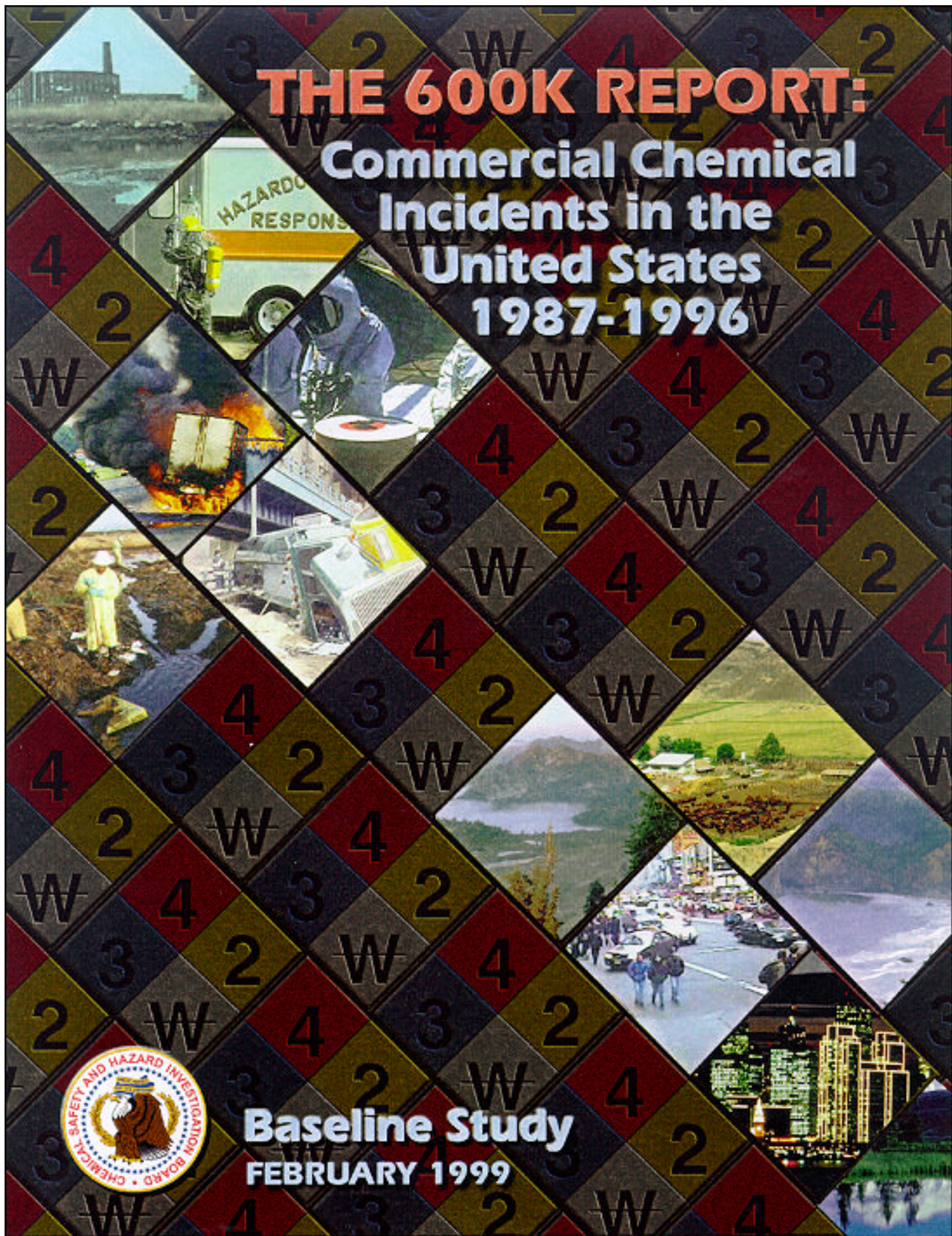


THE 600K REPORT: Commercial Chemical Incidents in the United States 1987-1996



Baseline Study
FEBRUARY 1999

THE 600K REPORT:

SPECIAL CONGRESSIONAL SUMMARY

COMMERCIAL CHEMICAL INCIDENTS IN THE UNITED STATES, 1987 - 1996

BACKGROUND AND PURPOSE

Why *The 600K Report*? Why, indeed? Why does the industrial equivalent of two 737 airplanes “crash” year after year, killing all passengers (256 people)? And why does no one seem to notice? While these remain questions today, the United States recently embarked on a journey whose destination is precise answers to the causes of and means of preventing chemical incidents . . .over 600,000 from 1987 through 1996 . . . , answers to help government and business take steps benefiting everyone.

Commercial chemical incidents occur tens of thousands of times each year, often with devastating and exorbitantly expensive consequences. They are indiscriminate in their effects. Workers, companies, the public, emergency response organizations, and all levels of government pay the figurative and literal price. Yet, until now and with few exceptions, chemical incidents have been invisible. Perhaps it is due to their pervasiveness, or to the common tendency to overlook what is taken for granted. More likely, however, their invisibility results from our nation’s lack of definitive knowledge about the picture of chemical incidents in the United States. *The 600K Report*, the product of the unprecedented analysis of reports of chemical incidents recorded in five federal government databases, and the baseline it establishes fill that gap. It is the first federal study that casts a wide net over the problem, looking at its magnitude and characteristics, and using . . .and highlighting the limitations of . . .the government’s own acknowledged “best” databases of reported chemical incidents at fixed facilities and during transit.

The 600K Report was prepared by the Chemical Safety and Hazard Investigation Board (CSB), an independent, nonpartisan, quasi-legislative agency that performs a unique role within and, domestically and internationally, on behalf of the federal government. Created as part of the Clean Air Act (Act), 42 U.S.C. § 7412, the CSB began operations in Fiscal Year 1998. Its mission, accomplished through a variety of programs and partnerships, is clear, focused and measurable: *reduce the occurrence of chemical incidents, thereby protecting workers, the public and the environment and lessening associated economic consequences.*

The CSB assists Congress with public policy analysis through its technical work, its evaluation of the performance and effectiveness of federal chemical safety programs, and its assessment of the cost and benefits of those programs to government and business. It makes recommendations for administrative and regulatory changes to other agencies' programs to enhance their effectiveness, and the overall effectiveness of the federal government, in promoting chemical safety. The CSB's work is done in support of Congressional direction contained in the Act, that it is to issue periodic reports (1) recommending measures to reduce the likelihood or consequences of accidental releases and (2) proposing corrective steps to make chemical processing, handling and storage as safe and free from injury as possible.

Many parties have a stake and role in preventing chemical incidents. This report, and the complementary information the CSB will produce in the future, is designed to give those parties a common basis on which to productively discuss and work toward the resolution of chemical safety concerns. Their collective, cooperative efforts can make the United States the world leader in chemical incident prevention . . . and the workplace as safe as an airplane.

BENEFITS

Prior to the CSB's study and publication of *The 600K Report*, no one knew with certainty the demographics (e.g., size, consequences, location) of the annual *reported* universe of United States commercial chemical incidents. While there have been earlier studies of the issue, they have been limited by such constraints as the period of time examined, number of data sources used, or chemical categories involved. As a result, long-term trend analyses based on multiple databases have not been possible. Similarly, the absence of sufficient information previously prevented objective, performance-based assessment of claims regarding the need for or success of any federal law, regulation or program relating to chemical safety and incident prevention.

This report establishes the first consolidated baseline on the status of the chemical incident problem. In turn, the baseline serves as the foundation on which Congress, the CSB and all other government agencies comprising the federal chemical safety system can begin to construct questions, find answers and develop strategies pertinent to chemical safety and incident prevention. The CSB needs this baseline in order to provide sound advice, as well as to set its own operating priorities and measure the results of its work. Only by analyzing data trends can the Agency and its stakeholders decide if it has been successful in preventing or eliminating incidents. This analytical report of ten years' of federal data on commercial chemical incidents is the culmination of the CSB's initial effort to define the chemical incident problem for itself, the Congress and the nation.

This report is the first step in providing federal, state and local government the knowledge needed to improve the decisionmaking process. In the absence of information, government has, of necessity, enacted laws containing chemical safety provisions without being able to determine their impact on the existing safety system. This has further complicated the regulatory structure without yielding assurance that the overall level of safety has improved. With this report, and subsequent information the CSB is committed to routinely providing, government will have an enhanced ability to objectively evaluate and (re)design laws, policies and operating programs, and allocate

tax dollars, to better ensure their cost-effective contribution to chemical safety and incident prevention.

This report is a resource that can be used to begin the effort to streamline and reduce the cost to government and business of the current chemical incident reporting safety. Observations made in the report about the data collection aspects of the incident reporting system provide a starting point from which those responsible for the data can construct a more efficient, reliable and effective interagency information network.

This report provides business, industry and labor access to currently unavailable incident information to help them identify trends which, if acted upon, can prevent loss of life or property. As important as accurate baseline incident information is to the CSB and the federal government, it is just as important to stakeholders. At present, routine sharing of information about chemical incidents rarely occurs among safety professionals within and across industry sectors. Often legal or institutional barriers (e.g., concerns about potential liability or competitive pressures) inhibit the exchange of data, even within companies. With eventual electronic access to the consolidated public data via the CSB's website (<http://chemsafety.gov>) and its national resource center for chemical safety information, everyone with an interest in and contribution to make toward chemical safety . . .including communities, environmental advocates, and academicians . . .will have a convenient way to learn more about and to track changes in the profile of incidents.

This report provides the CSB with a first-ever baseline of known incidents against which, with requisite expansion, it can measure whether it is accomplishing its Congressional mandate to protect lives, property and the environment by a demonstrable decrease in deaths, injuries, property and environmental damage due to chemical incidents. Positive progress in achieving the chemical safety goal is impossible to prove at this time, since no baseline yet exists which accurately describes the *total* number and *full* impact of chemical incidents in the United States. The CSB is working toward producing and maintaining such a comprehensive incident database because of its importance to the CSB's mission and to the overall effort of the federal government to prevent chemical incidents.

FEDERAL CHEMICAL SAFETY SYSTEM

The United States' chemical safety system is a composite of disparate laws, regulations, and programs pieced together and administered through numerous agencies (a minimum of 15, counting only those identified as having a role within the National Response System¹). While each piece of this composite was intended to address a specific, necessary safety goal, components of the system were not created or developed in full consideration of one another. Rather, the laws have addressed specific constituencies for specific purposes.

At present, it is not clear whether or how the multitude of federal chemical safety operations complement each other, or whether they are having any positive impact on reducing the occurrence of chemical incidents. For example, both OSHA and EPA enforce regulations designed to improve safety at facilities involved with chemicals. Open for debate is whether those regulations are having the desired results, especially in view of the findings presented in *The 600K Report*. The agencies comprising the federal government's chemical safety system themselves concluded that, because of how the government's chemical safety system developed, there are overlaps, inefficiencies, and some gaps in the statutory and regulatory framework as well as in the government's management structure². As a consequence, the system may be unnecessarily burdensome and confusing for government, business, and the public, and failing to produce intended results. Nowhere is this situation clearer than in the incident reporting arena.

¹ EPA Report Number 550-R-93-002, December 1993

² EPA Report Number 550-R-93-002, December 1993

STUDY PROCEDURES

At the end of Fiscal Year 1998, the CSB initiated a baseline study of reported commercial chemical incidents, occurring within the United States over a ten-year period (1987 through 1996), in order to identify the scope, characteristics and trends of those incidents. The CSB relied on existing data contained in five major databases already developed and regularly used by other agencies in support of their respective missions. These five federal databases, identified by the federal government as comprising the "core" collection of reported incidents³ (i.e., notices of "accidental" releases, as opposed to intentional ones), were merged into a consolidated statistical database to conduct this study, resulting in the federal government's first comprehensive picture and central repository of chemical incident information. All commercial chemical incidents at fixed facilities or that were transportation-related, with the exception of any marine oil spills, were identified using:

- U.S. Fire Administration's National Fire Incident Reporting System (NFIRS)
- Department of Transportation's Hazardous Materials Incident Reporting System (HMIRS)
- U.S. Coast Guard, National Response Center's Incident Reporting Information System (IRIS)
- Environmental Protection Agency's Emergency Response Notification (ERNS)
- Occupational Safety and Health Administration's Integrated Management Information System (IMIS)

A total of 10.1 million incident reports contained in the linked databases were screened, of which 874,000 met the study's selection criteria: contained a company name and some limited address information, involved a hazardous chemical, occurred at a commercial facility (fixed or mobile), and did not occur on water (if a commercial transportation incident). By linking and comparing records within and between the databases to identify and eliminate duplicate reports on the same incident, the 874,000 reports were reduced to 604,653 appearing to be unique. Data elements on each of these distinct incidents were extracted from the five source databases, supplemented by other proprietary information obtained from The Dun & Bradstreet Corporation, to populate the

³ EPA Report Number 550-B-95-001, September 1995

resultant CSB database. The primary areas of focus for purposes of data analysis are shown below.

Major Sorting Schema for Variables within CSB's Incident Reports Database

INFORMATION CATEGORIES	KEY DESCRIPTORS ¹	ILLUSTRATIVE ANALYSES
Incident Location	State County Zip Code	<i>Total Number of Chemical Incidents, 1987 – 1996</i> (Exhibit A; page 16)
Incident Type	Fixed Facility Road Air Rail Pipeline	<i>Distribution of Chemical Incidents by Type</i> (Exhibit B; page 17)
Incident Consequence	Death Injury Evacuation Property Damages (estimated cost)	<i>Chemical Incidents, Deaths, and Injuries by Type</i> (Exhibit C; page 18)
Facility Type	Industry SIC (nature of business) Processing Storage Disposal End User	<i>Number of Chemical Incidents by Type of Facility</i> (Exhibit D; page 19)
Incident Chemical	Name CAS Number UN/NA Number Hazard Class	<i>All Chemicals, Less Fuel Products, Associated with More Than 1000 Incidents in the Ten-Year Period</i> (Exhibit E; page 20)
Incident Time	Hour Day Week Month Year	<i>Number of Incidents by Month</i> (Exhibit F; page 21)
Incident Cause	Mechanical Human Natural Phenomenon	<i>Number of Chemical Incidents by Initiating Event</i> (Exhibit G; page 22)

NOTE: ¹Some descriptors also are identified as *other* and *unknown*. These are used in instances when it was impossible to assign something more definitive, due to lack of sufficient data in the source database(s).

DATA LIMITATIONS

The process of analyzing the individual databases revealed their variability and inconsistencies, differences that likely are not recognized by the casual user of the data. That user may mistakenly believe the databases constitute a single, coherent operational infrastructure. The variations in the reporting systems are reflective of the variations between the agencies that comprise the federal government's chemical safety system. Beyond emphasizing the fact that there are many pieces to the safety puzzle, and that they do not necessarily fit together to form a single picture, analysis of the databases raised questions about data quality, comparability, reliability and value, and about the cost-benefit of federal agencies' programs that rely on the data. While these matters are briefly addressed in *The 600K Report*, they will be examined in detail in a Fiscal Year 2000 follow-on CSB report. This subsequent report will result from a separate study undertaken in support of the Clean Air Act's requirement that the CSB issue regulations on reporting chemical incidents.

Examples of limitations of the source databases and data used in this study follow.

- While each of the data sources used in the study contains chemical incident data of interest to the CSB, none captures certain mission-critical information: identification of root causes of or contributing factors to chemical incidents.
- Major gaps exist within certain vital data fields, such as address information (e.g., address information is totally missing or only partially shown in some reports). Given that the databases are primarily intended for use by response and investigation personnel, it is difficult to understand and rationalize the apparent lack of quality control procedures.
- It is very difficult, and frequently impossible, to compare and combine data, and thereby eliminate duplicate incident reports (within and between databases). Obstacles include use of different names and spellings for the same chemical, and use of different methods for identifying what appears to be the same incident.

- There is no consistent definition of the term "chemical" among the agencies comprising the federal chemical safety system. Aside from coloring the type and scope of information each agency collects, this lack of standardization may explain discrepancies between databases (i.e., why incidents do not appear in multiple databases when it appears they should). Further, lack of standardized reporting requirements may confuse those who might otherwise report incidents and may lead to their failure to report.

Sufficiency and quality of government data on chemical incidents impact public policy decisions, operational program performance, allocation and application of human and fiscal resources and, most importantly, lives and livelihoods. A feeling of security and confidence should surround the federal chemical safety system, as it does the federal aviation system. Stakeholders should be able to look at "good" data, compare it with program emphases and outcomes, and feel comfortable with noted trends in the direction of change in chemical safety. The question is how to achieve that state of comfort.

Existing incident data offer some insights into the problem of chemical safety, but also evidence significant shortcomings that limit the data's use in tackling the problem. The study's findings provide initial direction on vital matters to address in order to improve data quality and agencies' program performance and, hence, the federal government's ability to attain its goal of reducing the frequency, severity, and personal and economic cost of commercial chemical incidents. The following is a non-inclusive list of those matters.

- How are the agencies which are collecting the incident data using it?
- What is the cost of collecting and maintaining the data, is that cost justified, and are there other alternatives to the present schema that should be considered?
- How valid are policy decisions which are based on the data, and what are the measurable benefits realized from those decisions?
- How effective are program operations which are based on the data, in terms of demonstrable performance in targeting and correcting causes of chemical incidents?
- Is business being burdened by requirements based on specious data?

MAJOR FINDINGS

Commercial chemical incidents . . . causing fatalities, injuries, evacuations or property damage . . . happen more frequently than most Americans would ever imagine. They occur all over the country, in every state, on railways, highways and waterways, and in all kinds of industry, government and commercial facilities. During the period 1987 - 1996, chemical incidents were recorded in 95% (3,145) of the nearly 3,300 United States counties (see Exhibit A, *Total Number of Chemical Incidents, 1987 – 1996*).

The five federal government incident databases identified 605,000 unique chemical incidents during the ten-year period, 42% occurring at fixed locations occupied by industrial and commercial businesses and 43% related to transportation (see Exhibit B, *Distribution of Incidents by Type*).

About 29 percent of the incidents (176,183 incidents) resulted in at least one death or injury (9,705 incidents), evacuation of workers and/or the public (4,167 incidents), or property damage (164,082). The balance of the 604,653 incidents held the potential for consequences but, fortunately, reportedly none resulted. Over the ten-year period examined, approximately 2,550 people each year were killed or hurt . . . there were 2,565 deaths (with an average of 127 incidents per year resulting in at least one death) and 22,949 injuries (see Exhibit C, *Chemical Incidents, Deaths, and Injuries by Type*).⁴

All states experienced chemical incidents, with seven accounting for nearly one-half of the total: California, Texas, Ohio, New York, Illinois, Michigan and Louisiana. A list of the top 15 states shows California as number one (with 100,000 incidents during the period 1987 – 1996), nearly double the number of incidents recorded for Texas (55,209), the second leading state. The remainder of the top 15 states, in descending

⁴None of the data specify whether the chemical release involved in the incident directly caused any of the deaths or injuries. In particular, some deaths and injuries reported in transportation may be attributable solely to physical impact unrelated to the chemical release. However, data collected directly by CSB in 1998 and future will not count deaths and injuries unrelated to the chemical release as chemical incident impacts. Source: the “*The 600K Report*” – *Commercial Chemical Incidents in the United States, 1987-1996*, U.S. Chemical Safety and Hazard Investigation Board, Washington, D.C., February, 1999

order, are Ohio, New York, Louisiana, Illinois, Michigan, Pennsylvania, Florida, New Jersey, Massachusetts, Virginia, Maryland, Kansas and Tennessee.

Incidents were most frequently reported for chemical manufacturing and fuel companies. However, there were nine industries (including the aforementioned two) whose members experienced over 5,000 incidents during the period studied. Of fixed facilities, those categorized as end use facilities (i.e., a facility that was a “consumer” of chemicals) reported the most incidents (see Exhibit D, *Number of Chemical Incidents by Type of Facility*).

While gasoline was the chemical most often involved in incidents (128,000 reports), the total number of incidents involving all other flammable and combustible liquids exceeded 128,000. In addition to fuel products, there were 45 other chemicals involved with 1,000 or more incidents (see Exhibit E, *All Chemicals, Less Fuel Products, Associated With More Than 1,000 Incidents in the Ten-Year Period*).

Most of the incidents occurred during the normal working hours comprising the typical work day. Inexplicably, incidents peaked in the summer, remaining at almost the same exact level during June, July and August. In September there was a dramatic 14% drop to 48,789 incidents from the August high of 56,669 incidents (see Exhibit F, *Number of Chemical Incidents by Month*).

Actual causes of incidents are not recorded in the databases. Rather, only the presumed initiating event is identified (i.e., what apparently “happened” and where the system appeared to have “broken down”). Since the majority of incident reports are made and recorded before any investigation of an incident is conducted, in most instances the reasons cited constitute the best guess on the part of the person filing the report. Mechanical failures were cited as leading to 40 percent of the incidents. Human factors, both unintentional and intentional acts, were cited in another 27 percent of the reports. The effects of natural phenomena accounted for only one percent of the incidents. Approximately 29 percent of the incident reports did not indicate an initiating event (see Exhibit G, *Number of Chemical Incidents by Initiating Event*).

CONCLUSIONS

The CSB's *The 600K Report* offers some new statistics that describe the *known* universe of chemical incidents for the ten years from 1987 through 1996. There were over 60,000 incidents per year, on average, during each of the ten years and approximately 10,000 in total that resulted in at least one death or injury. While the numbers are startling, they do not tell the whole story and can indeed be misleading. Current federal databases on chemical incidents do not provide a comprehensive picture of chemical incidents, primarily because each database was designed to meet only the requirements of its agency, e.g., to ensure quick and capable emergency response, or to record enforcement actions. Thus, individually they do not contain all information necessary to provide a cumulative, comprehensive statistical description of all reported chemical incidents. Also, it is probable that many chemical incidents that occurred over those ten years never made it into any national records. Many incidents failed to meet minimum threshold reporting requirements. Finally, we can assume that numerous incidents that met threshold requirements were still not reported because the parties with knowledge of a particular incident may not have known that incident should have been reported.

There is also a lack of consistency across the data sets even though similar data are being collected. In addition, the data do not provide an accurate picture of how seriously these incidents have affected our nation in terms of environmental damage and economic loss resulting from these events. Most importantly from a safety standpoint, existing databases do not contain information on the root causes of incidents or patterns of causes that are the most solid clues to prevention.

Despite these limitations, existing data confirm that the problem of chemical safety is large, widespread and not fully understood at the national level. In particular, the CSB study is in agreement with similar conclusions that industry, labor, environmentalist, and public safety leaders have separately reached from their own experiences:

- The frequency of serious chemical incidents is significant enough to warrant national concern.

- Many chemical incidents are unreported. Consequently, the country's understanding of the frequency and severity of chemical incidents that occur throughout the nation is incomplete.
- The sources of chemical incidents are diverse, ranging from highly industrialized petrochemical facilities to manufacturers of consumer products to commercial and public works facilities.
- There is no central resource in the United States for information on preventing chemical incidents.

In spite of ten years' worth of new laws, regulations and expenditure of hundreds of millions of dollars, government data show a relatively constant level of commercial chemical incidents in the United States, except for an unexplained increase in 1994. The planes continue to drop from the industrial sky. This information raises the question of how effective the federal government's current chemical safety system is in preventing chemical incidents. Might a new strategy be needed? In order to answer that question, and as Congress created it to do, the CSB intends to further refine its analysis of the ten-year "look back" at chemical incident statistics.

There is much to be learned about the nature of the 600,000 incidents in the nation's new but nascent composite federal database. The CSB will carry out a detailed study of that data, and, in the future, incorporate new incidents as well as new information to address safety and prevention needs. It will identify additional needs and information sources by continuing to collaborate with national and international industry and government bodies, work which already has permitted the CSB to serve as a rudimentary crossroad or clearinghouse for worldwide collection and sharing of chemical safety lessons learned. Armed with first-ever, consolidated baseline data of chemical incidents, the CSB, the Congress and other federal agencies will be in a better position to establish priorities for and apply resources to improving chemical safety and preventing incidents.

As industries emerge and decline, as facilities age, as macro and micro economic conditions fluctuate, as technologies mature, as corporate management adjusts how business is conducted (e.g., varying its reliance on automation or on contract employers), the hazards and associated risks of working with chemicals change. Moving from a

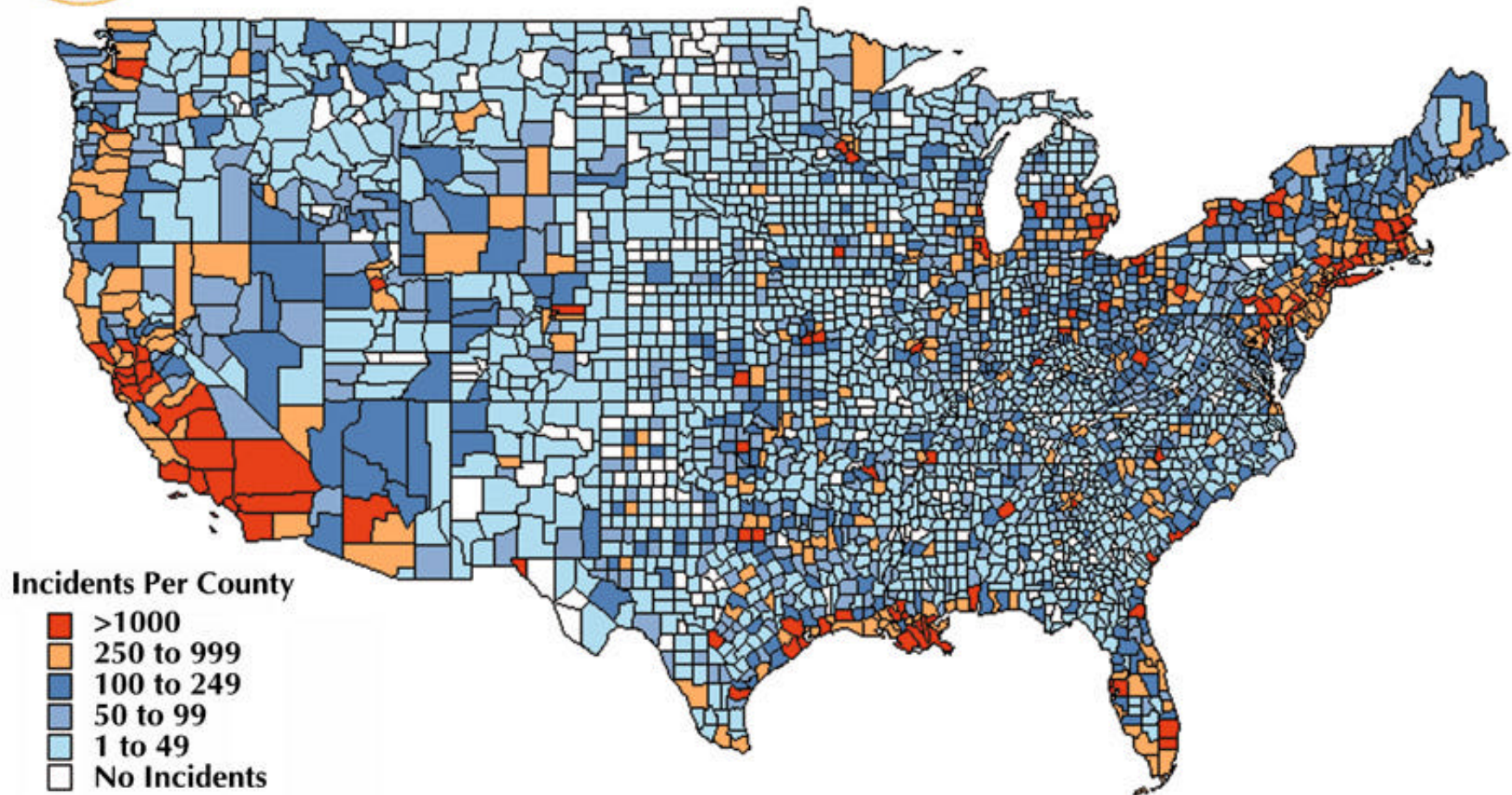
reactive to a proactive, results-driven role in preventing chemical incidents and their associated consequences requires the ability to predict and then react to these shifts in the commercial world. The General Accounting Office, which evaluates federal operations on behalf of Congress, advised the CSB to focus its efforts on outcomes, not outputs: “. . . suggest focusing on the results of doing this work, such as preventing or eliminating accidents shown by the analysis of data trends. . . .it will take time to see some of the results of these actions. . .begin by establishing a baseline.”⁵

The 600K Report is the first step . . .the beginning, not the end. . . in the long process of systematically identifying and addressing the factors contributing to industrial chemical incidents, and reducing and, hopefully, eliminating those incidents. Whether predicting and planning for the future, or measuring change over time, valid and reliable conclusions depend on valid and reliable data. The CSB is dedicated to bringing about action and results through information and knowledge, and to making certain that those working to prevent incidents need never again “fly blind” on their trip to chemical safety.

⁵ GAO handout, dated February 17, 1998, and presented to CSB staff on February 27, 1998



TOTAL NUMBER OF CHEMICAL INCIDENTS, 1987-1996

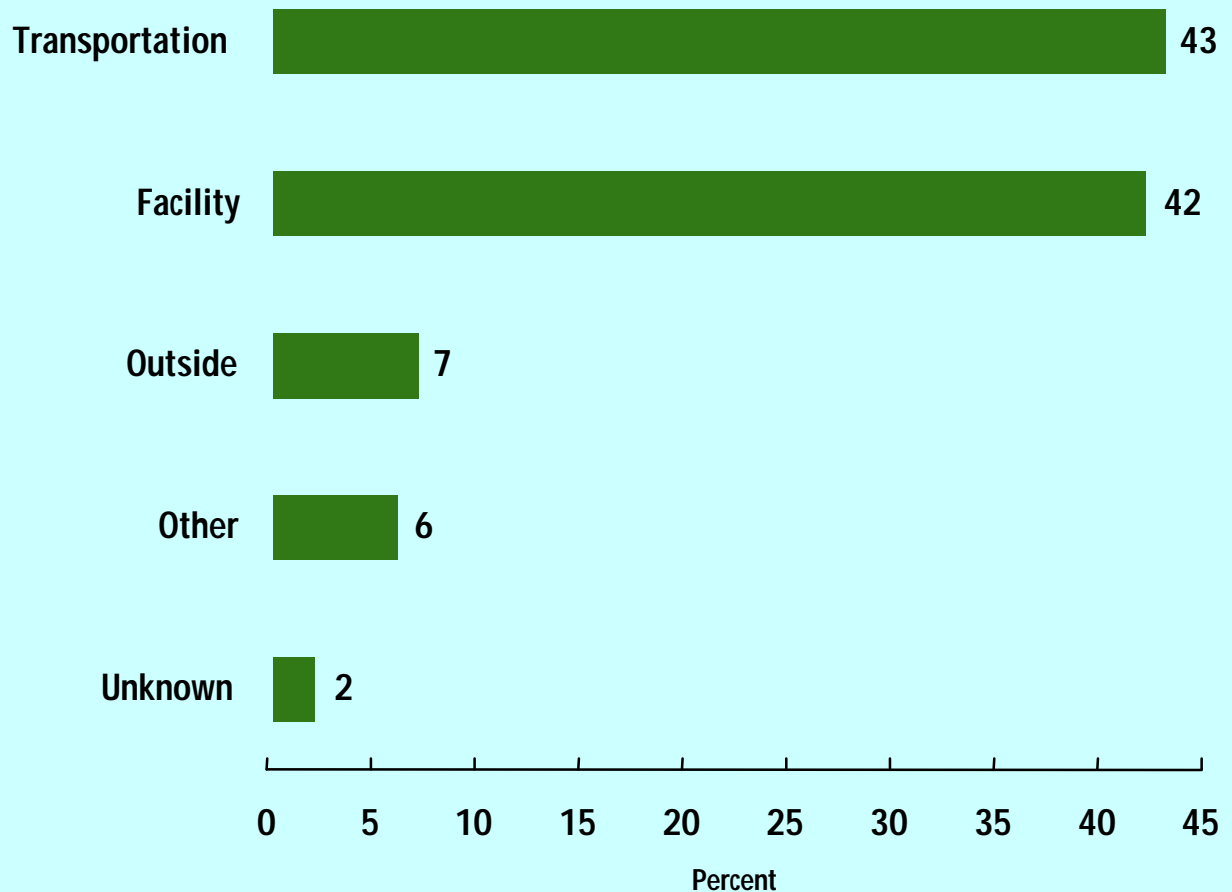


* All chemical incidents, fixed facility and transportation, reported with a valid state and county code.

Exhibit A

February 24, 1999

Distribution of Chemical Incidents by Type



OUTSIDE INCIDENT—An incident where the reported location is not specifically inside or on the grounds of any type of fixed facility, and no information indicates the incident is the immediate result of transportation. An example of a report that would be classified as such would be a chemical or chemical container that was found in an open area, with no apparent source reported. Frequently, these incident reports contain a code such as “dumping,” “discovered,” and “abandoned/discarded.”

OTHER INCIDENT—An event where the information used to classify an incident is not within defined codes. Example: valid property type code = A, B, or C; field contains D.



CHEMICAL INCIDENTS, DEATHS, INJURIES BY TYPE, 1987-1996

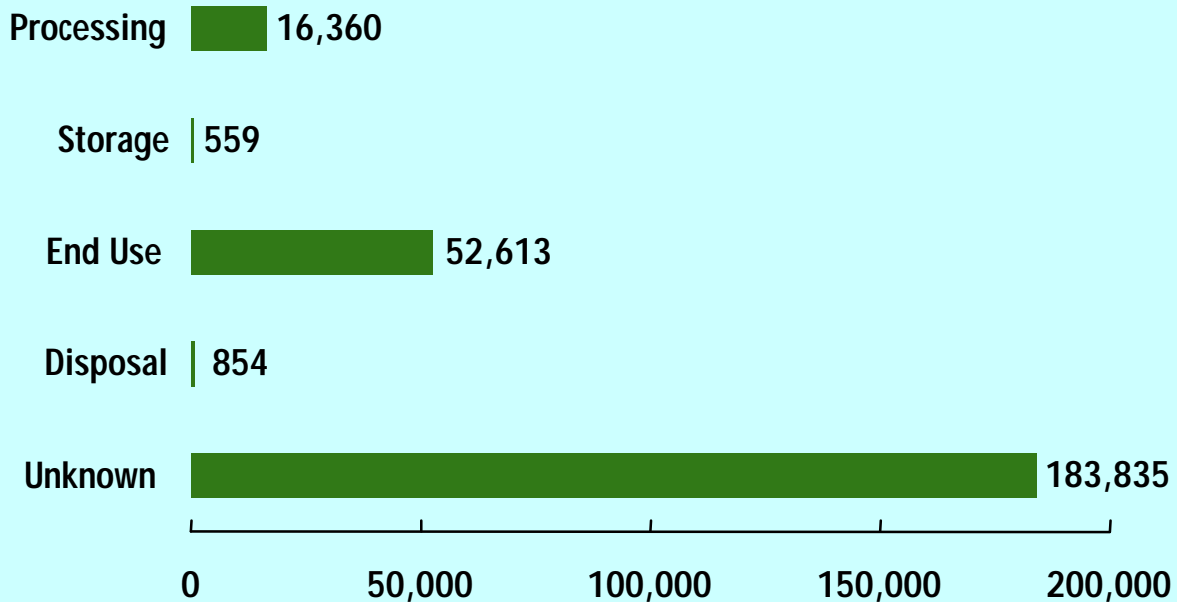
Fixed Facility

Year	Chemical Incidents	Deaths	Injuries
1987	23,433	45	734
1988	24,413	62	930
1989	28,954	49	1,407
1990	24,195	23	959
1991	25,125	26	883
1992	26,523	18	825
1993	27,086	17	1,039
1994	28,220	17	1,334
1995	24,165	42	937
1996	22,107	34	914
Total	254,221	333	9,962

Transportation

Year	Chemical Incidents	Deaths	Injuries
1987	20,544	92	900
1988	21,202	404	745
1989	22,694	165	1,103
1990	22,993	91	1,060
1991	23,049	131	990
1992	25,045	122	1,015
1993	28,723	128	1,149
1994	33,969	130	1,429
1995	30,257	162	1,080
1996	30,683	505	924
Total	259,159	1,930	10,395

Number of Chemical Incidents by Type of Facility



PROCESSING — A facility where the data reported specifically indicate that the facility is used for processing or transformation of chemicals from one form to another, in bulk, for some later use or distribution.

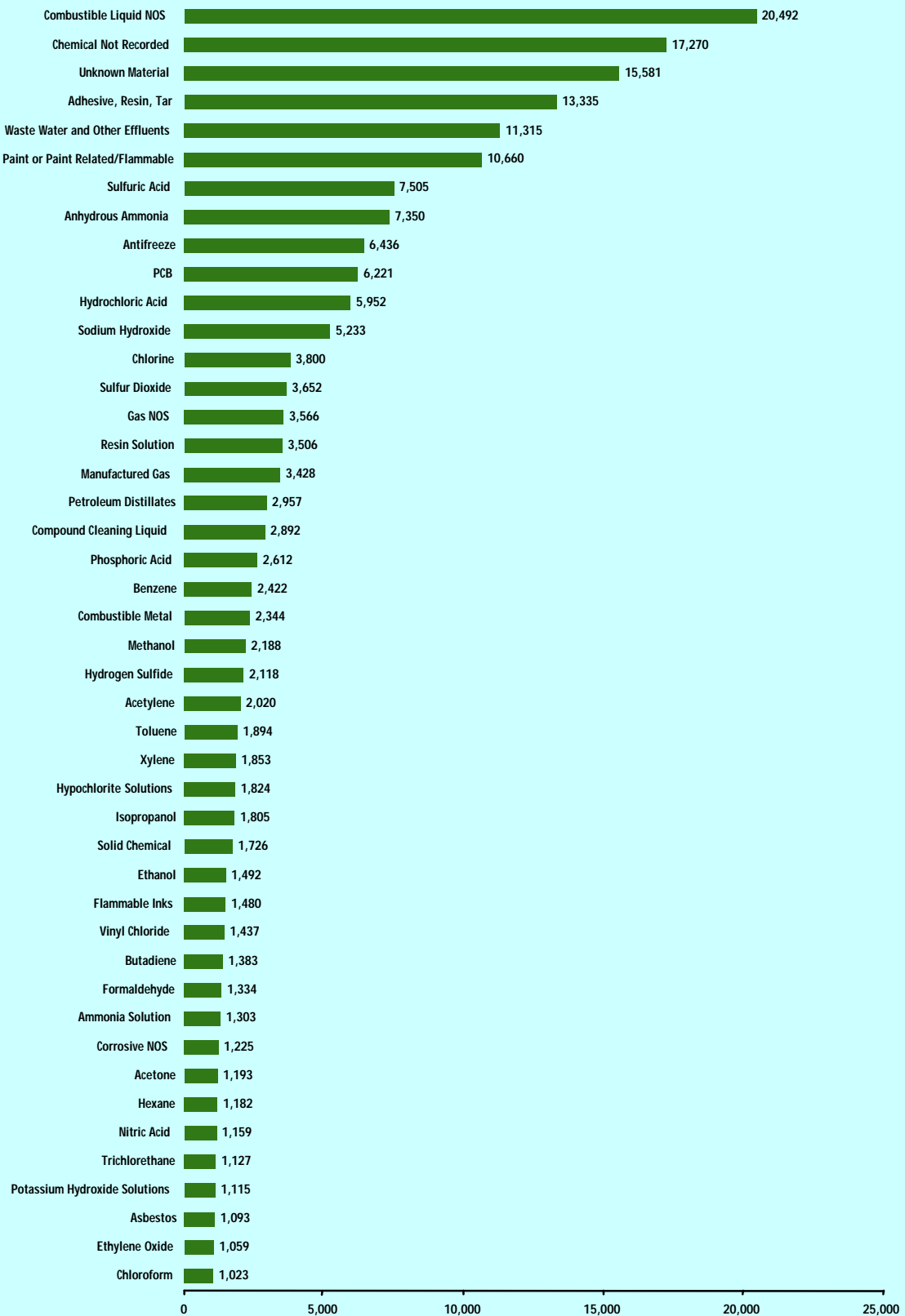
STORAGE — A facility where the data reported specifically indicate that the facility is used for the storage of chemicals.

END USE — A facility where chemicals are used on a consumer basis. An incident that contained facility information that did not fall into “storage,” “disposal,” or “processing” facility is, by default, placed in this category.

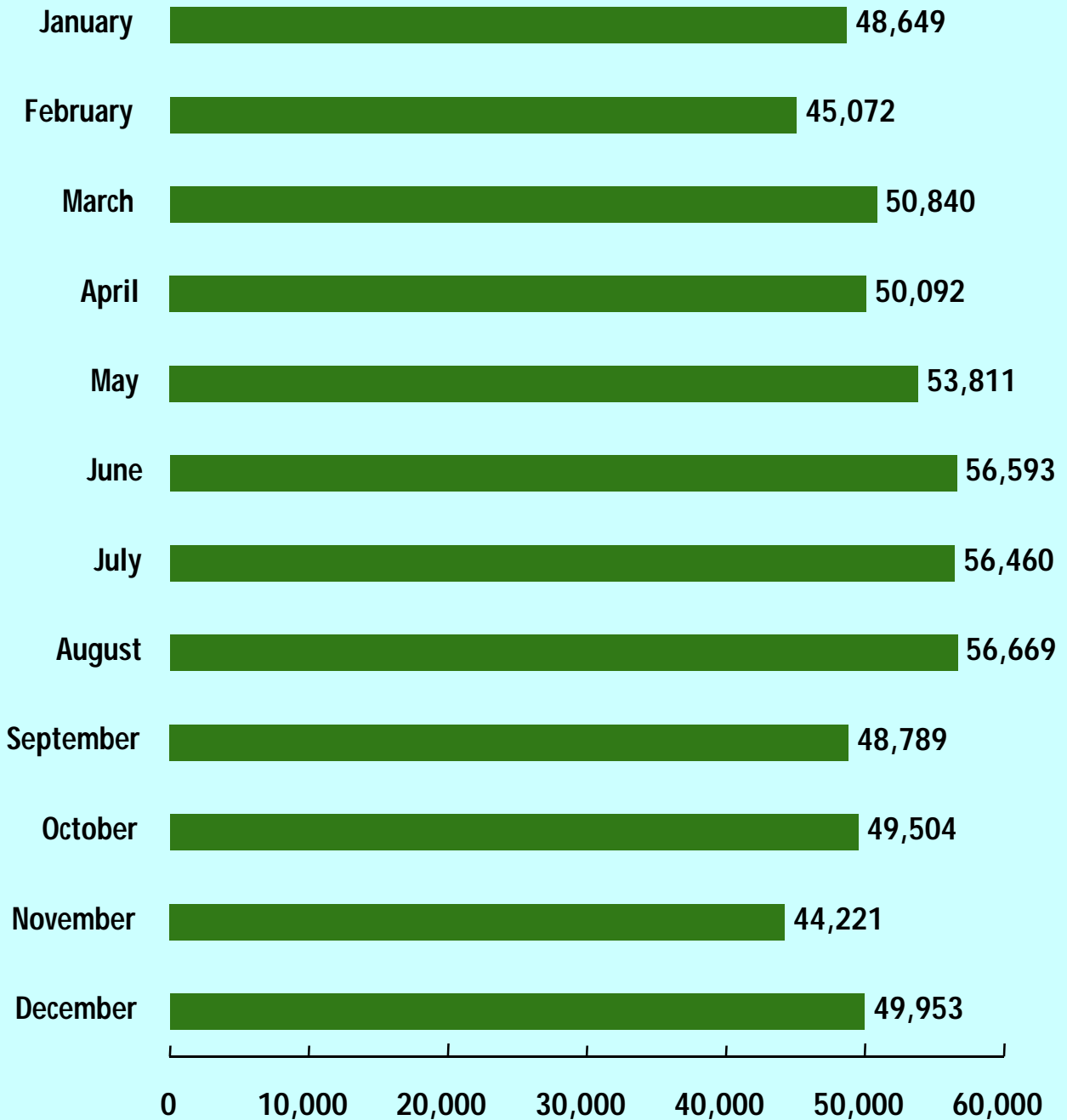
DISPOSAL — A facility where the data reported specifically indicate that the facility is used for the disposal of waste, garbage, or refuse.

UNKNOWN — An incident where there was enough information to classify it as a facility, but the fields needed to determine the type of facility contained no data.

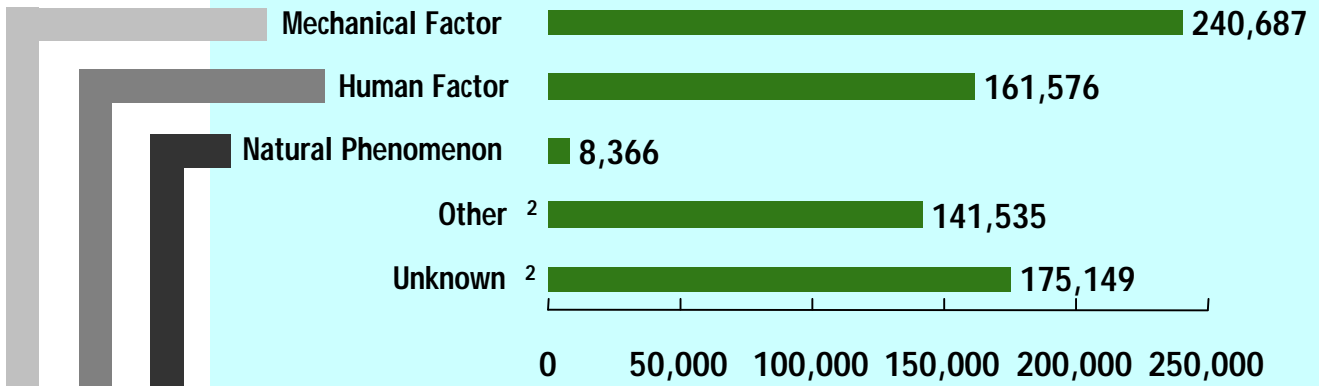
All Chemicals, Less Fuel Products, Associated With More Than 1,000 Incidents in the Ten-Year Period



Number of Chemical Incidents by Month (604,653 Incidents 1987-1996)



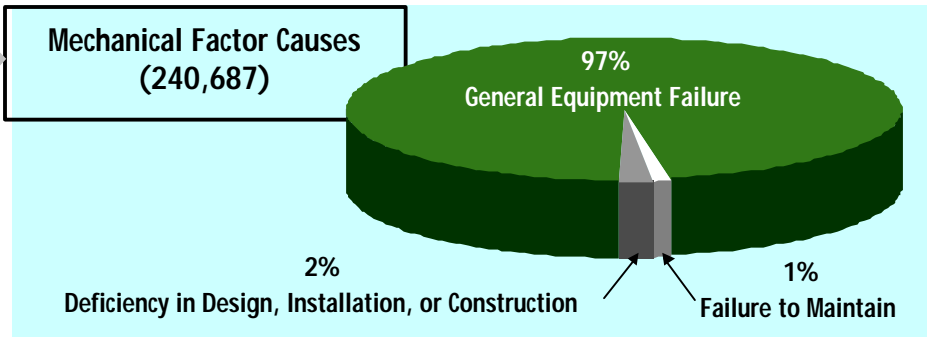
Number of Chemical Incidents by Initiating Event ¹



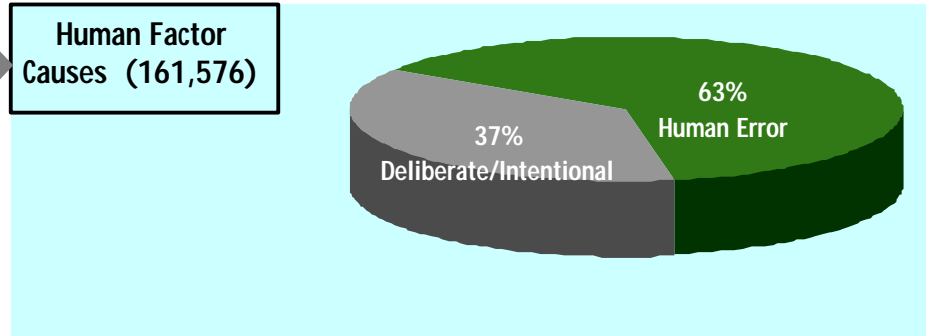
¹ The numbers total to more than the number of incidents as an incident may have more than one initiating event.

² No detail available.

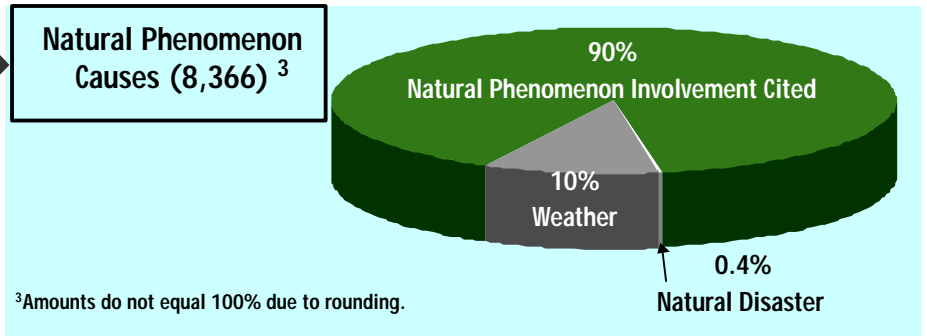
Mechanical Factor Causes (240,687)



Human Factor Causes (161,576)



Natural Phenomenon Causes (8,366) ³



³Amounts do not equal 100% due to rounding.