Chapter 4

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Planning to prevent accidents and to improve emergency response requires information on the nature of hazardous materials accidents that might occur, the areas of highest risk, and the types of materials most likely to be involved. Until recently, State and local officials had scant information of this sort, but many have now initiated studies documenting the amount and types of hazardous materials stored within or moving through their jurisdictions to help develop plans for accident prevention and emergency response. This chapter describes State and local efforts to gather and analyze hazardous materials data for planning purposes and identifies related issues.

The impetus for gathering information and planning is often a hazardous materials incident for which a jurisdiction found itself ill-prepared. A 1979 chemical plant fire in downtown Memphis prompted the mayor to initiate a planning and data collection program. When Memphis became a part of a U.S. Department of Transportation (DOT) demonstration program, the city used DOT funds to expand and refine the effort. Release of phosphorous trichloride from an overturned railroad car in Somerville, Massachusetts, caused 400 people to seek medical attention and was the catalyst for the Commonwealth to undertake a planning study with the goal of improving emergency response procedures. Other jurisdictions have become sensitive to the danger of hazardous materials accidents because they are transportation centers or major corridors of hazardous materials traffic.

Photo credit: Research and Special Programs Administration, DOT

Information on the type of hazardous materials stored for distribution in a community is important for planning and emergency preparedness.

Starting in 1981, the Office of Hazardous Materials Transportation within DOT sponsored studies in seven jurisdictions on a wide range of issues related to hazardous materials transportation; these studies were to lead to development of comprehensive management plans to serve as models for other localities. The seven jurisdictions were: the Central Puget Sound Region; the San Francisco Bay Area; Indianapolis; Memphis; New Orleans; Niagara County, New York; and the Commonwealth of Massachusetts. The sites represented a range of population sizes, locations, types of political units, and levels of existing planning. All plans covered four general topics: hazard identification, assessment of local capabilities, prevention, and response. Each plan reflects local economic conditions, perceived needs, and other demographic characteristics.

To collect information for this chapter, OTA examined a variety of sources. The seven DOT demonstration projects and the studies carried out by States under the State Hazardous Materials Enforcement Development (SHMED) Program were particularly valuable. So, too, was a multimodal study prepared for Virginia, which represents an early attempt by a State to collect comprehensive information on hazardous materials movements by all modes of transportation, At the municipal and regional level, OTA reviewed a hazardous materials transportation study recently completed for the New York City area and the preliminary results of studies now in progress in Houston and Denver. In addition, federally funded studies of monitoring and enforcement ef-

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forts for transport of radioactive materials were examined.

States that have undertaken hazardous materials data collection and planning studies have used a variety of Federal funding sources, including SHMED program monies and Federal Highway Administration (FHWA) planning funds, as well as their own resources. However, aside from the DOT demonstration sites, local governments have found funding such studies difficult. No Federal program currently exists specifically for local planning studies, and State planning efforts remain concentrated at the State level.[1] State responsibility for planning is often scattered among several departments, complicating local officials' efforts to obtain funds. Planning officials complain that they cannot get local funds for accident prevention and emergency response planning until an accident occurs. All local planning studies and data collection efforts have depended primarily on outside financial support. Typically, little or no information is gathered prior to receiving a funding grant, and once the grant expires, sustaining staff efforts becomes difficult. OTA found that acquiring data for planning remains a significant problem for many local jurisdictions.

[1]Thomas White, City Council member, Greenbelt, MD, in U.S. Congress, Office of Technology Assessment, "Transcript of Proceedings—OTA Workshop on State and Local Activities in Transportation of Hazardous Materials," Washington, DC, May 30, 1985, p. 155.

DATA COLLECTION ACTIVITIES

Federal Data Collection

Numerous Federal offices have responsibility for hazardous materials data collection, although only those relevant to State and local needs are discussed here. DOT information-gathering efforts include:

- Research and Special Programs Administration, Office of Hazardous Materials Transportation: collects data on incidents (spills) by all modes except bulk water.
- U.S. Coast Guard: collects accident and spill data for waterborne commerce.
- Federal Railroad Administration: collects rail accident data.
- Federal Aviation Administration: collects data on aviation accidents and spills.
- FHWA, Bureau of Motor Carrier Safety: collects accident and incident data on highway transportation.

The Bureau of the Census and the Interstate Commerce Commission collect commodity flow data. The Census Bureau's Commodity Transportation Survey contains useful multimodal information on all commodity shipments, but, as it is conducted only once every 5 years, its information is not current. Furthermore, it is difficult to extract information on hazardous materials shipments. In addition, the information requested of the responders varies with each survey, so trend analysis is difficult. The Interstate Commerce Commission collects railroad waybill data, which can be analyzed to yield commodity flow data about hazardous materials shipped by rail.

The format of each of these commodity flow databases makes them so difficult to compare that they are not useful to State and local governments. For example, hazardous materials information is not distinct from other commodities; identification of the commodities is often too imprecise to determine whether hazardous materials is involved; there is no information on routing; the codes used to identify the hazardous materials commodities are not the same in each database; and no officially recognized cross-reference table exists to permit integration of data from different databases.

State and Local Studies

No single best approach to State and local data collection emerged from OTA's research. When a State undertakes a study, a lead agency is usually designated, often the Department of Transportation or State Police, with assistance provided by an office of emergency preparedness or comparable agency.

For cities, municipal planning staffs, private consulting firms, or university-based research groups do most of the data gathering and analysis. For example, a New Orleans planning study was conducted by a member of the mayor's staff hired with grant funds, and the knowledge accumulated during the study continues to be a major asset for the city. Fire departments are the other local public agency most frequently involved in data gathering.

Techniques and results vary according to the local situation and experience and the particular interests and resources of the agencies involved. Nonetheless, it has been possible to identify the types of data that have been found useful, effective methods, and commonly encountered problems. The following kinds of studies have been found to provide the background information necessary for planning and emergency preparedness:

- Inventory of hazardous materials stored at fixed facilities: Records the quantity and type of hazardous commodities stored in manufacturing, wholesaling, distribution, or storage facilities within the jurisdiction. Data are obtained by means of questionnaires, interviews, and inspections, and from public records, such as fire inspection records and business tax records.
- Hazardous materials transportation analysis: Identifies the quantities and types of hazardous materials transported through the jurisdiction by each transportation mode and the most frequently used routes. Data are gathered by questionnaires, roadside inspections, and review of company records.
- Hazards assessment or identification of hazards and high-risk locations: Analyzes factors such as population density, transportation system characteristics, and past incidents to determine where the risk of a hazardous materials incident is greatest or where the impact would be the most severe.

An inventory of fixed facilities is usually the first step in the data-gathering process. Any second step is usually a transportation analysis. Hazards assessment is usually last since it draws on data collected in the first two studies.

FIXED FACILITIES INVENTORIES

Knowledge of the extent and nature of hazardous materials manufacture and storage in the community is essential for prevention and response planning. Local governments have found that a facilities inventory can guide the purchase of equipment, conduct of training, location of response facilities, and assignment of personnel; and it provides a good indication of the type of hazardous material transported in the jurisdiction. Despite the importance of data on fixed storage sites, however, none of the seven jurisdictions taking part in the DOT demonstrations had previously compiled this information, although some had partial data as a result of regulatory requirements pertaining to nuclear materials, hazardous wastes, air pollution, or routine fire inspection procedures.

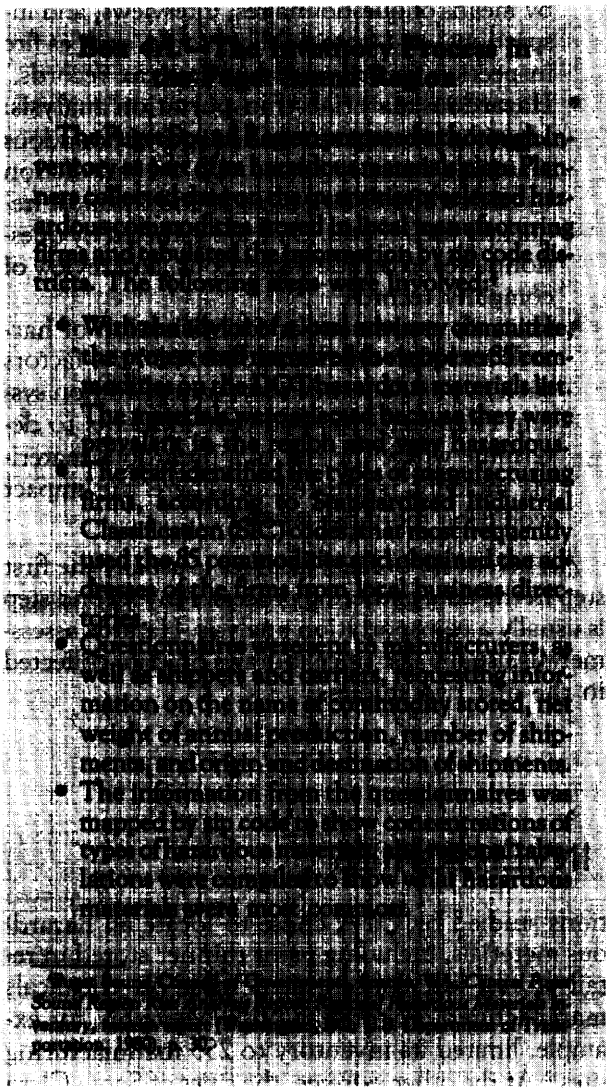
Local and Regional Inventories

One of the first decisions necessary in undertaking a hazardous materials inventory is what should be inventoried and in what detail. Some jurisdictions studied by OTA chose to locate all hazardous materials, including paint thinner stored in retail stores, but concentrated most on chemicals manufactured or stored in bulk. Memphis, for example, limited its inventory to 255 manufacturing sites.[2] At the other extreme, the cities of Santa Clara County, California, inventoried all materials identified by DOT as hazardous and stored in any quantity at commercial facilities, including drug stores.[3] The inventory is now kept current by the county. The majority of communities studied, however, have limited their surveys to selected commodities identified by the staff and advisory committees and to major facilities, measured by employment levels.

The Association of Bay Area Governments, around San Francisco, identified target commodi-

[2]National Conference of State Legislatures, October 1983 -December 1983, *Hazardous Materials Transportation Regional Workshops* (Denver, CO: 1983), p. 65.

[3]Cambridge Systematic, Inc., *Community Teamwork— Working Together to Promote Hazardous Materials Transportation Safety* (Washington, DC: U.S. Department of Transportation, 1983), p. 6.



ties but did not have the budget or manpower to administer the manufacturer and shipper questionnaire. Instead, Bay Area planners produced a series of small maps, showing the locations of manufacturing firms that frequently used the selected group of hazardous materials, anticipating that each county would eventually survey individual firms.[5]

In Memphis and Indianapolis, the initial data collection method was a questionnaire. Memphis identified 900 firms as potential hazardous materials storage sites. By eliminating the smallest firms on the advice of the local advisory committee and the fire department, the staff narrowed the list to 255 firms. Questionnaires sent under the auspices of the Memphis Fire Department asked for data on storage of material in 19 DOT hazard classes. Although followup to the questionnaire was a lengthy process, the city currently has information on the type, quantity, and location of stored hazardous materials, including site plans and names, addresses, and phone numbers of emergency contacts.[6] In Indianapolis, only 20 to 25 percent of the 1,200 local industries surveyed submitted responses to the questionnaire. The majority of manufacturers declined to participate because of their concern that the data might divulge proprietary information or that the time necessary to compile the data would be excessive. More recently, Indianapolis planners, in cooperation with the city and suburban fire departments, have prepared a simplified hazardous materials information form that they will ask manufacturers and distributors to complete. City staff pointed out to OTA that the fire departments now collect such detailed information as part of their fire prevention duties and that, as a result, they have established a good relationship with industry in the Indianapolis area.

Santa Clara County collects information by means of a regulatory procedure, which also finances the hazardous materials control program. To obtain a business license, all firms selling, using, or producing hazardous materials must provide local officials with an inventory and pay a fee based on the amount of materials stored. The fees help support the county's emergency response team and hazardous materials inspections. Local manufacturers and merchants are advised on the proper storage and handling of hazardous materials during these inspections.

Coordinated Use of Inventories

Inventories can provide information for many purposes in addition to planning. The Multnomah County Fire Department in Oregon collects information on hazardous materials storage at fixed facilities as part of routine fire inspections. The county's Office of Emergency Management stores the information in a computer along with data on

[5]Association of Bay Area Governments, San Francisco, CA, *Hazardous Spill Prevention and Response Plan* (Washington, DC: U.S. Department of Transportation, Research and Special Programs Administration, 1983).

[6]National conference of State Legislatures, op.cit.

chemical characteristics of the commodities, transportation routes frequently used, and performance profiles of major carriers. The county's specialized hazardous materials team has access to this database through a computer terminal located in the response vehicle. The computer system can provide information on where a specified product can be found at the site, how it is stored, and other chemicals that may be present. The system also provides information on the characteristics of all the chemicals known to be in the county, based on DOT and other standard classifications, and the names of organizations to call for additional product information.[7]

Not all communities give first priority to inventory of hazardous materials at fixed facilities. For example, Niagara County, New York, a rural county traversed by an Interstate highway, centered attention first on a survey of commodities transported through the county. New Orleans initially concentrated on coordinating and improving existing procedures for emergency responses However, the city has now turned attention to creating an inventory that will eventually be computerized by census tract and include all fixed storage facilities. In every city, gasoline is the most commonly stored hazardous material, and the New Orleans planning staff began by mapping underground tanks, on the assumption that this relatively limited inventory effort would ease the task of locating all gasoline stations. However, a number of substances other than gasoline are stored underground, making this effort a much more extensive and complicated task than anticipated,

State Inventory Studies

Massachusetts, also a DOT demonstration project participant, is one of the few States that has completed a fixed facilities inventory. For each of the State's 14 fire districts, State analysts used manufacturing directories to locate the firms with more than 100 employees that used or produced hazardous materials.[9]

[7]Puget Sound Council of Governments, op. cit.
[8]City of New Orleans, Hazardous *Materials Accident Prevention and Emergency Response Program* (Washington, DC: U.S. Department of Transportation, Research and Special Programs Administration, 1983), p. 10.
[9]Energy Resources, Inc., *Phase I: Determine the Nature and Scope of Hazardous Materials Transportation in the Massachusetts Region, Vol. I* (Cambridge, MA: U.S. Department of Transportation, 1982), p. 4-36.

Photo credit: Research and Special Programs Administration, DOT

Some common hazardous materials are typically transported in compressed gas cylinders.

In March 1983, the State of New Jersey passed a law requiring every firm manufacturing or handling hazardous substances to file a completed survey form with the State Department of Health and the county or local health, fire, and police departments. This information effectively provides a facilities inventory.

The State of Maryland has created a computerized registry of all toxic and carcinogenic substances stored at fixed sites. The State Department of Health and Mental Hygiene began gathering the data in 1979 with funds from a U.S. Environmental Protection Agency (EPA) grant. Currently, the registry contains inventories of more than 400 industrial users of toxic or carcinogenic substances. The data gathered comprise detailed information on 54 target chemicals selected by the department, including the maximum quantities stored and how they are transported. In the first data collection effort, the survey questionnaires returned were too incomplete to be useful. To obtain reliable data, staff members visited companies, spending as long as 2 days at each to assist them in completing the form. Data are updated annually, and personal visits are now usually necessary only for new firms. The staff estimates that the development of the computerized registry system cost over $400,000, not counting software development, which was paid for by the EPA grant, and annual operating costs. In addition to monitoring the quantities and types of chemicals being manufactured, stored, and transported in the State, the registry is also used to cross-reference

health and environmental information with chemical sites and activity.[10]

Community Support

The success of inventory efforts depends on the cooperation of public agencies, such as the fire and police departments, and private groups, such as chemical manufacturers, shippers, and carriers. Local advisory committees can be instrumental in obtaining such cooperation. Committees, appointed by elected officials, are usually multidisciplinary and composed of representatives from first response agencies, local industry, local and interstate carriers, and of public officials, educators, experts in hazardous materials, and environmentalists. Manufacturing and carrier representatives on a committee can advise researchers on how to approach local industry, recommend the project to their associates, and help assess the validity of data collected.

Although private sector support has at times been problematical, recent actions by the Chemical Manufacturers Association (CMA) indicate an increased interest by the chemical industry in cooperating with State and local planning efforts. In April 1985, CMA announced an industry-wide program designed to make chemical industry expertise available to local agencies, including furnishing planning groups with company safety data sheets on commodities manufactured and stored in the community.[11]

Right-To-Know

Inventories and surveys of facilities are effective ways to obtain data on the types and amount of hazardous materials present in a community or region. However, concerns about protecting trade secrets or other information considered to be proprietary (e.g., health or exposure data) have made some manufacturers unwilling to comply with requests for information. In response, many States and municipalities have enacted legislation, commonly referred to as "right-to-know" laws, that requires the release of information on the hazards associated with chemicals produced or used in a given facility. The majority of State right-to-know laws address both

[10] Max Eisenberg, Environmental Program, Maryland Department of Health and Mental Hygiene, personal communication with OTA staff, March 1985.

[11] Chemical Manufacturers Association, press release, Washington, DC, April 1985.

Table 4.1.—State Right-to-Know Laws, 1985

State	Community provisions	Worker provisions
Alabama		x
Alaska		x
Arizona		
Arkansas		x
California		x
Colorado		
Connecticut	x	x
Delaware	x	x
Florida	x	x
Georgia		
Hawaii		
Idaho		
Illinois	x	x
Indiana		
Iowa	x	x
Kansas		
Kentucky		
Louisiana	x	x
Maine	x	x
Maryland	x	x
Massachusetts	x	x
Michigan		x
Minnesota		x
Mississippi		
Missouri	x	
Montana	x	x
Nebraska		
Nevada		
New Hampshire	x	x
New Jersey	x	x
New Mexico		
New York[a]		x
North Carolina	x	x
North Dakota	x	x
Ohio		
Oklahoma		
Oregon	**x**	**x**
Pennsylvania	x	x
Rhode Island	x	x
South Carolina		
South Dakota		
Tennessee	x	x
Texas	x	x
Utah		
Vermont	x	x
Virginia		
Washington	x	x
West Virginia	x	x
Wisconsin		x
Wyoming		

[a] Although New York has not passed community right-to-know regulations, in December 1983, Governor Cuomo issued an executive order requiring the Department of Environmental Conservation to inventory all toxic chemicals used, stored, or disposed of in the State.

SOURCES: National Conference of State Legislatures, "State Hazardous Materials Policy: Issues Raised by the Bhopal Incident," State *Legislative* Report, vol. 10, No. 1, January 1985; personal communication with Janis Adkins (cd.), *Right-To-Know News* (Washington, DC: Thompson Publishing Group, Oct. 22, 1985); and Department of Occupational Safety, Health, and Social Security of AFL-CIO, list of State right-to-know laws.

community and employee access to information about workplace hazards. Table 4-1 lists the States that have passed such laws. Increasing numbers of local governments are also enacting their own right-to-know statutes.

The provisions of these laws are not uniform, either in terms of the obligations placed on industry or in terms of the types of hazardous materials covered. States have also taken different approaches to exemptions according to business size or quantities of material involved and the extent to which firms may protect trade secrets.

The requirements of right-to-know laws most relevant to hazardous materials planning and emergency response include providing public access to information on hazardous materials present in a State or locality, conducting inventories or surveys, establishing recordkeeping and exposure reporting systems, and complying with container labeling regulations for workplaces. Other requirements do not pertain directly to hazardous materials planning or emergency response but to worker protection (e.g., training and certification programs, posting of warning signs and notices, provision of protective equipment, and employee rights to refuse to work under certain conditions).

In 1983, the Occupational Safety and Health Administration (OSHA) established a national hazard communication standard for employees in the manufacturing sector.[12] One part of this standard requires chemical manufacturers and importers to prepare a Material Safety Data Sheet (MSDS) for all hazardous chemicals produced or imported. Employers covered by the OSHA standard must have an MSDS for each hazardous chemical they use. Moreover, some States require that copies of the MSDS also be submitted to a State agency or local fire chief as part of their community right-to-know programs.

The OSHA standard is intended to preempt State right-to-know laws for workers, but it does not apply to right-to-know laws pertaining to disclosure of information to State and local planning agencies concerned with emergency preparedness and response. Pending judicial and congressional actions on the scope of the OSHA standard may have an effect on existing State and local provisions and on the establishment of national community right-to-know requirements.

[12] 29 CFR 1910.

TRANSPORTATION STUDIES

In addition to fixed facility inventories, State and local governments have tapped a variety of public and private sources to collect data on truck, rail, air, and water transportation. Small towns and rural counties are particularly interested in transportation data because they see their greatest risk as a hazardous materials accident on an Interstate highway or railroad line passing through their jurisdiction. The type and quantity of hazardous materials carried by each mode and the principal routes used comprise the information most frequently collected for planning, risk analyses, routing decisions, and emergency response preparation. Because the data-gathering problems are different for each mode, highway, rail, air, and water transport are discussed separately and divided into local/regional and State studies.

Truck Studies—Local/Regional

DOT demonstrations and other projects reviewed by OTA put high priority on information about highwy transport of hazardous materials because trucks far outnumber other types of hazardous materials carriers, carry the largest share of the hazardous materials shipments, and are involved in the greatest number of incidents. At the national level, however, little detailed information is available about hazardous materials movement by truck. Even the U.S. Census of Transportation, the most commonly used source of statistical information about highway transportation, does not contain enough detail to isolate hazardous commodities from other materials carried by truck.

Because of the lack of a central database on commodity flow, State and local planners have had to devise special means to collect data on highway transport of hazardous materials. The primary methods are questionnaires, visual surveys, and inspections. Several jurisdictions have sent out questionnaires to shippers, carriers, and manufacturers requesting information about hazardous materials shipments and the routes most frequently used.

Analysts in the Puget Sound Region, using questionnaire responses, truck route locations, and other information provided by local governmental departments, mapped the routes by which 85 target commodities moved within and through the region. The results of the research were useful, but the process was time-consuming and complex. Many firms did not answer the parts of the questionnaire concerning routes most frequently used, and planners had to make assumptions and later verify them by a visual check of truck movements. This involved recording placarded trucks according to commodity type at several strategic locations over a 17-day period.

Memphis used a questionnaire to gather data from local shippers and manufacturers, but only 28 out of 68 firms responded to the initial request for commodity flow information.[13] City officials believe that some respondents reported low volumes of hazardous materials, especially petroleum products, and State Highway Department tax records showed that the truckers had substantially underreported the flammables category on the questionnaire. In a survey conducted recently of manufacturers and transporters of hazardous materials in the New York City and New Jersey area, only 20 percent of those solicited returned completed questionnaires. This response, however, was considered high, since gathering and supplying the requested information was time-consuming, and most firms do not normally record production and shipping information according to hazard class or routing patterns.[14]

Other localities, without the time or resources for questionnaires, have resorted to visual surveys of trucks along major highways. Checkpoints, usually at weigh stations, are set up, and government employees or students count the placarded trucks passing through, recording the commodity class of each shipment. This type of survey was done in the San Francisco Bay area and in Indianapolis.

Truck Studies—State

Several States have successfully conducted surveys of the volume and types of hazardous materials carried by truck. In many cases, the States have had the resources and the authority to combine a visual survey with an inspection and driver interview. The earliest full-scale study was carried out in 1977 to 1978 by the Virginia Department of Transportation Safety as part of a multimodal analysis of hazardous materials transportation. During July and August 1977, all trucks passing 38 survey points on Interstate and primary roads were stopped by State or local police. Shipping papers were inspected, and the drivers were interviewed on the types of materials carried, origin and destination of the trip, and the sequence of routes taken. Officers also checked to see if the placarding was correct and classified the carrier as company-owned, independent, common carrier, or personal vehicle. The study findings provided Virginia officials with a current database on commodity flow and a good measure of the level of compliance with existing Federal and State regulations. The survey found that 13 percent of the trucks carried hazardous materials, of which 76 percent was flammable, combustible, or corrosive liquid. Petroleum products were the most common cargoes.[15]

Virginia conducted a followup survey between April and December 1978, using nine survey points located at weigh stations along Interstate routes. Researchers found that, by reducing the number of survey points, the costs of the study were substantially reduced, and the data yield per man-hour increased.

The findings of the survey showed a drop in the percentage of trucks carrying hazardous materials, from 13 percent in 1977 to 7 percent in 1978. It is not clear whether this drop was related to the decrease in checkpoints. The total quantity of hazardous cargoes did not decrease similarly. The average

[13] City of Memphis Division of Fire Services, *Hazardous Materials Task Force Final Report* (Memphis, TN: 1981), p. 24.

[14] Raymond Scanlon, "A Regional Study on Hazardous Materials Transportation," draft report, Port Authority of New York, 1983, p. 15.

[15] J.W. Schmidt and D.L. Price, Virginia Polytechnic Institute, *Hazardous Materials Transportation in Virginia* (Richmond, VA: Virginia Department of Transportation Safety, 1980), p. XII.

load per truck increased from 8.6 tons in 1977 to 12.9 tons in 1978. The researchers could not explain the variation between 1977 and 1978 in volume and load per vehicle. The study has not been updated, so the question remains unanswered. The heaviest hazardous materials traffic was on Interstate highways in and around cities, because urban areas are the principal origins and destinations of petroleum products. The number of placarding violations found by inspectors increased from 34 percent in 1977 to 55 percent in 1978.

According to one Virginia official, the State hopes to develop trained response teams for high-risk areas.[16] In the meantime a number of localities in Virginia have developed their own emergency response training plans. For example, Newport News, Virginia, has instituted hazardous materials Level I, II, and III certification programs.[17]

Several States, including Maryland, Illinois, South Dakota, and Arizona, have analyzed hazardous materials transportation as part of the SHMED program, which allowed assessments of the volume and nature of hazardous materials traffic. Over a l-year period from October 1981 to September 1982, Washington State conducted a truck study, surveying the amounts of hazardous materials moving through the State and the type of carrier used. The study found that approximately 400 million tons, 175 million gallons, and 17 million cubic feet of hazardous materials moved annually through the State.

The Washington State methodology was similar to that of the Virginia study. The State Utilities and Transportation Commission set up checkpoints at 11 locations on major highways. All trucks were stopped and checked for 4-hour periods twice a month. The checks included an inspection of shipping papers and an interview with the driver about cargo, quantity carried, origin, destination, and type of carrier. The data were tabulated and sorted using the Automated Hazardous Materials Surveillance Program, a computer program designed for the study that can sort survey data according to date, location, commodity, and truck type and cross-check it with accident and violation data. Researchers found that although independent truckers carry 50 percent of the cargo, they are involved in 75 percent of the accidents.[18]

In 1982 and 1983, the South Dakota Department of Public Safety surveyed drivers and inspected approximately 340,000 trucks at highway checkpoints. Less than 1 percent of the trucks carried hazardous materials. The most common hazardous materials cargos were flammable liquids, explosives, corrosives, and flammable gases. The two Interstate highways passing through South Dakota were used for at least part of the trip by 90 percent of all hazardous materials shipments. The survey found that 55 percent of the hazardous materials shipped were intrastate, primarily flammable liquids and gases. These findings are consistent with the results of other studies. In addition, questionnaires were sent to a 10-percent sample of all carriers and to all shippers located in South Dakota. Approximately one-half responded. The results generally substantiated the highway inspection findings concerning route used, load size, and predominant type of cargo. Most intrastate shipments were local deliveries of 25 miles or less, usually originating in one of the larger cities. Although most deliveries were local, carriers indicated that their trucks spent as much as 40 percent of their time on Interstate highways.[19]

OTA research indicates that even when State transportation data collection programs are in place, cities within the State are not aware of this data resource and consequently do not make use of it.

Rail Studies—Local/Regional

Data collection on bulk rail shipments of hazardous materials can be extremely important to many cities, particularly rail distribution centers such as Memphis and Indianapolis, where data are needed for emergency planning and response purposes. Information on commodities transported, measured by rail carloads, is generally available on request from the major railroads, most of which have computerized cargo records. Computer information indicating the location of hazardous materials cars in the train and instructions on emergency response

[16]Steve Gainor, Virginia State Emergency Management Agency, personal interview with OTA staff, July 1985.
[17]T.S. Walls, Fire Chief, Newport News, VA, personal communication, Nov. 1, 1985.
[18]U.S. Department of Transportation, Materials Transportation Bureau, *SHMED Program Workshop Proceedings, Salt Lake City, Utah, 1983* (Washington, DC: 1983), p. 206.
[19]Ibid., p. 186.

procedures is available on the train as well as through railroad offices. Conrail can provide detailed print-outs listing the type and quantities of hazardous materials carried on each section of the line. For example, in Indianapolis, Conrail provided planners with the number of rail cars carrying specific types of hazardous materials that originated and terminated in the city's three major rail yards.[20] In communities served by other railroads, the availability and detail of the data depend on the extent to which the line is computerized. In addition, the Association of American Railroads has compiled a list of the 138 chemicals most frequently carried by the railroads. It has developed detailed fact sheets for the commodities that are incorporated into computerized train information and waybills.[21]

Memphis has produced a detailed profile of hazardous materials flows from data provided by the six railroads serving the city. Even though local planners were aware that a large volume of hazardous materials was handled by railroads in Memphis, the daily average of 150 rail cars carrying a total of 10,000 tons surprised them.[22] In the Indianapolis and Memphis studies, the mix of commodities shipped by rail from local firms was found to be the same as the national mix carried by all railroads, probably because both cities are major rail transfer points or chemical distribution centers.

Rail Studies—State

Only a few statewide studies of rail transportation of hazardous materials have been conducted. Massachusetts, as part of the research phase of a 1981 planning project, inventoried all the major rail lines in the State and obtained information on the types and quantities—in carloads—of hazardous materials shipped by three of the four largest railroads. Researchers concluded that relatively small amounts of hazardous materials were moved by rail in Massachusetts. In 1980, for instance, Conrail transported less than 1,700 carloads of hazardous materials in the Commonwealth. The study pointed out that most of the interstate and intrastate point-to-point rail line distances in Massachusetts are relatively short, making truck service very competitive.

Virginia, as part of a multimodal study in 1977 to 1978, collected data from the 10 railroads serving the State. The railroads provided waybill samples for subsections of each line. With this information, analysts estimated the number of cars per day carrying hazardous materials, the tons of hazardous materials carried per day, and the number of trains containing hazardous materials cars. In most cases, the class of the hazardous material was identified, and the data tabulated by DOT hazard class. When waybill information was not available, researchers had great difficulty gathering reliable data.[23] The study findings showed that corrosives accounted for almost half the volume of hazardous materials transported by rail (or approximately 195 tons per day), followed by flammable liquids with 51 tons per day, and nonflammable compressed gas with 43 tons per day. Corrosive materials and flammable liquids, primarily petroleum products, accounted for 58 percent of the total hazardous materials shipped by rail and 52 percent of all hazardous materials shipped by truck. The heaviest rail flow of hazardous cargo was in and around cities, a reflection of the demand for petroleum products in urban areas.

The State of Oregon requires annual summaries by milepost segment of all rail shipments of Class A explosives and poisons. These data are used for emergency response planning.

Air Transportation Studies

The transportation of hazardous materials by air is controlled by the Federal Aviation Administration's (FAA) Civil Security Division. Since hazardous shipments account for less than 3 percent of total hazardous materials tonnage moved nationally and since shipments are generally small, State and local governments do not appear to be particularly concerned about air transport. At the New Orleans, Memphis, and Boston airports, for example, FAA conducted surveys of the types and quantities of hazardous materials shipments and provided local planners with the data. To augment FAA data, re-

[20] City of Indianapolis, IN, *Demonstration Project to Develop a Hazardous Materials Accident Prevention and Emergency Response Plan* (Washington, DC: U.S. Department of Transportation, 1983), p. 36.

[21] Patrick J. Student (cd.), *Emergency Handling of Hazardous Materials in Surface Transportation* (Washington, DC: Bureau of Explosives, Association of American Railroads, 1981).

[22] National Conference of State Legislatures, op. cit.

[23] Schmidt and Price, op. cit., pp. 113-115.

searchers in at least two DOT demonstration studies obtained data on shipment characteristics for the air freight carriers. Local planners do not have access to information on hazardous materials carried by military aircraft.

Water Transportation Studies

Ports play an important role in hazardous materials commerce. For example, 4.5 million tons of hazardous materials pass through the Port of Seattle each year—about 27 percent of the total cargo handled. Over half of the Nation's chemicals move through the Port of Houston. Local planners rely on studies by the U.S. Corps of Engineers as their primary data source. The corps compiles the type and quantities of commodities transported into and through all major navigable waterways and harbors in the United States. The corps provided Massachusetts researchers with the annual tonnage by commodity group for 1978 for both the main Boston Harbor and the nearby New Bedford Harbor, However, the data classification system used by the corps does not always identify specific commodities. For instance, the "basic chemicals" category contains some nonhazardous materials; this leads to overestimates of the actual amounts of hazardous materials. However, none of the States or cities reviewed by OTA found this problem sufficient reason to conduct a separate or additional study. Two port cities, Seattle and Boston, supplemented the corps data with information on tonnage of commodities available from local regulatory agencies and the U.S. Coast Guard.

Federal Data on Shipment of Radioactive Materials and Wastes

In 1973 to 1975 and 1977 to 1981, two series of studies involving a number of States were conducted jointly by the Nuclear Regulatory Commission (NRC) and DOT for the purpose of collecting information on the transportation of low-level radioactive materials. These studies were the foundation for what became the SHMED program to help develop State prevention and enforcement capability, Data were gathered on low-level radioactive waste sites; shipments by highway, air, and water, and the history of accidents and incidents. Findings were used to determine gaps in Federal regulatory programs and in Federal and State enforcement efforts. These studies, stimulated by State and local concerns over lack of adequate surveillance of shipments of low-level radioactive materials and wastes, effectively proved the advantages of and need for continued inspection and enforcement training and implementation at Federal and State levels.[24] Interest in enforcement of regulations governing radioactive materials led to broader Federal and State cooperative efforts on the general problem of prevention and emergency response planning for all types of hazardous materials.

Photo credit: Research and Special Programs Administration, DOT

Marking for radioactive materials, required by Federal regulations.

Data on movement for high-level radioactive materials and wastes, including spent fuel, are treated differently from other hazardous materials data–both legally and institutionally. DOT has primary responsibility for surveillance and monitoring of low-level radioactive materials and wastes, while DOT and NRC share regulatory and enforcement authority for high-level radioactive materials and wastes.

NRC requires licensees to provide advance notice for certain nuclear shipments to provide physi-

[24] Steve N. Solomon, *State Surveillance of Radioactive Material Transportation,* NUREG-1015 (Washington, DC: U.S. Nuclear Regulatory! Commission, Office of State Programs, 1984), p. 5.

cal protection of special nuclear materials to prevent theft, diversion, or sabotage, and to notify NRC regional offices of impending special shipments of nuclear materials. These requirements, in effect since 1975, were expanded in 1979 to include spent nuclear fuel. In the NRC Reauthorization Act of 1980, Congress directed NRC to expand its shipment notification procedures to include State governments. In its rulemaking, NRC indicated that:

> . . . the purpose of the rule is to provide States with information not otherwise available to them, which will enable them to contribute to the safety, security and ease of transport of shipments.[25]

While there is no central database available on the number of licensees, information can be extracted from two Federal databases to obtain an approximation of shipping activity for high-level commercial wastes and materials (excluding Department of Energy shipments). A study conducted by the Battelle Memorial Institute for DOT analyzed States' use of the information on transport shipments of spent nuclear fuel through their jurisdictions. Of the States surveyed, 14 out of 15 maintain a file of notifications. Five States pass the information on to other State agencies, two make subsequent notifications to other elements of the same agencies, and six subsequently notify officials at both the State and local levels. Two States make no further notification for security reasons.

The primary benefit of notification identified by almost all States surveyed was that awareness of impending shipments allowed them to take precautions and alert emergency response agencies. The Battelle report concluded that the notification system was working well under current NRC regulatory procedures; however, some caution was indicated about the adequacy of the notification systems if shipment levels increase as expected in the 1990s.

Notification Laws as Tools for Data Gathering

As part of the search for available and reliable data for hazardous materials planning, OTA examined State and local notification requirements as a potential source of information. The Battelle study, cited above, identified 136 State and local notification laws pertaining to hazardous materials transportation. The vast majority of these apply to trucks; a few apply to rail. Of the 136 regulations and ordinances, 62 apply statewide, 42 are local, and 32 apply to transportation facilities such as bridges, tunnels, turnpikes, and airports.[26] Notification requirements! as defined by the study, include prenotification by shippers and carriers, periodic summaries, and reports on individual shipments filed after a trip. Prenotification is required by 100 State and local regulations, 14 call for periodic reporting, and 22 concern individual trip reports. Local government regulations applying to transportation facilities almost universally require prenotification. Table 4-2 lists State and local notification laws and the types of hazardous materials covered.

The Battelle study found that State and local governments typically give two reasons for enacting notification requirements: to provide data for planning (including better routing and safety regulations), and to improve emergency response. Over two-thirds of the jurisdictions identified planning as an important objective of their laws, citing the need to gather information about the types and quantities of materials shipped through their jurisdictions and information on trip scheduling and routes frequently used. Many also indicated they require advance notification to alert response teams when a potentially hazardous shipment is due.

Although these regulations could be valuable means of gathering data, most produce little usable data because they apply to a very narrow range of materials or because they are not enforced. State and municipal governments have tended to regulate only one high-risk commodity, usually spent fuel or high-level radioactive wastes, although some also include other radioactive materials and low-level wastes. Only four States have laws requiring prenotification for other classes of hazardous materials. While data on radioactive materials are important, such shipments constitute such a small percentage of all hazardous materials traffic that prenotification for this one class provides only partial satisfaction of local needs. Recently, some communities have acted to broaden notification requirements to include other types of hazardous materials.

[25] Battelle Memorial Research Laboratories, Battelle Human Affairs Research Center, *Assessment of State and Local Notification Requirements for Transportation of Radioactive and Other Hazardous Materials* (Columbus, OH: Jan. 11, 1985), pp. 88-112.

[26] Ibid.

Table 4-2.—Commodities Covered by Notification Requirements, 1985

	Spent fuel and/or high-level waste	Other radioactive materials	Hazardous wastes	Other hazardous materials
State:				
Arkansas			X	X
California	X			
Colorado			X	
Connecticut	X	X		
Florida	x	x		
Georgia	x	x	x	x
Illinois			x	
Louisiana			x	
Maine		x	x	
Massachusetts	x		x	
Michigan	x	x		
Mississippi	x	x		
Nevada	x	x		
New Hampshire				x
New Jersey	x	x		
New Mexico	X	X		
North Carolina	X			
Ohio	X	X		
Oregon				x
Rhode Island	X	X	X	
South Carolina	X	X		
Tennessee	X			
Vermont	X	X		
Virginia	X	X	X	
Total	17	14	9	4
Local:				
Chickaswa, AL			X	
Phoenix, AZ			X	X
Tempe, AZ				X
Tucson, AZ	X	X		
Morro Bay, CA	X	X		
New London, CT	X	X		
Garden City, GA	B	x		
Lawrence, KS	B	x		
Covington, KY	x	x	x	X
Kenner, LA				X
Kent County, MD	X			
Prince George's County, MD	X	X		
Newton, MA	X			
Ypsilanti, MI	B	X		
Missouli, MT	X	X		
Binghamton, NY	X			
Geneva, NY	X	X		
Ithaca, NY	X	X		
Jefferson County, NY	X	X		X
New York, NY	X	X		
Rockland County, NY	X	X		
St. Lawrence County, NY	X	X		
Syracuse, NY	X	X		
Tompkins County, NY	X	X		
Vestal, NY	X	X		
Yates County, NY	X			
Facilities:				
Golden Gate Bridge, CA	X	X		
Delaware Memorial Bridge, DE	X	**X**	X	X
Francis Scott Key Bridge, MD	X	X		X
Harry W. Nice Memorial Bridge, MD	X	X		X
John F. Kennedy Memorial Highway, MD.	X	X		X
Susquehanna River Bridge, MD.	X	X		X

Table 4=2.—Commodities Covered by Notification Requirements-Continued

	Spent fuel and/or high-level waste	Other radioactive materials	Hazardous wastes	Other hazardous materials
William Preston Lane, Jr. Memorial Bridge, MD	X	X		X
Massachusetts Turnpike Authority, MA.	X	X		
Blue Water Bridge, MI.	B	B		X
Mackinac Bridge, MI	X	X		X
Garden State Parkway, NJ	X	X		
Newark International Airport, NJ	X	X		X
New Jersey Turnpike, NJ	X	X		X
Bayonne Bridge, NY	X	X		X
George Washington Bridge:				
Expressway, NY	B	X		
Lower Level, NY.	B	X		
Upper Level, NY	X	X		X
Geothals Bridge, NY	X	X		X
Holland Tunnel, NY	B	X		
Kennedy International Airport, NY	x	X		X
La Guardia Airport, NY	x	X		X
Lincoln Tunnel, NY	B	X		

NOTE: X= existing; B= bans on transportation.

SOURCE: Battelle Human Affairs Research Center.

Lack of enforcement of notification regulations means that there is little reason for shippers and carriers to comply, and as result, little information is gathered. Several local agencies were found to be unaware of the notification laws they were supposed to enforce. Some community officials reported that they have never received a notification even though it is required by local ordinance. The Battelle study observed that, while there are instances of conscientious enforcement and data collection, many local agencies charged with enforcing regulations on prenotification give the task relatively low priority. Often when information is collected, it is simply filed and not used for planning purposes.

Florida and Massachusetts are among the exceptions to these conclusions. Florida checks with disposal facilities to identify carriers failing to comply with radioactive waste notification requirements. Letters are sent to shippers summarizing violations, and monthly reports are sent to the nuclear utilities in Florida summarizing recent shipments. According to State officials, the radioactive waste database is useful in long-range planning, and they plan to identify different types of waste streams and use the information to improve transportation, treatment, and disposal policies. Massachusetts has six notification regulations governing shipments of hazardous wastes: three require individual trip reports, two require periodic reports, and one requires prenotification. The information gathered is used in a variety of ways, including verifying delivery of the waste and alerting local health agencies and emergency response teams. Carriers' monthly reports are stored in a computerized file and could be referred to during compliance investigations or matched with manifests submitted by shippers, although this procedure has not yet been put into practice.

HAZARDS ASSESSMENT STUDIES

State and local planning and emergency preparedness can be improved by studies assessing the chances of an accident occurring and identifying the most likely locations. Such assessments are important for contingency planning, for practical decisions about locating equipment and allocating manpower, and for developing routing plans.

A few jurisdictions have used sophisticated mathematical techniques of risk analysis to estimate the probability of an incident and its severity. Most communities, however, find it adequate to map the areas where the risk of a hazardous materials incident is highest or where there would be the greatest public danger or the most damage. Data for this type

of study can be assembled either from a fixed facility inventory or a transportation study. Much useful information is also available from public records routinely kept for other purposes by State and local public works, transportation, environmental, and planning departments. Normally a hazard assessment requires the following kinds of information:

- transportation network maps and descriptions;
- highways and streets used by hazardous materials carriers;
- tunnels, bridges, and rail crossings;
- railroad yards and truck terminals;
- highway accident data;
- locations of past hazardous materials incidents and materials involved;
- concentrations of hazardous materials manufacturing or storage sites;
- areas of high population density;
- location of schools, hospitals, and other especially vulnerable groups; and
- water supply and sewer facilities.

More advanced assessments might also include special analyses of the types and quantities of hazardous materials transported through the community and the location of emergency response teams and equipment.

The San Francisco Bay area study drew on information of this sort to determine the risks in each of the nine participating counties. The analysis included a narrative description, supplemented by maps of each county. In rural Niagara County, planners found it adequate to use just three factors to assess the probability and impact of highway hazardous materials accidents. Analysts obtained accident data for trucks from the State Police and information on environmentally sensitive areas from the county and combined those with data on the volume of hazardous materials flow on the major highways obtained from a special transportation survey conducted as part of the study. The analysis showed that areas along the Interstate highway had the highest risk.[27]

Some localities have used more complex mathematical-risk models. As part of the Puget Sound Plan, consultants combined data from transportation inventories and data on geographic characteristics, population density, and environmental conditions in the region with a mathematical model of hazardous materials behavior in order to predict the incidence and impacts of hazardous materials spills. The analysts also used a fault-tree technique for various types of transportation equipment to estimate probabilities of releases actually occurring as the result of an accident. The results of the Puget Sound study were used in making routing recommendations for trucks carrying liquefied petroleum gas.[28]

There have also been some notable State hazard assessments. Massachusetts and Virginia used data obtained in the inventory studies described earlier to evaluate risk areas in their States. Massachusetts ranked the risks as high, medium, or low for each of the 14 fire districts in the State. Among the factors considered were employment in firms producing or storing hazardous materials, proximity to a port facility, and the volume of truck traffic on the major highways. Virginia identified the locations where the risk was highest for both train and truck incidents. For rail, the risks were calculated for an incident on the main track, at highway crossings, and in yards. The analysis indicated that the variables with the highest correlation to accidents were the volume of hazardous materials being transported, the curve of the track, the speed limit for freight trains, and the grade of the track.

The most difficult data-gathering problem in State and local studies has been obtaining reliable information on past hazardous materials incidents. Most fire departments do not keep separate records of hazardous materials incidents, although fire departments in some large metropolitan areas are beginning to develop special hazardous materials report forms for use in internal planning. State and local planners usually must rely on outside sources, some of which may be unreliable or contradictory. The experience of the Bay Area planners illustrates the difficulty of collecting data on spills: of 16 Federal, State, regional, and local sources contacted, only 9 could provide data on past incidents within the timeframe of the demonstration study. Moreover,

[27] Waste Resource Associates for the Niagara County Legislature, *Demonstration Project to Develop a Hazardous Materials Accident Prevention and Emergency Response Plan* (Washington, DC: U.S. Department of Transportation, 1983), pp. 3-4.

[28] Battelle Memorial Research Laboratories, *Hazardous Materials Transportation Risks in the Puget Sound Region* (Washington, DC: U.S. Department of Transportation, 1981), p. 1-1.

these sources did not have a common standardized format, and sources reporting the same incident often varied considerably. The U.S. Coast Guard Pollution Incident Reporting System for spills on navigable water was found to be particularly useful since it contained detailed and comprehensive reporting of date, time, location, material, quantity, source, cause, and anticipated cleanup costs.

The DOT Office of Hazardous Materials Transportation (OHMT) maintains a file of all reported incidents involving spills of hazardous materials in interstate commerce, and State and local agencies have access to this information. Because OHMT's reporting rules do not, in most cases, require reports on spills in intrastate commerce, many truck accidents of considerable local significance do not show up in OHMT's file. It is the responsibility of each transportation company involved in an incident involving a spill of hazardous materials, as defined by Federal regulations, to report it to OHMT. Currently no effective enforcement exists for this Federal regulation, so, in effect, accident reporting is voluntary. In addition to the OHMT incident file, the FHWA Bureau of Motor Carrier Safety maintains a truck registry list and monitors the accident record of trucking companies as part of its inspection program, It also uses this registry to report to the Interstate Commerce Commission on the safety record of carriers applying for an additional license.

State and local researchers trying to analyze accident records for their area studies report that the OHMT incident file is not useful to them, however. A New York City study found that when 30 major spills widely reported in the press were tracked through the OHMT records, only 12 were found. The 18 unreported incidents, according to press reports, had resulted in 18 deaths, 9 persons missing, and 187 injured.[29] Even if a State keeps complete accident records, local staffs are usually unaware of this resource, and many communities find their own accident data incomplete. Niagara County, for example, had too few recorded hazardous materials transportation accidents to draw significant inferences. On the other hand, Memphis planners found a wealth of information in the 972 incidents recorded by the city fire department in a single year.

[29] Scanlon, op. cit., p. 48.

FINDINGS

- **Financial assistance for data collection and planning activities is needed by many localities.** Potential sources of funds include Federal, State, and local government cooperative programs with industry, and registration or user fees.
- Hazardous materials storage facility inventories provide important background for hazardous materials transportation planning, as well as data for response and prevention planning. Data may be developed from questionnaire surveys, public records, and industrial directories. Questionnaires often require followup and are most effective when sent out under the auspices of public agencies such as fire departments.
- Local advisory committees can be very helpful in identifying the hazardous substances to be inventoried and in soliciting the cooperation of the private business sector.
- **Data on commodity flow is needed by State and local governments for hazard assessments and planning.** Databases pertaining to commodity flow are kept by various Federal agencies, but the agencies do not use the same commodity identification codes, and the databases are not interactive. Consequently, the data are not useful to State and local governments.
- Because of the absence of a reliable national hazardous materials transportation database, State and local governments have undertaken their own studies to determine what is transported near, within, and through their communities.
  - –Successful State surveys combine truck and cargo inspection with driver interviews. Visual counts of placarded trucks have several drawbacks, because many trucks are placarded incorrectly or not at all.

–Rail commodity flow data are increasingly available as the industry computerizes.
–Data on types and quantities of hazardous materials transported by air and water do not appear to be major concerns for States and local communities.

- **A** reliable, comprehensive Federal accident record system is needed. Current Federal efforts **are too fragmented to be useful to State and local agencies.**

. Department of Defense and Department of Energy shipments of explosives or radioactive materials are of concern to State and local governments, which understand the need for secrecy about such shipments, but want guarantees that Federal enforcement and emergency response efforts will be adequate when an accident occurs.