An Industry Perspective on Reporting Releases of Toxic Chemicals

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ABSTRACT

The Toxics Release Inventory has created a valuable accounting system for emissions from selected facilities in the United States. These publicly available data have prompted companies to voluntarily set priorities and establish emissions reductions goals. The Emergency Planning and Community Right-to-Know Act is an excellent starting point, but it is not without problems. Care must be taken to use the Toxics Release Inventory appropriately, on a sound scientific basis, and set priorities to improve these data.

Introduction

The Emergency Planning and Community Right-to-Know Act (EPCRA) is a valuable law. For the first time, certain industrial manufacturers are required to quantify and publicly announce emissions of specific chemicals, including releases to the environment and shipments of waste to off-site facilities for treatment, storage, or disposal. These manufacturers must submit a Toxic Chemical Release Inventory (TRI) report to the U.S. Environmental Protection Agency (EPA) every year. EPA then compiles that information into a national computerized database that is publicly accessible in libraries, at governmental offices, and on-line through a computer. The manufacturer's efforts to compile data and the use of this information by manufacturers, regulatory agencies, and the public have been generally beneficial. The system is imperfect; it can be misused, but its mere existence has revolutionized environmental reporting.

TRI's Uses

Investigation and Measurement

Even without public accessibility, determining the total releases and transfers for a plant's toxics chemical release inventory is useful. For the first time, engineers have had to scrutinize their processes as a whole and quantify wastes released to all media. As an investigative and measurement tool, this multimedia inventory has helped provide a baseline of certain toxics releases and, in some cases, has revealed valuable information for process improvements that otherwise might not have received adequate attention.

Planning

As a planning tool, the TRI provides manufacturers with an excellent base to determine priorities for improvement and offers a starting

point on which to build other programs and set goals within a production facility. After a facility determines the amount of emissions and compiles data, progress toward an emissions reduction goal can be quantified, measured, and compared. Over the four years that Toxics Release Inventories have been required, individual facilities have used these data to improve their processes and operations. Progress is evident. Manufacturers have achieved emissions reductions, and downward trends in combined emissions have been reported yearly.

Communication

The TRI is also an excellent communication tool. Within a plant, the tremendous effort to put together data from numerous sources and departments has made every employee aware of toxic emissions. Public availability of the data and publication of numerous analytical reports have made many Americans, including industrial workers, regulators, private citizens, and special interest groups, more aware of emissions. Some companies have set up Community Advisory Councils to disseminate information on releases and the effects of chemicals.

A relatively concise tool, the TRI is a nationally uniform source of information about the quantities of and trends in chemical emissions from individual and various groups of facilities; data are available by industry, state, release, or chemical type.

Because EPCRA focuses on the community's right-to-know and not just the plant's compliance with environmental regulations, many jobs now focus on accommodating the community's information needs and concerns. Plant and environmental managers, even operators and plant engineers, now spend more time communicating with the public about emissions and operations, a change from past years when the plant or the technical community was the foremost focus. By hearing about citizens' concerns firsthand, manufacturers have realized that just making a good product is not enough. Being responsive to citizen concerns and communicating to make the public feel comfortable with plant operations has changed the way manufacturers do business.

Initiating Other Programs

The TRI has also acted as a catalyst to initiate other programs and trends. Without any regulatory pressure, many companies have volunteered to set emissions reduction goals, which vary for each company but range from Monsanto's plan (the first company to publicly announce a goal) to reduce toxic U.S. air emissions by 90 percent by 1992, to Hoescht's decision to stop underground injection of wastes completely, to Union Carbide's goal of reducing ambient toxic air concentrations to 1/1000 of the workplace standard, to Rohm and Haas' worldwide objective — to reduce its TRI air emissions 75 percent by 1996. Reduction levels range from 20 to 100 percent; target goal years range from 1991 to 2000 to "ultimately"; some goals address only carcinogens or CFCs, others address all waste; some goals are worldwide, others are U.S. only — but all will result in improvements that might not have been made if the TRI were not available.

Building on industry's initiative, the EPA has developed the 33/50 program, also known as the Industrial Toxics Project. A voluntary reduction program, 33/50 includes more than 200 of the companies invited to commit to reducing national aggregate emissions of 17 toxic chemicals from the 1988 TRI levels 33 percent by the end of 1992 and 50 percent by the end of 1995. These 17 chemicals were selected because they are released into the environment in large quantities or are toxic or hazardous pollutants and because the releases might be reduced through pollution prevention practices.

Some companies have already extended TRI-type reporting worldwide. Others have included additional chemicals in their inventories that may be present at a particular plant but are not toxic or not prevalent enough to merit inclusion in EPA's national database. Some companies have tried to determine the impact of their releases on surrounding communities by estimating ground-level concentrations of air emissions on a case-by-case basis. Facilities can use data appropriately for their unique situations to assess impacts on their local community. Employing the same impact analysis for all facilities nationwide would be a misuse of that data.

Partly because of the initiatives that came out of the TRI program, voluntary programs are being tested for other laws and regulations. More effective emissions reductions can often be achieved than with the old "command and control" strategy of past legislation and regulations. The Clean Air Act Amendments of 1990 include an Early Reduction Program: sources that achieve

an early 90 percent reduction from 1987 air emissions levels can be granted a six-year extension from the potentially more stringent standards for control that will soon be required. The regulatory reform agenda encourages cooperative and inclusive implementation, flexibility in regulations, and use of regulatory negotiations and roundtable discussions to address the concerns of all interested parties, including the regulated community, special interest groups, and regulators, during development of regulations. Numerous voluntary goals committed to by a variety of companies show that effective reductions can be made without a command from EPA to install pollution control devices.

TRI's Drawbacks

Burdensome Reporting

The reporting itself and addressing the issues that result from reporting are a tremendous burden, although the benefits seem to outweigh the problems. Fortunately, many companies find that generating emissions inventories for the TRI broadens employees' knowledge, organizes process information, improves communication and awareness, and reveals areas for process and product improvement. Many companies employ at least one person whose sole job is to read and interpret TRI regulations, guidances, notices, interpretations, and bulletins; participate in training courses and meetings about TRI; and facilitate reporting from the company's regulated facilities. Some companies develop calculation and internal guidance manuals, provide in-house training sessions every year, and set up extensive databases to handle the tremendous quantity of information generated to fulfill the reporting requirements. Staff at each facility must understand the regulations and communicate these standards to employees who identify emissions points and measure emissions.

To calculate pounds of emissions, staff tap data from numerous sources, including

- safety/health/environmental/ambient monitoring or stack tests,
- design specifications,
- operating instructions,
- basic chemistry/engineering/biology principles,
- accounting records,
- inventories,
- production records,
- raw material and product lists,
- upset or spill reports,
- licenses and permits,
- waste manifests,
- material safety data sheets,
- operating logs,
- compliance reports,
- performance tests, and
- process flowsheets.

Emissions determinations must be verified, documented, and defensible. Even the determination of whether a facility or chemical meets the reporting threshold or de minimis limits for inclusion in the calculations can be a major task. For the first year of reporting, the 13 Rohm and Haas manufacturing facilities and their corporate staff spent approximately $200,000 for monitoring and consulting and 7,000 hours to prepare TRI data. The burden has not changed much over the years. The TRI is a massive, complicated, and intricate program and database. Efforts to improve data quality are ongoing. Changes are continually being made to Rohm and Haas' operations and staff as well as to EPA's TRI program, so additional training is required.

Incomplete Representation of Toxic Chemical Releases

The TRI program and database, while called the national Toxics Release Inventory, does not represent all releases of toxic chemicals in the United States, nor does the TRI list of chemicals include all of the toxics released. In addition, not all of the chemicals on the list are toxic; some are there because companies use large amounts of these substances or because these chemicals affect the environment. The Congressional Office of Technology Assessment estimates that the TRI data represent only a portion of total toxic chemical releases to the environment.

Only manufacturers are required to report; however, processors and other users of chemicals emit toxics as well. (Automobiles are the major source of toxic emissions in the outdoor air we breathe. However, most exposures to toxic air emissions originate from products used indoors.) Lastly, the General Accounting Office estimates that almost one-third of those manufacturers covered by the regulation have not filed the required reports.

Misrepresentation of Off-site Transfers as Emissions

The TRI defines emissions as "releases to the environment and transfers to off-site facilities." Usually, the materials transferred to off-site facilities are treated further and rarely released to the environment.

- Organics can be degraded by bacteria in publicly owned treatment works (POTWs) or by incineration.
- Acids and bases can be neutralized to common salts.
- Ammonium sulfate, which accounts for the highest quantity of transfers to POTWs, is a form of fertilizer.
- Methanol, the second highest quantity of transfers, is decomposed by bacteria into carbon dioxide and water.

Transfers to off-site treatment or recycling facilities cannot be equated with environmental releases, especially if these data are used to evaluate or represent effects on human health and the environment. Therefore, the total TRI emissions represent some quantity between total waste generated and total emissions to the environment. Unfortunately, because a distinction is not made when releases and transfers are entered in the emissions database, the common usage definition of emission is applied to transfers as well. This practice interferes with setting appropriate priorities for release or risk reduction and forces goal setting to an intermediate step where achievement may have no effect on the quantity of chemicals released to the environment.

Diversion Away from Risk Reduction

The TRI includes only total pounds of emissions of certain chemicals, with an emphasis on reducing pounds of chemical emissions. No ranking exists to distinguish high from low toxicity chemicals on the list, nor can exposure be assessed on a national level to determine risk. Generally, the highest quantity of chemicals emitted have the lowest toxicity because the focus has been on reducing emissions of high toxicity chemicals.

Pounds are the unit of measure in the national database; therefore, industries focus on reductions in pounds and set different priorities than if they focused on reducing risk. For any given chemical, risk can be reduced by lowering emissions if the public is exposed to the chemical. But to lower risks from a variety of chemicals, toxicity and exposure are as important as pounds emitted. In addition, reducing the amount of chemicals sent for off-site treatment that converts organic materials to carbon dioxide and water or burns them for energy recovery will minimally reduce risk in comparison to similar reductions in actual releases to the air, water, or land. In fact, if coal is burned in place of a clean waste organic stream, risks increase from ensuing emissions of lead, mercury, nitrogen oxides, and sulfur oxides.

Right-to-Understand Problems

The public has a right to know and also a right to understand. Improvements in education and communications are needed to inform the public, legislators, regulators, regulated communities, and special interest groups who make the policy decisions. Laws or programs based on a misguided premise do not solve problems — some actions even exacerbate the situation. More data are not necessarily better. The paper quagmire generated by data collection can impede any effort toward improvement and effective management. An expanded TRI cannot solve every environmental issue; however, hysteria about toxics use and focusing only on specific risks without considering benefits do not serve the public good.

Conclusion

Industry wants to be given a tool that, along with regulations, can be used to improve both operations and the environment. The TRI is only part of a set of tools, not the whole picture. Priorities for exposure and risk must be incorporated with considerations for relative toxicity and the TRI emissions data. A holistic approach based on sound science, reason, and pragmatism that truly helps industries improve the quality of life is the only way to deal with today's environmental concerns.

Recommendations

With four years of reporting behind us, we have learned from our experience. Some recommendations for developing a reporting system have become clear.

■ **A release inventory should focus on releases.** The Toxics Release Inventory of emissions includes both releases and transfers to off-site treatment, storage, and disposal facilities. In 1988, over 25 percent of the pounds reported in the database were transfers, not releases. The misrepresentation of transfers as equivalent to releases distorts these data and obscures the priorities. The combined data make it difficult to measure progress on priorities set for release and risk reduction.

■ **The chemical list must be developed based upon sound science, with the specific purpose of the TRI in mind and with care to include truly toxic chemicals.** The list of TRI chemicals, called the list of toxics, includes nontoxic chemicals and does not include some that are toxic. It was created by combining two preexisting chemical lists that were developed for other purposes. Some of the chemicals were listed because they are used in high quantities. No emissions are reported for almost 20 percent of the chemicals on the list, and some are not used by manufacturers in significant quantities.

■ **The regulated community should include the major emitters of toxic chemicals.** Only manufacturers in a given set of Standard Industrial Classification Codes have been targeted to report emissions for the TRI. Thus, emissions in the database are only from a select group of emitters and do not represent a complete inventory. Care should be taken, however, not to logjam the system by including small emitters of negligible quantities of chemicals.

■ **Efforts should focus on collecting useful data because this information determines goals and priorities.** The TRI database cannot solve every environmental problem but should be used as a tool in combination with other tools. Collecting extraneous pieces of information wastes time and energy, jams and overwhelms the system, and detracts from data effectiveness. More data are not always better. Essential to the process are key accurate data that can be used and managed to drive goals and address real problems. Collecting unnecessary information can obscure relevant data and push priorities away from risk reduction.

■ **A pragmatic, reasonable approach incorporating sound science and considering relative toxicities, risk, and exposure should be used to set priorities.** Laws, programs, and goals based on faulty assumptions or focused on intermediate waste handling steps will not affect releases to the environment and exposure to toxic chemicals. Collecting pertinent data and setting appropriate priorities is the only way to focus on and improve the quality of life.

Breakout Sessions

The Breakout Sessions presented the approach used by the U.S. Environmental Protection Agency (EPA) in implementing a significant right-to-know program concerning the releases and transfers of toxic chemicals. It is essential to note from the start that EPA's way of implementing these requirements is being discussed only to show that the concept can be successfully implemented, not to suggest that EPA's way is the only approach.

Implementation and Program Issues of the U.S. Toxics Release Inventory (TRI)

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Introduction

After two tragic accidents in 1984 and 1985 when chemicals were released in Bhopal, India, and Institute, West Virginia, the United States enacted the Emergency Planning and Community Right-to-Know Act (EPCRA) to improve local communities' ability to prepare for chemical emergencies and, more importantly, provide public access to information on local chemical hazards. EPCRA establishes a structure at the state and local levels to assist communities in planning for chemical emergencies and requires businesses to provide information on various chemicals used in their facilities

One of EPCRA's requirements was a Toxics Release Inventory (TRI) that would compile industry reports on annual releases to the air, water, and land of over 300 chemicals and 20 chemical categories. The U.S. Environmental Protection Agency (EPA) was given the task to develop and implement the TRI. For this program, EPA must collect and maintain massive amounts of information on a database that is publicly accessible through an on-line computer system and other means, such as microfiche at local libraries.

To ensure consistent, accurate, and useful data, EPA carefully designed and coordinated the TRI program to balance the needs and burdens of all interested parties — government, industry, public interest groups, and the public. TRI's key components include: regulatory development, outreach, data management, public access, and enforcement.

Establishing TRI

In establishing the TRI program, EPA had to determine which facilities would report on which chemicals. The law mandated the basic reporting elements and required manufacturing facilities with 10 or more full-time employees to report annual releases of specified chemicals, including specific high volume industrial chemicals, carcinogens, and water quality priority pollutants. Because the list of chemicals was compiled from two prepared earlier by New Jersey and Maryland, it included some not currently in production and others that did not meet toxicity criteria. Therefore, EPA established a petition process to allow anyone to request addition or deletion of chemicals based on established toxicity criteria that include evidence of

- reproductive dysfunction or
- neurological disorders or
- heritable genetic mutations or
- cancerous, teratogenic, and/or other health effects as well as significant adverse effects to the environment.

EPA must respond within 180 days to any petition, and changes to the list must be made under federal regulatory procedures.

With the list of toxic chemicals as the focal point, EPCRA mandated that only facilities whose primary business activities are manufacturing products for use in commerce are required to report under the TRI program. Smaller manufacturing facilities must have 10 or more full-time employees and exceed specified reporting thresholds. The following separate thresholds were established for particular uses of the toxic chemicals: manufacturing (including importing), processing (incorporating) the toxic chemical into the final product, and any non-incorporative uses.

To ease the reporting burden, EPCRA required a phased-in threshold approach. Thresholds are based on the following culminative amounts per listed toxic chemical or chemical category over the calendar year:

- **Manufacturing (including importing) or processing:**
  - 75,000 pounds (approx. 34,000 kilograms) for calendar year 1987,
  - 50,000 pounds (approx. 23,000 kilograms) for calendar year 1988, and
  - 25,000 pounds (approx. 11,000 kilograms) for calendar year 1989 and annually thereafter.
- **Non-incorporative uses:**
  - 10,000 pounds (approx. 4,500 kilograms) annually.

Reporting TRI Data

While most of the parameters for determining which facilities should be subject to TRI reporting were set by statute, the format for reporting information was not. EPA had to design a format and data elements that balanced the need for useful data with the requirement to provide clear and concise guidance to the regulated community. Form R was the result.

Form R is used for two types of information: facility-specific and toxic chemical-specific. One Form R must be submitted for each reported toxic chemical or chemical category. The facility-specific information requested on the Form R includes not only physical location but also a facility identification number that links the TRI with other databases for different environmental regulations and for identifying economic activities conducted at the facility. Form R also identifies key personnel who can provide EPA or the public with further information on a facility's toxic chemical use.

To meet the toxic chemical-specific information requirements, facilities must report the identity and the use for each toxic chemical used in processes and indicate how much of each is released to the environment, transferred off-site for disposal, or treated on-site. Releases must be classified by medium (air, water, or land) and by source: point (discharges to surface water) or non-point (fugitive emissions from piping). If waste is transferred off-site, facilities must report the destination and the amount and type of waste treatment, disposal, or recycling.

In 1990, with the passage of the Pollution Prevention Act (PPA), reporting on waste minimization activities such as source reduction and recycling, became mandatory. The PPA aims to minimize waste generation by establishing a source reduction program at EPA and assisting states to provide information and technical assistance. Under PPA, facilities are required to estimate the total quantity of toxic chemical in waste that is released, treated, and recycled on- and off-site and provide a basis for those es-

timates. In addition, facilities must provide information on source reduction activities instituted in each reporting year and include information on how they identified the activity and what impact the activity had in reducing wastes.

Facilities are not required to collect new data but can use available data, such as process information, inventory records, data collected through monitoring required by other laws, and engineering estimates as the basis of estimates of waste quantity. No more than two significant digits of accuracy are required. Facilities must retain records of this information for three years.

Under EPCRA, only chemical identity can be claimed a trade secret. Facilities must supply a generic chemical name on Form R submitted for public use and substantiation of their trade secret claim to EPA. In general, only EPA and health officials have access to trade secret data; however, concerned citizens can petition for release of a chemical's identity.

Recognizing that many facilities receive incomplete information on chemicals contained in mixtures or trade name products, EPA has required companies that supply such mixtures or products to identify the name and concentration of any listed TRI chemical contained in them. This information has helped facilities accurately calculate how much, if any, of a listed TRI chemical they are using. The supplier notification requirement does not apply to consumer products, and certain activities that involve toxic chemicals are exempt from TRI reporting, including

- procedures that use mixtures containing *de minimis* concentrations,
- processes that incorporate toxic chemicals into articles (acids in batteries),
- laboratory activities,
- janitorial and motor vehicle maintenance, and
- transportation of toxic chemicals under active shipping papers.

Assuring Data Quality

To assure the quality of the TRI data, EPA has conducted telephone surveys and site visits to facilities to identify common errors. Telephone surveys identify reporting and estimation problems and provide guidance to improve data quality. Site visit audit surveys quantitatively assess the accuracy of data submitted from year to year. Generally, the results are positive: through increased communications with industry and clear guidance, data quality has been improving.

As revealed by audit surveys, the main errors occur during

- threshold determination,
- Form R completion, and
- release estimation.

Each year, EPA tries to reduce errors and increase compliance by focusing expanded outreach activities on specific industries where many errors occur and publicizing enforcement cases.

Ensuring Compliance

To enforce TRI participation, EPA takes action when either a Form R is not submitted or evidence indicates a significant data error. Enforcement can be triggered by comparisons of Form Rs from facilities in the same industry; referrals on the federal, state, and local level; and complaints. Computer algorithms are used to check TRI data and generate notices of noncompliance. The penalty policy promotes consistent actions and enforcement through EPA inspections as well as citizen suits to improve compliance, which currently stands at approximately 75 percent. EPA has been encouraging facilities to settle cases out of court through environmentally beneficial expenditures, such as instituting source reduction activities or providing equipment for local emergency response groups.

Outreach to industry, states, and the public is another important way EPA ensures compliance. Examples include training and technical support for industry, financial and technical assistance for states, and fee waivers and database assistance for community groups wanting access to TRI data.

Conclusion

After more than five years, the TRI program is still evolving and growing. EPA, Congress, and other environmental groups are exploring ways to enhance and expand the TRI program, including

- expanding the types of facilities required to report,
- adding other toxic chemicals to the list,

- requiring reporting based on actual releases rather than on use thresholds,
- reporting on peak releases as well as total annual releases,
- mandating data on listed chemicals entering as well as exiting facilitys' process(es), and
- requiring facilities to develop toxics use reduction plans.

EPA has learned many lessons from the years spent collecting data on toxic chemical releases. The Agency has determined that centralized reporting is critical. As technology improves, magnetic media reporting will help reduce the data management burden on this centralized system. Data quality depends on clear, consistent guidance and ongoing technical assistance, which must be periodically improved to reflect the needs of the respondents. Supplier notification provides critical data to users of mixtures and trade name products. Lastly, EPA has found that aggressive outreach and enforcement can improve compliance and data quality.

Information Management

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Introduction

In October 1986, the U.S. Congress passed the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA). The Toxic Chemical Release Inventory (section 313) is one of the major sections of EPCRA. In defining TRI's purpose, section 313(h) provides that: "The release forms required under this section are intended to provide information to the Federal, State, and local governments and the public, including citizens of communities surrounding facilities."

Section 313(j) further states: "The Administrator shall establish and maintain in a computer data base a national toxic chemical inventory . . . [and] shall make these data accessible by computer telecommunications and other means. . . ."

EPCRA requires annual reports to EPA of the direct release of toxic chemicals to all environmental media (air, water, and land) or off-site transfer to sewage treatment plants (POTWs) or other off-site facilities, such as commercial landfills. All manufacturing facilities — from orange juice manufactures to car companies to members of the chemical industry — that have 10 or more full-time employees and manufacture or process more than 25,000 pounds or use more than 10,000 pounds of any one of approximately 300 chemicals and 20 chemical categories must submit these data, which form the Toxic Chemical Release Inventory (TRI).

When EPCRA was passed in 1986, EPA was faced with the task of developing a structure to handle Congress' requirements. Because this was a totally new endeavor, EPA worked closely with state and local governments, industry, environmental groups, information providers, and universities to develop and implement the information management aspects of TRI. In retrospect, it is clear that involving all of the parties with an interest in TRI early in its implementation has had a great deal to do with its success.

EPA's TRI Information Management Infrastructure involves collection, management,

distribution, and integration of the toxic chemical information. Procedures for each stage are outlined in the following paragraphs.

Collecting TRI Information

Before a single document was submitted to EPA, various tasks relating to the ultimate collection of data were undertaken. EPA developed guidance documents, held industry workshops, and established a place for industry to call for help. Staff were hired and a reporting center was established to handle the influx of data — an average of 85,000 forms per year from 23,000 industrial facilities.

Each year, facilities receive a reporting package that contains the TRI forms, an instruction manual for filling in the form, and a magnetic media package that enables them to file information electronically. Training is offered throughout the year at industry conferences and workshops to help avoid any mistakes in completing the forms. A TRI Hotline is also available to answer any questions a company may have about the form or the process (1-800-535-0202; 703-920-9877).

Managing TRI Information

To manage TRI information, systems were developed to keep track of all documents and store and aggregate data, allowing analysis. A comprehensive data quality program has been established, which includes quality management of data processing, industry review of release numbers, and release estimate assessments, including on-site evaluations.

The magnitude of the TRI data collection is illustrated by the following figures for number of individual chemical forms, by year, as of November 1991:

- 1987: 79,057;
- 1988: 84,693; and
- 1989: 82,513.

Facilities submit an average of 60 data elements per form for each reporting year. EPA entered over five million data elements from forms received for 1987 through 1990 In the fall of 1990, Congress passed the Pollution Prevention Act of 1990, effective for the 1991 reporting year and thereafter. The act added about 50 percent more data to TRI reporting and will lead to between eight and nine million data elements for 1991 reporting. Other activities underway that either increase the number of facilities required to report or the number of chemicals on which reporting will be required will affect this total.

Three procedures ensure data quality. The first identifies and corrects data entry errors. Next, errors in facilities' data are identified and, where possible, corrected. The final procedure enhances data submitted by facilities.

During data entry, computerized edits and algorithm checks are used to verify the keyed information. Edit checks, which occur at the point of data entry, prompt the keyers to verify a variety of critical fields, including:

- Facility name,
- State/city/zip code,
- Latitude/longitude,
- Possible duplicate submissions,
- Presence of negative values, and
- All release data over 100,000 pounds.

In addition, computerized algorithm checks are made on:

- chemical name/CAS number,
- facility Dun & Bradstreet number,
- parent company Dun & Bradstreet number, and
- NPDES permit numbers.

Four separate activities ensure a high level of data entry reliability. First, at least 25 percent of each keyer's work is verified. Following this step, random audits of data entry data quality are taken. (The accuracy rate at this stage is about 99.5 percent. After the next three steps, this rate is even higher.) Next, a variety of reports are used to identify aberrations, then each facility is mailed its release and transfer numbers to verify. Finally, high-level staff manually examine critical data elements after all data for a particular year have been entered.

Most numbers reported are relatively small; however, to study trends, scientists must be concerned with the many large numbers for releases and transfers found in the database, and the final checks before data release recognize this. All numbers over 500,000 pounds are verified. In addition, EPA verifies all release/transfer numbers that cause a facility to be selected as one of the top 25 in a state by total releases and transfers or one of the top 25 facilities in a state,by environmental media. Additionally, the top 250 facilities by

amount of increase and the top 250 by amount of decrease are also verified. In addition, reports are sent to the regions and states for another look before public release.

In addition to these data quality procedures for EPA staff, a number of activities are undertaken to determine whether submitters have done their jobs correctly. Notices of Noncompliance are issued when the facility has made such a significant error that the data cannot be entered. Notices of Technical Error are issued when a computerized check of the submitter's data (verified by a person) indicates a problem in submission. Additionally, computer-generated changes are used to clean up table values and county names, verify zip codes, states, and counties, and where possible, correct submitted latitude and longitude numbers.

Because computers do not really "think," it is often necessary to normalize data categories to enhance usability. Some significant normalization has occurred with respect to county names, facility names, parent company names, inserting zip code centroid latitude and longitude, and inserting Federal Information Procedure System codes for state and county.

Distributing TRI Information

The wide range of users of TRI data has indicated a need for multiple products, training, and services. EPA makes TRI data available through "computer telecommunications and other means." The states and others (such as industry, environmentalists, the media, and health officials) also make these data available in various unique ways.

TRI information is distributed to a variety of users, including EPA employees in both Headquarters and the regions, local and state government employees, academics, librarians, health professionals, industry, and private citizens. National, state, and local governments are using the data to shape both voluntary and regulatory environmental programs, and many companies are deciding to make dramatic voluntary reductions in toxic releases. Private citizens are studying data on releases of chemicals in their communities. This information has created a strong demand for further analysis and facilitated comparison across the different environmental media.

These multiple users have varied needs, such as national or state data sets, extracts, and analyses, so information is distributed through different means. For example, while developing the original infrastructure, a partnership was formed between EPA and the U.S. National Library of Medicine, which added the Toxics Release Inventory to its previously established health and environmental information network. This online means of assessing TRI data has already answered over 300,000 database queries.

In addition to online service, EPA provides TRI data in other formats, including a national report that is an easy-to-understand summary of the database and microfiche located at over 3,300 U.S. libraries. Diskettes of each state's emission reports have been distributed to 50 state health and environment departments, and more than 500 libraries at universities across the United States have the database on CD-ROM. Magnetic tape is also available for those interested in adding the TRI information to their large computer system. All of these products are available at reasonable prices to anyone who wants them.

In addition, training sessions are held regularly for both industry and the user community. A TRI Hotline and a user support service line (TRI US) have been established to help less sophisticated users in programs and searches.

Integrating TRI Information

TRI continues to expand with each additional year of data added to the system. As the system grows and more users become familiar with the data, the number of uses and opportunities for integrating TRI with other databases will continue to expand. As of 1991, three years of data are available, which allows for multi-year trend analyses. Because of the geographic orientation of TRI, data can be displayed through the Geographic Information System.

TRI has been a driving force for linkage to other information sources. The use of common data elements (for example, facility name) allows matching with other databases to create new information sets. As the only publicly available database for multi-media environmental information, TRI and its uses will continue to grow.

Computer Tools for TRI Analysis

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Risk Assessment and Risk-based Decisionmaking

Toxics Release Inventory (TRI) data can support many risk-based decisions, including ones that establish priorities for follow-up risk evaluations and target subcategories of facilities, chemicals, industries, and geographic areas for voluntary reduction efforts, enforcement, or regulatory development. Such decisions must focus on relative rather than absolute and quantitative risks. Despite uncertainties in release estimation methods, range reporting, and limited coverage, TRI data are still extraordinarily useful for relative risk evaluations. This information can also provide a starting point for absolute risk evaluations that may be needed to support development of regulations.

Major features of risk assessment are usually incorporated in these analyses either explicitly or implicitly. The risk assessment process includes consideration of a chemical's toxicity to various organisms, release patterns and characteristics, and environmental transport and fate as well as the presence, size, and types of exposed populations.

Although several common types of TRI analyses (summaries of total releases and transfers, for example) do not appear to be risk-based, they can be considered so by using the following simplifying assumptions:

- The toxicities of all chemicals are the same,
- The potential for exposure is the same for each release medium,
- No differences exist in environmental conditions from facility to facility, and
- The size of the potentially exposed population is assumed to be equal or not regarded as significant.

Assessment Tools for Risk Decisions

Major TRI assessment tools that support risk screening applications include software for database management, graphic display and mapping, and statistical analysis; the Geographic Information System (GIS); and exposure and risk models. All can be used at several decision levels.

Such factors as available data and personnel, time, cost, and the degree of uncertainty acceptable in a particular decision influence the choice of tools. Typical TRI analyses performed on computers include simple combinations of releases and transfers, toxicity-weighted combinations, and use of TRI data with environmental models for semi-quantitative or quantitative risk estimates.

Simple Assessments

Simple combinations usually include summations of release data or releases and transfers. Most summaries can be compiled through database management systems by facility (across chemicals and release media), geographic area (county), industry sector, chemical, or medium. To support such analyses, EPA uses dBase, ADABASE, SAS, and the ARC/INFO GIS. The Office of Pollution Prevention and Toxics has developed a set of SAS routines, collectively called TRIPQUIC, that allow easy construction of summaries, which can be displayed as tables, graphs, or maps. These simple combinations are constructed directly from verified data contained in TRI submissions.

Weighted Combinations of Emissions

Weighted combinations of release data most often use information on toxicity endpoints of TRI chemicals to weight the releases and transfers. Such weights can be constructed on the basis of a toxicity ranking, either qualitative (high-medium-low) or quantitative (for example, 6 on a scale of 1 to 10). Weights can also be derived directly from toxicity values: LD_{50}, cancer potency slope factors, or acceptable dose levels.

Producing weighted combinations of release data is a relatively straightforward process when databases of toxicity information can be related to release data files by a Chemical Abstracts Service number. Reports can be created by choosing only selected carcinogens or by multiplying releases by a toxicity rank or concern level. TRI data have been used by analysts in several EPA regions, states, and interest groups to develop such weighted assessments. In most cases, though, these combinations do not include an exposure-based weighting scheme.

Qualitative Risk Screening

Using risk screening to develop relative indicators of concern incorporates additional exposure information and allows greater use of professional judgment in determining priorities. EPA's *TRI Risk Screening Guide* provides one suggested approach. Developed to support reviews of TRI data by local officials (especially those not already involved in conducting risk assessments), the guide suggests consideration of releases, toxicities (human and aquatic), environmental fate, receptor populations, and uncertainties or gaps in release and toxicity data. The primary output of a risk screening assessment (as described in the guide) is a grouping of facility- and chemical-specific releases into high-medium-low categories.

Risk screening assessment is most appropriate for small area comparisons, such as 10 to 50 facilities in a county, because of the time involved in manipulating the appropriate data. EPA is developing an automated version of the guide to support analyses of larger groups of releases, and various TRI data users are considering numerous other approaches to risk screening.

The process of risk screening requires data on chemical releases, toxicity information, chemical fate parameters, and distribution of human as well as wildlife populations and environmentally sensitive areas. A wide range of health and environmental effects were considered when the guide was developed, including chronic toxicity, carcinogenicity, human acute toxicity, and acute and chronic toxicity to aquatic organisms.

Toxicity ranking factors can be developed from existing regulatory levels, such as the Comprehensive Environmental Response, Compensation, and Liability Act's reportable quantities, or from data on effective dose levels, called "reference doses." Major toxicity data sources for risk screening include the *TRI Risk Screening Guide's* Appendix A, Roadmaps' PC database, the Integrated Risk Information System, other on-line data sources such as the Hazardous Substances Data Bank, the International Agency for Research on Cancer's chemical monographs, and the International Register of Potentially Toxic Chemicals' toxicity data.

Major site-specific data used in risk screening include:

- wind speed and direction,
- stream flows,

- soil characteristics, and
- receptor population information.

Data are often available from local weather stations, natural resource management agencies, and planning or health organizations. Information to support evaluations of receptor population can be derived from maps showing household distribution or from a census of population retrieved by using PC GEMS or GIS, which can also delineate sensitive populations (schools and hospitals) and environments (wetlands and parks).

The Office of Pollution Prevention and Toxics' Graphical Exposure Modeling System (GEMS) includes many features for risk screening applications. PC GEMS supports data management and retrieval, mapping of points or areas, and multimedia exposure modeling. However, the most frequently used TRI risk evaluations cannot support the amount of data required for a quantitative modeling assessment. PC GEMS also requires considerable hard disk space on a personal computer, and therefore, a subset, Screen GEMS, has been developed to support risk screening. The features of Screen GEMS include:

- Data on selected environmental characteristics, such as prevailing wind patterns and stream flows;
- Receptor information, including data to construct tables of populations living near sites and identify downstream drinking water intakes; and
- Integration tools that assist in developing site maps of population, rivers, and political boundaries.

Quantitative Risk Screening of TRI with Environmental Models

In risk-based decisions, TRI data often can be enriched by incorporating computerized models in the evaluation. Key issues in such assessments are the availability of additional input data and the degree of uncertainty that can be communicated readily to users. Models provide a convenient way to incorporate site-specific factors affecting exposure and may allow calculation of risk estimates on relative toxicity. However, the TRI reporting form does not include all the data necessary for a modeling analysis. If the decision to be supported allows their use, generic release input parameters may be appropriate. In other cases, additional site-specific data may be needed to support more accurate risk assessments.

TRI data can be evaluated by using semi-quantitative modeling with generic input data or quantitative risk modeling with site-specific information. The semi-quantitative approach employs the models' numerical results in a qualitative sense to support scoping or ranking. In such cases, the facilities or chemicals with the highest estimated risks can be grouped as a priority for additional action. A fully quantitative approach allows estimation of population risks to determine permit limits or other regulations.

The major differences between the two approaches are the data requirements, necessary expertise, and uncertainty of results. For example, significant additional data are needed to conduct an atmospheric exposure and risk assessment using a model in GEMS or PC GEMS. The Industrial Source Complex—Long-term model estimates annual average concentrations from stack, area (fugitive), or volume emissions. Major inputs to estimate data include site location, emission rate, and stack data (height, temperature, velocity, diameter), together with wind speed and direction. To additionally estimate exposure, data are required on population distribution around the site. Also, annual average concentrations and exposure can be used in conjunction with a cancer potency unit risk factor to estimate individual and aggregate cancer risks over a lifetime. The TRI form provides only the annual total emissions of each chemical (from all sources within a facility) and site location.

The Office of Pollution Prevention and Toxics employs semi-quantitative risk screening in the Existing Chemicals Process to target chemicals for possible regulation under the Toxic Substances Control Act and highlight possible facilities for voluntary emissions reduction of TRI chemicals. Such assessments are being developed for about 30 TRI chemicals, with all TRI sources in the United States modeled for each.

EPA has not attempted to develop reliable quantitative risk estimates for TRI chemicals using site-specific data. Such an effort would require contacting facilities for detailed data on most or all of the individual stacks or vents and better estimates of size and perimeter boundaries. TRI data reported by industry are summarized not only from many production processes but also from multiple release points within a process. In a fully quantitative assessment, such sources should be evaluated individually.

A major new analysis tool recently available within EPA and elsewhere, the Geographic Infor-

mation System (GIS), can support a variety of TRI analyses. GIS manages both geographic and geographically referenced "attribute" data; in TRI, these data are single points that represent facilities. Examples of geographically linked attribute data used in TRI risk screening include TRI releases and transfers, populations associated with census enumeration areas, stream flows linked to stream segments, and populations associated with drinking water utilities.

The GIS includes a standard database management system that can manipulate attribute data, and its ability to develop information about spatial relationships not assessed before is especially powerful. A simple example of a spatial analysis would be a total of all records within a single county, when the county name or code is part of the record. Such analyses can be supported in most database environments and in SAS.

An intermediate example of spatial analysis might be a summation of all points within a specified distance and direction of another point — such as populations or postal zip polygon centroids near a facility. An advanced example of GIS assessment might be a computation of total acreage of endangered species habitat within a floodplain downstream of a TRI facility, given the facility location, river trace, topography, and rainfall and species ranges. The GIS can also support development of models or scoring systems.

EPA regions are using GIS to integrate data collected to implement environmental laws and support risk-based priority setting. At least two regions have developed TRI scoring systems that assign weights to releases and transfers by degree of chemical toxicity concern.

Conclusions

The TRI is extremely useful for risk-based decisionmaking. Most applications involve some form of simplified risk assessment or screening to target application of scarce resources on releases presenting the highest risks.

Many decisions can be supported by TRI analyses; however, they may require assessments with different levels of specificity and accuracy Because of uncertainties in emissions data and cost and time requirements to collect additional information, most decisions that rely on TRI analyses depend on relative risk between one group of chemicals, facilities, industry sectors, and geographic areas and another. Often, a high-medium-low ranking can be used.

Data needs for assessments vary according to which elements of risk are considered and the degree of uncertainty that is appropriate to a decision. Chemical toxicity data are needed for risk screening. Several kinds of site-specific data on environmental conditions and receptor populations are required to extend evaluations to include exposure factors.

EPA's *TRI Risk Screening Guide* outlines a process that results in high-medium-low rankings of facility-chemical combinations. Its appendices contain useful information on relative chemical toxicity and environmental fate parameters.

Numerous computer tools can provide access to data needed for risk screening and support various analyses. Notable examples include database management systems (ADABASE, dBase); statistical packages (SAS); the Geographic Information System (ARC/INFO and mapping packages); and environmental models (GEMS and PC GEMS).

Models make incorporation of most factors needed for risk-based assessment relatively easy. However, the results of modeling analyses, particularly those created with generic input assumptions, should be used cautiously. Such results can often be used qualitatively to help set relative priorities. Several EPA offices have found these approaches useful in performing TRI data analyses. Many other TRI data users are exploring the use of these and related techniques in their analyses.

Data Use and Analysis

Setting Environmental Priorities with the Toxics Release Inventory

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ABSTRACT

The Toxics Release Inventory (TRI) data are used at the U.S. Environmental Protection Agency to target resources and help establish priorities. This session will explore various initiatives in which EPA and private industry enter into cooperative joint ventures to prevent pollution using TRI data as the measure of success. It will also discuss regulatory activities at EPA that have been triggered by an analysis of the TRI data and its influence on laws passed by the United States Congress as well as by local governments in the United States. An analysis of TRI's role in focusing environmental inspection and enforcement activities will complement the description of its role in pollution prevention.

The Toxics Release Inventory is used by different people for different reasons. It is certainly used by the states and federal government, but also by the press, academic and citizens' groups, and industry. My presentation will focus on how EPA and Congress rely on TRI when developing legislation and regulations. EPA also uses TRI to enforce the regulations, assess environmental and health risks, and measure our environmental progress.

During this past year, a number of important federal activities were heavily influenced by TRI, including several pieces of legislation. The most important for the Toxics Release Inventory and the Office of Pollution Prevention and Toxics has been the passage of the Pollution Prevention Act of 1990, which puts into law EPA's policy to prevent pollution from being generated in the first place. This act establishes a source reduction program at EPA and provides state governments with technical support, particularly for smaller businesses, in determining pollution prevention opportunities.

The Pollution Prevention Act charged EPA to establish a pollution prevention office, now the Office of Pollution Prevention and Toxics. EPA has developed a strategy, set up grants for state and local governments, and established a source reduction clearinghouse that exchanges publicly available information on pollution prevention techniques, processes, and process changes. EPA also gathers information on source reduction, recycling, and changes in releases under the TRI reporting requirements.

We call the report collected under the TRI the "Form R" for releases. Basically, Form R tells companies to look aggressively and actively for pollution prevention opportunities, document what kinds of action they have taken to determine those opportunities, and, most importantly, to predict what they are going to do in the future.

The other uses of TRI at EPA are interesting. We perform a fair amount of targeting of our enforcement and inspection activities, using the toxics release information. Because these are multimedia data, we are able to compare the

reports for air and land emissions and, for the first time at EPA, to actually put together teams that will go out and do multimedia enforcement. Also, we can look at priority enforcement targets based on the amounts of emissions that have been reported because they are very high or do not look very logical and suggest that something may be wrong with the kind of report being used. TRI allows us to leverage our enforcement resources, to use them where they will do the most good.

In addition, we have been encouraging environmentally beneficial expenditures. EPA can fine a company for failing to follow regulations; however, if the firm can demonstrate that it has voluntarily engaged in substantial expenditures for pollution prevention, it will get a partial credit against the fine. This is one of the ways TRI has advanced EPA thinking on enforcement.

TRI has been used by other agencies to validate other laws. The Internal Revenue Service, the United States' tax collection agency, has compared emissions reports with the amount of taxes collected, thereby using TRI as an enforcement tool. State and local governments, particularly local municipalities, have also used TRI data to assess the appropriateness of different kinds of buildings in a particular neighborhood. For example, should a school be permitted to be in an area where emissions or releases have been reported? Banks have also used the data to determine the riskiness of financing the purchase of particular pieces of real estate.

EPA has been using TRI information to more narrowly focus risk assessments. The list of chemicals included under the TRI was given to EPA by Congress. EPA is evaluating this list systematically for potential new additions. Of the 77 TRI chemicals that have been subjected to priority screening so far, EPA's Office of Pollution Prevention and Toxics has identified 57 chemicals for more detailed testing that will undoubtedly influence regulations.

TRI is also being used by other EPA offices to assess risk and regulate activities. For example, the Office of Water has used the TRI to identify possible sources of well and groundwater contamination. TRI data are also used to identify sources of toxic discharges into nationally significant estuaries near our Great Lakes as well as in the Gulf of Mexico area, where EPA has major priorities. The TRI also helps to identify priority geographic areas of the country where EPA could concentrate efforts and resources.

The TRI also measures progress. To determine whether people really are reducing pollutants, EPA is studying pollution prevention practices, including kinds of activities, to create a TRI environmental indicator program.

One of the most publicly acclaimed programs at EPA is the 33/50 Project whose goal is to have selected corporations voluntarily reduce 17 selected TRI chemicals 33 percent by 1992 and 50 percent by 1995. Six thousand major U.S. corporations were asked to sign up for this program; to date, 700 have voluntarily promised to meet or exceed these goals for the 17 chemicals. A number of companies have voluntarily committed to meet the same goals in their international operations. The 1988 TRI data will be the baseline for measuring progress in the 33/50 program.

The new Pollution Prevention Act requires companies to identify the methods used to find pollution prevention opportunities and then report which process actually reduced pollution. An EPA clearinghouse will contain that data as well as the Form R reports, and they will be publicly available.

It has been difficult to determine, however, whether the environment is really better off. Now that EPA has three years of data, it can start assessing trends.

Other issues include changes companies make in methods of accounting and measurements to understand better how the law applies to them. Unfortunately, EPA does not have an easy way to determine the relative risk associated with the chemicals in the TRI because it cannot measure what an increase or decrease of 10 million pounds means for the environment as a whole.

EPA is now trying to develop a Toxics Release Inventory indicator that will determine whether the United States is better off and whether it is making environmental progress. This indicator, which is <u>not</u> a measure, is highly controversial because it will require some balancing of a number of scientific, policy, and philosophical judgments; i.e., things like carcinogenicity and reproductive and environmental hazards. But we are convinced that we need to go farther than simply announcing total pounds or total kilograms each year.

The TRI indicator is a priority of EPA Administrator William Reilly. EPA will use it to allocate resources so that they are sent to areas where risks can be reduced most efficiently and effectively.