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California SARA Title III Section 313 data for reporting years 1987 and 1988

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Abstract

The Office of Hazardous Materials Data Management of the California Environmental Affairs Agency processes the Toxic Release Inventory (TRI) forms sent to the State. These forms contain quantitative information on hazardous materials releases to air, water, and land, and are submitted annually to both state and federal governments. The forms are edited and the data entered into a data base resident on a microcomputer. Data from the reporting years of 1987 and 1988 has been processed. After excluding sodium sulfate from the 1987 data, due to the delisting of this chemical for 1988 reporting, the number of pounds reported for 1988 is reduced, compared to 1987, from 234 million pounds to 212 million pounds. Approximately the same number of companies filed in each reporting year—1,768 in 1987 and 1,681 in 1988. Much of the total of the chemical releases can be attributed to a small number of chemicals, industry types, or specific companies. While some reconciliation problems remain, such as from year to year and federal versus state, this information represents an important milestone towards the goal of obtaining comprehensive quantitative information on the release of hazardous materials into the environment.

Introduction

SARA Title III Section 313

Section 313 of the federal Emergency Planning and Community Right-to-Know Act requires the annual submittal of the federal Environmental Protection Agency (EPA) Form R to both the EPA and the designated state agency. The intent of this reporting requirement is to inform the public about routine releases of toxic chemicals into the environment, assist organizations in gathering data, and aid in the development of regulations, guidelines, and standards. Companies are required to report the following general categories of information:

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- *Identification.* Name, location, and type of business.
- *Discharge location.* Site to which chemicals are released, including air, on-site land, water, under-ground injection, publically owned treatment works (POTW),, and off-site land transfer.
- *Chemical.* Identification and quantity of each chemical released to each environmental medium.
- *Other.* Information about waste treatment and waste minimization.

Companies must file if they meet the following three criteria: (1) Employ 10 or more full-time employees; *and* (2) Do business in Standard Industrial Classification (SIC Code) 20 through 39 (manufacturing); *and* (3) Manufacture, process, or otherwise use above the threshold amount of a listed chemical during the calendar year. Lists of applicable SIC codes, chemicals, and threshold values are given in the federal reporting package, which may be obtained from: Section 313 Document Distribution Center, P.O. Box 12505, Cincinnati, OH 45212.

The forms received by the federal government are entered into the Toxic Release Inventory System (TRIS), a federal data base. A version of this data base is available at the National Library of Medicine for public access. A national summary of the 1987 data has been released [1].

Office of Hazardous Materials Data Management

In California, the designated agency for processing of the Form R is the Environmental Affairs Agency, and the processing of these documents is performed by the Office of Hazardous Materials Data Management within the Agency. This Office performs several functions related to the integration and dissemination of hazardous substances information, including the SARA Title III Section 313 (SARA 313) information. This paper describes both the operation and composition of the California SARA 313 data base, based upon the Form R's submitted to the State, and will discuss both the 1987 and 1988 reporting years.

SARA 313 data base development

The information reported on the Form R is primarily intended to inform the public about releases of toxic chemicals into the environment. Accordingly, in keeping with this "right-to-know" orientation, the SARA 313 forms were developed with an emphasis on data collection. Definition of summary reports from the forms or an associated data base was apparently not performed prior to designing the forms, and many of the data elements were apparently mandated by federal law.

We developed our data base with the same viewpoint, which was to satisfy public information requests. Initially, we developed a rudimentary data base to assist in locating and copying documents. However, after we photocopied over 30,000 pages within six months, we determined that a more complete data

base would be cost effective. We then proceeded to enter selected data from the Form R's and we now satisfy almost all of our information requests with computer-generated reports. We have processed almost 700 information requests to date from both the public and private sectors.

The information collected on the Form R does *not* represent a comprehensive quantitative picture of hazardous substances released into the environment, for the following reasons:

(1) Only companies meeting the reporting criteria must file a Form R.
(2) Underreporting may be a problem. While filing of the Form R is mandatory, a "master list" of companies meeting the filing criteria does not exist. Therefore, initial contact and follow-up of companies which must report cannot be done. Many companies may remain unaware of the filling criteria.

Keeping those limitations in mind, the data can be viewed as minimum estimates of hazardous chemical releases.

Methods

As discussed in the previous section, the data base was established primarily to house information from a mandated data collection form, the Form R, and to satisfy requests for this information in an automated fashion.

Although California had the largest number of submitters nationwide [1] the volume was low enough to allow us to edit the data *at input time*, eliminating the need for a written correction procedure. Any questions about data were typically resolved over the telephone. A list of files used is given in Table 1, and lists of the data elements entered and their respective edits are given in Tables 2 and 3.

The data base was developed using ORACLE Professional 5.1B, on a Compaq

TABLE 1

California TRI system files. The facility, offsite, and chemical files house the data entered from the TRI forms. The remaining files are reference files used for on-line data validation purposes during data entry

File name	Function
Facility	Contains reference information on facility name, location, etc. from page 1 of Form R
Off-site	Contains off-site destination and POTW information from page 2 of Form R
Chemical	Contains chemical information on releases from pages 3–5 of Form R
Chemical reference	Reference chemical list
County	Reference county list
SIC Code	Reference SIC Code list

TABLE 2

Facility file description. This file houses the facility identification information, most of which is on page 1 of the form[a]

Form R field	Name	Type	Description	Edit criteria
N/A	Facility	Number(6)	EAA Facility filing number	Number set automatically by system
N/A	FacID	Char(15)	TRIS Filing number (joins the same Facility between filing years)	None
1.3	Repyear	Number(2)	Reporting year, 87, 88, 89, etc.	Number set by system
3.1	Facname	Char(50)	Facility name	None
3.1	Facstrt	Char(50)	Street address	None
3.1	Faccity	Char(25)	City	None
3.1	Faccnty	Number(2)	County number	Must be between 01 and 58
3.1	Faczip	Char(5)	Zip code	Must be between 90000 and 96999
3.1	Faczipex	Char(4)	Zip code extension	Numeric
N/A	P65	Char(1)	Does Fac file s313/Prop 65 chems	Y or Null, set by system
N/A	s302	Char(1)	Does Fac file s313/SARA 302 chems	Y or Null, set by system
3.5.A	SIC1	Number(4)	Primary Standard Industrial Classification (SIC) Code	Numeric
3.5.B	SIC2	Number(4)	Secondary SIC	Numeric
3.5.C	SIC3	Number(4)	Secondary SIC	Numeric
3.6	Lat-Deg	Number(3)	Latitude degrees	Numeric
3.6	Lat-Min	Number(2)	Latitude minutes	Numeric
3.6	Lat-Sec	Number(2)	Latitude seconds	Numeric
3.6	Lon-Deg	Number(3)	Longitude degrees	Numeric
3.6	Lon-Min	Number(2)	Longitude minutes	Numeric
3.6	Lon-Sec	Number(2)	Longitude seconds	Numeric
3.7	Dandb	Char(11)	Dun and Bradstreet number	None
3.8	EPA	Char(12)	EPA number	None
3.9	NPDES	Char(9)	NPDES Permit Number	None
3.3	T-name	Char(30)	Technical contact name	None
3.3	T-phone	Char(12)	Technical contact phone	None
3.4	P-name	Char(30)	Public contact name	None
3.4	P-phone	Char(12)	Public contact phone	None
N/A	Rec-date	Date	Date data entered into EAA system	Set by system
N/A	Amn-date	Date	Date of a Form R amendment	DD-MM-YY-Format
N/A	LEPC	Number(1)	Local emergency planning committee region number	Set by system
N/A	Facility	Number(6)	EAA facility number	Assigned by computer
N/A	FacId	Char(15)	TRIS filing number	Assigned by system
1.2	CAS	Char(12)	Chemical Abstract Service number	Reads chem89 file to bring back chemical name and SARA 313 info.
1.3	Chemname	Char(40)	Chemical name	Assigned by computer if CAS no. is in Chem89 file. Else key entered

Form R field	Name	Type	Description	Edit criteria
5.1A.A1	F51A1	Number(1)	Fugitive air range *	Null, 0, 1 or 2
5.1A.A2	F51A2	Number(8)	Fugitive air emission estimate #	Numeric, no decimals
5.1B	F51AB	Char(1)	Fugitive air emission code +	None
5.2A.A1	F52A1	Number(1)	Stack air range *	Null, 0, 1 or 2
5.1A.A2	F52A2	Number(8)	Stack air emission estimate #	Numeric, no decimals

[a]The various column headings are:
Form R field—Corresponding data element on the TRI form, N/A means not available
Name—Data element name in the data base
Type—Field length and type on the data base
Description—Description of the data element
Edit criteria—Edits which must be passed for each data element before the record is added to the data base
Symbols: * 0 or Null = No entry; 1 = 1–499 pounds; 2 = 500–1000 pounds
Pounds
+ M = Monitored data; C = mass balance calculations; E = Published emission factors; 0 = other engineering estimates
% Summary total of all estimates for the chemical. Uses of 250/750 for any range 1/2 estimates.

Deskpro 286 with 3 MB of RAM and an 80 MB hard drive, running DOS 3.31. Comparisons of California and federal data bases were performed on the same hardware using Dbase III Plus. Extraction of data from the files was performed using appropriate SQL (Structural Query Language) commands.

Rationale for data base environment

Any edits performed on the data occur at data entry time. No post-entry edits are performed. These edits are based upon subsequent use of the data, and primarily ensure that only numeric data are entered in numeric fields. This edit process was chosen because it is more cost effective than post-entry edit procedures when low document volumes are processed. While California has the highest reporting volume nationwide [1], the volume of approximately 25,000 pages is relatively low for a data system. After all data are entered, all forms are verified manually with the data system. Typically, one year's data are processed in this fashion within three months using one microcomputer.

The use of a microcomputer instead of a larger platform was chosen on the basis of both cost effectiveness and reduced system development time. To enhance performance, a 386-based microcomputer is scheduled to replace the current one. Conversion to a mainframe data center environment will be considered if volume constraints or multiple user access become an issue. The system is currently accessed by one person at a time, and one programmer analyst assumes all system responsibilities.

TABLE 3

Chemical file description—This file houses the chemical and quantitative release information from pages 3 and 4 of the TRI form. Column headings and symbols are identical to Table 2

Form R field	Name	Type	Description	Edit criteria
5.2B	F52AB	Char(1)	Stack air emission code +	None
4.0	Max-Amt	Number(2)	Maximum amount of inventory code	N/A
N/A	H2OC1	Number(5)	No. 1 water emission site code	Numeric, no decimals
5.3.1A.A1	To-H2OR1	Number(1)	No. 1 water range code *	Null, 0, 1 or 2
5.3.1A.A2	To-H2OE1	Number(8)	No. 1 water emission estimate code #	Numeric, no decimals
5.3.1A.1B	To-H2OB1	Char(1)	No. 1 water range code +	N/A
N/A	H2OC2	Number(5)	No. 2. water emission site code	Numeric, no decimals
5.3.2A.A1	To-H2OR2	Number(1)	No. 2 water range code *	Null, 0, 1 or 2
5.3.2A.A2	To-H2OE2	Number(8)	No. 2 water emission estimate #	Numeric, no decimals
5.3.2A.2B	To-H2OB2	Char(1)	No. 2 water emission code +	N/A
N/A	H2OC3	Number(5)	No. 3 water emission site code	Numeric, no decimals
5.3.3A.A1	To-H2OR3	Number(1)	No. 3 water range code *	Null, 0, 1 or 2
5.3.3A.A2	To-H2OE3	Number(8)	No. 3 water emission estimate #	Numeric, no decimals
5.3.3A.1B	To-H2OB3	Char(1)	No. 3 water emission code +	N/A
5.4A.A1	To-UGR	Number(1)	Underground injection range *	Null, 0, 1 or 2
5.4A.A2	To-UGE	Number(8)	Ugrd injection emission estimate #	Numeric, no decimals
5.4B	To-UGB	Char(1)	Ugrd injection emission code +	N/A
5.5.1	To-LANC1	Char(3)	No. 1 land disposal code	Numeric, no decimals
5.5.1A.A1	To-LANR1	Number(1)	No. 1 land range code *	Null, 0, 1 or 2
5.5.1A.A2	To-LANE1	Number(8)	No. 1 land emission estimate #	Numeric, no decimals
5.5.1B	To-LANB1	Char(1)	No. 1 land emission code +	N/A
5.5.2	To-LANC2	Char(3)	No. 2 land disposal code	Numeric, no decimals
5.5.2A.A1	To-LANR2	Number(1)	No. 2 land range code *	Null, 0, 1 or 2
5.5.2A.A2	To-LANE2	Number(8)	No. 2 land emission estimate #	Numeric, no decimals
5.5.2B	To-LANB2	Char(1)	No. 2 land emission code +	N/A
5.5.3	To-LANC3	Char(3)	No. 3 land disposal code	Numeric, no decimals
5.5.3A.A1	To-LANR3	Number(1)	No. 3 land range code *	Null, 0, 1 or 2
5.5.3A.A2	To-LANE3	Number(8)	No. 3 land emission estimate #	Numeric, no decimals
5.5.3B	To-LANB3	Char(1)	No. 3 land emission code +	N/A
N/A	POTC1	Number(5)	No. 2 POTW disposal site code	Numeric, no decimals
6.1.1.1.A1	To-POTR1	Number(1)	No. 1 publicity owned treatment works (POTW) code *	Null, 0, 1 or 2
6.1.1.1.A2	To-POTE1	Number(8)	No. 1 POTW release estimate #	Numeric, no decimals
6.1.1.1.1B	To-POTB1	Char(1)	No. 1 POTW release code +	N/A
N/A	POTC2	Number(5)	No. 2 POTW disposal site code	Numeric, no decimals
6.1.1.2.A1	To-POTR2	Number(1)	No. 2 publicly owned treatment works (POTW) code *	Null, 0, 1 or 2
6.1.1.2.A2	To-POTE2	Number(8)	No. 2 POTW release estimate #	Numeric, no decimals
6.1.1.2.1B	To-POTB2	Char(1)	No. 2 POTW release code +	N/A
N/A	OFFC1	Number(5)	No. 1 offsite disposal site code	Numeric, no decimals
6.2.1.2.A1	To-OFFR1	Number(1)	No. 1 offsite release range code *	Null, 0, 1 or 2
6.2.1.2.A2	To-OFFE1	Number(8)	No. 1 offsite release estimate #	Numeric, no decimals
6.2.1.2.2B	To-OFFB1	Char(1)	No. 1 offsite release code +	N/A
6.2.1C	OFFY1	Char(3)	No. 1 offsite release treatment code	Numeric, no decimals
N/A	OFFC2	Number(5)	No. 2 offsite disposal site code	Numeric, no decimals

Form R field	Name	Type	Description	Edit criteria
6.2.2.2.A1	To-OFFR2	Number(1)	No. 2 offsite release range code *	Null, 0, 1 or 2
6.2.2.2.A2	To-OFFE2	Number(8)	No. 2 offsite release estimate #	Numeric, no decimals
6.2.2.2.2B	To-OFFB2	Char(1)	No. 2 offsite release code +	N/A
6.2.2C	OFFY2	Char(3)	No. 2 offsite release treatment code	Numeric, no decimals
N/A	OFFC3	Number(5)	No. 3 offsite disposal site code	Numeric, no decimals
6.2.3.2.A1	To-OFFR3	Number(1)	No. 3 offsite release range code *	Null, 0, 1 or 2
6.2.3.2.A2	To-OFFE3	Number(8)	No. 3 offsite release estimate #	Numeric, no decimals
6.2.3.2.2B	To-OFFB3	Char(1)	No. 3 offsite release code +	N/A
6.2.3C	OFFY3	Char(3)	No. 3 offsite release treatment code	Numeric, no decimals
N/A	OFFC4	Number(5)	No. 4 offsite disposal site code	Numeric, no decimals
6.2.2.A1	To-OFFR4	Number(1)	No. 4 offsite release range code *	Null, 0, 1 or 2
6.2.2.A2	To-OFFE4	Number(8)	No. 4 offsite release estimate #	Numeric, no decimals
6.2.2.2B	To-OFFB4	Char(1)	No. 4 offsite release code +	N/A
6.2.5C	OFFY4	Char(3)	No. 4 offsite release treatment code	Numeric, no decimals
N/A	OFFC5	Number(5)	No. 5 offsite disposal site code	Numeric, no decimals
6.2.2.A2	To-OFFR5	Number(1)	No. 5 offsite release range code *	Null, 0, 1 or 2
6.2.2.A2	To-OFFE5	Number(8)	No. 5 offsite release estimate #	Numeric, no decimals
6.2.2.2B	To-OFFB5	Char(1)	No. 5 offsite release code +	N/A
6.2.5C	OFFY5	Char(3)	No. 5 offsite release treatment code	Numeric, no decimals
7.0 (any)	F7sw	Char(1)	Waste treatment methods used (Y or N)	N/A, default N
8.0 (any)	F8sw	Char(1)	Waste minimization methods used (Y or N)	N/A, default N
3.1.A	F31A	Char(1)	Use of chemical code, Y or Null	N/A, default null
3.1.B	F31B	Char(1)	Use of chemical code, Y or Null	N/A, default null
3.1.C	F31C	Char(1)	Use of chemical code, Y or Null	N/A, default null
3.1.D	F31D	Char(1)	Use of chemical code, Y or Null	N/A, default null
3.1.E	F31E	Char(1)	Use of chemical code, Y or Null	N/A, default null
3.1.F	F31F	Char(1)	Use of chemical code, Y or Null	N/A, default null
3.2.A	F32A	Char(1)	Use of chemical code, Y or Null	N/A, default null
3.2.B	F32B	Char(1)	Use of chemical code, Y or Null	N/A, default null
3.2.C	F32C	Char(1)	Use of chemical code, Y or Null	N/A, default null
3.2.D	F32D	Char(1)	Use of chemical code, Y or Null	N/A, default null
3.3.A	F33A	Char(1)	Use of chemical code, Y or Null	N/A, default null
3.3.B	F33B	Char(1)	Use of chemical code, Y or Null	N/A, default null
3.3.C	F33C	Char(1)	Use of chemical code, Y or Null	N/A, default null
N/A	AIRTOT	Number(11)	Total air emissions %	Computed by system
N/A	H2OTOT	Number(11)	Total water emissions %	Computed by system
N/A	LANDTOT	Number(11)	Total land emissions %	Computed by system
N/A	POTWTOT	Number(11)	Total POTW emissions %	Computed by system
N/A	OFFSTOT	Number(11)	Total offsite release %	Computed by system
N/A	UGTOT	Number(11)	Total U.G. inj. emissions %	Computed by system

Results and discussion

For both 1987 and 1988, the number of filers and chemicals submitted were similar (Table 4). This is somewhat unexpected, as the reporting threshold for

TABLE 4

Annual volume—Number of companies, number of chemicals and annual volume for each reporting year are listed

Year	Number of filers	Number of chemicals	Release volume (pounds)
1987	1768	5557	233,771,839[a]
1988	1681	5849	211,798,557

[a]Because sodium sulfate was deleted from the chemical list for 1988 reporting, for comparison purposes we have excluded it from the 1987 totals as well.

1988 dropped to 50,000 pounds from the 1987 threshold of 75,000 pounds. We therefore had anticipated that additional facilities would file in 1988. Year-to-year comparisons are further complicated by the delisting of sodium sulfate for the 1988 reporting cycle. Of additional concern is the observation that several hundred companies filed for either 1987 or 1988, but not for both years. We are currently investigating these apparent reporting discrepancies, and preliminary results indicate that many of these are due to oversight on the part of facilities that should be reporting.

Quantities released

During 1987, the amount of sodium sulfate released to surface water and by underground injection was so great that other chemical releases were a small percentage of the total volume. Furthermore, reporting of sodium sulfate was not required for 1988. The remainder of this discussion therefore excludes sodium sulfate, which we believe allows for more meaningful comparisons.

During 1987, the greatest release by medium was to the air, followed by off-site land, POTW, surface water, onsite land, and underground injection (Fig. 1). The 1988 data follow roughly the same pattern, except that during this reporting year the POTW amount slightly exceeded the offsite land amount. Also, the underground injection amount in 1988 increased almost tenfold, due to one facility's activity.

The total number of pounds reported in 1988 was reduced by over 20 million pounds as compared to the reported releases for 1987 (Table 4). Some reductions are to be expected due to facilities controlling their releases. On the other hand, some increase in reported amounts for 1988 would have been predicted based upon the lowering of the reporting threshold from 75,000 pounds to 50,000 pounds. We are currently attempting to better understand the situation. The main reductions in reported releases are to POTW and off-site locations. The POTW reduction can be readily explained by decreased reporting of acids and bases. This presumably correlates with an increasing awareness that neutralized acids and bases do not have to be reported. Reductions in offsite transfer

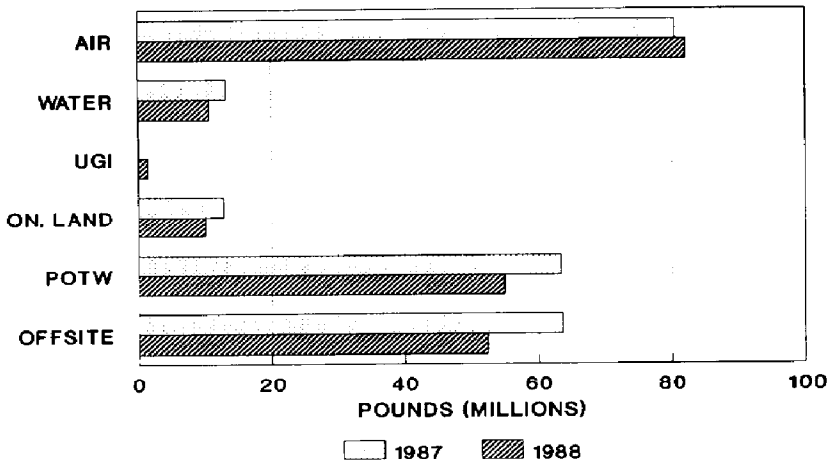

Fig. 1. Bar graph of annual releases to environmental media—For 1987 and 1988, releases to each medium are illustrated.

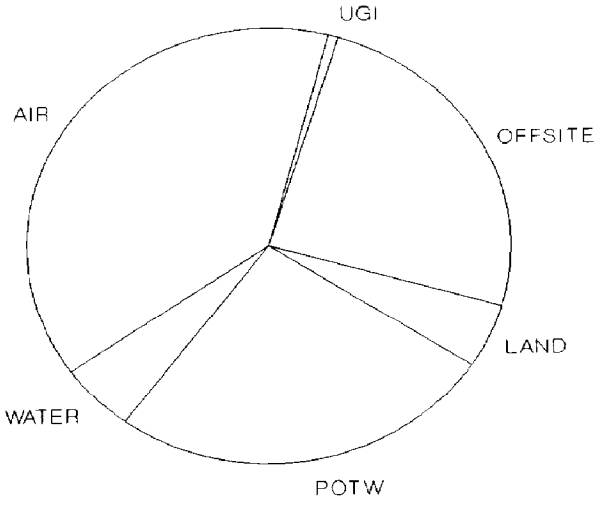

Fig. 2. Pie chart of 1988 releases to environmental media—The distribution of 1988 releases to each medium is illustrated.

releases could similarly be accounted for by an increased awareness of the fact that offsite transfers for recycling do not have to be reported.

The distribution of quantitative releases to each reported medium is illustrated by Figs. 1 and 2. Releases to the air, POTW, and off-site transfers clearly dominate the total releases, accounting for 89% of the total releases. Releases to surface water, on-site land, and underground injection (UGI) comprise the remaining 11%.

The 1988 data presented represents reported releases from 1681 companies in 301 4-digit SIC codes on 173 different chemicals. At first glance this paints

a complex picture, but in reality the release patterns can be simplified considerably for analytical purposes by examining the data from other perspectives.

Tables 5, 6, and 7 have been included to illustrate the top 20 chemicals, SIC codes, and counties reporting chemical releases. These listings illustrate the major chemicals, SIC codes, and counties as reported, but this representation can be misleading because releases to all environmental media are combined. The complexity of the reporting picture is illustrated in Table 8, which lists the number of different companies, SIC codes, chemicals, and counties reporting releases by the environmental medium. When the releases to each medium are analyzed to identify the top 5 chemicals, SIC codes, and counties, however, the complex picture presented in Table 8 simplifies for all releases except air and off-site land. In fact, a large fraction of the quantity of chemicals released to each medium (except air and off-site land) is accounted for by two counties, two chemicals, and two SIC codes, as follows:

POTW (Fig. 3).

Counties: Los Angeles, Orange

TABLE 5

Releases, by chemical, in descending order—Chemical releases to all media were summarized and listed in descending order

Chemical	Pounds[a]
Ammonium sulfate	34,142,000
1,1,1-Trichloroethane	23,608,000
Aluminum oxide[b]	16,251,000
Ammonia	13,517,000
Methanol	12,432,000
Sodium hydroxide[c]	11,540,000
Chlorinated fluorocarbon (Freon 113)	7,599,000
Ammonium nitrate	7,110,000
Acetone	7,016,000
Methylene chloride	6,131,000
Toluene	5,684,000
Methyl ethyl ketone	5,295,000
Tetrachloroethylene	5,063,000
Hydrochloric acid	5,058,000
Xylene	4,788,000
Sulfuric acid	4,016,000
Glycol ethers	2,741,000
Nitric acid	2,503,000
n-Butyl alcohol	2,326,000
Copper compounds	2,133,000
All others (152 chemicals)	32,846,000
Total	211,799,000

[a]Rounded to nearest thousand.
[b]Delisted beginning with 1990 reporting year.
[c]Delisted beginning with 1989 reporting year.

TABLE 6

Releases, by SIC Code, in descending order—Releases to all media were summarized by 4-digit SIC Code and listed in descending order

SIC Code	Name	Pounds[a]
2819	Industrial inorganic chemicals	37,364,000
2911	Petroleum refining	22,083,000
2611	Pulp mills	11,132,000
2873	Nitrogenous fertilizers	9,049,000
3728	Aircraft parts and auxiliary equipment	7,479,000
3721	Aircraft	5,027,000
3711	Motor vehicles and passenger car bodies	5,011,000
3679	Electronic components	4,574,000
3411	Metal cans	4,263,000
3674	Semiconductors and related devices	4,140,000
3471	Electroplating, plating, etc.	4,121,000
2851	Paints, varnishes, etc.	3,872,000
3089	Plastics products	3,501,000
3341	Secondary smelting and refining of nonferrous metals	3,438,000
3321	Gray and ductile iron foundries	2,977,000
2821	Plastics materials, etc.	2,952,000
3761	Guided missiles and space vehicles	2,882,000
2879	Pesticides and agricultural chemicals	2,867,000
3429	Hardware	2,714,000
3316	Cold-rolled steel sheet, strip, and bars	2,566,000
	All others (287 SIC codes)	69,787,000
	Total	211,799,000

[a]Rounded to nearest thousand.

Chemicals: Ammonium sulfate, sodium hydroxide
SIC codes: 2819—industrial inorganic chemicals
2873—nitrogenous fertilizers

Surface water (Fig. 3)
Counties: Humboldt, San Bernardino
Chemicals: methanol, ammonia
SIC codes: 2611—pulp mills
2819—industrial inorganic chemicals

On-site land (Fig. 4)
Counties: San Bernardino, Alameda
Chemicals: ammonium nitrate, aluminum oxide

TABLE 7

Releases, by county, in descending order—Chemical releases for each county were summarized and listed in descending order

County	Pounds[a]
Los Angeles	96,113,000
Orange	26,853,000
San Bernandino	12,582,000
Contra Costa	10,985,000
Humboldt	10,822,000
Alameda	8,680,000
San Diego	8,496,000
Santa Clara	8,350,000
Riverside	3,147,000
Sacramento	3,065,000
Kern	2,635,000
San Joaquin	2,476,000
Fresno	1,906,000
Ventura	1,888,000
Solano	1,767,000
Placer	1,438,000
San Mateo	1,326,000
Merced	1,284,000
Inyo	1,018,000
San Francisco	891,000
All others (27 counties[b])	6,077,000
Total	211,799,000

[a]Rounded to nearest thousand.
[b]11 counties had no reported releases.

TABLE 8

Number of reporting types by release medium—The number of different companies, SIC codes, chemicals, and counties are listed for each release medium

Number	Air	Water	UGI	On-site Land	POTW	Off-site Land
Companies	1373	57	3	57	569	744
SIC Codes	283	33	2	42	160	208
Chemicals	152	59	10	47	109	129
Counties	45	18	2	25	31	35

SIC codes: 2819—industrial inorganic chemicals
3321—gray and ductile iron foundries

Underground injection (Fig. 4)
Counties: Kern

Chemicals: ammonia
SIC codes: 2911—petroleum refining

As illustrated by the pie charts in Figs. 3 and 4, the bulk of the transfers or releases to POTW, surface water, on-site land, and underground injection are accounted for by a surprisingly low number of chemicals, SIC codes, and counties. In contrast, releases to the air and transfers to off-site land present a more complex picture (Fig. 5). These variations by environmental medium must be considered when analyzing summary data across all environmental media, such as Tables 5–7. In these tables, individual chemicals, SIC codes or counties may represent primarily a release or transfer to only one environmental medium, which could lead to incorrect interpretations of the data. This is illustrated by Table 9, which lists the major chemical releases to air. This list is entirely different from the one presented in Table 5, which lists total releases to all media.

One further consideration in the analysis of SARA 313 data involves the transfer of chemicals to a POTW or offsite location. For geographic comparisons by county, the POTW data are probably accurate, since most POTWs will reside in the same county as the dischargers. Thus, the county in which the chemicals are actually released to the environment (*from* the POTW) is most likely the same as the county in which the chemicals are released *to* the

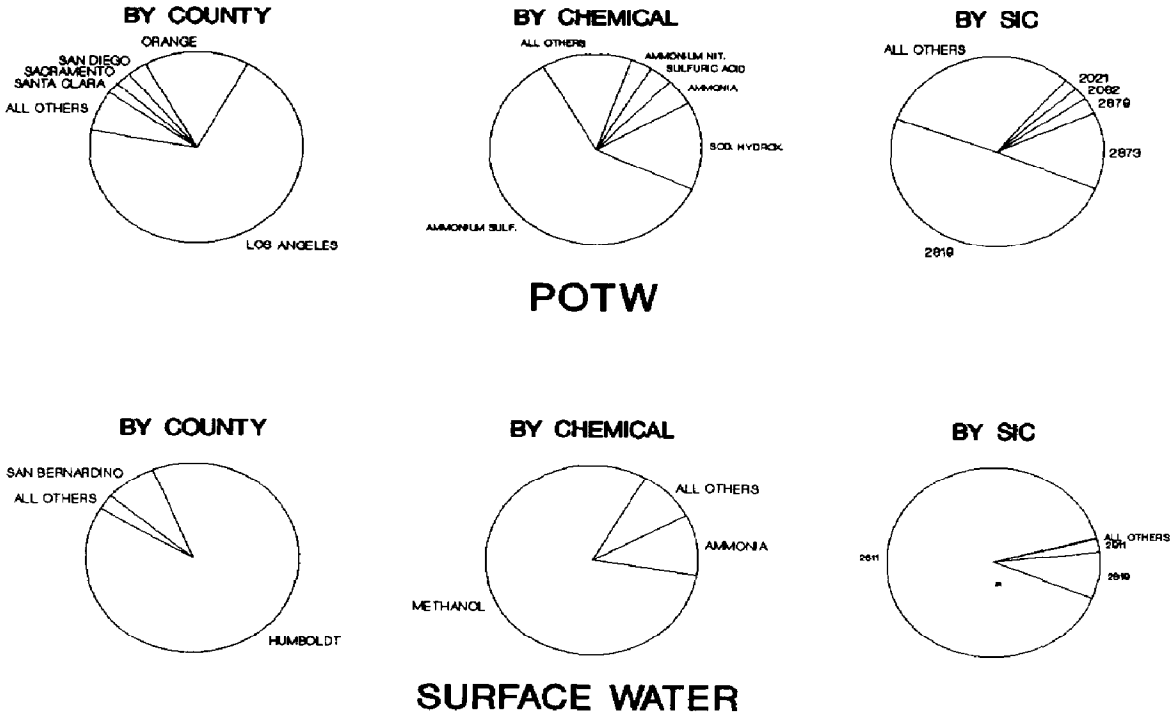

Fig. 3. Pie charts of releases to POTW and surface water. The top 5 counties, chemicals, and SIC codes are illustrated.

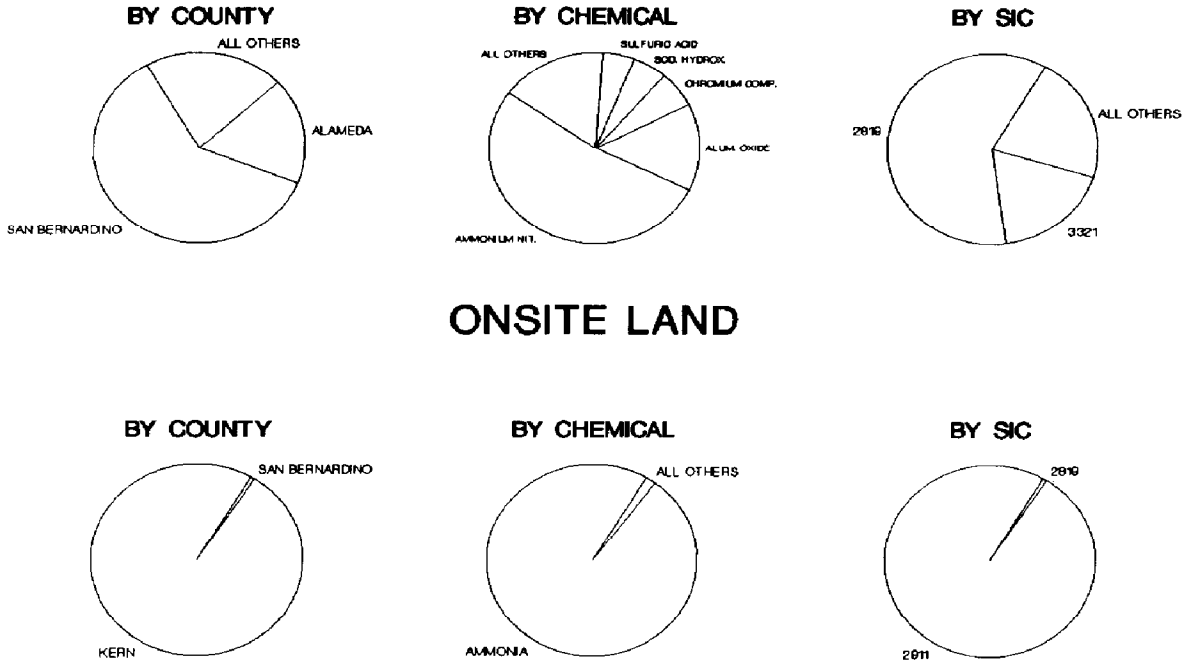

Fig. 4. As Fig. 3 for Onsite land and underground injection.

POTW. However, off-site transfers can easily cross county boundaries. Therefore, attention should also be given to the county containing the treatment, storage, disposal, or recycling facility which receives the waste. This is demonstrated by Fig. 6, which shows both the generating and receiving counties. The major counties receiving offsite transfers are very different from the counties shipping the chemicals. This result is readily explained by the fact that only a few off-site facilities exist in California.

Data quality

Data quality issues have been a major concern. These concerns fit into several categories.

Reporting universe

Unfortunately, no "master list" exists of companies which meet the reporting requirements. As a result, reporters are for the most part self-identified. With the cooperation of the California Employment Development Department, we have referenced the filing requirements in a business newsletter with wide distribution (7). Also, Region IX of the Environmental Protection Agency (EPA) has been actively pursuing enforcement actions against nonreporters. However, no comprehensive picture of percent compliance exists.

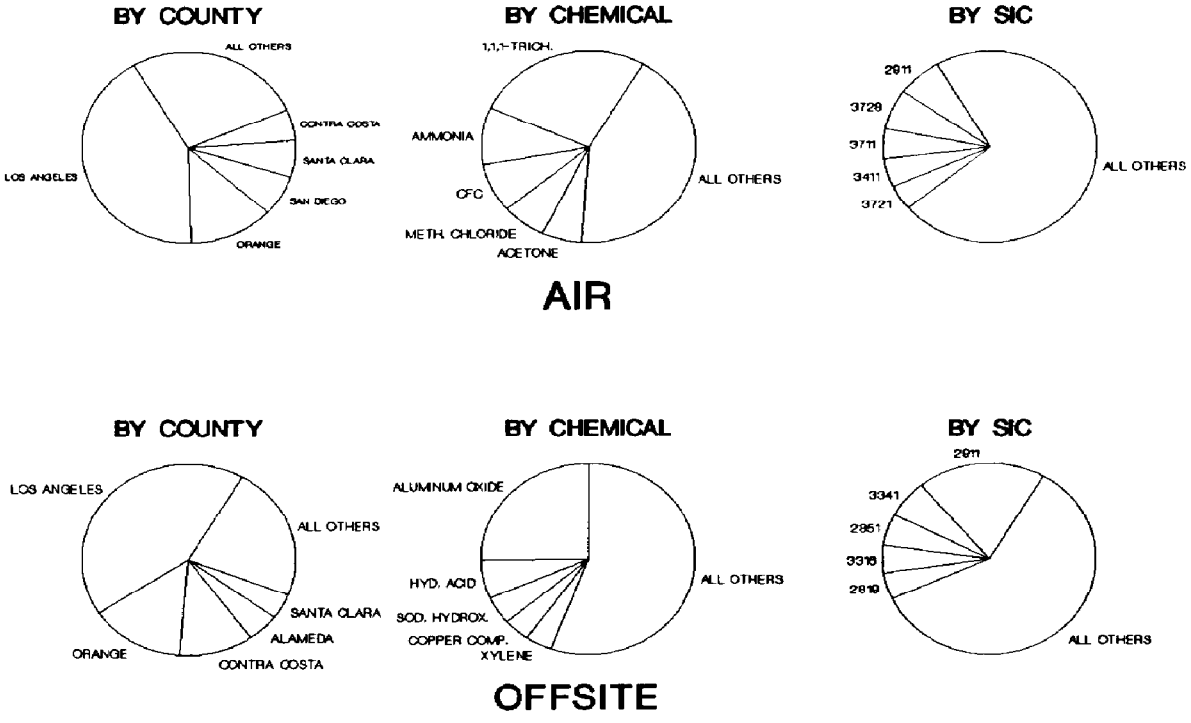

Fig. 5. As Fig. 3 for air and offsite.

Basis of estimates

One of the provisions of this legislation was that a company need not install new monitoring procedures to produce their estimates, and that mass balance, published emission factors, or "other approaches" could be used as the basis for the estimates. The public scrutiny given to the TRI data could lead to a more conservative approach regarding estimated releases.

Increased knowledge

Due to the fact that 1988 is the second year of reporting, some companies may be more knowledgeable about estimating chemical releases. This could result in large changes in volume estimates in both positive and negative directions.

Latitude–longitude

These spatial coordinates are required for the submittal of the 1988 form, and could be of potential use in geographic information systems. Although two pages of instructions as to how to derive latitude and longitude estimates are given with the reporting form, this can be a difficult calculation for inexperienced personnel. We have examined the spatial coordinates on a gross scale, and approximately 10% of companies reporting provided latitude and longi-

TABLE 9

Air releases, by chemical, in descending order—Chemical releases to air were summarized and listed in descending order

Chemical	Pounds	Percentage
1,1,1-Trichloroethane	21,866,576	26.6
Ammonia	7,922,497	9.6
Chlorinated fluorocarbon (Freon 113)	6,819,771	8.3
Methylene chloride	5,508,856	6.7
Acetone	4,874,538	5.9
Tetrachloroethylene	4,630,800	5.6
Toluene	3,756,221	4.6
Methyl ethyl ketone	3,378,913	4.1
Xylene	2,615,519	3.2
Methanol	2,387,030	2.9
Butyl alcohol	2,138,478	2.6
Glycol ethers	1,876,799	2.3
Styrene (monomer)	1,731,787	2.1
Aluminium oxide	1,531,203	1.9
Hydrochloric acid	1,095,167	1.3
All others	10,238,439	12.5

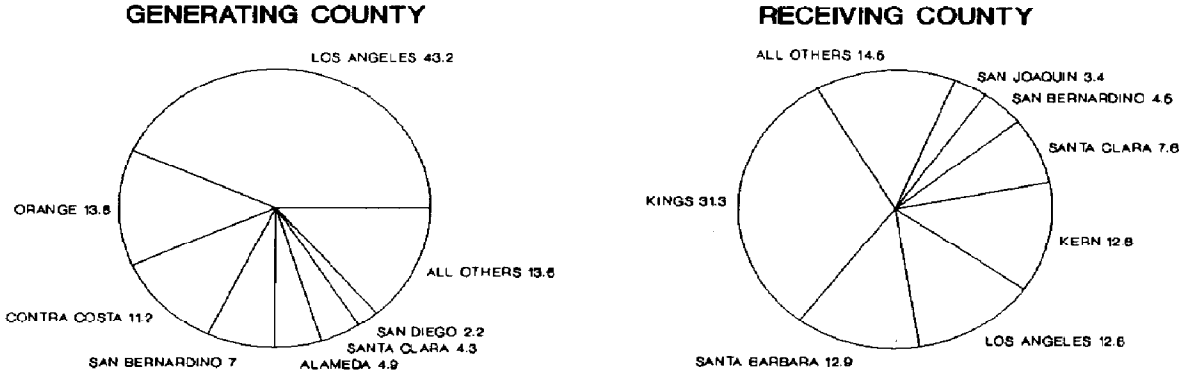

Fig. 6. Pie chart of off-site transfers by county—The distribution of off-site transfers by generating or receiving county is illustrated.

tude coordinates which represent locations outside of California. While all reporting facilities are physically located in California, the reporting of spatial coordinates placed some companies in the Pacific Ocean, Atlantic Ocean, North Africa, and even the Arctic!

Federal vs. state reporting

The federal law requires dual submittal of the TRI documents to both the federal and state governments. While this requirement was most likely in-

cluded in an effort to make the data more readily available, it is clearly a major flaw in the system design. With companies reporting to two different locations, both the universe of reporting facilities and the processing of document updates will inevitably be out of synchronization, ensuring discrepancies between federal and state data bases. Our first examination of this synchronization problem, in October of 1988, compared the federal and state lists of facilities reporting for 1987. We found that fully 30 percent of the companies reported either to California, or to the EPA, but not to both! After three different efforts to synchronize, in cooperation with the federal EPA, we have been able to ensure that for 1987 almost all companies have reported to both agencies. Results for the 1988 reporting year are not yet available.

Further evidence of this problem is shown in Table 10, which compares the results of a national report based on federal data [1] with data from state data bases maintained by California, from New York [8], and Illinois [9]. The federal reporting universe, in terms of number of facilities reporting, is 112 percent of New York's, 126 percent of Illinois's, and 94 percent of California's.

Further discrepancies arise when reported releases are compared. The overall totals are remarkably similar, with the federal data ranging from 102 to 107 percent of the states' totals. However, when the results are examined by medium of release, the federal data varies from 33 percent (New York, underground injection) to 150 percent (California, off-site land) of the states' totals. This suggests major discrepancies between state and federal versions of the data. We are currently pursuing investigations into reasons for these quantitative discrepancies in California. At least a portion of the discrepancies may

TABLE 10

Federal versus state reporting, 1987—Reported releases from state and federal versions of 1987 TRI data bases are listed from New York, Illinois, and California. The percent shown in each case represents the federal release amount divided by the state release amount

	Reported releases (Pounds in millions)							Number of Facilities
	Air	Surface	POTW	On-site	UGI	Off-site	Total	
New York	87.6	54.0	78.8	15.6	1,499	84.4	320.5	683
Federal	89.4	56.1	65.3	17.6	500	97.6	326.1	765
Percent	102	104	83	113	33	116	102	112
Illinois	92.7	33.1	184.4	13.4	14.2	102.0	439.9	938
Federal	99.2	33.4	199.1	11.2	14.2	111.6	468.8	1,185
Percent	107	101	108	84	100	109	107	126
California[a]	80.7	3,821.1	203.5	36.3	1,529.4	65.0	5,736.0	1,768
Federal	82.7	3,834.8	246.1	47.7	1,530.9	97.6	5,839.8	1,662
Percent	102	100	121	131	100	150	102	94

[a]Unlike previous tables, this listing includes sodium sulfate because the release volume could not be readily subtracted from the federal data.

be due to the lack of synchronization of companies reporting to both state and federal governments, as previously discussed.

Lessons learned

Uses of the data

The TRI information represents the first unified reporting of hazardous materials releases to multiple environmental media. While this does not give a complete picture of environmental releases, due to the SIC code and business size limitations, the data is an excellent first step towards a complete quantitative picture of chemical releases to the environment.

The role of the State Environmental Affairs Agency is the collection, maintenance, and dissemination of the data, with enforcement actions remaining a federal responsibility. We have presented summaries of the data at a professional meeting [2] and the data have been used for several reports prepared by environmental organizations [3–6], as well as many news articles. We have received almost 700 requests for the data in various forms, as shown in Table 11. The SARA 313 reporting requirement was implemented to meet "right-to-know" needs, and most public reports and news articles based upon the data do indeed fit into that category [3–6].

Systems design

The following are not new concepts, but rather are data processing fundamentals reaffirmed by the SARA 313 process:

(1) *Dual submittal.* The submittal of forms to both the state and federal governments results in the creation of separate data bases which will rarely be in synchronization.

(2) *Lack of report definition.* During systems development, the products produced should be defined prior to developing the reporting forms, ensuring that necessary data, and only necessary data, are collected. For example, prior iden-

TABLE 11

California TRI information requests—Information requests were broken down by various types and various sources of organizations requesting the data

Request type	Count	Requesting source	Count
Geographic area	258	Government	246
Single company	167	Business sector	201
Chemical	94	Environmental groups	107
Industry group	27	News media	62
Other	137	Other	67
Total	683	Total	683

tification of uses of the data could have identified the need for peak-release information, which is now being considered for the fourth year of data collection. Also, because the SARA 313 forms were designed for right-to-know purposes without pre-defined products, much effort is currently directed toward finding uses for the data.

Automation

The automation of the right-to-know process was cost-effective and relatively inexpensive in both staffing and equipment costs. Most requests for information relate to the data, not the forms, and can be satisfied by computer-generated reports.

Public impact

The issues about data quality have been discussed earlier. However, a major positive impact on data quality has occurred due to public scrutiny of the data. Companies have revised reports on the basis of newspaper stories discussing chemical releases. This gives the public a role in the quality assurance process, and should enhance the data quality.

Quantitative chemical releases

Analysis of quantitative chemical releases must be performed with caution, because medium-specific releases can be explained by releases from only a few companies. Large magnitude releases by single companies can skew data for SIC codes and counties and cause misinterpretation of the data.

Risk

One of the driving forces behind public scrutiny of SARA 313 data is the identification of risk. However, this is difficult to determine for many reasons, including no information on actual exposure, as no ranking of relative risk of the chemicals, no peak release information, and dependence of risk upon the medium of release.

Summary and conclusions

The total volume of hazardous materials releases has dropped slightly from 1987 to 1988. Much of the over 200 million pounds released involves a relatively small number of chemicals, companies, and SIC Codes.

The TRI data have proven to be an excellent first step towards the attainment of comprehensive quantitative information on chemical releases to all environmental media.

Although these data are collected only from selected SIC Codes, the existing reporting universe is ill-defined, and some data quality and synchronization problems exist, the numbers can nevertheless be used as minimum levels for

planning purposes. This serves to provide a baseline derived from detailed reporting rather than from mere conjecture.

Acknowledgements

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