Hazardous Materials Transportation Incident-Accident Information Systems

MARK ABKOWITZ AND GEORGE LIST

As concern over the safe transport of hazardous materials continues to grow, public officials are placing greater emphasis on the ability to conduct analyses of present practices and future policy initiatives. The capability to do this effectively is directly dependent on the quality and availability of information on previous transport accidents and incidents involving hazardous materials cargo. The objective of this paper is to explore the reporting requirements of hazardous materials transport incidents and accidents and to determine what use is and can be made of the information that is collected and stored. It is generally concluded that the primary reporting system offers considerable information from which to conduct policy analysis. However, the quality of this information has been subject to considerable criticism. Although the secondary sources of data are, in some cases, quite good, the incongruences among secondary databases and with the primary database are such that significant improvements in the primary information system are necessary. Several recommendations are made to improve the quality of hazardous materials transportation incident-accident information. They are not resource-intensive and deserve serious consideration in light of the health threats posed by hazardous materials releases.

As concern over the safe transport of hazardous materials continues to grow, public officials are placing greater emphasis on the ability to conduct analyses of present practices and future policy initiatives. The capability to do this effectively is directly dependent on the quality and availability of information on previous transport accidents and incidents involving hazardous materials cargo.

The objective of this paper is to explore the reporting requirements of hazardous materials transport incidents and accidents and to determine what use is and can be made of the information that is collected and stored. For the purposes of this study, hazardous materials are defined by statute [Hazardous Materials Transportation Act (HMTA)] and by regulation (49 CFR, Part 171.8, 1984) as substances and materials in quantities and forms that the Secretary of Transportation has found may pose an unreasonable risk to health and safety, or to property, when transported in commerce. The approximately 2,400 materials classified as such are listed in 49 CFR, Part 172 *(1)*.

Inclusive in this list are several substances and wastes classified as hazardous in order to coordinate the regulatory program of the U.S. Department of Transportation (DOT) with that of the Environmental Protection Agency (EPA). The primary reason for designating these materials as hazardous is their long-term effects on health and the environment *(2)*. For each substance, EPA has established a "reportable quantity" (RQ) that indicates the quantity and concentration of a chemical that could pose a threat of pollution. RQ's for most substances are 1 lb, although EPA is currently studying the effects of changing the RQ level *(3)*. Packages containing more than the RQ of the hazardous substance are subject to DOT regulation. DOT regulations also apply to hazardous wastes that are subject to EPA's manifest system under the Resource Conservation and Recovery Act (RCRA).

To carry out the regulatory requirements imposed by the HMTA, the Secretary of Transportation established the Office of Hazardous Materials Transport (OHMT), which was formerly known as the Materials Transportation Bureau. OHMT is responsible for regulating hazardous materials transport safety, including bulk transportation by water, which is promulgated by the U.S. Coast Guard [46 USC 170 and 391(a)]. OHMT's responsibilities also include coordination among the various DOT modal administrations and other federal agencies that are involved in the transport of hazardous materials.

The data for analyzing hazardous materials incidents emanate from the reports filed by carriers and others responsible for reporting to various agencies under federal regulations. Each database potentially applicable to the hazardous materials transport problem is described separately in the following discussion. These information sources and their relationship appear in Table 1.

OHMT HAZARDOUS MATERIALS INCIDENT REPORTS (HMIR)

In 1971 this database became the centralized federal system for uniform incident data. Before that time, hazardous materials regulatory authority was divided among the DOT modal administrations. Each agency independently developed criteria reflecting their particular needs for data collection and analysis. A wide range of hazardous materials reporting systems evolved, which resulted in redundant reporting, inconsistencies in definition and coverage, and reporting gaps.

A transportation-related incident is defined as any unintentional release of a hazardous material during transportation, loading or unloading, or temporary storage related to transportation. This includes releases of hazardous wastes and RQ's of hazardous substances discharged during transport *(4)*. Every incident must be reported to OHMT in writing (49 CFR, Parts 171 and 174–177), with the exception of consumer commodities that present only a limited hazard during transportation (ORM-D class), electric storage batteries, and certain

Department of Civil Engineering, Rensselaer Polytechnic Institute, Troy, N.Y. 12180-3590.

TABLE 1 INCIDENT/ACCIDENT DATABASES

Database	Maintaining Agency	Years	Modes	Accidents	Incidents	Exclusive Focus	
						Hazardous Materials	Transportation
Hazardous Materials Incident Reports (HMIR)	Research and Special Programs Administration, DOT	1971–present	All	Yes	Yes	Yes	Yes
Commercial Vessel Casualty File (CVCF)	U.S. Coast Guard	1963–present	Marine	Yes	No	No	Yes
Pollution Incident Reporting System (PIRS)	U.S. Coast Guard	—	All	Yes	Yes	Yes	No
Truck Accident File (TAF)	Bureau of Motor Carrier Safety, DOT	1973–present	Highway	Yes	No	No	Yes
Railroad Accident File	Association of American Railroads	1973–present	Rail	Yes	Yes	Yes	Yes
Air Accident File	FAA	—	Air	Yes	Yes	No	Yes
National Accident Sampling System (NASS)	NHTSA	1983[a]	Highway	Yes	No	No	Yes
Fatal Accident Reporting System (FARS)	NHTSA	1983[a]	Highway	Yes	No	No	Yes
National Response Center	U.S. Coast Guard	—	All	Yes	Yes	Yes	No
NTSB File	National Transportation Safety Board, DOT	—	All	Yes	No	No	Yes
Department of Energy database	Sandia National Laboratories	—	All	Yes	Yes	Yes	Yes
Washington State Accident File	Washington State Utilities and Transportation Commission	—	Highway	Yes	No	No	Yes

[a]"Hazardous materials" flag.

paints and related materials. These exceptions were established in 1981 and have decreased the number of reported incidents considerably. The exceptions, however, do not apply to incidents involving aircraft or those involving the transport of hazardous waste. The written response must be prepared by the carrier on DOT Form F5800.1 and must be submitted to OHMT within 15 days of discovery of the release *(5)*. Although carriers are required to report, any interested party may do so.

An additional telephone-reporting requirement is imposed on carriers when an incident has resulted in one or more of the following consequences as a direct result of the hazardous material:

- Fatality;
- Serious injury that requires hospitalization;
- Estimated carrier or other property damage exceeding $50,000;
- Fire, breakage, or suspected radioactive contamination involving shipment of radioactive material;
- Fire, breakage, or suspected contamination involving shipment of etiologic agents; or
- Situation of such a nature that, in the judgment of the carrier, should be reported.

The telephone report must be communicated immediately to the National Response Center (NRC), which is staffed 24 hr a day by the U.S. Coast Guard, but which handles the reporting of all significant hazardous materials spills under agreements with DOT and EPA. NRC, established in 1974, provides facilities, communication, information storage, and other needs for coordinating emergency response. It has two 24-hr toll-free telephone lines to receive the notifications and several other lines to relay the calls to response agencies that may need to know of the release.

The telephone report must include the following information:

- Name of reporter;
- Name and address of carrier represented by the reporter;
- Phone number where the reporter can be contacted;
- Date, time, and location of the incident;
- Extent of injuries, if any;
- Classification, name, and quantities of hazardous materials involved, if such information is available; and
- Type of incident and nature of hazardous materials involvement and whether a continuing danger to life exists at the scene.

This information is transmitted to the Transportation Systems Center every evening, where it is subsequently retained and managed by OHMT.

In many cases, carriers have made their telephone contact with CHEMTREC, a chemical transportation emergency center established in 1971 by the Chemical Manufacturers Association. On request, CHEMTREC provides referrals to those at the site of a transportation emergency involving hazardous materials. Since 1980, CHEMTREC has been officially required to notify the NRC of "significant" hazardous materials transportation incidents, those that cause, or have the potential for causing, considerable harm to the public or the environment. Despite this cooperative arrangement, a call to CHEMTREC only fulfills the NRC telephone reporting requirements, but it does not fulfill the federal written-report requirements.

Although spill reporting is a regulatory requirement, in practice it is handled on a voluntary basis. The incentive for

reporting as required is to avoid the possibility of a civil or a criminal penalty; the latter can be imposed if a person knowingly commits an act that violates an HMTA regulation. Civil penalties, which are more common than criminal penalties, can include a liability of up to $10,000 per violation, or one years' imprisonment, or both. Criminal penalties can be a fine of up to $25,000 or five years' imprisonment, or both.

However, because OHMT has very few inspectors to ensure compliance with these reporting requirements, and there is a general shortage of inspectors within the DOT modal administrations, it is basically agreed that the federal enforcement program does not by itself create an adequate deterrent to violations of the reporting requirement. It has also been suggested that even when violators are penalized, the level of the penalty is insufficient to deter future violations. The reason is that the costs of compliance are greater than those of the infrequent penalties. Thus, some operators may consider penalties to be merely an occasional cost of doing business *(2)*.

In support of this claim, it has been estimated by one source that 30 to 40 percent of reportable hazardous materials incidents are never reported (S. W. Ballou, Iowa Department of Water, Air, and Waste Management, May 1985). A recent study conducted by the Office of Technology Assessment (OTA) has found that the nonreporting problem may be even more acute than previously estimated *(6)*. EPA Region 7 officials have independently estimated that only about 10 percent of reportable releases under 100 gal are reported to EPA, the states, or the NRC if the substance released is not extremely hazardous. If 5 gal of an extremely hazardous substance were spilled, it would probably be reported; 90 percent of releases over 100 gal are reported; and 20 percent of all releases of polychlorinated biphenyl (PCB) are reported *(3)*. Transport-related incidents constitute 26 percent of the incident reports compiled by EPA *(7)*.

This information system has also been the subject of considerable criticism from the General Accounting Office (GAO) for the following reasons *(8)*:

1. OHMT is not receiving reports on all incidents because it relies on voluntary reporting from carriers;
2. Companies involved only in the loading, unloading, or storage of hazardous materials (e.g., shippers, freight forwarders) are not required to submit hazardous materials incident reports;
3. Reports are not required by OHMT for incidents involving hazardous materials shipped in bulk by water;
4. DOT has elected not to regulate firms involved only in intrastate transportation or to require them to submit hazardous materials incident reports;
5. OHMT has no systematic procedure for refining reported data that are incomplete or inaccurate; and
6. Because of the time limit on reporting and because only the carrier's perspective is solicited, the total consequence of an incident can be understated significantly.

Each of these factors works to understate the overall impact of hazardous materials transportation incidents in the United States.

Illustrations of these disparities have been noted in studies by GAO and others. GAO selected 30 hazardous materials transport incidents between 1976 and 1979 and requested OHMT data on them. OHMT had received reports for only 12 of the incidents. The 18 unreported incidents, according to news reports, resulted in 18 deaths, 9 missing persons, and at least 187 injuries. Concerning damage estimates, in investigations of five accidents involving the transport of hazardous materials between 1972 and 1979, the National Transportation Safety Board (NTSB) estimated the overall damage to be $42 million as compared to an estimate of $10.1 million from OHMT reports *(9)*. A more detailed study on nonreporting and misreporting conducted by OTA has substantiated these disparities *(6)*.

Despite the objections to the HMIR database, in many respects it serves as the most relevant database for conducting hazardous materials transport incident and safety analysis. The HMIR database is the only one exclusively devoted to hazardous materials transport incidents, and as such, it includes a number of descriptors that can be used to examine issues in packaging, labeling, cause, and public safety that might not otherwise be possible.

If the deficiencies in the database are accepted as stated, the total volume of hazardous materials incidents is underestimated. However, for the purposes of deriving distributions of events, causes, and consequences, and for some multimodal comparative analyses, the HMIR database may still be representative. The approximately 135,000 records that now make up the HMIR database may permit comprehensive analysis on the basis of statistical considerations.

SUPPLEMENTARY DATABASES

Independent of the OHMT incident-reporting system are several accident-reporting systems maintained by various DOT modal administrations. The term "accident" refers to a vehicular accident; most hazardous materials transport incidents are not caused by vehicular accidents. These reporting systems have been designed to cover all transportation accidents under the jurisdiction of the respective modal administrations, not just those involving hazardous materials. In most cases, however, there are special identifiers in the reporting format to permit the designation of an accident that involves hazardous cargo. This may be a particularly important form of secondary data, because the accident reports are usually based on an independent set of reporting procedures from the OHMT procedures, and thus are not subject to the same deficiencies as those noted for the OHMT information system.

Several sources of information outside of DOT also exist that, in some fashion, address the subject of incidents and accidents involving the transportation of hazardous materials.

Modal Administrations

In addition to coordinating activities with OHMT, the DOT modal administrations conduct their own record-keeping procedures for accidents under their purview. In many cases, the capability exists to isolate accidents that involve the transport of hazardous materials.

U.S. Coast Guard

The Coast Guard maintains two databases that include recognition of accidents or incidents, or both, involving hazardous

materials: the Commercial Vessel Casualty File (CVCF) and the Pollution Incident Reporting System (PIRS).

CVCF includes vessel accidents (domestic and foreign) occurring in U.S. waters that meet one or more of the following reporting criteria:

- Actual physical damage to property in excess of $25,000;
- Material damage affecting the seaworthiness, maneuverability, or efficiency of a vessel;
- Stranding or grounding (with or without damage);
- Loss of life; or
- Injury causing any person to remain incapacitated for a period in excess of 72 hr, except injury to harbor workers not resulting in death and not resulting from vessel casualty or vessel equipment casualty.

These data have been collected since 1963, and the only major reporting changes have been a move to an alphanumeric format in 1980 and a change in the damage threshold in August 1982 from $1,500 to $25,000. Categories in each record include vessel characteristics, event, cause, fatalities or injuries, and monetary damage. The major deficiency in the file is the lack of a commodity classification in the database. However, there are specific vessel codes that indicate whether the vessel was carrying hazardous cargo *(10)*.

The PIRS database consists of reports generated as required by the Federal Water Pollution Control Act (1965) and the Comprehensive Environmental Response, Compensation, and Liability Act (1980) (CERCLA). It includes all polluting spills into U.S. waters, including those occurring during transport. There is a special identification for transport-related spills, and materials are identified by name, so hazardous substance spills during transport can be tracked. The database also includes the quantity released, cause of the incident, and the date and location. In addition, the file contains potential incidents in which the Coast Guard was informed but a spill did not materialize *(11)*.

According to Coast Guard officials, the PIRS database is rather unreliable because of unedited files in which major errors often appear. Furthermore, only closed cases are available for analysis from the database, so recent cases—those that are tied up in the courts and those for which the Coast Guard district has neglected to update the file to show that a case has been closed—are not available and bias any conclusions reached by using the data. The Coast Guard is in the process of designing methods to address these problems.

The Coast Guard databases may be viewed as filling a rather obvious gap in the HMIR database, which is particularly weak in the marine mode. This is due in part to the lack of OHMT regulatory enforcement of bulk movements shipped by water.

Federal Highway Administration

FHWA's Bureau of Motor Carrier Safety (BMCS) maintains a database on accidents that has been operational since 1973. It includes any motor carrier accident in which a fatality or injury occurred or for which there was at least $2,000 in property damage. Reports are filed on Form 50-T, the format of which has remained relatively stable through the years. The BMCS database includes carrier identification and address, location of the incident, characteristics of the event, cause, information on the cargo, and consequences of the accident. The carrier identification, cargo description, and certain accident characteristics are such that congruence between the HMIR database and BMCS database may be achievable for incidents caused by vehicular accidents.

Federal Railroad Administration

FRA maintains its own accident-incident database from information generated by railroads, inspectors, and OHMT. Although the database includes events earlier than 1974, access to the pre-1974 data is rather difficult. The information included is similar to that described for the Coast Guard and FHWA databases. FRA has its own definition of incidents and accidents. An incident is an event that results in a death, reportable injury, or property damage. If the event results in a death or reportable injury and if damages exceed a threshold of $4,900, the event is classified as an accident. The threshold value has been increased by FRA over the years to approximate constant real value.

FRA performs a number of internal consistency checks to strengthen the validity of the database. These include the elimination of double-counting of events when more than one railroad files a report, spot checks of suspicious events, and occasional audits of railroad internal records.

During the past 10 years, more than 80,000 records have been included in the FRA file. Approximately 1,000 of these have involved releases of hazardous materials.

FRA also maintains an OHMT-enhanced database on hazardous materials incidents. The enhancements include the addition of accident location information, railroad code, and Standard Transportation Commodity Code (STCC) designation.

Federal Aviation Administration

The FAA maintains a computerized accident-incident database at their National Field Office in Oklahoma City. It consists of air accidents officially reported to NTSB and reports filed by FAA field inspectors. FAA makes a distinction between an accident and an incident on the basis of the dollar damage incurred in the reported event. The FAA database includes the pilot involved, the carrier, time of day, and other descriptors such as contributing circumstances and accident (incident) severity. Apparently it is possible to identify hazardous materials accidents and incidents in this database, because, according to FAA officials, 11 accidents and incidents involving hazardous materials have been reported in the past 5 years.

National Highway Traffic Safety Administration

NHTSA's National Center for Statistics and Analysis maintains accident data on police-reported accidents, including those that resulted in nonfatal injury or property damage, or both. The data are typically collected by each state under contractual agreement with NHTSA.

The file of reported accidents, called the National Accident Sampling System (NASS), was developed to provide an automated, comprehensive national traffic accident database. The accidents investigated and recorded in NASS are a probability sample of all police-reported accidents in the United States

(12). The data collection for a NASS-selected accident is very involved and includes characteristics of the accident, driver, occupants, and vehicle. Although the specific commodity being carried is not described, sufficient information exists to track accidents that are likely to have contained hazardous materials cargo. In fact, recently a hazardous materials "flag" has been added to the record description. However, outside of the date and location of the accident, there appears to be little or no congruence with the data collected by OHMT. Even so, the characteristics of the driver, road, and traffic may be important determinants of hazardous materials accidents for which OHMT does not have the appropriate information.

Those accidents that result in loss of human life are classified separately in the Fatal Accident Reporting System (FARS). The FARS file contains data on vehicles and persons involved in fatal accidents, defined as an event in which an accident-related death occurs within 30 days of the accident *(13)*. FARS is not a national sample; rather, it includes all fatal traffic accidents that are reported in the United States. Other than this distinction, however, the information collected parallels the NASS data and is subject to the same critique as that noted previously.

Other Useful Databases

The following information systems may also be useful in analyzing hazardous-materials transport safety. They are maintained by other federal agencies, state and local agencies, carriers, and trade organizations.

National Response Center

Although telephone reports to NRC are primarily intended to stimulate a response, the information provided in these reports can be used for policy analysis. Data items include the location of the incident, mode of transportation involved, material involved, and quantity released. The material definitions are coded differently than those in the HMIR, and causal factors are not considered in any fashion. However, the NRC database does provide a more balanced portfolio of incidents by various modes, particularly with regard to marine transport.

Environmental Protection Agency

EPA regional offices have personnel to receive notifications of releases of hazardous substances. These notifications are integrated into a regional incident-reporting system. Typical reports include the incident date, company involved, spill location, nature of the emergency, material spilled and volume, source of the spill, responding agency, nature of the response, and resolution. In the case of EPA Region 7, this information is in a computerized file.

EPA also receives the NRC reports and uses this information in concert with incidents reported to EPA regional offices, states, and local governments to formulate regulatory policy. Attempts are now being made to use the NRC reports as a management information system to support EPA initiatives.

National Transportation Safety Board

NTSB receives the NRC telephone reports, which are used to determine whether to proceed with an investigation. NTSB's investigation of transportation accidents is a multimodal activity. Their jurisdiction for conducting an investigation is based on the definition of a major vehicular accident as given for each mode in CFR 49.

An NTSB investigation begins with a multiple-day field investigation involving the shipper, carrier, government agencies, associations, and other interested parties. A report is subsequently generated that goes through several cycles of review and comment before it is finalized. The primary purpose of the report is to make recommendations to improve transportation safety on the basis of findings from the accident investigation.

A major advantage of the NTSB process is that the investigations involve other participants besides the carrier, are extremely thorough, and take place over a longer time frame, so that the full impact of the accident can be more accurately identified. As noted by GAO in their critique of the HMIR database, the damages reported by the carrier to OHMT often substantially underestimate those reported by NTSB *(8)*.

NTSB does maintain a database on the vital statistics of each investigated accident. Railroad and aviation accidents are stored in computer files. Highway and marine accidents are stored on coding sheets but have not as yet been logged into the computer system.

Department of Energy

The Department of Energy (DOE) maintains a database on all radioactive materials incidents based on the HMIR file and information from the Nuclear Regulatory Commission on the loss of control of radioactive materials. The database consists of approximately 70 percent HMIR records and 30 percent Nuclear Regulatory Commission records. It is on line, and is maintained by Sandia National Laboratories.

Nuclear Regulatory Commission

Besides the aforementioned activity, the Nuclear Regulatory Commission is the lead agency in conducting investigations of transport accidents involving radioactive materials. These investigations have focused on mechanical analyses of the containers involved in the accident for the purpose of improving their safe use in transporting radioactive materials *(14–17)*.

State and Local Agencies

Accident-incident databases maintained by state and local agencies vary considerably depending on the authorities involved and the level of commitment that has been made to managing the hazardous materials transport problem.

On the basis of limited observation, state and local agencies appear to be more directly involved in accident-reporting systems than in incident-reporting systems and focus much of their attention on the highway mode. This likely is due to the role of the state and local police in reporting traffic accidents and a more established and coordinated network of accident management. Some states do, however, have mandatory reporting of hazardous substance releases similar to CERCLA requirements, although many local agencies are unaware of these reporting requirements *(2)*.

However, there have been state and local attempts to focus on hazardous materials incidents. Much of this activity has been funded by OHMT in the form of demonstration projects to examine capabilities for hazardous materials accident prevention and emergency response.

The first of these projects, completed in 1981, was conducted by the Puget Sound Council of Governments (PSCOG). As part of its study, PSCOG examined hazardous materials movements and incidents within the region. Subsequent projects have been conducted by the state of Massachusetts; the cities of New Orleans, Memphis, and Indianapolis; the Association of Bay Area Governments (San Francisco); and Niagara County, New York. Although the grantees have, in some cases, made efforts to collect incident data from local sources, often the HMIR database has been accessed to identify incidents that have occurred in the study region *(18)*.

Other state and regional projects have explicitly examined hazardous materials incidents, but have relied heavily or exclusively on HMIR for their data. These include an analysis of hazardous materials transport by rail conducted by the state of New Jersey *(19)* and a multimodal study of the transportation of hazardous materials in the New York–New Jersey region *(9)*.

At the state level more-sophisticated applications center around the use of computerized accident record-keeping systems used in concert with flow data to determine accident rates and high-risk locations in the highway network. In the states of Utah, Washington, and New York, for example, computerized accident record-keeping databases are maintained that contain police accident investigation reports. Typically, these reports include, when a heavy truck is involved, the carrier name, vehicle type, contributing circumstances, accident severity, and so on. In the case of the state of Washington, the type of cargo (United Nations Code) is also included.

This type of database permits the extraction of heavy-vehicle accidents in which hazardous cargo was involved (or was likely to have been involved). This information can be portrayed against movement data to determine accident rates of vehicles transporting hazardous cargo, which can subsequently be used in the computation of transport risk profiles and the identification of safer procedures for routing hazardous materials. Although the capability to do this exists in the states of Washington and New York, the fragmented location of accident and movement data and their relationship with the offices responsible for policy analysis have served as constraints. These states are, however, moving in the direction of conducting improved analyses with those data that they collect and maintain.

The state of Maryland has largely overcome these problems. Several years ago, Maryland began a surveillance system of hazardous cargo movements at multiple checkpoints and different times of the day. It also instituted a state incident-reporting system by which any hazardous materials incident resulting in a reported spill is entered into the database. These two sources of information are subsequently compared to determine the level of hazardous materials transport safety in the state. This information has been used to successfully demonstrate a preferred nuclear materials routing system in Maryland. It should be noted that the accomplishments in Maryland have come after 10 years of activity and significant coordination among state agencies.

Carriers

Virtually all carriers retain copies of reports on accidents and incidents that they have filed with the appropriate authorities. However, personal contact with a few carriers has shown that the method used for reporting information on Form F5800.1 is rather arbitrary. For example, there was a consensus among carriers that the primary purpose of the form was to record an incident, but not to establish the accuracy of the details involved in the incident. For example, if the damage is rather small, it is often reported as no damage. Furthermore, when the damage is measurable, the carriers usually report the out-of-pocket cost and often include only the loss of cargo and not the cleanup cost.

In fact, beyond the reporting requirement to OHMT, there is little evidence that the incident reports are usually internally for any analysis purposes, not even for safety of operations. The carriers who were contacted also indicated that the 15-day reporting requirement is too short and that it is inappropriate for the carrier to assume the reporting requirement for loading and unloading incidents because they do not perform this function and often are unaware that an incident has occurred or do not know the details concerning it.

Association of American Railroads

The Association of American Railroads maintains its own hazardous materials incident database; the sources used are the inspector, the railroad, Form 5800.1, CHEMTREC, and telephone reports. Information includes date, incident location, incident type, source of the data, deaths and injuries, and estimated damage. The damage estimates can be segmented by equipment, lading, and fire and other damage. This database dates back to 1973.

REGULATORY USES OF DATABASES

The previously described databases serve a very important purpose for DOT, its modal administrations, and other agencies in terms of inspection, enforcement, and equipment requirements.

The size of the community involved with hazardous materials regulation is such that inspection of every facility, manufacturer, shipper, carrier, and so on, is infeasible, and modal administrations are required to use a variety of criteria to determine how best to deploy their finite inspection resources. As a rule, violation and incident experience are the indicators most frequently used to identify areas on which to concentrate their inspection efforts. The Coast Guard, for example, has redirected its inspection efforts toward "high-priority" vessels, the definition of which includes a vessel with a previously reported hazardous materials incident. BMCS and FRA also use selection criteria to determine inspection priorities, which are based in part on incident experience *(5)*.

Statistics generated by the hazardous materials incident databases are also used internally to measure program effectiveness, to improve prevention by identifying and analyzing causes and events, and for general regulatory and enforcement analysis. For example, OHMT is interested in the data for regulatory evaluation concerning packaging requirements.

BMCS uses its database for cargo container analyses. In the case of the railroad industry, DOT has used incident-accident data to examine container specifications for tank cars. This resulted in amendments to CFR 49 requiring thermal protection or insulation against external fire sources, tank-head protection against punctures, coupler modifications to resist disengagement, and other improvements to new cars or to existing equipment used to transport hazardous chemicals under pressure *(20)*.

There is reason to believe that incident-accident databases can be used to improve emergency response and disaster preparedness. For example, knowledge of locations with high accident frequency and of the flow of hazardous materials provides communities with a better understanding of the probability of an incident and the materials likely to be involved.

There has also been a broad set of requests for both accident and incident data from the private sector, including the legal profession, industry analysts, private citizens, consultants, and university researchers. In most cases, these are handled through distribution of a hard copy of the requested materials. Some databases are also accessible through on-line query by telephone access.

CONCLUSIONS AND RECOMMENDATIONS

This paper has focused on the reporting and data collection of accidents and incidents involving hazardous materials transport. As noted, the regulatory environment has evolved to a point at which OHMT should be the repository of information on hazardous materials transport incidents. Data collected by DOT modal administrations focus more generally on vehicular accidents, yet permit the identification of accidents that involve hazardous materials. Other databases serve to identify accidents and incidents involving hazardous materials. Because of this connectivity capability, the availability of these secondary databases in a supporting role is invaluable.

The HMIR database maintained by OHMT has become the best source of data on the causes, events, and consequences surrounding hazardous materials incidents. However, several reporting and data collection deficiencies exist that make it difficult to conduct unbiased analyses of hazardous materials transport incidents and safety without additional verification. The most useful sources of additional verification appear to be the NRC telephone reports, NTSB investigations database, state and federal agency accident files, and other related databases.

The NTSB damage estimates and probable causes are likely to be more accurate than those reported to OHMT within 15 days by the carrier. The number of incidents and accidents involving hazardous materials that go unreported to OHMT can be identified, in some respects, by examining accident reports filed with the modal administrations, state agencies, and NHTSA and incident reports filed with NRC, and comparing them with incidents reported in the HMIR file (even after this process, the number of unreported events may still be significant). This is particularly important in the case of the marine mode, for which reports on incidents involving hazardous materials transported in bulk are not requested by OHMT.

Although the additional sources of information are extremely important, in practice it is quite difficult to establish congruence among any of the databases. There are several reasons for this, the most important of which are different definitions of accidents and incidents, criteria for a reportable event, ability to track a hazardous cargo movement, and level of detail concerning specific commodity, contributing factors, consequences, and so on. Thus, the secondary data are not an adequate substitute for an improved primary information system.

A number of suggestions have been made to improve the accuracy and completeness of hazardous materials incident reporting. These recommendations focus on the contents of the incident report form, criteria and procedures for incident notification, and internal management of reported information *(6)*.

For example, the format of Form F5800.1 could be modified so that it is more standardized and does not allow too much flexibility in response, which has led in the past to incomplete reports and subjective judgments by OHMT data entry clerks. This would also simplify the data entry process and diminish the likelihood of redundant codes for the same data entry field. The amount of information required on Form F5800.1 does not appear to be excessive when contrasted with other incident-accident reporting systems, and could actually be expanded to include a few additional characteristics of the incident, if desired.

OHMT should work to change the idea that incident reporting is voluntary by policy initiative or by new legislation requiring mandatory reporting of incidents meeting the reporting criteria. In order to enforce more stringent requirements, the severity of penalties for noncompliance must be increased substantially. In response to issues raised by carriers, it would be beneficial to extend the reporting limit beyond 15 days, and perhaps also require shippers and receivers to file written reports when incidents involve loading or unloading operations.

Finally, OHMT management should focus internally on improving the completeness of filed reports, identifying and mediating misreporting, and identifying and prosecuting unreported incidents that meet the OHMT reporting criteria. This requires the cooperation of other government agencies in the form of data sharing and perhaps minor modification to their own reporting practices.

None of these recommendations are resource-intensive; in some cases, only one-time developmental expenses would be incurred. In light of the inadequacies in the current information system, this is a relatively inexpensive program for establishing a comprehensive basis for monitoring and regulating safety in the hazardous materials transport industry.

ACKNOWLEDGMENTS

The findings reported in this paper were based on research conducted for the Office of Technology Assessment of the U.S. Congress. The authors wish to express their appreciation for the advice, guidance, and technical assistance provided by Edith Page, OTA's director of the hazardous materials transportation study. They would also like to thank Betty Alix for her assistance in the preparation of this document.

REFERENCES

1. *Special Report 197: Transportation of Hazardous Materials: Toward a National Strategy*, Vol. 1. TRB, National Research Council, Washington, D.C., 1983.
2. *Hazardous Materials Transportation: A Legislator's Guide*. National Conference of State Legislatures, Washington, D.C., Feb. 1984.
3. *Economic Analysis of Reportable Quantity Adjustments Under Sections 102 and 103 of the Comprehensive Environmental Response, Compensation and Liability Act*. ICF, Inc., March 1985.
4. *Guide for Preparing Hazardous Materials Incident Reports*. Materials Transportation Bureau, U.S. Department of Transportation, Sept. 1980.
5. *A Guide to the Federal Hazardous Materials Transportation Regulatory Program*. U.S. Department of Transportation, Jan. 1983.
6. M. Abkowitz and G. List. *Hazardous Materials Transportation: Commodity Flow and Incident/Accident Information Systems*. Final Report. Office of Technology Assessment, Jan. 1986.
7. W. J. Keffer. *Incident Activity Report, Periods Covering June–August 1985, EPA Region 7*. Environmental Protection Agency, Washington, D.C., 1985.
8. *Programs for Ensuring the Safe Transportation of Hazardous Materials Need Improvement*. General Accounting Office, Nov. 1980.
9. R. D. Scanlon. *A Regional Study on Hazardous Material Transportation*. Howard S. Cullman Fellowship 1982–1983 Report. Port Authority of New York and New Jersey, World Trade Center, New York, 1984.
10. *Coding Instructions for the Automated File of Commercial Vessel Casualties*. U.S. Coast Guard, Feb. 1984.
11. *Polluting Incidents In and Around U.S. Waters, Calendar Year 1981 and 1982*. U.S. Coast Guard, Dec. 1983.
12. *National Accident Sampling System (NASS): Analytical User's Manual*. NHTSA, U.S. Department of Transportation, 1981.
13. *Fatal Accident Reporting Systems (FARS): User's Guide*. NHTSA, U.S. Department of Transportation, Aug. 1981.
14. Lawrence Livermore National Laboratory. *Mechanical Analysis of a Transportation Accident Involving Empty Shipping Casks for Radioactive Materials Near Hilda, South Carolina in November 1982*. Report NUREG/CR-3452. Nuclear Regulatory Commission, Oct. 1983.
15. Lawrence Livermore National Laboratory. *Simulation of Loading Conditions for a Type A Package Containing Americium-241 Involved in an Airplane Crash at Detroit Metro Airport in January 1983*. Report NUREG/CR-3536. Nuclear Regulatory Commission, Jan. 1984.
16. Lawrence Livermore National Laboratory. *A Highway Accident Involving Radiopharmaceuticals Near Brookhaven, Mississippi on December 3, 1983*. Report NUREG/CR-4035. Nuclear Regulatory Commission, April 1985.
17. SRI International. *Mechanics of a Highway Accident at Wichita, Kansas Involving Natural Uranium Concentrate*. NUREG/CR-0992 Nuclear Regulatory Commission, Aug. 1979.
18. *Demonstration Project to Develop a Regional Hazardous Materials Accident Prevention and Emergency Response Program*. Emergency Management Division, City of Indianapolis, Indiana, Oct. 1983.
19. *Incidence and Movement of Hazardous Materials in New Jersey*. Office of Freight Services, New Jersey Department of Transportation, Trenton, Dec. 1984.
20. *Transportation of Hazardous Materials*. Public Technology, Inc., Washington, D.C., Sept. 1980.

Publication of this paper sponsored by Committee on Transportation of Hazardous Materials.