5.

The estimates in Table 7-5 were calculated using the midpoint of each time range. Facilities that reported spending more than 100 hours provided an actual hour estimate which was used in the calculations. Therefore, these values can be compared to one another to identify differences between the SIC Codes, but are not necessarily an accurate estimate of the time required to complete each Form R. For example, if the upper end of each time range had been used to perform these calculations rather than the midpoint, the average time per Form R (across all facilities) is 24 hours rather than 18, as shown in Table 7-5. Table 7-5 discusses one particular data outlier: one SIC Code 371 facility reported a time of 200 hours per Form R which was more than double the next highest value in the database. Several estimates, as noted on Table 7-5, include and exclude this value. This SIC Code 371 facility reported this value because they believe they need to have someone key-enter MSDS information on a weekly basis to track their usage of EPCRA Section 313 chemicals.

For SIC Codes 33 and 36, Table 7-5 shows is that it takes more time per Form R for a facility to complete one Form R, compared to multiple Form Rs. These calculations were repeated (data not shown) and the same conclusions apply to facilities that complete "one or two" Form Rs, compared to more than two Form Rs. While this conclusion is reasonable, it does not appear to apply to SIC Code 37. Of the four SIC Code 37 facilities that filed only one Form R, all made one particular product. The remaining SIC Code 37 facilities made one or more products or were assembly lines handling hundreds of parts. The time each facility reported for completing Form R reports was similar. Thus, simple facilities making a limited number of products and those facilities making the same product(s) year after year may realize the same time efficiency in EPCRA Section 313 reporting as facilities submitting multiple Form Rs.

Table 7-4

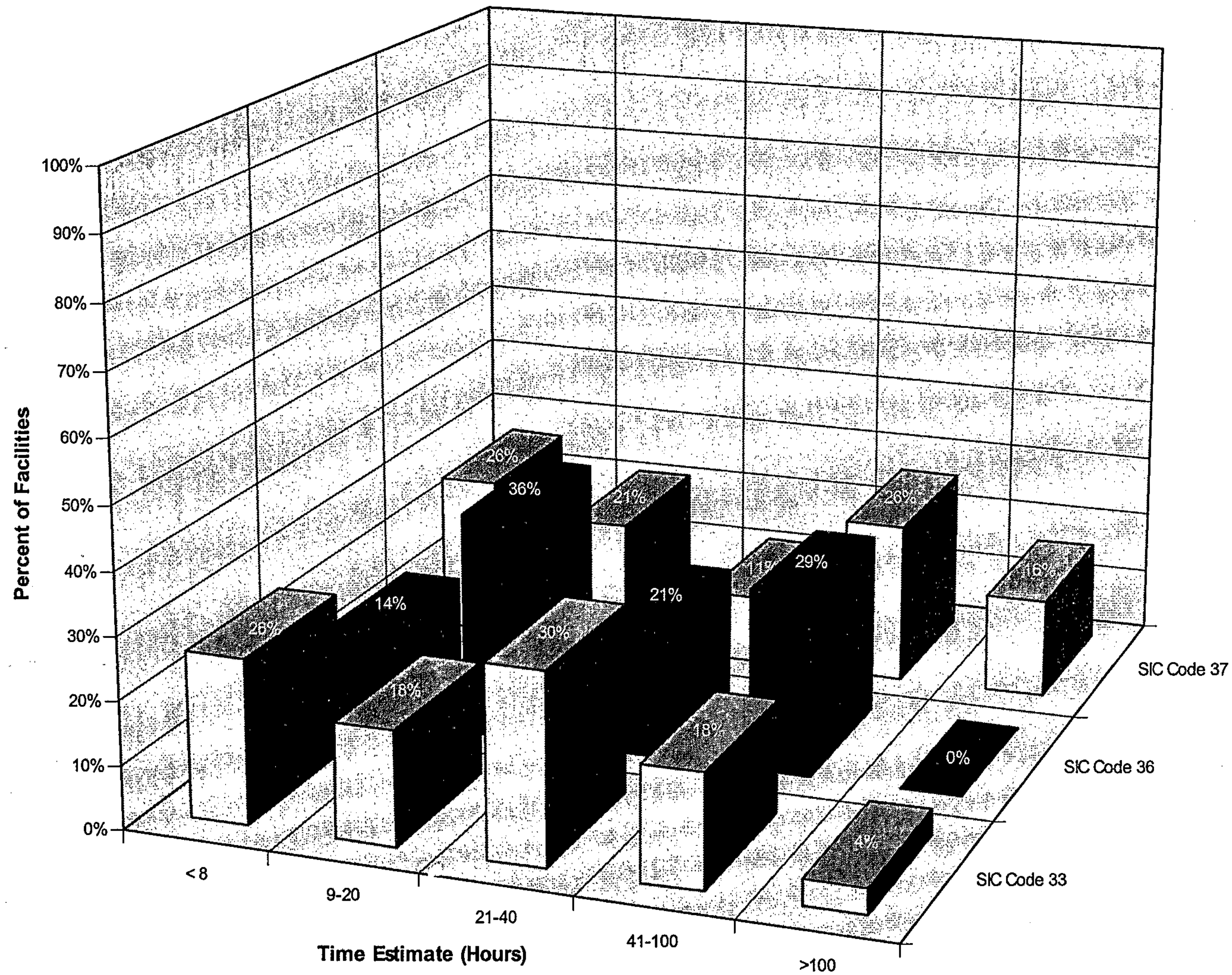
Number of Hours Required to Complete All Form Rs at Surveyed Facilities

Time Range Estimate	Percentage of Facilities		
	SIC Code 33	SIC Code 36	SIC Codes 37
≤8 hours	26	14	26
9-20 hours	18	36	21
21-40 hours	30	21	11
41-100 hours	18	29	26
>100 hours	4	0	16
Unknown	4	0	0

Table 7-5

Average Number of Hours Needed to Complete Each Form R

SIC Code	Data Subset	Time Estimate (Hours)
33, 36, 37	All data	18
33	All data	16
36	All data	16
37	All data	22
33, 36, 37	Facilities filing only 1 Form R	22
33, 36, 37	Facilities filing more than 1 Form R (with 1 outlier)	16
33, 36, 37	Facilities filing more than 1 Form R (without 1 outlier)	11
33	Facilities filing only 1 Form R	26
33	Facilities filing more Than 1 Form R	9
36	Facilities filing only 1 Form R	23
36	Facilities filing more than 1 Form R	10
37	Facilities filing only 1 Form R	9
37	Facilities filing more than 1 Form R (with 1 outlier)	25
37	Facilities filing more than 1 Form R (without 1 outlier)	12



May not add up to 100% because not all facilities reported the time estimate

Data for this figure can be found in Table 7-4.

Figure 7-1. Time Needed to Complete All Form Rs at Survey Facilities (SIC Codes 33, 36, and 37)

As indicated above, the average time needed per Form R is a function of the number of hours in the time range checked, and whether the midpoint or maximum of the range is used. However, the various time estimates listed in Table 7-5 represent an average range, and are significantly lower than the estimated average burden of 43 hours per Form R as listed in the Toxic Chemical Release Inventory Reporting Form R and Instructions for RY 1996.

7.3 Use of the Hotline

Of 60 facilities visited, 57% reported calling the EPCRA hotline for assistance in completing the Form Rs (although not necessarily about RY 1996). Figure 7-2 shows the percentage of visited facilities that called the hotline for the SIC Codes included in this analysis. Figure 7-2 indicates that personnel at about half of the primary metals facilities (SIC Code 33) called the hotline, and a greater percentage of the electronic and other electrical equipment (SIC Code 36) and transportation equipment facilities (SIC Code 37) called the hotline.

Most of the respondents in RY 1996 (85%) indicated that the hotline was helpful. However, two facilities stated that they had difficulty getting through to speak to an operator, and two other facilities stated that they received different answers from different operators. These same two complaints about the hotline were received during the analyses that EPA conducted for RY 1994 and RY 1995, in about the same frequency. One other facility commented that the hotline response was not helpful in RY 1995, but was helpful in RY 1996.

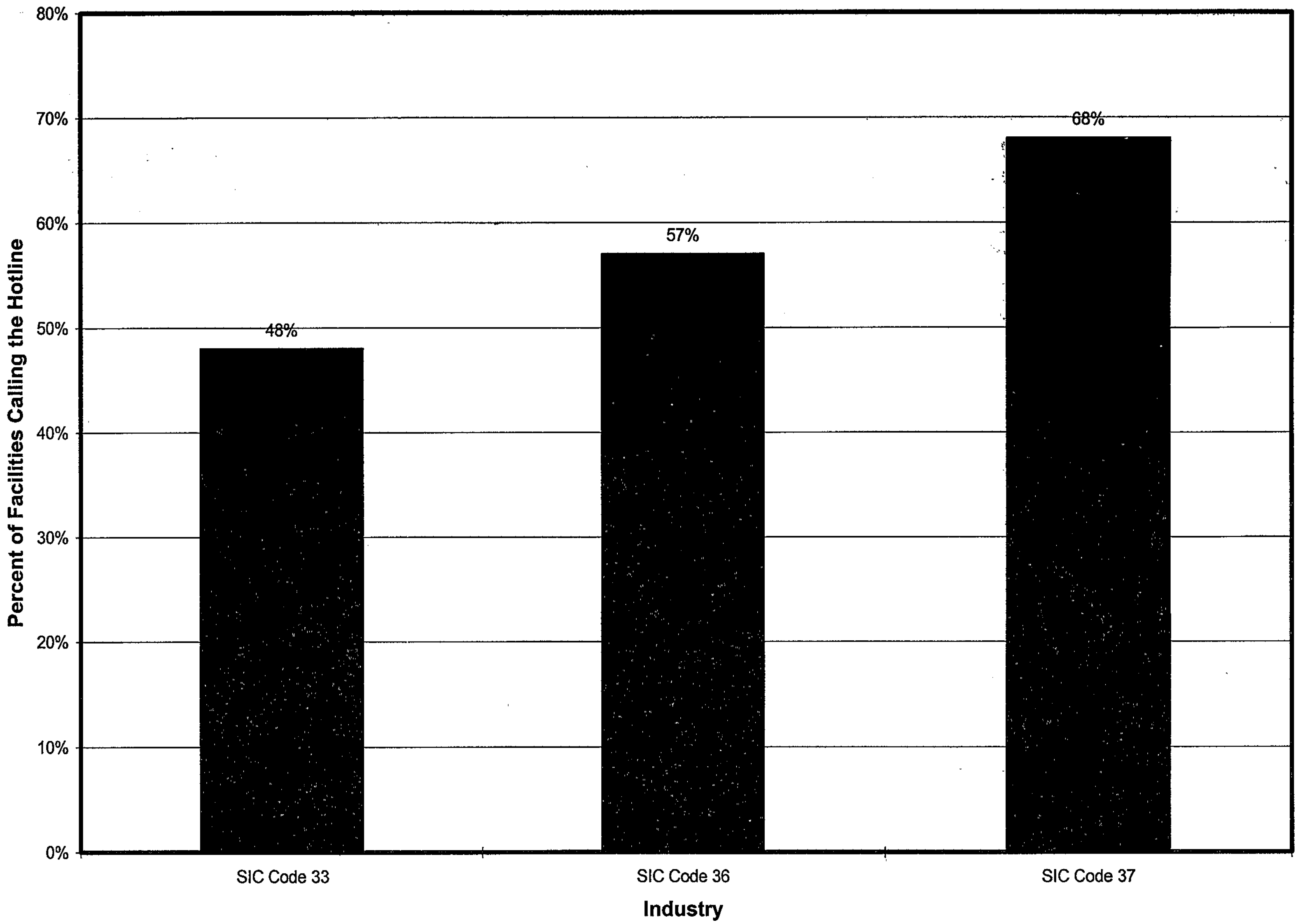


Figure 7-2. Percent of Facilities Calling the Hotline by Industry

7.4 Comments on the Form R Instructions and Guidance Manuals

Surveyors asked facility personnel for feedback on the Form R instructions, and for requests they may have for any additional guidance materials. Table 7-6 shows the number of respondents who identified a particular portion of the Form R instructions as unclear, for each SIC Code. The comments received were similar for each SIC Code.

Table 7-6

Comments on the Form R Chemical Specific Instructions

Subject Area	Number of Respondents Stating That a Particular Subject Area Was Unclear		
	SIC Code 33	SIC Code 36	SIC Code 37
Toxic chemical identity	0	0	0
Mixture component identity	0	0	1
Activities and uses of the toxic chemical	2	1	3
Releases to the environment on site	2	0	1
Transfers in waste to off-site locations	2	0	1
On-site waste treatment methods and efficiency and on-site energy recovery and recycling methods	1	0	3
Source reduction and recycling activities	0	1	1

General comments received about unclear portions of the Form R instructions are summarized below, with the number of facilities making each comment shown in parentheses. The list includes comments received from facilities in each SIC Code, and were not interpreted to be SIC-code specific. After the general comments are three separate lists, one for each SIC Code, of additional guidance materials that have been requested or comments on the Form R instructions that are SIC-code specific.

Unclear Areas of the Form R Instructions

- Definitions of manufacturing, processing, and otherwise use (4 facilities).
- The *de minimis* exemption (2 facilities).
- The article exemption (1 facility).
- The exemption for vehicles used on site (1 facility).
- The definitions of recycle versus reuse (5 facilities).
- The definition of metals versus metal compounds, e.g., nickel versus a nickel alloy (3 facilities).
- How to report metals entering POTWs (2 facilities).
- How to determine a facility's latitude and longitude (1 facility).
- The definition of an aerosol (1 facility).

SIC Code 33 - Primary Metals (RY 1996)

- Two facilities requested a guidance document that is industry specific (one was a steel manufacturer and the other was a foundry), and a third facility simply requested that more examples be presented.
- One facility suggested that EPA opinions be published as part of the guidance.
- One facility requested more information on which chemicals are in the glycol ethers category.

SIC Code 36 - Electronic and Other Electrical Equipment (RY 1996)

- One facility requested that EPA suggest methods (e.g., spreadsheet formats) for tracking EPCRA Section 313 chemicals used on site.
- One facility requested more guidance on estimating stormwater releases.
- One facility requested more guidance on estimating releases of acid aerosols (e.g., for hydrochloric acid).
- One facility requested that EPA release its instructions and guidance manuals in a more timely manner.

SIC Code 37 - Transportation Equipment (RY 1996)

- One facility suggested that the instructions contain less technical jargon; another facility requested "anything" to make the process simpler.
- One facility suggested that the instructions contain a list of references. Another facility requested that EPA explain where to find the answers to frequently asked questions. Another facility asked for a list of web sites (e.g., both EPA and environmental group web sites) that provide TRI information.
- One facility requested that more examples be included over a broader range of operations.
- One facility requested additional pollution prevention guidance.
- One facility requested a consistent method for estimating metal releases in stormwater.
- One facility requested that welding emission factors be published, with apportionments between different media categorized.
- One facility requested more guidance on emissions calculations.
- One facility requested, for EPA computer programs, that EPA write more easily understandable explanations of the program assumptions. A specific example was cited, the WIND program for estimating stockpile fugitive emissions.

7.5 Comments on the Automated Form R (AFR)

Sixty-three percent of the facilities surveyed for RY 1996 used the AFR to prepare their Form Rs. Two-thirds of the facilities that used the AFR stated that it was helpful, while one-third stated that it was not helpful. This information is shown in Figure 7-3.

The types of feedback received on the AFR are provided below. Every comment shown below was provided by more than one facility. Some of the comments, while described separately below (the way they were reported), may actually be different ways of describing the same problem.

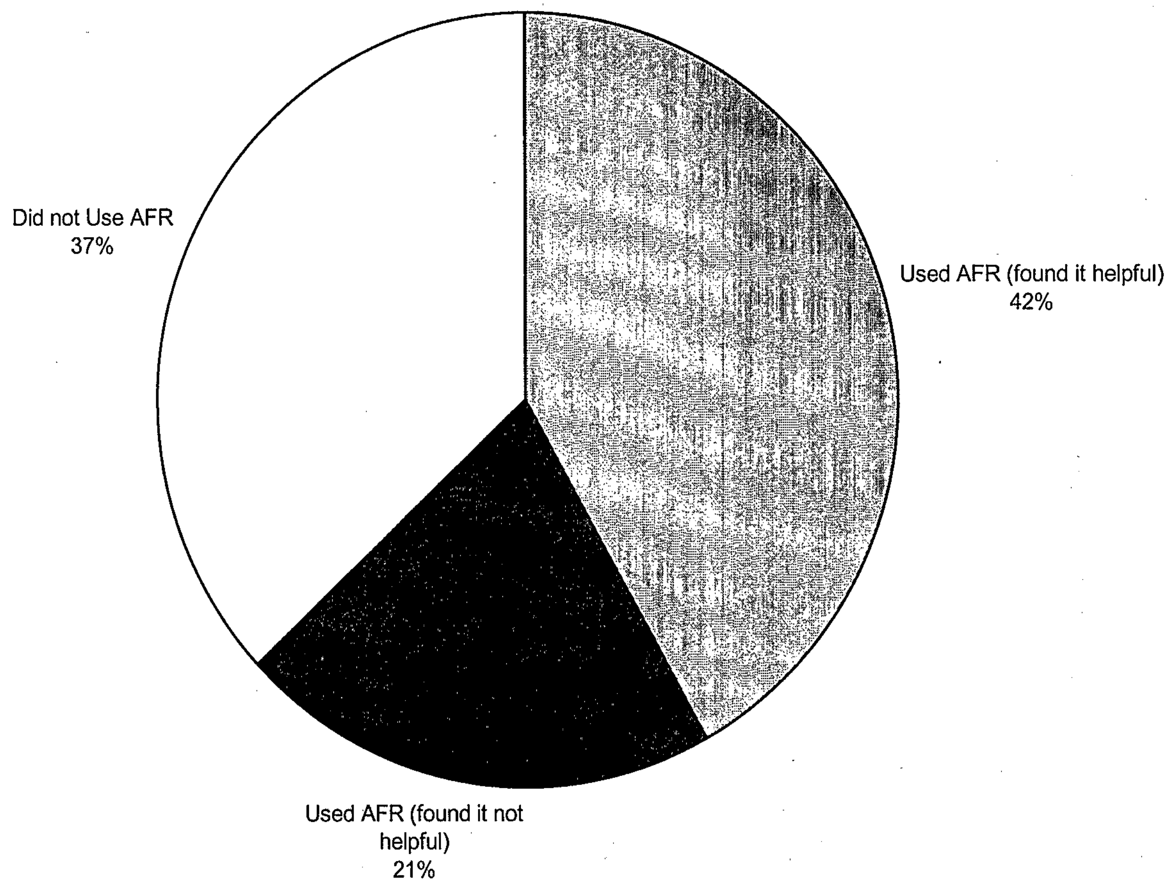


Figure 7-3. Percent of Facilities Using the Automated Form R

Positive AFR Comments

- Several facilities said the AFR is easy to use and saves typing time from year to year. Common data (such as facility name) are maintained from year to year and only the release information needs to be updated.

- Two commenters stated that the validation queries help reduce reporting errors, particularly in Section 8.

- Several commenters stated that the AFR software seems to be getting better with each release version.

Negative AFR Comments and AFR Suggestions

- Six facilities reported receiving diskettes for RY 1996 that were not readable, and therefore were not useable. One facility said they did not receive the AFR early enough in the year to use it; and that the AFR should be sent out earlier in the year.

- Several facilities said they had previously used a Windows version of the software, but they were mailed a DOS version this year. Most facilities did not want the DOS version and called the hotline to obtain a Windows version instead.

- Two facilities reported having problems installing the Windows version of the software for RY 1996; one of these facilities said it had worked better for RY 1997. One facility reported problems installing a Windows NT version of the software. One facility said that no information was available indicating that the AFR could not be loaded onto a computer on a network.

- Two facilities said that the Windows version of the software did not let them carry over data from the previous year (the opposite of the first positive statement made about the AFR).

- Five facilities reported that the software contains bugs but they did not elaborate. Many of the other bullets in this section probably explain some of these bugs. One facility said that they had technical problems with Sections 3.0 and 6.2 of the software. Another facility said that the AFR had switched some release totals around between reporting categories.

- Three facilities stated that the AFR would not let them report metals entering a POTW as a release for disposal; the software wanted to classify it as treatment.

- Two facilities said that the software would not let them enter NA in every place where they believed that NA was an acceptable response.

- One facility had a hard time entering extra off-site transfers. The software said releases to the environment and did not distinguish on site from off site releases.

This site ended up double-counting these releases. Once submitted, the facility could not access the database to correct the mistake.

- One facility received a Notice of Significant Error because data that they put into the AFR were not transferred onto the printed reports created by the AFR.
- One facility suggested that more specific error analyses be included. This facility had left out an EPA identification number for a hazardous waste disposal site, but the error message they received simply said an error occurred in the previous section.
- One facility said that the AFR User Support Hotline voicemail is always full of messages, and is unable to receive any more messages.
- Several facilities had trouble printing their reports once they were finished, and some could not print the reports at all. One facility stated that 1) each AFR page was printed onto two separate pieces of paper and 2) some of the printed text was garbled. One facility said that it could not print the AFR Users Guide.
- One facility suggested that the printer selection section needs to be updated. New printers come out every year and the AFR printer selection list is not keeping up.
- One facility suggested that the program should have an easier way to exit, or abort, the program.

7.6 Comments on Use of the Form A

Five facilities surveyed for RY 1996 filed at least one Form A report. The surveyors agreed that three of these facilities had used the Form A correctly, but two of the facilities had used the Form A incorrectly. At least eight other facilities could have filed at least one Form A but did not. Three of these facilities did not know about the Form A. Five of these facilities knew about Form As, but chose instead to file Form Rs because it was more convenient. These facilities said that they had to do the same threshold, release, and other waste management calculations regardless of the form they filed, and recording their estimates on the Form R, a form they were already familiar with, would take less time by comparison than learning the requirements of the new Form A.

The Form A requirements have been discussed in the reporting instructions for the past two years. Some facilities have correctly learned these requirements and used the Form As. The Form A requirements are also being emphasized in the new industry-specific guidance manuals that EPA is now preparing.

8.0 RECOMMENDATIONS

This section presents several recommendations for the EPCRA Section 313 program based on the results and conclusions of the RY 1996 data quality assessment based on site surveys. Improvements in reporting guidance and in the reporting instructions, as well as facilities' experience in completing Form R reports for the previous reporting years will continue to improve the data quality in the TRI database. Recommendations for continued improvement of the TRI database are listed in the following subsections.

8.1 Additional Guidance Concerning Form R Instruction and Documentation

General recommendations noted by site surveyors for all SIC Codes include a section introducing and explaining the Question/Answer document and guidance documents currently available from EPA in the front of the TRI instructions. Many facilities and trade associations did not read the entire TRI instruction booklet and, therefore, were not aware these documents existed. Many facilities also requested a TRI guidance document specific to their industry. Facilities frequently requested a guidance document on foundry operations as well as one on metal and metal compounds reporting. Site contacts responsible for filling out EPCRA Section 313 reports mentioned that a readily available list of TRI Internet sites would also be helpful.

Facilities across all SIC Codes visited expressed concerns about the Automated Form R (AFR). Three of the facilities reported that the original diskettes they submitted to EPA were deemed "unreadable". Therefore, EPA issued a Notice of Technical Error. EPA and the facility eventually resolved the issue and in each case the facility re-sent the appropriate forms. None of these facilities received a confirmation letter from EPA. When site surveyors arrived on site with copies of information extracted from the TRI database, discrepancies existed between the TRI information and the information the facilities sent to EPA. This problem indicates a potential systematic error when corrected AFRs are sent to EPA.

Specific comments from facilities in each of the SIC Codes visited are as follows:

SIC Code 33 - Primary Metals Industry

- Better definitions are needed in order to distinguish between recycling and reuse.
- More examples and applicability guidelines are needed for the *de minimis* and article exemptions.
- Better definitions are needed of metals versus metal compounds, and EPA guidance should be available on which to report if both the metal and metal compounds exceed the threshold.
- Clearer instructions are needed in reporting metals in Section 7 and 8.6 of the Form R (on-site treatment). One issue in question is whether an air pollution control device removing dust containing the metal should be included as treatment (and if so, what efficiency to report since the metal is not destroyed but is removed from the gas stream). Specific examples should be given in this scenario when the toxic chemical has a "dust or fume" qualifier and/or when the metal dust collected is actually the product to be sold. Another issue related to on-site treatment is whether to report "0" or "N/A" in Section 8 when an on-site treatment unit is reported in Section 7.

SIC Code 36 - Electronic and Other Electrical Equipment

- Clear guidance is needed on whether HCl and H_2SO_4 acid aerosols should be reported as being treated (Section 7 and/or Section 8) if the chemical was simply removed from an air stream and incorporated into an aqueous stream. Facilities felt the current guidance in the reporting instructions was unclear.
- Clear guidance is needed on whether a chemical that is destroyed when it is used to treat other chemicals is considered to be treated itself. Facilities were unsure if, or how, Sections 7 and 8.6 should be completed in this situation.
- More information is requested on determining production ratio, specifically for those EPCRA Section 313 Chemicals produced as by-products or where the production ratio is determined by something other than the annual production ratio of the final product.

- Better documentation is requested when EPA delists a chemical, but includes it in a chemical category. A few facilities were tracking specific diisocyanate or glycol ether chemicals that were once on the EPCRA Section 313 list, but are now included in the diisocyanates or glycol ethers category instead of being listed separately. Facilities suggested leaving these chemicals in the EPCRA Section 313 with a note to include them in the chemical category instead.
- Better definitions are needed to distinguish between the minor category classifications (manufacturing aid vs. processing aid).

8.2 Additional Guidance Concerning Threshold Determinations

Although the nature and extent of threshold determinations varies from one industry to the next, some general lessons can be learned from the mistakes identified by the site surveyors. Table 8-1 lists common errors made by facilities when determining thresholds and offers several recommendations to avoid making such errors in the future. These recommendations may also be useful to EPA when developing future releases of TRI reporting instructions.

8.3 Additional Guidance Concerning Release Estimates

Table 8-2 lists common errors made by facilities in all SIC Codes surveyed when estimating release and other quantities managed as waste, and offers several recommendations to avoid making such errors in the future.

Table 8-1

Recommendations for Avoiding Errors in Threshold Determinations

Error Observed in Determining Thresholds	Recommendation for Avoiding Error in Future TRI Reporting Years
Facility did not document results of threshold determinations.	Reporting instructions should emphasize that documentation requirements apply to both threshold determinations and release and other waste management estimates.
Facility assumed EPCRA Section 313 chemicals exceeded thresholds, rather than calculating annual usages and comparing these amounts to reporting thresholds.	Facilities should be informed that assuming thresholds are exceeded, rather than calculating annual usages for EPCRA Section 313 chemicals, is a common source of errors in TRI reporting. Reporting instructions should encourage facilities not to assume thresholds are exceeded, even for chemicals used in very large or very small quantities.
Facility overlooked EPCRA Section 313 chemicals that were purchased in mixtures.	Facilities should carefully review the most recent MSDS for every mixture brought on site to identify all EPCRA Section 313 chemicals used during a reporting year.
Facility considered only raw materials used for production and overlooked chemicals used for other purposes.	Facilities should take a systematic approach to identify all chemicals and mixtures used in production and non-production capacities, including catalysts, underground injection well treatment chemicals, wastewater treatment chemicals, and the like.
Facility environmental staff was unaware that certain EPCRA Section 313 chemicals were used at the plant.	Facilities should implement measures, such as chemical usage logs or hazardous chemical inventories, to ensure that environmental staff are aware of all EPCRA Section 313 chemicals used in industrial applications.
Facility did not account for EPA's most recent threshold determination guidance.	EPA should enhance outreach efforts to ensure that all facilities are aware of revised reporting guidelines well in advance of submission deadlines.

Table 8-2

Recommendations for Avoiding Errors in Identifying Release and Other Waste Management Activity Types and Sources

Observed Error	Recommendation for Avoiding Error in Future TRI Reporting Years
Overlooked stack emissions from storage tanks, or reporting these emissions as fugitives.	Instructions should emphasize this potential release source and briefly discuss the definition of loading, working, and breathing losses from tanks (and the methodology to calculate them).
Overlooked container residue	Instructions should emphasize that even a "RCRA empty" drum is expected to contain a residual (possibly up to two inches) and that it must be considered for TRI reporting. Also, note that on-site drum rinsing and disposal of the rinsate will result in a discharge to water.
Overlooked acid aerosols manufacturing	Instructions should indicate that if H_2SO_4 or HCl is used anywhere in the plant as an aerosol, regardless of whether the process is enclosed or not, their usage should be applied to the threshold determination and release and other waste management calculations.
Incorrectly reporting disposition for off-site transfers	Instructions should emphasize that facilities should attempt to determine the type of receiving facility that is accepting the transfers and exactly how the material sent is being managed (or directly reused) by the receiving facility.
Questions on on-site recycling	Provide a definition of recycling and include examples of streams that can be considered as being recycled in Sections 7 and 8. An example would be used metals or metal compounds. Specifically, what waste management activity must be applied to a used metal for it to be considered recycled versus reused.
Definitions of source reduction	Consider shortening the list of codes for source reduction and providing definitions for each code.
Questions of on-site treatment of waste stream containing metals	Provide clarification of on-site treatment definitions pertaining to waste streams containing metals. Facilities completing Sections 7a and 8.6 of the Form R for metals are confused as to when treatment refers to collection versus actual destruction of a metal.

Table 8-2 (Continued)

Recommendations for Avoiding Errors in Identifying Release and Other Waste Management Activity Types and Sources

Observed Error	Recommendation for Avoiding Error in Future TRI Reporting Years
Confusion on energy recovery	Few facilities marked metals as going to energy recovery, either on-or off-site. The TRI Reporting Instructions should explicitly state that metals do not have a BTU value high enough for energy recovery, and should be marked as going to disposal or recycling.
Reporting releases as zero versus a range code representing a small amount	For air and water releases, standard guidance is needed on when it is reasonable to claim NA or zero versus "guessing a small amount" - range code A or B. (e.g. metal processed in amounts up to 10 pounds a year through furnaces, reactors, etc. Is it reasonable to claim zero or NA?) Standard guidance is needed for consistent release and other waste management estimates.
Questions on Section 8 amounts.	Facilities would like a simple formula for releases in each block of Section 8. (e.g., Section 8.1 = 5.1 + 5.2 + 5.3 + 5.4 + 5.5 + 6.2 (disposal only)). This will cut down on errors and double counting.
Clarification of the treatment definitions in Sections 7 and 8 of the Form R for organic and inorganic chemicals.	The definitions in the two sections are currently different, which can cause problems when reporting. Confusion occurs when: 1) chemicals go through a treatment system but are not destroyed. Facilities need direct guidance to claim zero efficiency, and then what to put in Section 8 (zero or NA); 2) facilities may report the amount sent to treatment versus the amount treated. Current guidance is confusing because facilities are supposed to report the amount sent to energy recovery and the amount sent to recycling, but not the amount sent to treatment (they should correctly report the amount treated instead).
Clarification on how to calculate production ratio for "processed" and "otherwise used" chemicals.	Facilities often used sales receipts or quantities released from year to year rather than an activity index that relates directly to the chemicals used.

9.0 REFERENCES

1) 1994 and 1995 Toxic Release Inventory Report, USEPA, March 1998

Appendix A

SURVEY INSTRUMENT

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

1998
(TRI REPORTING YEAR 1996)
TRI DATA QUALITY
SURVEY INSTRUMENT

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

FACILITY FACT SHEET

Date of Visit: ____________ through ____________________________

Facility Name: ____

Facility Address: ____

____

City: ____

State: ____________ Zip Code: ______________________________

Mailing Address (if different from street address): ____________________

____

Telephone: ____________ Fax: ______________________________

Facility Contact: ____

Site Surveyors: ____

____

Pre-visit Telephone Contact: __________________________________

Reviewers: ____

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

PRE-VISIT
TELEPHONE CONTACT

TECHNICAL REVIEW

1. How many Form R (reporting year 1996) chemical reports were submitted for this facility? __________

2. How many 313 chemicals were identified by this facility, but not reported, for reporting year 1996? __________

3. Did the facility submit any <u>revised</u> Form R chemical reports for reporting year 1996?

   YES....☐ NO...☐ *(Skip to Q.5)*

4. List the chemicals which had <u>revised</u> chemical reports.

   ____
   ____
   ____
   ____

5. Did the facility submit any withdrawal requests to EPA for the reporting year 1996?

   YES....☐ NO...☐ *(Skip to Q.7)*

6. List the chemicals which had withdrawal requests.

__________	Approved ☐	Denied ☐
__________	Approved ☐	Denied ☐
__________	Approved ☐	Denied ☐
__________	Approved ☐	Denied ☐

7. How many full-time equivalent employees did the facility have in 1996? ________

   NOTE: If there were less than 10 full-time equivalent employees in 1996, do <u>not</u> visit this facility. Terminate discussion with facility at this time.

Facility ID: |_|_|_|-|_|_|_|_|-|_|_|_|

8. Briefly describe the industrial processes performed at this facility in 1996.

____

____

____

____

9. Has the facility's process operations significantly changed since 1996 (including equipment, chemicals, feedstock, etc.)?

YES.....☐ NO....☐ *(Skip to Q. 11)*

10. Briefly describe any process changes.

____

____

____

____

11. Has the facility implemented any new treatment, disposal, energy recovery, recycling or source reduction activities since 1996?

YES.....☐ NO.....☐ *(Skip to Q. 13)*

12. Briefly describe any new treatment, disposal, energy recovery, recycling or source reduction activities.

____

____

____

____

LOGISTICS

13. Will the facility be operating under typical conditions at the time of the visit?

YES....☐ NO.....☐

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

14. What personal protective equipment will be needed to participate in a facility tour?

Hard Hat ☐

Safety Boots ☐

Safety Glasses ☐

Respirator ☐

Other: ____________________

____

15. How long is a typical tour? If unknown, how many square feet does the facility occupy? ______________
(Consider this information when planning the type and duration of tour that would be most useful).

16. Hotel recommendation: ____

____

17. Directions to facility: ____

____

____

____

18. Time to meet: ____

19.1 Is a confidentiality agreement required to be completed for this facility?

YES...☐ NO....☐ *(Skip to Q. 20)*

19.2 Has a confidentiality agreement been completed?

YES...☐ NO....☐

20. Will the person who completed the Form R and all supporting materials be available during the site visit?

YES...☐ NO....☐ Alternate Contact: ______________________

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

21. Describe the type and quantity of supporting material available for the Form R calculations.

____

____

____

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

SECTION 1.0
REPORT PREPARATION

1.1 Who prepared the release estimates in the facility's Form R chemical reports? (*Check all that apply)*

Facility Environmental Staff .... ☐

Corporate Environmental Staff .... ☐

Facility Staff .... ☐

Consultant/Contractor .... ☐

Safety Department Staff .... ☐

Other, specify____ ☐

1.2 Check all EPA documents and other references used to estimate releases and control efficiencies.

NONE.....☐

TRI Reporting Form R and Instructions, 1996 Version
(EPA 745-K-95-051) .... ☐

Estimating Releases and Waste Treatment Efficiencies for the TRI ("Green Book")
EPA 560/4-88-002 .... ☐

Title III Section 313 Release Reporting Guidance
EPA/560-4-88-004 a through q, Estimating Chemical Releases .... ☐

Compilation of Air Pollution Emission Factors, AP-42 .... ☐

Industry Trade Association Materials/Seminars .... ☐

Privately Sponsored Seminar Materials .... ☐

EPA-Sponsored Training Workshops .... ☐

MSDSs .... ☐

Facility ID: |_|_|_|-|_|_|_|_|-|_|_|_|

Computer Programs (list)________________________________ ☐

____

Other ________________________________ ☐

____

____

1.3 What is your estimate of the time needed to fulfill the reporting requirements of Section 313 for 1996? Please include familiarization with the regulation and reporting instructions, completion and internal review of the reporting forms, and documentation of all information in your reports. (This is the total time for all Form Rs.)

≤ 8 Hours . . . . ☐

9 - 20 Hours . . . . ☐

21 - 40 Hours . . . . ☐

41 - 100 Hours . . . . ☐

> 100 Hours . . . . ☐

If > 100 Hours, please fill in number of hours . . . . ________

1.4 Did you find the 1996 Form R reporting instructions useful?

YES.....☐ NO....☐

1.5 Did you feel any section of the instructions provided with the Form R were unclear?

YES....☐ NO.....☐ *(Go to Q. 1.6)* NA....☐ *(Skip to Q. 1.6)*

1.5.1 Check the appropriate section below and briefly explain the difficulty encountered.

Facility Reporting Determination . . . . ☐

____

____

Part I. Facility Identification Information . . . . ☐

____

____

Facility ID: |_|_|_|-|_|_|_|_|-|_|_|_|

Part II. Chemical Specific Information *(Circle number of all that apply)* .... ☐

1. Toxic Chemical Identity
2. Mixture Component Identity
3. Activities and Uses of the Toxic Chemical
4. Maximum Amount On-Site
5. Releases to the Environment On-Site
6. Transfers in Waste to Off-Site Locations
7. On-Site Waste Treatment Methods and Efficiency and On-Site Energy Recovery and Recycling Methods
8. Source Reduction and Recycling Activities

1.6 Did you call the Emergency Planning and Community Right-to-Know Hotline?

YES....☐ NO....☐ *(Skip to Q.1.7)*

1.6.1 Did you find the operator's response helpful?

YES....☐ NO....☐

If no, explain ______________________________

1.7 Have you ever received any assistance from EPA Regional or headquarters staff to prepare the Form R reports?

YES....☐ NO....☐

1.8 Has EPA or your state ever contacted you with questions about any of the reported estimates (excluding computer generated notices)?

YES....☐ NO....☐

1.9 Has the facility received any Notices of Significant Error, Notices of Noncompliance, or Notices of Technical Error from EPA or the state for any 1996 reports?

YES....☐ NO....☐

1.10 Does the facility use any computer software to track toxic chemicals brought on site, used, or identified in MSDSs?

YES....☐ NO....☐

If yes, identify: ______________________________

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

1.11 Did you use the Automated Form R (AFR) electronic reporting to submit your Form Rs?

YES....☐ NO....☐ *(Skip to Q.1.12)*

1.11.1 Did you feel the AFR helped to reduce any errors on the Form R?

YES....☐ NO....☐

1.11.2 Describe any comments on the use of the AFR.

____

____

____

____

1.12 Are there additional guidance manuals that EPA should develop to provide more clarification on Form R reporting?

YES....☐ NO....☐

____

____

____

____

1.13 If a Form R was completed and the total annual reportable amount was less than 500 pounds, why did the facility <u>not</u> complete the short form for the alternate threshold reporting?

____

____

____

____

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

SECTION 2.0
INTRODUCTION AND FACILITY TOUR
(313 CHEMICALS PRESENT ON-SITE)

2.1 List all chemicals reported on the facility's Form R Chemical Reports.

Chemical Name — CAS # — Not a Section 313 Chemical

________________ |_|_|_|_|_|-|_|_|-|_| ☐
________________ |_|_|_|_|_|-|_|_|-|_| ☐
________________ |_|_|_|_|_|-|_|_|-|_| ☐
________________ |_|_|_|_|_|-|_|_|-|_| ☐
________________ |_|_|_|_|_|-|_|_|-|_| ☐
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________________ |_|_|_|_|_|-|_|_|-|_| ☐
________________ |_|_|_|_|_|-|_|_|-|_| ☐
________________ |_|_|_|_|_|-|_|_|-|_| ☐
________________ |_|_|_|_|_|-|_|_|-|_| ☐
________________ |_|_|_|_|_|-|_|_|-|_| ☐

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

2.2 List all **Section 313** chemicals not reported on the facility's Form R chemical reports, but documented by the facility.

NONE....☐

Chemical Name	CAS #	Not a Section 313 Chemical
____________________	|_|_|_|_|_|-|_|_|-|_|	☐
____________________	|_|_|_|_|_|-|_|_|-|_|	☐
____________________	|_|_|_|_|_|-|_|_|-|_|	☐
____________________	|_|_|_|_|_|-|_|_|-|_|	☐
____________________	|_|_|_|_|_|-|_|_|-|_|	☐
____________________	|_|_|_|_|_|-|_|_|-|_|	☐
____________________	|_|_|_|_|_|-|_|_|-|_|	☐
____________________	|_|_|_|_|_|-|_|_|-|_|	☐

2.3 List **ALL** other Section 313 chemicals not reported or documented, but identified by the surveyor during the site visit.

NONE....☐

Chemical Name	CAS #
____________________	|_|_|_|_|_|-|_|_|-|_|
____________________	|_|_|_|_|_|-|_|_|-|_|
____________________	|_|_|_|_|_|-|_|_|-|_|
____________________	|_|_|_|_|_|-|_|_|-|_|
____________________	|_|_|_|_|_|-|_|_|-|_|
____________________	|_|_|_|_|_|-|_|_|-|_|
____________________	|_|_|_|_|_|-|_|_|-|_|

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

2.4 List all mixtures identified during the facility tour which may contain Section 313 chemicals.

(a) Mixture Name	(b) Identify Section 313 Chemical Present	(c) Concentration of Chemical[1]	(d) Amount of Mixture Used in 1996[2]	(e) Amount of Section 313 Chemical Used[2]

[1] If concentration of chemical is below de minimis (0.1 wt.% for carcinogens, 1.0 wt.% for all others), do not include mixture in threshold determination.
[2] Complete columns d and e during threshold determination.

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

Process Diagram(s):

(identify release points **and chemicals**)

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

Treatment Unit, Disposal, Energy Recovery, Recycling or Source Reduction Operation(s):

(identify release points **and chemicals**)

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

Facility Tour Notes:

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

Facility Tour Notes (Cont'd):

Chemical Name: ______________ Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

CAS # |_|_|_|_|_|-|_|_|-|_|

SECTION 3.0
REVIEW OF THRESHOLD DETERMINATION

3.1 How is this chemical employed at the facility? *(Check all that apply)*

	Facility	Reviewer			Facility	Reviewer
3.1.1	☐	☐	**Manufacture**			
			a.	Produced at the facility	☐	☐
			b.	Imported by the facility	☐	☐
			c.	For on-site use/processing	☐	☐
			d.	For sale/distribution	☐	☐
			e.	By-product	☐	☐
			f.	Impurity[1] (% = _____)	☐	☐
3.1.2	☐	☐	**Process** *(incorporative activity)*			
			a.	Chemical reactant (raw materials, intermediates, etc.)	☐	☐
			b.	Formulation component	☐	☐
			c.	Article component	☐	☐
			d.	Repackaging	☐	☐

[1]If impurity is present below de minimis concentrations (0.1% for carcinogens, 1% for others), it is exempt from reporting.

Chemical Name: ______________ Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

	Facility	Reviewer			Facility	Reviewer
3.1.3	☐	☐	**Otherwise Use** *(nonincorporative activity)*			
			a.	Chemical processing aid (added to reaction mixture)	☐	☐
			b.	Manufacturing aid (process lubricants, coolants, etc.)	☐	☐
			c.	Ancillary use (cleaners, degreasers, lubricants)	☐	☐
3.1.4	☐	☐	**Exempt Uses**			
			a.	Used in laboratory activities	☐	☐
			b.	Structural component	☐	☐
			c.	Routine janitorial/facility grounds maintenance	☐	☐
			d.	Personal employee use	☐	☐
			e.	Motor vehicle maintenance	☐	☐
			f.	Intake water component	☐	☐
			g.	Contained in an article	☐	☐

3.2 Was the chemical reported by the facility?

YES....☐ *(Go to Q.3.3)* NO....☐

3.2.1 If no, why did the facility decide this chemical was not reportable?

a. Below threshold .... ☐

b. Exempt .... ☐

c. Overlooked chemical .... ☐

d. Other (specify)______________________________________ ☐

____

Chemical Name: ______________ Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

3.3 Are all uses of the chemical exempt from reporting according to the surveyor or are all uses of the chemical a non-aerosol form of sulfuric acid or hydrochloric acid?

YES....☐ *(Go to Q.3.10)* NO....☐ *(Continue)*

3.4 **Does documentation which supports the threshold determination exist? (Documentation is defined as any type of data available at the facility in any form which can be used to recalculate the estimate)**

YES....☐ NO....☐

3.4.1 If no, why not?

a. Documentation cannot be located .... ☐

b. Documentation was not retained by facility .... ☐

c. Facility unaware that documentation is required .... ☐

d. Facility overlooked the chemical *(Skip to Q.3.6)* .... ☐

e. **Other (specify)** ______________________________ .... ☐

3.5 What was the basis of estimate used by the facility for the amount manufactured, processed, or otherwise used in 1996? *Check all that apply.*

a. Purchase/inventory records .... ☐

b. Emission Factors .... ☐

c. Mass balance .... ☐

d. Assumed threshold exceeded (no calculations completed) .... ☐

e. Process recipes/MSDS .... ☐

f. Monitoring data .... ☐

g. Production data .... ☐

h. Other (specify)____ ☐

____

Chemical Name: ______________ Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

3.6 How much chemical did the facility manufacture, process, or otherwise use in 1996?[2]

		Facility	Reviewer
a.	Manufactured	________ lbs	________ lbs
b.	Processed	________ lbs	________ lbs
c.	Otherwise used	________ lbs	________ lbs

d. Facility did not estimate these quantities . . . . ☐

3.7 Was the reviewer's estimate of the amount of chemical manufactured, processed, or otherwise used recalculated using available documentation or recreated using other facility data?

a. Recalculated, with no error . . . . ☐

b. Recalculated, within a factor of 2 . . . . ☐

c. Recalculated, within a factor of 10 . . . . ☐

d. Recalculated, greater than a factor of 10 . . . . ☐

e. Recreated, with no error . . . . ☐

f. Recreated, within a factor of 2 . . . . ☐

g. Recreated, within a factor of 10 . . . . ☐

h. Recreated, greater than a factor of 10 . . . . ☐

i. Facility did not estimate these quantities . . . . ☐

3.8 Was a threshold exceeded for this chemical in 1996?

YES....☐ *(This chemical should have been reported. Continue)*

NO.....☐ *(This chemical should not have been reported. Skip to Q 3.10)*

---

[2]Record calculations and assumptions for the threshold determination on the worksheet in Section 6.0.

Chemical Name: ______________ Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

3.10 This chemical was:

a. Correctly reported .... (Go to Section 4.0) ☐

b. Correctly not reported .... (Skip to next chemical) ☐

c. Incorrectly reported .... (Go to Q.3.11) ☐

d. Incorrectly not reported .... (Go to Q.3.12) ☐

3.11 Why was this chemical incorrectly reported?

a. Facility reported, although amount used was below threshold .... ☐

b. Facility incorrectly assumed threshold was exceeded .... ☐

c. Chemical activity was misclassified .... ☐

d. Threshold quantity was miscalculated .... ☐

e. Chemical was exempt .... ☐

f. Chemical has been delisted/modified .... ☐

g. Other (specify)_______________________________________ ☐

____

(Skip to next chemical)

Chemical Name: ______________ Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

3.12 Why was this chemical incorrectly not reported?

a. **Chemical ~~activity~~ was overlooked** .... ☐

b. Chemical activity was misclassified .... ☐

c. Threshold quantity was miscalculated .... ☐

d. Other (specify)____ ☐

____

(Continue to Section 4.0)

3.13 If the facility completed a short form for this chemical, are the releases less than 500 pounds?

YES....☐ *(Skip to the next chemical and document the release calculations)*

NO.....☐ *(Go to Section 4.0)*

SECTION 4.0

REVIEW OF RELEASE TYPES

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

Section 4.1 Sources of Chemical Releases and Transfers

In the reviewers opinion, document whether or not the facility should have included releases from the following sources (1):

Chemical Name ____________ CAS # |_|_|_|_|_|-|_|_|-|_|	Fugitive Air	Stack Air	Receiving Stream	Under-Ground Injection	Land On-Site	POTW	Off-Site Transfer
SOURCE							
A. ~~Process vents/stacks~~							
B. Pumps/valves/flanges							
C. Volatilization from process areas							
D. Volatilization from treatment areas							
E. Storage tank/stock pile losses							
F. Accidental spills/releases							
G. Waste treatment discharge streams							
H. Stormwater runoff							
I. Process discharge streams							
J. Housekeeping practices/clean-up wastes (i.e., solvent)							
K. Container residue							
L. Treatment sludges, recycling or energy recovery by-products							
M. Combustion by-products							
N. Other ____________							

NOTE: COMPLETE ALL ROWS AND COLUMNS.

If a Form R was completed:

(1) Y = Yes, release source should be included in release estimate that surveyor calculates in Section 5 and facility identified this release type.

N = No, release should be included in release estimate but facility overlooked this release type.

NA = This source was not present at the facility for this chemical

If a Form R was not completed (overlooked chemical):

Y = Release source should be included

NA = Release source was not present at the facility for this chemical

SECTION 4.2 (a) and (b)

CODE LIST

Q1

Y	=	Yes
N	=	No
NA	=	Facility overlooked this chemical

Q2

FE	=	Fugitive air
PS	=	Stack air
RS	=	Receiving stream
UI	=	Underground injection
LA	=	Land on site
PW	=	POTW
TOSD	=	Off-site transfer (disposal)
TOST	=	Off-site transfer (treatment)
TOSR	=	Off-site transfer (recycling)
TOSE	=	Off-site transfer (energy recovery)
NA	=	Facility does not have a release to this medium

Q3

Y	=	Yes
N	=	No
NA	=	Facility overlooked this chemical

Q4

FES	=	Releases are only fugitive releases and are not released to a stack.
SFE	=	Releases are to a stack and not released as fugitives.
VPC	=	Chemical is a volatile organic chemical (VOC) and was not reported as an air release.
ACID	=	Mineral acids, which were neutralized, were included.
POTW	=	Wastewater discharge is to a POTW and not a receiving stream.
RECS	=	Wastewater discharge is to a receiving stream and not to a POTW.
ONLAND	=	Releases are to an on-site landfill, not to an off-site landfill.
OFFLAND	=	Releases are to an off-site landfill, not to an on-site landfill.
NOER	=	Off-site energy recovery does not take place in a legitimate energy recovery system.
NOCOMB	=	Toxic chemical does not have a heating value high enough to sustain combustion.
NR	=	Site visit concluded that chemical is not released to this medium.
OTH	=	Other ______
NA	=	Facility correctly identified release type or facility overlooked chemical
TNOTD	=	Sent to treatment, not disposal
OVRL	=	Overlooked release type (e.g. drum residue not considered)
DNOTT	=	Releases are to disposal not treatment

Q5 Y = Yes

CODE LIST (Continued)

Question	Code		Description
	Y1	=	Yes, but facility incorrectly identified release type
	Y2	=	Yes, but documentation is unclear or incomplete
	N1	=	Documentation cannot be located
	N2	=	Documentation was not retained by facility
	N3	=	Facility unaware that documentation required
	N4	=	Facility overlooked chemical
	N5	=	Facility overlooked this release type
	N6	=	Other ______
	NA	=	Facility does not have a release for this medium
Q6	Y	=	Yes
	N1	=	Facility unable to locate data
	N2	=	Facility did not retain data
	NA	=	Monitoring data not used
Q7	Y	=	Yes
	N	=	No
Q8	1	=	Facility derived factors
	2	=	EPA published factors (not chemical-specific)
	3	=	Trade association factors
	4	=	Other ______
	NA	=	Factors not used in engineering calcs
Q9	Y	=	Yes
	N1	=	Facility misinterpreted de minimis rule
	N2	=	Other ______
	NA	=	Facility does not have de minimis wastestreams
Q10	Y	=	Yes
	N	=	No, facility overlooked treatment
	NA	=	No on-site treatment of this chemical for this release medium occurred
Q11	Y	=	Yes
	N	=	No
	NA	=	No treatment efficiencies were not used
Q12	Y	=	Yes
	N	=	No
	NA	=	Facility does not have a release for this medium
Q13	MP	=	Spent metal plating bath
	CW	=	Cleaning waste
	WTS	=	Waste treatment sludge
	SC	=	Spent catalyst
	SPS	=	Spent process solvent
	OTH	=	Other: ______ ______
	NA	=	Facility does not have recycling releases

Note: This code list refers to the questions for the Section 4.2(a) and (b) table on page 27 and 28.

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

Section 4.2a Review of Release Types (On-Site Releases)

Chemical Name ______________ CAS # |_|_|_|_|_|-|_|_|-|_|	Fugitive Air §5.1	Stack Air §5.2	Receiving Stream §5.3	Underground Injection §5.4	Land On Site §5.5
1. Did the facility identify a release type on the Form R?					
2. Enter surveyor's release types.					
3. Did the facility correctly identify the release type?					
4. If Q.3 is NO, identify the reason that the release type was incorrectly identified, otherwise enter NA.					
5. Is documentation on the facility's release estimate available for review?					
IF Q.5 IS NO OR NA, SKIP TO QUESTION 12					
6. If monitoring data were used, is it available for review?					
7. Were chemical-specific EPA emission factors used?					
8. If other factors were used in engineering calcs besides those in Question 7, what was the source of those factors?					
9. Were all air or waste streams containing ≥1% or ≥0.1% (carcinogens) of the chemical included in release calculations?					
10. Was on-site treatment of this chemical included in release estimates?					
11. Were treatment efficiencies reported consistent with measurement data, vendor specs, or EPA-published efficiencies? (2)					
12. Does the facility have information available to estimate the amount of this chemical released during 1996?					

~~(1) If no, document all streams double counted in release calculations in Section 6.0~~
~~(2) If no, document inconsistency of treatment efficiencies used in Section 6.0~~

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

Section 4.2b Review of Release Types (Off-Site)

Chemical Name ____________ CAS # |_|_|_|_|_|-|_|_|-|_|	POTW §6.1	Off-Site Transfer (disposal) §6.2	Off-Site Transfer (treatment) §6.2	Off-Site Transfer (recycling) §6.2	Off-Site Transfer (energy recovery) §6.2
1. Did the facility identify a release type on the Form R?					
2. Enter surveyor's release types.					
3. Did the facility correctly identify the release type?					
4. If Q.3 is NO, identify the reason that the release type was incorrectly identified, otherwise enter NA.					
5. Is documentation on the facility's release estimate available for review?					
IF Q.5 IS NO OR NA, SKIP TO QUESTION 12					
6. If monitoring data were used, is it available for review?					
7. Were chemical-specific EPA emission factors used?					
8. If other factors were used in engineering calcs besides those in Question 7, what was the source of those factors?					
9. Were all air or waste streams containing ≥1% or ≥0.1% (carcinogens) of the chemical included in release calculations?					
10. Was on-site treatment of this chemical included in release estimates?					
11. Were treatment efficiencies reported consistent with measurement data, vendor specs, or EPA-published efficiencies? (2)					
12. Does the facility have information available to estimate the amount of this chemical released during 1996?					
13. If appropriate, characterize the recycling stream (*use multiple codes if necessary*).					

~~(1) If no, document all streams double counted in release calculations in Section 6.0~~
~~(2) If no, document inconsistency of treatment efficiencies used in Section 6.0~~

Section 4.2c Review of Release Types (On-Site Treatment, Energy Recovery or Recycling)

Chemical Name ____________ CAS # |_|_|_|_|_|-|_|_|-|_|	On-Site Treatment (§7A or 8.6B)	On-Site Energy Recovery (§7B or 8.2B)	On-Site Recycling (§7C or 8.4B)
1. Did the facility identify an on-site treatment, energy recovery, or recycling method in §7 on the Form R? (1)			
2. Enter surveyor's identification of on-site methods. (2)			
3. Did the facility correctly identify the on-site method? (1)			
4. If Q.3 is NO, identify the reason that the method was incorrectly identified, otherwise enter NA. (3)			
5. For on-site treatment in §8.6B, did the facility only report the quantity of chemical destroyed during treatment? (4)			
6. For on-site recycling in §8.4B, did the facility report the quantity of chemical recovered from recycling? (4)			
7. If appropriate, characterize the recycling stream (*use multiple codes if necessary*): (5)			
8. Describe the type of recycling unit: (6)			

(1) Y = Yes
N = No
NA = Facility overlooked this chemical

(2) TR = On-site treatment
ER = On-site energy recovery
REC = On-site recycling
NA = Facility does not use this on-site method

(3) OFFLAND = Releases are to an off-site landfill, not an on-site landfill
NOER = Off-site energy recovery does not take place in a legitimate energy recovery system
NOCOMB = Toxic chemical does not have a heating value high enough to sustain combustion
NR = Toxic chemical is not recycled
OTH = Other: ____________
NA = Facility correctly identified on-site method or facility overlooked chemical.

(4) Y = Yes
N = No
NA = Facility did not identify this on-site method

(5) MP = Spent metal plating bath
CW = Cleaning waste
WTS = Waste treatment sludge
SC = Spent catalyst
SPS = Spent process solvent
OTH = Other: ____________
NA = Facility did not estimate recycling releases

(6) **Identify type of on-site recycling unit used. See §7.C of Form R.**

SECTION 5.0

REVIEW OF RELEASE ESTIMATES

Section 5.1 Review of Release Estimates (On-Site Releases)

For each on-site release identified in Section 4.2a (Question 2), complete the following table:

Chemical Name ____________ **CAS #** |_|_|_|_|_|-|_|_|-|_|	**Fugitive Air §5.1**	**Stack Air §5.2**	**Receiving Stream §5.3**	**Underground Injection §5.4**	**Land On Site §5.5**
1. Enter <u>facility's</u> release estimate (in lbs) (1)	A B C	A B C	A B C	A B C	A B C
2. What method(s) did the facility use to estimate their release? (2)					
3. Based on data available to the facility, is this the most accurate method to determine a release estimate? (3)					
IF Q.3 IS YES, SKIP TO QUESTION 6					
4. What is a better method(s) which could be used to calculate a <u>more accurate</u> release estimate? (2) (4)					
5. Enter the reviewer's release estimate using a <u>more accurate method(s)</u> (5)	A B C	A B C	A B C	A B C	A B C
6. Enter the reviewer's release estimate using the <u>same method</u>(s) as the facility. (5)	A B C	A B C	A B C	A B C	A B C

(1) Range Codes:
- A = 1-10 lbs
- B = 11-499 lbs
- C = 500-999 lbs
- N1 = Release estimate was not included on Form R but should have been, skip to Question 4
- N2 = Facility overlooked this chemical, skip to Question 4
- NA = Facility does not have a release to this medium, do not continue with this medium
- N3 = **Release estimate was included but should not have been, do not continue with this medium but enter facility release (i.e, N3, 100)**

(2)
- M = Monitoring data or direct measurements
- C = Mass balance calculations
- E = EPA chemical-specific emission factors
- OC = Engineering calculations (**"minor calcs"**) (this includes factors that are not chemical-specific)
- OJ = Engineering judgement (**"guess"**)
- OH = Hazardous waste manifests
- O = Other _____
- NA = Facility did not estimate release

(3) Y = Yes
N = No

(4) Document why this method is more accurate in Section 6.0

(5) NA = Facility did not estimate release
[Note: <u>Enter the number that was calculated. Only enter a range, if a range is the most accurate quantity that can be calculated</u> for Q5.]
Document release calculations in Section 6.0

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

Section 5.2 Review of Release Estimates (Off-Site)

For each off-site release identified in Section 4.2b (Question 2), complete the following table:

Chemical Name ____________ CAS # |_|_|_|_|_|-|_|_|-|_|	**POTW §6.1**	**Off-Site Transfer (disposal) §6.2**	**Off-Site Transfer (treatment) §6.2**	**Off-Site Transfer (recycling) §6.2**	**Off-Site Transfer (energy recovery) §6.2**
1. Enter facility's release estimate (in lbs) (1)	A B C	A B C	A B C	A B C	A B C
2. What method(s) did the facility use to estimate their release? (2)					
3. Based on data available to the facility, is this the most accurate method to determine a release estimate? (3)					
IF Q.3 IS YES, SKIP TO QUESTION 6					
4. What is a better method(s) which could be used to calculate a more accurate release estimate? (2) (4)					
5. Enter the reviewer's release estimate using a more accurate method(s) (5)	A B C	A B C	A B C	A B C	A B C
6. Enter the reviewer's release estimate using the same method(s) as the facility. (5)	A B C	A B C	A B C	A B C	A B C

(1) Range Codes:
- A = 1-10 lbs
- B = 11-499 lbs
- C = 500-999 lbs
- N1 = Release estimate was not included on Form R but should have been, skip to Question 4
- N2 = Facility overlooked this chemical, skip to Question 4
- NA = Facility does not have a release to this medium, do not continue with this medium

(2)
- M = Monitoring data or direct measurements
- C = Mass balance calculations
- E = EPA chemical-specific emission factors
- OC = Engineering calculations (**"minor calcs"**) (this includes factors that are not chemical-specific)
- OJ = Engineering judgement (**"guess"**)
- OH = Hazardous waste manifests
- O = Other _____
- NA = Facility did not estimate release

(3) Y = Yes
N = No

(4) Document why this method is more accurate in Section 6.0

(5) NA = Facility did not estimate release
[Note: Enter the number that was calculated. Only enter a range, if a range is the most accurate quantity that can be calculated for Q5.]
Document release calculations in Section 6.0

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

Section 5.3 Review of Form R §8 Data (On-Site Releases or Off-Site Transfers)

Chemical Name ____________ CAS # |_|_|_|_|_|-|_|_|-|_|	Quantity Released §8.1B	Quantity Used for Energy Recovery Off Site §8.3B	Quantity Recycled Off Site §8.5B	Quantity Treated Off Site §8.7B
1. Enter facility's estimate from §8, Column B, on the Form R. *(Enter NA if facility did not estimate)*				
2. Enter facility's basis of estimate. (1)				
3. Calculate the quantity released or transferred using the method in footnote (2).				
4. Are the facility's estimate (Q.1) and the quantity released or transferred from Q.3 the same? (3)				
5. If Q.4 is NO, provide notes or an explanation detailing any differences in the calculation of Section 8 data.				

(1) TECH = Used the following technique:

- Form R §8.1B = [§5.1 + §5.2 + §5.3 + §5.4 + §5.5 + §6.2 (disposal only) - §8.8]
- Form R §8.3B = §6.2 (energy recovery only) - §8.8
- Form R §8.5B = §6.2 (recycled only) - §8.8
- Form R §8.7B = §6.1 + §6.2 (treated only) - §8.8

NOBASE = Data for Section 8 was estimated, basis not provided
OTH = Other: ____________

NA = Facility did not estimate; **do not continue with this medium.**

(2) [Note: Use the best release estimate from Section 5.1 and 5.2 of this survey to calculate these quantities.]
Document the calculations in Section 6.0.

(3) Y = Yes
N = No
NA = **Facility did not estimate**

Section 5.4 Review of Form R §8 Data (On-Site Treatment, Energy Recovery, or Recycling)

For the on-site treatment or energy recovery method(s) identified in Section 4.2c (Question 2), complete the following table. Only recreate on-site recycling estimates that were provided by the facility. Do not estimate on-site recycling releases NOT identified by the facility.

Chemical Name ____________ CAS # |_|_|_|_|_|-|_|_|-|_|	On-Site Treatment (§7A or 8.6B)	On-Site Energy Recovery (§7B or 8.2B)	On-Site Recycling (§7C or 8.4B)
1. Enter the facility's estimate of quantity from §8, Column B, of the Form R. (1)			
2. What method did the facility use to estimate the amount treated, sent to energy recovery, or recovered from recycling? (2)			
3. Based on data available to the facility, is this the most accurate method to estimate the amount treated, sent to energy recovery, or recovered from recycling? (3)			
IF Q.3 IS YES, SKIP TO QUESTION 6			
4. What is a better method which could be used to calculate a more accurate estimate? (2)			
5. Enter the reviewer's estimate using a more accurate method. (4)			
6. Enter the reviewer's estimate using the same method. (4)			

(1)
- N1 = Estimate was not included on Form R but should have been, skip to Question 4.
- N2 = Facility overlooked this chemical, skip to Question 4.
- NA = Facility does not have this on-site method, **do not continue with this medium.**

(2)
- M = Monitoring data or direct measurements
- C = Mass balance calculations
- E = EPA chemical-specific emission factors
- OC = Engineering calculations (this includes use of factors which are not chemical-specific)
- OJ = Engineering judgement
- OH = Hazardous waste manifests
- O = Other ____________
- NA = Facility did not estimate quantities for this on-site method

Document the method used by the facility and/or alternate methods used in Section 6.0

(3)
- Y = Yes
- N = No
- NA = Facility does not have this on-site method

(4)

Document calculations in Section 6.0.
NA = Facility did not estimate release.

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

Section 5.5 Review of Form R §8 Data (Production Ratio/Activity Index and Source Reduction Activities)

Chemical Name ____________ CAS # |_|_|_|_|_|-|_|_|-|_| Production Ratio/Activity Index	Production Ratio/Activity Index (§8.9) and Source Reduction Activities (§8.10)		
1. Enter the facility's estimate from §8.9 of the Form R. (Enter NO if facility did not estimate)			
2. Enter facility's basis of estimate (1).			
3a. Is this estimate based on a variable that most directly affects the quantities of the toxic chemical generated as **"waste"** quantities? (2)	3a.		
3b. If Q.3a is NO, enter surveyor's choice for alternate basis.	3b.		
3c. If Q.3a is NO, enter surveyor's production ratio estimate.	3c.		
Source Reduction Activities	**Activity #1**	**Activity #2**	**Activity #3**
4a. Enter the source reduction activity codes from Section 8.10 of the Form R.	4a-1.	4a-2.	4a-3.
4b. Provide a text description of the source reduction activity.	4b-1.	4b-2.	4b-3.
4c. Is this activity "source reduction" (i.e., not recycling, treatment, energy recovery, or disposal) (2)?	4c-1.	4c-2.	4c-3.

Possible source reduction activities noted by the surveyor:

(1)

TCM	=	Ratio of amount of the toxic chemical manufactured in 1996 to 1995
TCPV	=	Ratio of production volume in 1996 to 1995
TCU	=	An activity index of the amount of toxic chemical used in 1996 to 1995
HR	=	An activity index of the amount of operating hours for an activity in 1996 to 1995
WT	=	An activity index or production ratio based on a weighted average of data from several processes
OTH	=	Other: ____________
NA	=	The manufacture or use of the chemical began in 1996.

(2)

Y	=	Yes
N	=	No

SECTION 6.0

CALCULATION WORKSHEETS

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

THRESHOLD DETERMINATION WORKSHEET

Chemical Name: ______________________			
Description of Use	Amount Manufactured	Amount Processed	Amount Otherwise Used
TOTALS			

Calculations:

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

~~MAXIMUM AMOUNT ONSITE WORKSHEET~~

~~Chemical Name:~~ ____________________

~~**INSTRUCTIONS:**~~ ~~*Calculate the maximum amount of the chemical onsite at any one time during the reporting year. Keep in mind the following:*~~

- ~~*All storage areas where this chemical may be kept;*~~
- ~~*The amount of chemical being used at any time; and*~~
- ~~*The amount of chemical in each waste stream.*~~

Storage Areas:

Total: ______

Chemical in Use:

Total: ______

Chemical in Waste Streams:

Total: ______

Total On-Site: ______

Facility ID: |_|_|_|-|_|_|_|-|_|_|_|

RELEASE ESTIMATE WORKSHEET

Chemical Name: ______________ Release Type ______________________________________

CAS # |_|_|_|_|_|_|-|_|_|-|_| SI Page # _________ Question # ______________

INSTRUCTIONS: *Record all calculations for release estimates below. ~~in the appropriate sections.~~ Be sure to identify if calculations use the same method as the facility or a more accurate method.*

Appendix B

September 21, 1998

Mr. Environmental Contact
Company Name
Address
City, ST 00000

Dear Mr. Environmental Contact:

Your facility has been randomly selected by the U.S. Environmental Protection Agency (EPA) to participate in a data quality survey of facilities that submitted 1996 reporting year Form Rs for the Toxic Chemical Release Inventory (TRI) under Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA). The purpose of the survey is to evaluate the quality of the data submitted on the Form R chemical reports and to provide feedback to EPA that can be used to improve the reporting instructions, guidance, or the reporting form. Eastern Research Group, Inc. (ERG) is working with EPA to conduct survey visits to approximately 60 facilities randomly selected from the TRI database in the following SIC Codes: 33, 36 and 37.

Participation in this program is voluntary. However, we believe your participation will provide a valuable evaluation of the threshold calculations and release and transfer estimates for your facility, which will assist you in future Form R reporting.

ERG technical staff members will visit your facility at a date between May and July 1998. Most visits will last 1 day, depending on the number of chemical reports you submitted and the number of Section 313 chemicals located on site. We will spend the majority of that time reviewing the methodology and data that your facility used to make threshold calculations and release and transfer estimates for the 1996 reporting year. During the site visit, we will need your assistance to tour the plant in enough depth to allow us to understand your manufacturing processes and to identify potential release points. We will make every effort to minimize disruptions to your schedule while we are on site.

We will contact you by telephone within the next week to arrange a date for the site visit. I would like to emphasize that the name and location of your facility will not be released to EPA in order to ensure confidentiality of your facility's information. All data collected on this project will be tabulated and reported to EPA in summary form only. At the project conclusion, facility identification information will be destroyed.

The EPA Project Manager for this program is Velu Senthil of the Office of Pollution Prevention and Toxics (OPPT). Enclosed is a letter from him requesting your participation.

Thank you for your cooperation. If you have any questions, please feel free to call me.

Sincerely,

Program Manager

Enclosure