**Mary Kay O'Connor Process Safety Center**

# Feasibility of Using Federal Incident Databases to Measure and Improve Chemical Safety

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The Mary Kay O'Connor Process Safety Center was established in 1995 with a goal to improve chemical safety in the chemical process industries. The Center is associated with the Texas Engineering Experiment Station, of The Texas A&M University System, Chemical Engineering Division.

The Center provides a uniquely neutral forum to address chemical process safety for all stakeholders, industry, government, labor, and the general public.

This document represents the collective work of the Mary Kay O'Connor Process Safety Center researchers and staff in support of the National Chemical Safety goals. The ongoing research efforts of the Center will be presented in similar documents as work is continued. Each research document serves as an individual step in achieving the national safety goals. These documents will be included in an overarching document pertaining to chemical safety in the United States.

The research presented in this report was conducted by the Mary Kay O'Connor Process Safety Center. The opinions and analysis expressed in this report are solely the responsibility of the Mary Kay O'Connor Process Safety Center.

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## 1.0 Introduction

Many federal agencies gather information about the chemical industry. Under statutory mandate, the agencies gather data on releases of chemicals, and on injuries, illnesses, and fatalities caused by chemicals. These federal databases, some of which have received information for over three decades, may provide the information needed to develop trends of chemical-related incidents. However, despite the magnitude of data available, chemical industry stakeholders cannot answer the question, "How do we assess chemical safety in the United States?"

In 1995, the U.S. Environmental Protection Agency (EPA) stated in its *Users Guide to Federal Accidental Release Database*s, "The existence of many different (and often incompatible) federal databases makes it difficult to develop a national picture of the problem of accidental releases." EPA also determined federal databases do not provide comparable data sets. This lack of standardization has inhibited data interpretation, comparative analysis, and cross agency use of accident data to make workplaces and communities safer.

The Mary Kay O'Connor Process Safety Center (Center) conducted a review of seven federal databases to determine which information would be useful for analyzing chemical incidents and establishing indicators on the status of chemical safety in the United States.

Specifically, with this report, the Center reviewed federal databases to determine:

- The strengths and weaknesses of the databases for the purposes of creating chemical safety metrics;
- The type of vetting process that must be used to produce accurate data;
- Which information in a specific federal database can provide the means to establish a baseline measurement of chemical safety;
- What other types of information can be gathered about chemical safety from the databases (e.g., causes and consequences); and
- Ways to improve the databases and the ability to measure chemical safety.

The Center identified the following federal databases that provide the information needed to establish a measurement of chemical safety at fixed facilities:

- National Response Center (NRC) Incident Reporting Information System (IRIS);
- EPA Risk Management Program (RMP) 5-year Accident History Database;
- EPA Accidental Release Information Program (ARIP) Database;
- Bureau of Labor Statistics (BLS) Databases for the U.S. Occupational Safety and Health Administration (OSHA);
- U.S. Centers for Disease Control and Prevention (CDC) Wide-ranging On-line Data for Epidemiological Reporting (WONDER); and
- U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry (ASTDR) Hazardous Substances Emergency Events Surveillance (HSEES) Database.

## 2.0 Background and the National Chemical Safety Program

The Center undertook this review of databases as part of the National Chemical Safety Program (NCSP). This effort drew on the expertise and advice from a Roundtable, composed of a diverse group of stakeholders involved in chemical safety. The Roundtable established the following national goals for chemical safety:

- **Chemical incidents are zero;**
- **Chemical enterprises have earned the public's trust; and**
- **Public, government, and facility interactions improve safety and reduce risk.**

Members of the Roundtable recognize that attaining the national goals is a long-term proposition and therefore should not establish a timetable for achievement. All stakeholders should remember it is important to show progress towards the goal, rather than to focus solely on an absolute standard. To show progress, an accurate measurement of chemical safety in the United States must first be determined to provide a benchmark against which to measure progress. While a clear understanding of the current state of chemical safety is being established, the stakeholders should work to achieve the national safety goals.

At the 1999 Roundtable meeting, the stakeholders provided the Center with a preliminary discussion of chemical safety indicators that could measure the status of chemical safety and, specifically, the movement toward the vision of "chemical incidents are zero." The potential measures and indicators were identified as:

- Trends in total number of incidents;
- Trends in the number of facilities reporting incidents, including the percent of reporting facilities;
- Trends in publicizing near-misses;
- Trends in the use of safety culture building programs; and
- Trends in the level of effort to install prevention programs.

For the "trends in total number of incidents," the Roundtable recommended that an incident report should include the following criteria and characteristics:

- The appropriate items from the definition of an incident;
- Quantities released;
- Severity of consequences;
- Ownership; and
- The type of information required in various reports submitted to government agencies.

These measures and indicators were the starting point for this report in assessing the federal databases for useful information that may provide measurements. The Center is conducting subsequent analysis to determine which indicators will provide the most valuable data. This analysis will be presented in a future report.

## 3.0 Definitions

In its 1995 *Users Guide to Federal Accidental Release Database*s, EPA states, "Each regulatory agency charged with controlling hazardous material has developed at least one accident reporting system or database to accommodate its specific accidental release notification requirements and data needs. Consequently, the databases reflect different statutory definitions and terms (e.g., spill, release, accident, incident), different chemical lists, and different impact concerns (e.g., death)."

Prior to the review of federal databases, the Center established specific criteria and limitations in its scope of work to establish information specification priorities. This section provides the required definitions, reasoning, and limitations needed to analyze the databases to determine the status of industrial chemical safety in the United States.

The Center established its own definitions to arrive at the most consistent and inclusive definition for several key terms, such as incident and hazardous substance.

***Chemical safety*** is defined as:

> **The management principles and systems applied to the identification, understanding, and control of hazards involved in the manufacture or use of chemicals to prevent injuries and incidents.**

A ***fixed facility*** is defined as:

> **Any building, structure, piece of equipment, or installation involved in the manufacture or use of a hazardous substance that is located at one location or belongs to the same industrial group or under the control of a one person from which an incident could occur.**

A ***chemical incident*** is defined as:

> **The sudden unintended release of or exposure to a hazardous substance that results in or might reasonably have resulted in, deaths, injuries, significant property or environmental damage, evacuation or sheltering-in-place.**

A ***hazardous substance*** is defined as:

> **Any chemical, including a petroleum product, that is toxic, reactive, flammable, asphyxiating, or that presents a potential hazard to people, the environment, or property because of pressure or temperature.**

These definitions utilize common elements from across several federal agencies, including: the EPA Chemical Emergency Preparedness and Prevention Office; OSHA; U.S. Chemical Safety and Hazard Investigation Board; U.S. Coast Guard; the U.S. Department of Transportation (DOT) Office of Hazardous Materials; the DOT Office of Pipeline Safety; the U.S. Department of Interior Minerals Management Service; the U.S. Department of Health and Human Services ATSDR; U.S. Bureau of Alcohol, Tobacco and Firearms; U.S. Mine Safety and Health Administration; and the National Response Center.

However, this report analyzes many data sources that employ other criteria in the definition of "incident." Where possible the records are filtered to meet the Center's definition. In other cases, this was not entirely possible and the information was used in an "as is" form.

Incidents involving the manufacture, processing, packaging, storage, transportation, distribution, and commercial use of hazardous substances are included in the Center's definition. The emphasis in this report is on fixed facilities. Consumer products, drugs, alcoholic beverages, biological agents, radioactive materials, and vehicle fuel are excluded from this report.

## 3.1 Inclusions and Exclusions of Incidents

The definition of an incident adopted in this report is intended to be broad enough to include all significant acute incidents involving hazardous substances in commercial settings.

However, there are several reasons to limit the definition to exclude incidents with a very low probability of causing harm. The number of incidents could be endless if limitations on the types of chemicals and quantities released are not employed. In addition, to fully understand incidents, reliable data about each incident, its cause, and effects must be fully documented.

For example, the U.S. Coast Guard's data on oil spills provide a lesson on the trade off between the number of incidents and their significance. In 1998, the U.S. Coast Guard recorded 8,315 spills, of which 7,962 (95.8 percent) were less than 100 gallons. Only 353 spills were greater than 100 gallons. Yet, these 353 spills accounted for 95.7 percent of the total volume of oil spilled. For the 7,962 spills that were less than 100 gallons, the median spill size was one gallon.

Setting limits for other chemicals is far more difficult due to wide variations in volatility, reactivity, flammability, and toxicity. For many substances, release quantities of one to 10 pounds may cause significant harm (e.g., hydroflouric acid).

In an attempt to gather the most valuable data and limit incidents with a very low probability of causing harm or are not directly related to the purposes of this report, the Center has compiled a list of incidents that will be included and excluded.

For the purposes of the report, incidents that will be ***included*** for fixed facilities are:

- Incidents that involve primarily legal activities, even if laws are violated during the activity;
- Fires and explosions involving portable liquid propane gas (LPG) tanks, if they involve a failure of the tank or integral valves;
- Drowning in water, if chemicals are the initiating cause;
- Incidents on offshore platforms in U.S. waters are included if they involve oil and gas processing;
- Incidents at government facilities;
- Hazardous waste sites;
- Fires in warehouses that contain chemicals, if the chemicals are involved in the fire or lead to evacuations or sheltering-in-place, even if the cause of the fire was not related to the chemicals;
- Sheens of oil on water, if the spill is large with known consequences or causes;
- Spills of "small" quantities of low hazard materials, such as ambient temperature and pressure hydraulic fluid, lubricants, heat transfer fluids, and antifreeze, only if there are known consequences; and
- Explosions of blasting materials and pyrotechnics during their manufacture, storage, and transportation.

In an attempt to limit the number of incidents with a low probability of causing harm or are not directly related to industrial chemical safety, the incidents that will be ***excluded*** for fixed facilities are:

- Inherently illegal activities such as illicit drug manufacturing, arson, terrorism, theft, and intentional illegal dumping of chemicals;
- Residential fires caused by natural gas, LPG distribution systems, or gas appliances;
- Fires and explosions involving LPG tanks that involve appliances and supply hoses;
- Spills of vehicle fuel and vehicle fires;
- Drug overdoses and drug poisonings;
- Intentional inhalation of chemicals (i.e., huffing);
- Poisoning due to carbon monoxide as a result of poor combustion in a residence or from a vehicle;
- Incidents at private residences involving consumer products used by the occupants;
- Mine fires and explosions involving naturally occurring gases;
- Blowouts resulting from natural pressure in an oil or gas field;
- Incidents involving radioactive materials, unless a chemical reaction caused or significantly contributed to the incident;
- Sheens of oil on water, if the source, quantity, or effects are unknown;
- Spills of "small" quantities of low hazard materials such as ambient temperature and pressure hydraulic fluid, lubricants, heat transfer fluids, and antifreeze, unless there are known consequences; and
- Damage and injuries resulting from the intentional detonation of blasting materials and pyrotechnics.

## 4.0 Review of Federal Databases

The Center conducted a thorough analysis of many existing federal databases that accept information on chemical incidents. As shown in Table 1, seven federal databases were analyzed because they provided the best publicly-available information that could be used to establish metrics of chemical safety at fixed facilities. This section provides an overview of the information captured by federal databases including:

- Covered universe, which explains what type of facilities must report and what regulation mandates the gathering of the data;
- Time period during which information has been collected;
- Collection method, which explains how the agency gathers the required information;
- Principal data elements of the database, that provide a brief description of the type of data found in the database;
- Strengths of the database; and
- Weaknesses of the database.

***Table 1: Available Federal Databases***

| Agency | Databases |
|---|---|
| U.S. Environmental Protection Agency | • **Risk Management Program (RMP) 5-year Accident History**<br>• **Accidental Release Information Program (ARIP)** |
| Centers for Disease Control and Prevention (CDC) | • **Wide-ranging On-line Data for Epidemiological Reporting (WONDER)** |
| Occupation Safety and Health Administration (OSHA) | • **Occupational Injury and Illness (OII)**<br>• **Census of Fatal Occupational Injuries (CFOI)** |
| National Response Center (NRC) | • **Incident Reporting Information System (IRIS)** |
| Agency for Toxic Substances and Disease Registry (ATSDR) | • **Hazardous Substances Emergency Events Surveillance (HSEES)** |

After each database discussion is a description of the vetting process that the Center conducted to extract useful data. This section is followed by examples of results that the data can produce. The strengths and weaknesses that each database provides is discussed in relation to the Center's objective for the NCSP.

## 4.1 Incident Reporting Information System (IRIS) Database

***Covered Universe***

IRIS contains data on reported releases from fixed facilities, marine/offshore facilities, pipelines, and transportation vehicles. Many federal statutes require reporting of releases to the National Response Center (NRC).

Oil spills are reported under:

- Section 311(b) of the Federal Water Pollution Control Act of 1973;
- Section 306(a) of the Outer Shelf Lands Act Amendments of 1978; and
- Section 18(b) of the Deepwater Ports Act of 1974.

Chemical spills are reported under:

- Section 302 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980;
- Section 304 of the Emergency Planning and Community Right-to-Know Act of 1986; and
- Federal Hazardous Materials Transportation Laws.

Pipeline spills are reported under the Hazardous Liquid Pipeline Safety Act.

Air releases are reported under:

- Clean Air Act;
- Toxic Substances Control Act;
- Federal Hazardous Materials Transportation Laws; and
- Resource Conservation and Recovery Act.

***Time Period***

1990-1999

***Collection Method***

This database is used primarily for emergency response notification and is operated 24 hours a day, 7 days a week. The initial notification of a release is usually by telephone. These reports are comprised of mostly short answer questions.

***Principal Data Elements***

The database contains data on oil, chemical, biological, and etiological discharges into the environment anywhere in the United States or its territories. The NRC collects information nationally on reports of hazardous material releases as well as releases of hazardous substances and oil from fixed facility and transportation incidents.

Two files, INCRPT and MATRPT, compose the IRIS database. The INCRPT file contains information about the location of the release, the company owner of the facility (when it applies), a short description of the incident, and the information related to the consequences (affected medium, fatalities, injuries, evacuations, cost of damages) of the incident. No information regarding the

| | |
|---|---|
| | released substance is reported in this file. The MATRPT file contains the information related to the chemical substance(s) involved in the incident (name of the substance, CHRIS code, and quantity and phase of the released chemical). |
| ***Strengths*** | NRC handles approximately 30,000 telephone calls each year, of which approximately 25,000 are unique incidents. Coverage of such a large number of incidents provides a basis for statistical analysis to capture meaningful national trends. |
| ***Weaknesses*** | While reporting to the NRC is required by a number of statutes, it also receives numerous "complaints" from the public.<br><br>The NRC also collects in the same database non-chemical related events such as railroad crossing accidents. Also, both actual and potential releases may be reported to IRIS.<br><br>Many of the reported incidents are spills of fuel from motor vehicles and small spills of low hazard materials such as lubricating oil and oil sheens on water with unknown sources, quantities, and effects.<br><br>Because this system contains initial reports, the information is preliminary and many times inaccurate or incomplete. There also is duplicate reporting of incidents.<br><br>The completeness and accuracy of chemical names depends on the knowledge level of the person reporting the incident. |

### 4.1.1 Vetting Process and Results

To determine which information in the IRIS database would be useful for the purposes of analyzing the status of chemical safety at fixed facilities, the Center:

- Eliminated records related to substances that were not considered hazardous chemicals;
- Identified and removed internal repeated records; and
- Developed queries to identify the number of accidents and their main consequences according to the type of accident (fixed facility or transportation) and the affected medium.

As mentioned above, two files, INCRPT and MATRPT, compose the IRIS database. The Center downloaded data for 1998. The total number of records present in INCRPT and MATRPT files were 28,573 and 28,367, respectively. A preliminary search of internally repeated records was performed on the INCRPT file, and 36 records were deleted.

***Step 1: Eliminate records related to substances that are not considered hazardous chemicals.*** As discussed previously, NRC collects initial notification of incidents, and anybody can report spills or incidents. Thus, some of the records included in this database are related to releases that are not chemical incidents.

By using key words in a file search, the Center identified and deleted reports that did not meet the Center's definition of an incident to avoid a bias in the analysis. A total of 2,081 MATRPT and 4,217 INCRPT records were deleted in this step.

***Step 2: Identify and remove internal repeated records.*** The reports received by the NRC are entered in the database as incident reports. Since one single incident can be reported by many different people, several reports with different record numbers can be generated for the same event. In order to avoid inflated results by counting one event multiple times, the Center performed queries to identify and eliminate multiple reports. This step represents the most difficult part of the procedure because of problems associated with the reporting system, for example:

- Because NRC collects initial reports on chemical incidents, sometimes the reported information is incomplete or incorrect based on the personal perception of the person reporting the incident;
- Sometimes the exact location and address of the event is reported in different ways;
- Sometimes the exact time of occurrence of the event can vary according to the person reporting the incident;
- The name of the chemical substance can be reported by chemical name, trade name, or common name according to the knowledge and information available to the person reporting the event; and
- Spelling errors of addresses and chemical names also are common within the database.

As a result, the Center performed several queries to explore a combination of aspects to detect the repeated records. Each query was designed to search for records with a specific combination of information in the listed fields. The retrieved records were possible duplicated records that were manually analyzed to decide if they were duplicates. In this process, if an incident was evidently repeated, the record with more incomplete information was deleted. When there was uncertainty and it was not possible to clearly identify the repetition (i.e.; lack of data), no records where deleted. A total of 208 records were identified as repeated and deleted. At the end of this step, the number of records for INCRPT and MATRPT were 23,648 and 25,639, respectively.

***Step 3: Queries and Results.*** With the vetting completed, the Center took the remaining files in the INCRPT and MATRPT and performed queries to test whether the data could provide the beginnings of a baseline measurement of incidents in 1998. As shown in Table 2, the results of the queries provided information about the number of incidents, number of deaths, and number of injuries for spills originated by fixed facilities.

***Table 2: Incidents, Fatalities, and Injuries at Fixed Facilities***

***Source: NRC IRIS (1998)***

| | Incidents | Fatalities | Injuries |
|---|---|---|---|
| **Petroleum Products** | | | |
| • Events on Land | 1858 | 23 | 57 |
| • Events on Water | 348 | 0 | 5 |
| **Non-Petroleum Products** | | | |
| • Events on Land | 4,439 | 4 | 554 |
| • Events on Water | 711 | 0 | 27 |
| **Total** | **7,356** | **27** | **643** |

The number of events is obtained from the INCRPT file (the same event is counted once even if the incident involves a spill of multiple substances). The reports with deaths and/or injuries were analyzed individually to

detect fatalities and injuries caused only by the chemical substances. This was done by analysis of the Incident Description field and they were used to obtain the reported numbers only when the fatalities or injuries were clearly caused by the chemical substance and not by the dynamics of the event.

### 4.1.2 Functionality of the Database for NCSP Purposes

***Strengths for the Center's purposes.*** The Center contends that the data provide an indication of the total number of incidents involving petroleum and non-petroleum products discharged into navigable waterways or onto land.

***Weaknesses for the Center's purposes.*** Because this system contains initial reports, the information is preliminary and many times inaccurate or incomplete. Statistical analysis of the consequences of these releases is generally not justified due to the preliminary nature of the information. From comparison of the incident counts in various databases, the Center determined that notifications to the NRC are not being made in many cases.

## 4.2 RMP 5-year Accident History Database

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| ***Covered Universe*** | RMP-covered facilities that have released a listed substance, which is stored above a threshold quantity and results in fatalities, injuries, or significant environmental or property damage, are required to report 5-year accident histories. |
| ***Time Period*** | 1994-1999 |
| ***Collection Method*** | 5-year Accident History Report |
| ***Principal Data Elements*** | The database contains information on RMP-covered facilities that meet the reporting criteria listed in the "Covered Universe." The facility must provide EPA with the following information:<br>• Date, time, and approximate duration of the release;<br>• Chemical(s) released;<br>• Estimated quantity released in pounds;<br>• Type of release event and its source;<br>• Weather conditions, if known;<br>• Onsite impacts;<br>• Known off-site impacts;<br>• Initiating event and contributing factors, if known;<br>• Whether off-site responders were notified, if known; and<br>• Operational or process changes that resulted from investigation of the release. |
| ***Strengths*** | The reporting is from a well-defined universe of facilities, and it allows statistical treatment of the frequency of releases per facility or process unit that is not available from other systems. The reports do address such items as the causes and consequences of the release and steps taken to prevent or mitigate future incidents. |

***Weaknesses***

Future data from EPA's 5-year Accident History Database may provide more information to determine statistically significant trends and the effects of implementing the EPA RMP Rule and OSHA Process Safety Management (PSM) Standard for Highly Hazardous Chemicals, which were promulgated to improve safety in the chemical industry.

The database is limited to RMP-covered facilities that have experienced an incident with a consequence involving a listed chemical stored above its threshold quantity. The reporting criteria exclude a large number of incidents. As a result, only 1,900 releases are reported from about 14,500 facilities for the 5-year period. Of the 1,900 releases, only 1,500 were required to be reported, because 400 of the incidents were without consequences. The RMP data are currently only available in 5-year cycles beginning in 1994.

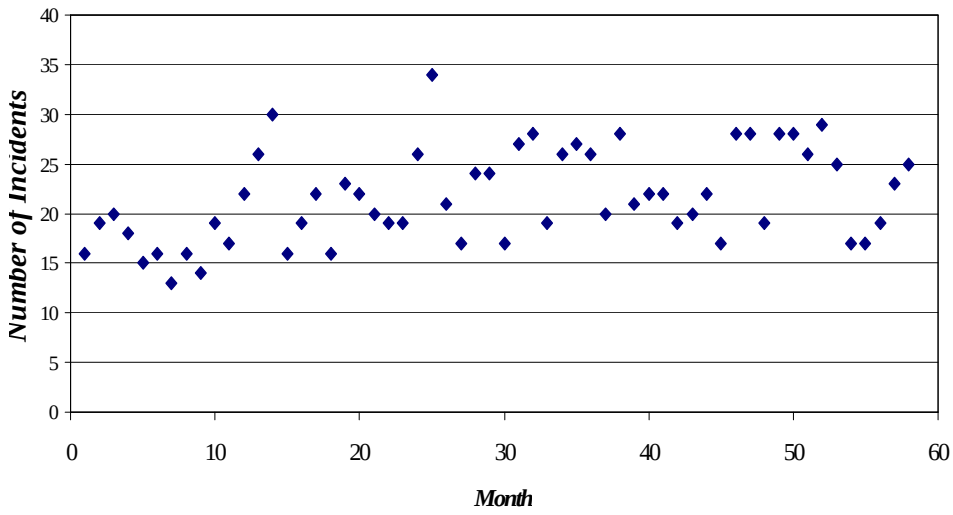
By limiting reporting to cases with consequences, much information is lost about releases without consequences. Releases without consequences or near misses provide valuable information on how to prevent incidents and the ability to predict consequences.

There may be corrections and revisions to RMP*Info at any time through submission by a facility of a corrected RMP. It is critical in performing analysis to report the date of the last revision and any notable modifications to the data.

## 4.2.1 Vetting Process and Results

The Center did not face vetting challenges with the RMP 5-year Accident History database, because "incidents" in the database met the Center's definition criteria. However, the Center did review "Accident Epidemiology and the U.S. Chemical Industry: Preliminary Results from RMP*Info," prepared by Paul Kleindorfer, Harold Feldman, and Robert Lowe of the Wharton School, which presented the statistical analysis used to identify questionable data in the RMP*Info by examining incidents with unusually large or small values of critical data. The 5-year Accident History database is part of the RMP*Info database. The Center eliminated the erroneously reported fatalities as documented in the Wharton report.

***Figure 1: Number of Incidents Required to be Reported - by Month***
***Source: RMP 5-Year Accident History (1994-1999)***




Because of the limited time frame and relatively small scope of the covered universe, any initial trending may not be statistically significant. For example, Figure 1 shows a scatter diagram of the number of incidents per month over the five year reporting period. Variations may be the result of random chance rather than the impact of regulation. The data do not provide clear trending information for the Center's purposes of establishing a benchmark measure.

However, the diversity of the variables in the RMP 5-year Accident History database do provide the Center the opportunity to analyze data not found in other federal databases. For example, Figure 2 shows the consequences of a release as a function of the number of full-time employees (FTEs).

In addition, the Center's review of the RMP 5-year Accident History database provided an analysis, shown in Figure 3, of the number of incidents along with their corresponding quantity released and the consequences.

***Figure 2: Release Consequences by Full Time Employees***
***Source: EPA RMP 5-Year Accident History (1994-1999)***

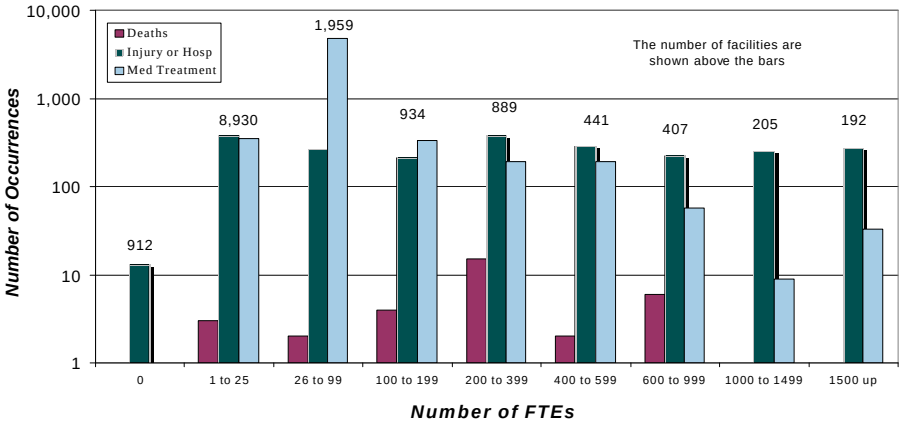
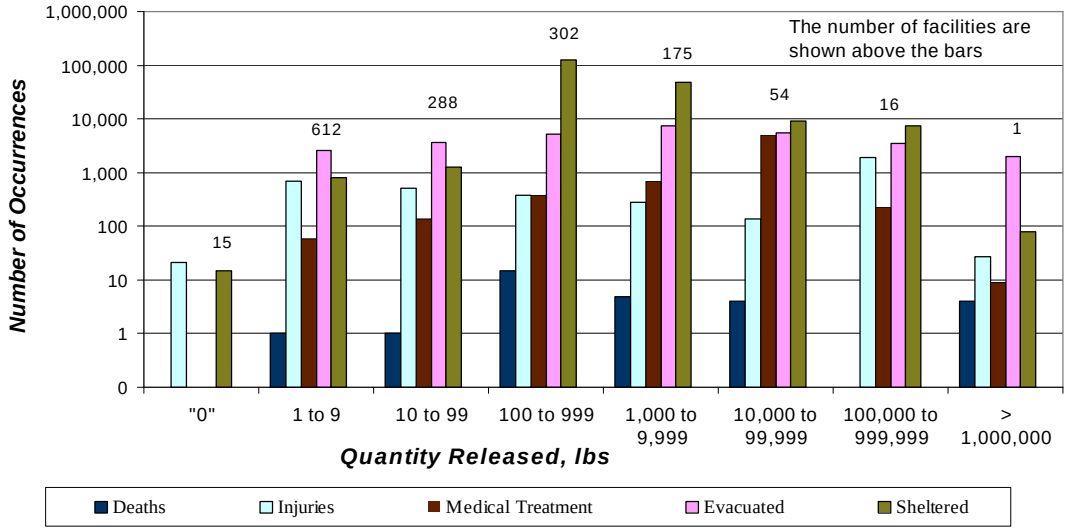



***Figure 3: Quantity Released and Consequences - All Chemicals***
***Source: EPA RMP 5-Year Accident History (1994-1999)***




## 4.2.2 Functionality of the Database for NCSP Purposes

***Strengths for the Center's purposes.*** This database represents a large and potentially useful source of information, which could be used for risk reduction efforts because of the diversity of the data variables.

***Weaknesses for the Center's purposes.*** Because of the specificity of the requirements, the reported incidents in the RMP 5-year Accident History database may be many fewer than the actual incidents, that may be of interest for analysis. The information available also may not be statistically significant because of the relatively short period of time and variability of the number of incidents from month to month.

Also, because the two primary programs intended to improve chemical safety, the RMP Rule and the OSHA PSM standard, were implemented during the period covered by the database, the Center may not be able to

ascertain the effects of these regulations using the RMP 5-Year Accident History database. The RMP Rule went into effect in June 1996 and compliance was required by June 1999. While the incidents reported in the EPA 5-year Accident History database begin in 1994, the OSHA PSM standard went into effect in May 1992 and complete compliance was required by May 1997.

## 4.3 Accidental Release Information Program (ARIP) Database

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|---|---|
| ***Covered Universe*** | Facilities were asked by EPA to provide information to the ARIP database if the facility reported an incident to the EPA Emergency Response Notification System and the release event met one or more of the following criteria:<br>• The release resulted in a death or injury;<br>• The release involved 1,000 pounds or more of a hazardous substance with a reportable quantity of 1, 10, or 100 pounds, or the release involved 10,000 pounds or more of a hazardous substance with a reportable quantity of 1,000 to 5,000 pounds;<br>• The release was the fourth through tenth release in a 12-month period; or<br>• The release involved an extremely hazardous substance from Section 302 of Emergency Planning and Community Right-to-Know Act.<br><br>EPA was authorized to gather this information under:<br>• Section 3007(a) of the Resource Conservation and Recovery Act;<br>• Section104(b)(1) and (e) of CERCLA;<br>• Section 308(a) of the Clean Water Act; and<br>• Section 114 of the amended Clean Air Act. |
| ***Time Period*** | 1986-1992 |
| ***Collection Method*** | Facilities were requested to complete a questionnaire with 23 questions. |
| ***Principal Data Elements*** | The ARIP database was developed by EPA in 1986 to determine the causes of accidental chemical releases, to identify the steps that could be taken by industrial facilities to prevent releases, and to outline industry prevention practices.<br><br>The facilities were asked to provide information about the facility, the listed chemical, the circumstances and causes of the incident, the accidental release prevention practices and technologies in place prior to the event, and any additions or changes made to these technologies and practices as a result of the event. The questionnaire focuses on several areas of accident prevention including hazard assessments, training, emergency response, public notification procedures, mitigation techniques, and prevention equipment and controls. |
| ***Strengths*** | ARIP is one of the larger collections of incidents with details concerning causes, consequences, operating mode, and corrective actions. ARIP has collected over 4,800 release records since it inception. |

The data are considered accurate because the data are provided directly by facilities several months after the release when most information should be known. This system provides detailed information about causes and prevention practices not available in most other systems.

***Weaknesses***

This program is discontinued. No trends with time can be gathered. The chemicals reported are the ones reported to EPA under existing statutes and regulations, which tend to exclude gasoline, methane, ethane, propane, and other chemicals, some of which are included in the EPA 5-year Accident History database.

In September 1993, EPA took steps to streamline the database by including only releases with significant offsite consequences, such as casualties, evacuations, sheltering-in-place, or any other necessary precautions taken by individuals off-site as a result of a release. In addition, the questionnaire for the database has been revised over time so that some information was added and other information was deleted. Thus, analysis on some data fields cannot be performed on the entire database.

In addition, the short description of the incident is not contained in the database and must be analyzed in the hard copy of the questionnaire. The collection of ARIP data was dependent on the sometimes uneven collection efforts of the EPA regions; therefore, the data do not truly represent the geographical distribution of releases, nor do they reflect release trends over time.

### 4.3.1 Vetting Process and Results

This database does not require a vetting process because the definition of "incident" falls within the Center's criteria. Because the database is discontinued, the Center cannot use the data to establish a baseline measurement. However, as shown in Table 3, ARIP contains valuable information on chemical safety that is not

***Table 3: Releases, Fatalities, and Injuries by Industry Segment (SIC)***

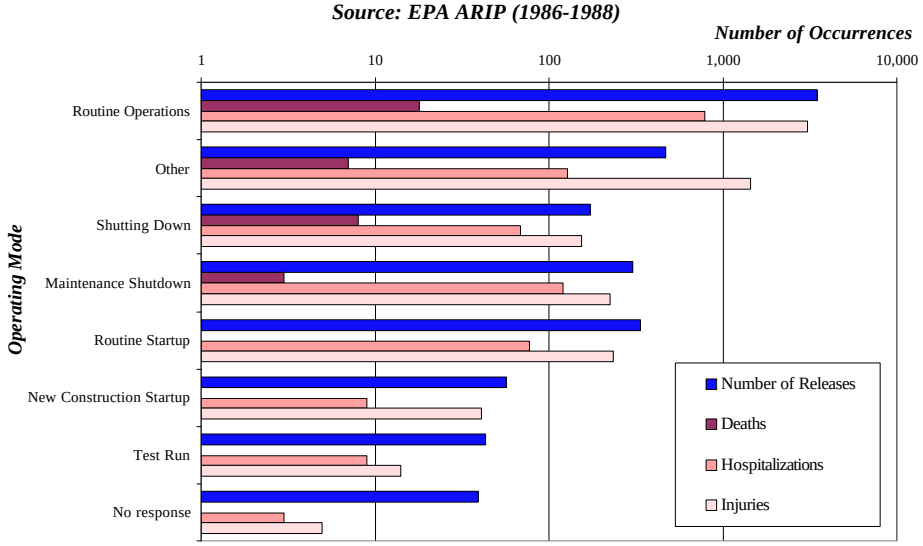
***Source: EPA ARIP (1986 – 1988)***

| SIC | | Releases | % of Releases | Deaths | Hospital | Injuries |
|---|---|---|---|---|---|---|
| 28xx | Chemical Manufacturing | 2341 | 48 | 18 | 351 | 1858 |
| 2911 | Petroleum Refining | 440 | 9 | 6 | 61 | 1251 |
| 20xx | Food Processing | 372 | 8 | 3 | 116 | 390 |
| 5xxx | Distribution | 148 | 3 | 3 | 136 | 189 |
| 3xxx | Other Manufacturing | 512 | 10 | 1 | 135 | 302 |
| 49xx | Utilities | 311 | 6 | 1 | 146 | 248 |
| 26xx | Paper Manufacturing | 281 | 6 | 1 | 71 | 297 |
| | Others | 514 | 10 | 3 | 186 | 612 |
| | | | | | | |
| | **Total** | **4919** | **100** | **36** | **1202** | **5147** |

available in other databases. The Center analyzed the number of releases, deaths, hospitalizations, and injuries by Standard Industrial Classification (SIC) code during the years of 1986 to 1988, shown in figure 4.

The Center's analysis of the ARIP database produced very specific, quite useable information, e.g., releases and injuries associated with various operating modes.

***Figure 4: Releases and Injuries by Operating Mode***
***Source: EPA ARIP (1986-1988)***




## 4.3.2 Functionality of the Database for NCSP Purposes

***Strengths for the Center's purposes.*** The total database is large enough to provide meaningful analysis and conclusions. Primarily, ARIP will allow the Center to analyze causes and consequences for the years before the implementation of the RMP 5-year Accident History database.

***Weaknesses for the Center's purposes***. The database is no longer operational and will not provide trends with time. In addition, based on the taxonomy and criteria used in selecting the information to include in the database, that data available may be statistically insignificant.

## 4.4 Bureau of Labor Statistics (BLS) Databases

| | |
|---|---|
| ***Covered Universe*** | All OSHA-covered facilities. (The Center reviewed the Occupational Injury and Illness tables and the Census of Fatal Occupational Injuries tables.) |
| ***Time Period*** | 1972 to 1999 |
| ***Collection Method*** | • Survey of Occupational Injury and Illness (SOII)<br>• Census of Fatal Occupational Injuries (CFOI) |
| ***Principal Data Elements*** | The BLS database is a comprehensive statistical system covering work-related deaths, injuries, and illnesses in private industry. Work-related fatalities are counted and profiled more accurately in a separate BLS table, Census of Fatal Occupational Injuries. Survey information on nonfatal incidents involving days away from work profiles:<br>• Occupation and other demographics (e.g., age and gender) of workers sustaining such injuries and illnesses;<br>• The nature of these disabling conditions and how they occurred; and<br>• The resulting time away from work. |

| | |
|---|---|
| ***Strengths*** | SOII statistics are based on an annual sampling of about 250,000 companies in the United States. Useful detail for chemicals and industries involved in accidents exists. The data have been collected and reported in a consistent manner since 1992. Thus, trends from 1992 can be determined and compared with injury rates. |
| ***Weaknesses*** | Chemical incidents are only identified for cases with days away from work. Also, the survey was redesigned between 1987 and 1992; thus, statistical analysis is limited for the years prior to 1992. |

## 4.4.1 Vetting Process and Results

The data are based on a statistical sample that BLS extrapolates to the whole nation; therefore, the Center was not able to vet the data.

Using the data available in the Occupational Injury and Illness table, the Center determined the number of days away from work due to chemical exposure, as shown in Figure 5.

From the BLS database, the Center selected the data by industry segments, such as metal plating and polishing, chemical and allied products, petroleum refining, and paper mills. The BLS database allows analysis into sub-segments of the industry as shown in Figure 6.

***Figure 5: Selected Industry Segments with High Rates of "Days Away" Due to Chemicals Source: OSHA OII***

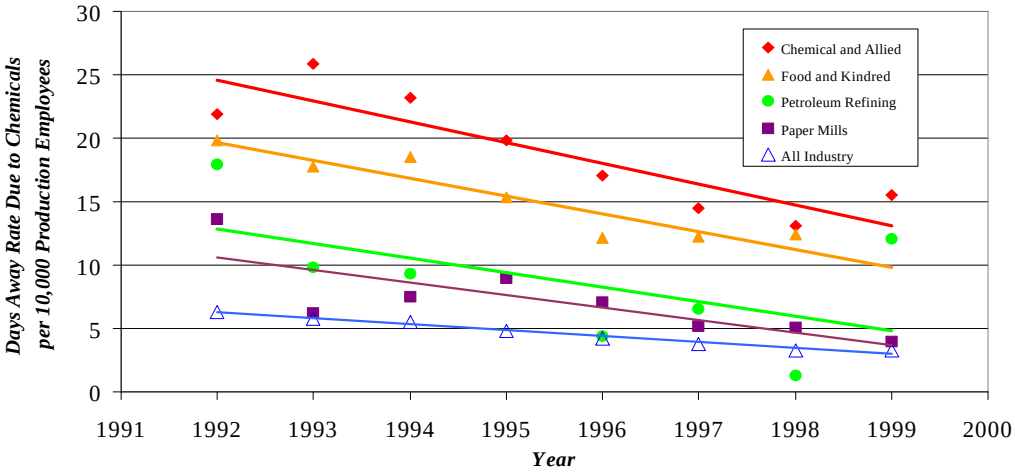
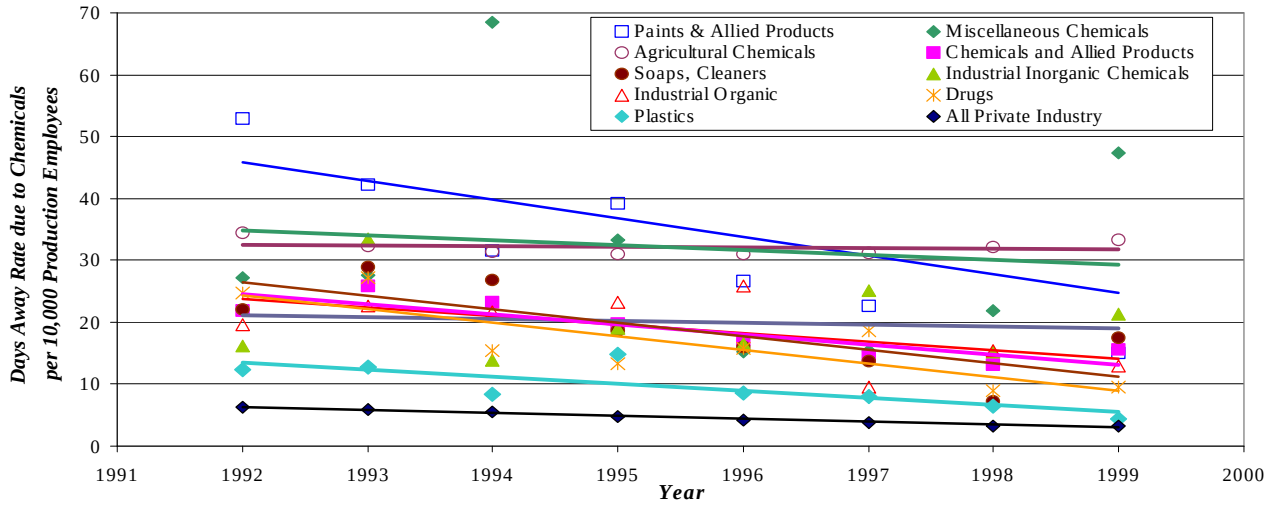



***Figure 6: OII Rates in Chemical Manufacturing Segments, due to Chemicals Source: OSHA OII***



### 4.4.2 Functionality of the Database for NCSP Purposes

***Strengths for the Center's purposes***. This system contains valuable information on chemical incidents resulting in injuries or fatalities. There are no arbitrary limitations due to type of facility, chemical lists, or threshold quantities.

***Weaknesses for the Center's purposes.*** OSHA's definition of an incident is broader than the definition adopted by the Center. OSHA's definition includes all workplace incidents that result in days away from work and excludes light duty cases.

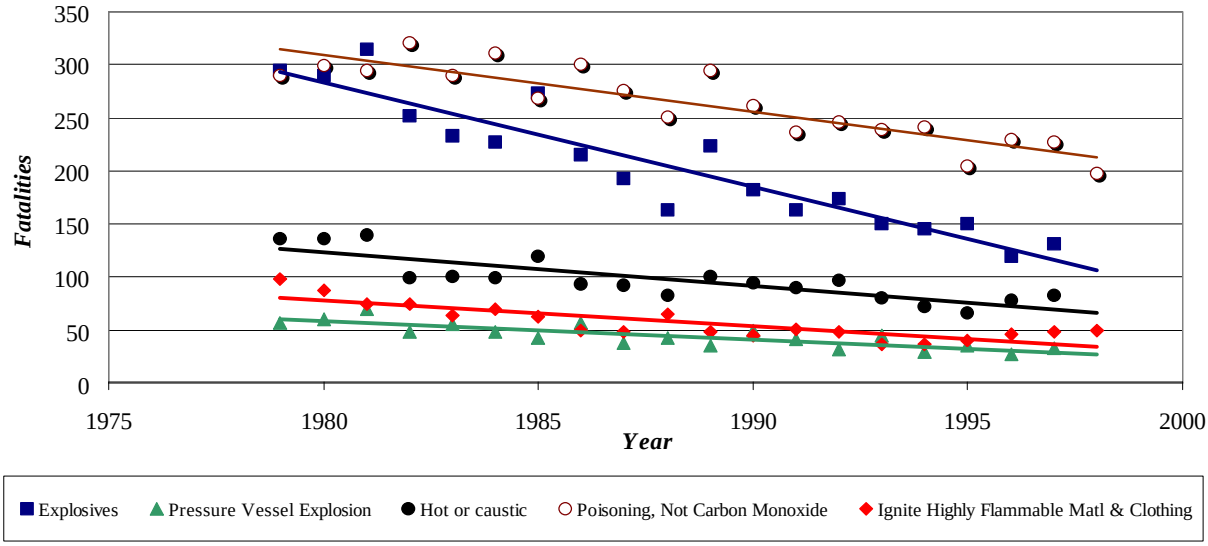
## 4.5 Wide-Ranging On-line Data for Epidemiological Reporting (WONDER)

| | |
|---|---|
| ***Covered Universe*** | All fatalities in the United States |
| ***Time Period*** | 1979-1997 |
| ***Collection Method*** | Death certificates as recorded by physicians. |
| ***Principal Data Elements*** | This database provides the numbers of fatalities and their associated causes. |
| ***Strengths*** | The WONDER database is useful for the purpose of determining overall trends in fatalities due to chemicals. The database allows sorting by codes that describe a class of chemicals or a type of event. It also allows sorting by the age of the deceased. This feature was used to eliminate victims under 20 years of age as it is unlikely these were industrial accidents.<br><br>Unlike most other databases, a physician, who is presumably not biased when determining the cause of death, codes the data. The data are available since 1979, that provide a long and statistically significant trend analysis. |
| ***Weaknesses*** | The scope of incidents in WONDER is very broad and contains incidents such as a teenager huffing butane that resulted in a fatal incident, and incidents involving consumer products in residences.<br><br>The data are not related to specific incidents.<br><br>Public access to WONDER is limited. Thus it is not possible to eliminate selected types of incidents. Data can be gathered only by presenting queries on the number of fatalities due to a certain cause in a given year by age group. |

### 4.5.1 Vetting Process and Results

Several fields within WONDER contain confidential information that is not available outside of the CDC. The Center was not able to conduct vetting because of limited access to the database. From the WONDER database, the Center analyzed fatalities by chemical type, as illustrated in Figure 7.

*Figure 7: U.S. Fatalities in all Locations due to Chemicals for Persons Age 20 and Up*
*Source: CDC WONDER*




## 4.5.2 Functionality of the Database for NCSP Purposes

***Strengths for the Center's purposes.*** The WONDER database is very useful for the purpose of determining trends in fatalities due to chemicals.

***Weaknesses for the Center's purposes.*** The CDC database does not allow the public to review individual cases. Data can be gathered only by queries on the number of fatalities due to a certain cause in a given year by age group. WONDER includes nonindustrial incidents.

## 4.6 Hazardous Substances Emergency Events Surveillance (HSEES) Database

***Covered Universe***

Sixteen state health departments currently have cooperative agreements with ATSDR to participate in HSEES. The state health departments report an "event" if it meets the HSEES definition, which is "any release(s) or threatened release(s) of at least one hazardous substance". A substance is considered hazardous if it might reasonably be expected to cause adverse human health effects. Releases of petroleum products are excluded from this system.

***Participating States***

- Alabama
- Colorado
- Iowa
- Louisiana
- Minnesota
- Mississippi
- Missouri
- New Jersey
- New York
- North Carolina
- Oregon
- Rhode Island
- Texas
- Utah
- Washington
- Wisconsin

***Time Period***

1990-1998

***Collection Method***

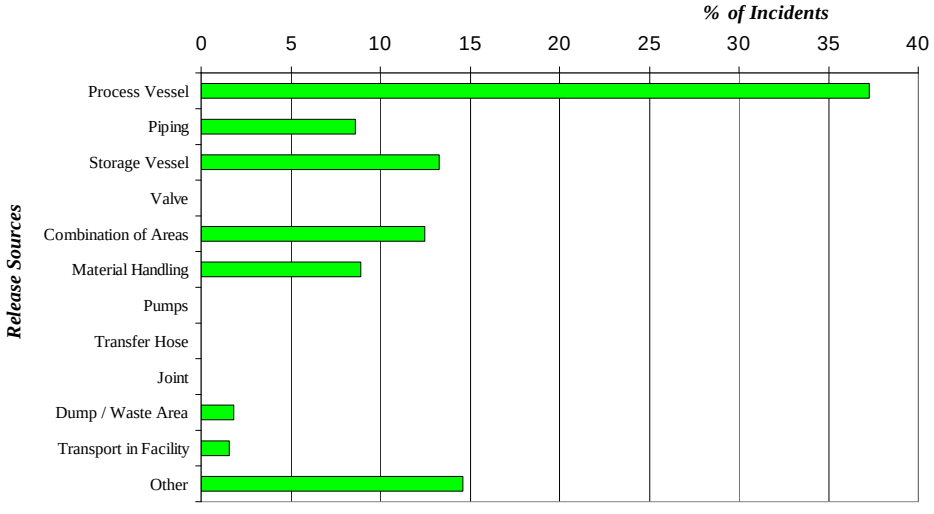
Data are entered by participating state health departments into a Web-based application that enables ATSDR to access data instantly for analysis.

| | |
|---|---|
| ***Principal Data Elements*** | Data collected on incidents for this database include the following:<br>• Time, date, and day of the week;<br>• Geographical location within the facility where the event occurred;<br>• Event type (fixed-facility or transportation-related event);<br>• Factors contributing to the release;<br>• Environmental sampling and follow-up health activities;<br>• Specific information on injured persons: age, sex, type and extent of injuries, distance from spill, population group (employee, general public, responder, student), and type of protective equipment used;<br>• Information about decontaminations, evacuation, or shelter-in-place;<br>• Land use and population information to estimate the number of persons at home or work who were potentially exposed; and<br>• Whether a contingency plan was followed and which plan was used. |
| ***Strengths*** | ATSDR has a proactive approach to incident collection that facilitates more complete and accurate reporting.<br>• More details on type of injury and personal protective equipment than many other sources. |
| ***Weaknesses*** | The ATSDR HSEES program covers only 16 states, and excludes petroleum products. The public does not have access to the data; ATSDR provides summary reports of the data. However ATSDR and/or the Center are planning to implement an online search system. |

## 4.6.1 Vetting Process and Results

The Center was not able to conduct vetting on ATSDR data because ATSDR provided reports, not actual data. Because the Center could not filter the data, the Center accepted the ATSDR incident definition. However, there are a few known instances where the ATSDR definition deviates. For example, ATSDR includes illegal activities, such as methamphetamine manufacturing and near misses. The Center determined that near-misses account for less than 2 percent of the reported cases.

***Figure 8: Percent of Incidents by Release Sources for Fixed Facilities***
***Source: ATSDR (1998)***




The Center used 1998 data from the HSEES database for its analysis. In 1998, only 13 states participated in the ATSDR program. The states were Alabama, Colorado, Iowa, Minnesota, Mississippi, Missouri, New York (excluding New York City), North Carolina, Oregon, Rhode Island, Texas, Washington, and Wisconsin. Figure 8 demonstrates the release sources for fixed facilities in those 13 states.

### 4.6.2 Functionality of the Database for NCSP Purposes

***Strengths for the Center's purposes.*** HSEES captures data for more than 5,000 events annually, which provides a large base of information to analyze. For this report, the Center did not have direct access to the data. But recently, the Center has gained access to the actual data, which will provide an opportunity for a vetting process to benefit the National Chemical Safety Program. Future analysis of HSEES is expected to yield favorable results.

***Weaknesses for the Center's purposes.*** The scope of the data is limited to the states that are participating in the program, which may vary; therefore extrapolation of the statistical analysis from this data to the rest of the nation is uncertain.

## 5.0 Conclusions on the Usefulness of the Federal Databases

The federal databases, most of which are online and searchable, offer an opportunity to analyze the status of chemical safety. Following an examination of common data elements that could be normalized and provide statistically verifiable samples, the Center determined that a beginning point for assessing chemical safety should include an analysis of the number of fatalities, injuries, and releases related to specific chemicals.

When the Center, in collaboration with the Stakeholders, reaches agreement that the base indicators of performance are fatalities, injuries, and releases, then the databases reviewed in this report can provide the groundwork for measuring chemical safety for fixed facilities in the United States. The actual process for normalizing the base indicators of performance to produce a usable model will be addressed in future research efforts of the Center. Table 4 highlights available indicators by their data source.

***Table 4: Federal Databases and Potential Indicators***

| Agency - Databases | Chemicals Involved | Number of Incidents | Fatalities | Injuries |
|---|---|---|---|---|
| NRC – IRIS | Ö | Ö | Ö | Ö |
| EPA - ARIP | Ö | Ö | Ö | Ö |
| EPA - RMP | Ö | Ö | Ö | Ö |
| OSHA | Ö | | Ö | Ö |
| ATSDR - HSEES | Ö | Ö | Ö | Ö |
| CDC - WONDER | Ö | | Ö | Ö |

Unfortunately, there are several issues with the databases related to accurate analysis of chemical safety. Currently many federal, state, and local agencies are collecting and reporting chemical incidents. However, each agency can only collect information on incidents within their legislative authority. Subsequent rulemaking further limits the scope of data collection in many cases. Because of the varying focus amongst agencies, the data collected and the terminology employed vary widely. The agencies are generally limited to certain chemicals, at or above predetermined threshold quantities, in particular for fixed facilities or transportation modes. These limitations stymie efforts to gain an overview of all chemical incidents and chemical safety in the United States.

In addition, many of the federal systems rely solely on self-reporting of incidents by the companies or parties involved. While federal law mandates incident reporting, it is not known how many incidents each year go unreported. A significant effort is required to identify and vet the incidents, which are reported multiple times to multiple agencies. An independent means of checking for accuracy and completeness is not conducted due to the significant manhours of contact required with each reporting company by a third party. On the other hand, some agencies use proactive means of searching for incidents, which ensures a certain level of accuracy; however, their scope is limited in other ways.

Improvements made in the federal databases would result in a clearer picture of national chemical safety. Even with the improvements, information gathered from the federal databases is imperfect. The Center must continue to perform a thorough review as a part of its quality control process. Vetting, in many instances, must still be performed on the databases before useful data can be presented to demonstrate the status of chemical safety in the United States.

## 6.0 Forward Vision

The NCSP established as the national goals for chemical safety:

- **Chemical incidents are zero;**
- **Chemical enterprises have earned the public's trust; and**
- **Public, government, and facility interactions improve safety and reduce risks.**

To achieve the goals, stakeholders must have a benchmark against which they can measure progress. The Center began the National Chemical Safety Program to identify and establish an accurate measurement of chemical safety in the United States.

As previously discussed, there are many imperfections with the current state of federal databases. However, the Center is confident that applying sound statistical methodologies to the current databases can allow for accurate measurements.

The Center recommends to the federal agencies responsible for their data:

- **Making the data fully searchable would enhance access to the information in all databases.** The CDC WONDER database and the ATSDR HSEES database, for example, are not accessible to the public; therefore, analyses of the data are greatly limited. The Center and ATSDR have reached a data sharing agreement for the HSEES information from 1993 through 1998. The agreement includes subsequent years as the information becomes available. Certain fields in the HSEES databases will, however, be deleted by ATSDR for confidentiality reasons. The Center seeks to reach similar agreements with other agencies to improve access to the data.

- **Establish a more thorough quality assurance/quality control process to eliminate data entry errors and record duplication.** For example, the Center identified several duplicated records in the NRC database.

- **Ensure that incidents that are required to be reported are in fact being reported.** The Center determined that a significant number of incidents were not reported to the NRC through a review of the U.S. Department of Transportation Hazardous Material Information System and Office of Pipeline Safety databases. Federal, state, and local agencies, in cooperation with NRC, should ensure two-way communication concerning incidents. Ideally, all incidents would be reported to the NRC leaving only the task of tracking and vetting the data to the Center.

The Center suggests to the industry business segments:

- **Voluntary reporting of incidents involving chemicals with known consequences**. This voluntary act would help improve the completeness of data on chemical safety, address the

limitations of the EPA RMP 5-year Accident History database, and increase the usefulness of the HSEES databases, which are restricted by regulatory requirements and funding issues but offers the most valuable data on incidents and their causes. To be successful, voluntary reporting would require a policy change by EPA to accept and maintain the new information. This reporting would be an important enhancement based on the Center's determination that many injuries are caused by releases much smaller than the thresholds quantities reported under the RMP rule.

The Center intends to move forward by:

- **Determining the indicators and metrics that will provide an accurate measurement of chemical safety;**
- **Working to improve the existing federal databases.** For example: standardize the terminology, promote delivery of quality controlled data, and develop information as needed from other sources to gain a complete understanding of each incident;
- **Applying the vetting processes discussed in this report to the existing federal databases.** The resulting metrics on chemical safety should yield information on the causes, consequences, and other patterns of chemical incidents in the United States;
- **Tracking the indicators and metrics by business segments and geographic areas.** The Center considers that an integrated data system would be the most practical approach to determine trends within a business segment or geographic area, by chemical and by consequence. Therefore, it is a Center priority to explore more fully the feasibility of such a system in future research efforts;
- **Requesting business segments, public agencies (LEPCs), and public responders to provide metric information and governmental agencies to fund these initiatives.** This information would serve as a check and balance between federally reported information and the actual results of industry, the public, and response organizations without excessive funding burdens.

The Center calls all stakeholders to:

- **Influence the database owners to act upon the presented recommendations;**
- **Seek ways to gain standardization in the key data elements, e.g., definition of an incident;**
- **Take an active role in promoting chemical process safety through local organizations, e.g., LEPCs;**
- **Work to establish and institutionalize the indicators and metrics used to measure chemical safety in the United States;**
- **Openly support all stakeholders adopting and showing progress towards meeting the national goals.**