

TRANSPORTATION RESEARCH

CIRCULAR

Transportation Research Board, National Academy of Sciences, 2101 Constitution Avenue, Washington, D.C. 20418

THE TEN MOST CRITICAL ISSUES IN HAZARDOUS MATERIALS TRANSPORTATION

modes

- 1 highway transportation
- 3 rail transportation
- 4 air transportation
- 5 other

subject areas

- 11 administration
- 12 planning
- 13 forecasting
- 14 finance
- 15 socioeconomics
- 16 user needs
- 17 energy and environment
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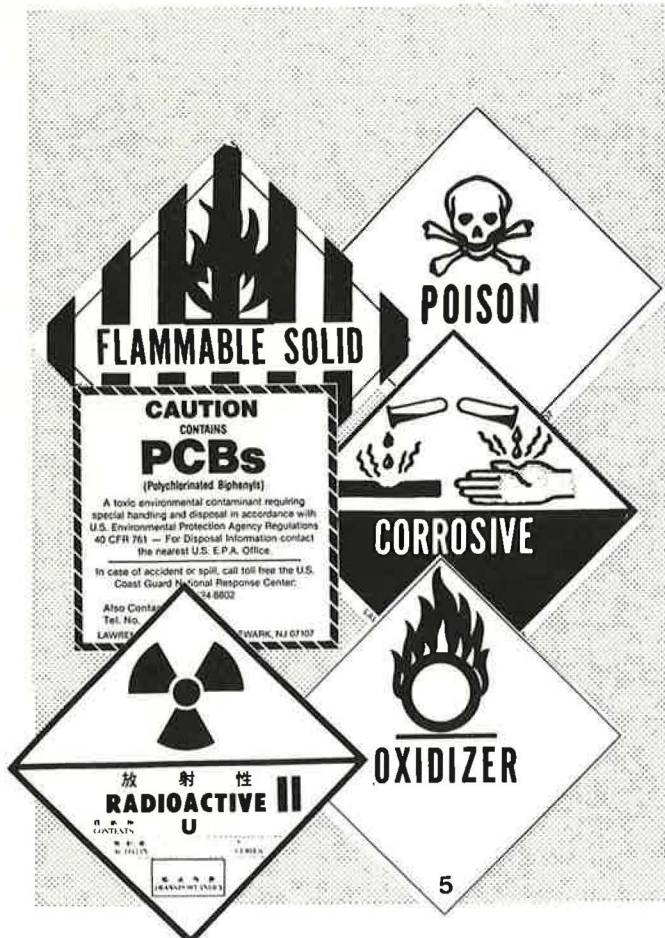


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THE TEN MOST CRITICAL ISSUES

The commonplace safe transport of hazardous materials is an essential characteristic of our technologically complex society. This society must be sensitive to interruptions in the safe transport of these materials, and industry and government must maintain public confidence in the safety of hazardous materials transportation systems. The design and maintenance of the equipment, routes, and facilities, and the plans, policies and regulations that make up the hazardous materials transportation network must keep pace with the increasing demands for hazardous materials movement. A continuous improvement of the hazardous materials transportation system is necessary in order to preserve public confidence.

Legislators, regulators, shippers, carriers, planners, emergency management officials, manufacturers, and researchers need a common base of agreement and understanding on the most critical issues in hazardous materials transportation. Given this agreement and understanding, policymakers will be less likely to respond to emotional pressures and media demands with actions that fragment system improvement. In order to provide a basis for a reasoned approach and a common strategy to improve the nation's hazardous materials transportation system, the Transportation Research Board's Committee on Transportation of Hazardous Materials presents in the following their judgment of the ten most critical issues in hazardous materials transportation today. The issues are not listed in order of importance.

REGULATIONS

The two issues discussed below concern regulatory controls. These issues are believed by the committee to be of widespread interest among the hazardous materials transportation community.

Issue 1: Harmonious International, Federal, State and Local hazardous materials regulatory controls

Statement of the Problem. International, national, state and local hazardous materials regulations sometimes conflict. The conflicts exist both across regulations and within regulations. Regulations at the Federal level can place undue burdens on commerce at the international, state and local levels; international, state and local regulations can place undue burdens on interstate commerce. Harmonious regulations at all levels are more desirable than preemptive procedures. Preemptive procedures cannot be applied to conflicts which reach to the international level.

International and Federal Regulatory Controls. The Department of Transportation has attempted to consolidate all applicable hazardous materials regulations. However, shippers still must comply with regulations put forth by the International Air Transport Association (IATA), International Maritime Consultative Organization (IMCO), Regulatory Commission (NRC), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), and the Department of Energy (DOE). The conflicts between these regulations can be a serious problem for international shipments. A shipment which is properly described and packaged and in acceptable quantities for international movement might be unlawful for domestic shipment. An example of this is a product containing flammable compressed gas. The product is prohibited from domestic air transport, but is acceptable for international air movement.

The Department of Defense states that a major reason for noncompliance with regulations is the

difficulty in complying with 49 CFR for the movement of hazardous materials within the continental United States, conversion to the International Maritime Dangerous Goods Code (IMDGC) for export, or vice versa (National Transportation Research Board, 1979a). They also state that inconsistencies between 46 and 49 CFR and IMDGC are another major reason for noncompliance.

Federal, State, and Local Regulatory Control. The issuance of regulations below the Federal level is often in response to local events and pressures. Regulations can originate not only with municipalities, but also with pesticide boards, departments of ecology, etc. It is difficult to obtain legislation from many local sources which is mindful of greater transportation system needs and also responsive to local pressures.

At the state level all states except one have adopted all or part of the Federal hazardous materials regulations or have similar regulations of their own (National Transportation Safety Board, 1979a). The states which promulgate their own legislation often address only certain substances. For example, Rhode Island put forth extensive rules governing the transportation of liquified petroleum gas (LPG) and liquified natural gas (LNG). The U. S. District Court issued an injunction against the regulations. The injunction was then supported by a U. S. District Appeals Court ruling. The injunction was granted before the U. S. Department of Transportation ruled that the Rhode Island regulations were inconsistent with Federal regulations and were, therefore, preempted. The Rhode Island confrontation is an example of the conflicts across jurisdictions which can occur over hazardous materials regulations.

Rhode Island was attempting to control for an unusually intensive local transportation of liquified gas. This potential exposure was given public attention and public officials, in order to discharge their responsibilities and to maintain public confidence, enacted what they believed were reassuring and effective measures. The local perspective was not in harmony with requirements at other levels of government.

Routing Regulations. The basis of hazardous materials transportation rulemaking has two objectives: maintaining and enhancing current levels of safety, and anticipating and preventing catastrophes (Fiste, 1978). The problem is that well-intentioned regulations can place restrictions at the local levels which affect interstate transportation. Some hazardous materials routing restrictions on tunnels and bridges appear essential. Other restrictions appear to be discordant to some affected organizations. For example, the New York City Health Code provision which banned the transportation of most radioactive materials through that city resulted in a petition to DOT by a shipper to preempt that provision. The preemption was not issued. Rulemaking adjustments were required to enable such preemptions. Hearings on a DOT proposed rulemaking on highway routing of radioactive materials are now being held in five cities throughout the country. There has been a resulting growth in routing restrictions in local jurisdictions for vehicles transporting hazardous materials.

Toward a Solution - a Forum. A possible means to obtain harmony appears to be the establishment of a forum for proposed rules for Federal, state, and local rulemakers in order that the problems posed for each by proposed legislation can be examined and understood by all before rules are enacted. This process might also serve to buffer emotional reactions to local events which pressure for hasty responses which can lead to ill advised regulations. The forum

should provide for communication among all levels of government during proposed rulemaking at any level of government. The forum should enable the voices of the public and private sectors to be heard.

Issue 2: The complexity of DOT's Hazardous Materials Regulations and the need to convert some of them from detailed specifications to performance base criteria

Statement of the Problem. The Department of Transportation's Hazardous Materials Regulations are too complex.

Complexity of Regulations. There was little discussion of regulations among the committee members that did not eventually turn to the complexity of DOT hazardous materials regulations. It was felt that some DOT regulations could be simplified by changing their base from engineering specifications to performance criteria. However, as one member put it, simplistic solutions to complex problems might not be appropriate. There are merits to detailed specifications. General concern exists, without a doubt, for the complex nature of hazardous materials transportation regulations.

About eighty-five petitions a year for substantive hazardous materials transportation rulemaking are received by DOT from carriers, shippers, trade associations, state regulatory agencies, hazardous materials packaging and containers manufacturers, the general public and from within DOT. Less than 5% of the petitions come from DOT itself (Fiste, 1978).

These petitions may involve existing rules or may require additional rules. Therefore, the rule-makers are constantly presented with the potential for increasing complexities and undetected inconsistencies. These petitions are well motivated and are often in the interests of safety or efficiency. Therefore, the dynamics of the regulatory process must maintain effective mechanics for a continuous effort toward simplification and reduction of regulations.

The complexity of the regulations is demonstrated by the great volume of pages involved. Forty-nine CFR, Parts 100 to 199 include over 1200 pages and is revised at least once a year. Many of the paragraphs require compliance with referenced specifications from other documents and sources. Add to the content of one regulation the contents of other regulations which relate to or interact with 49 CFR such as regulations from EPA, NRC, FEMA, and others, and the task of mastery of the regulations is enormous.

A special study of noncompliance with hazardous materials safety regulations (National Transportation Safety Board, 1979a) was conducted after investigations of eight serious accidents (occurring since 1972) which involved hazardous materials in transit. These investigations found noncompliance with regulations for packaging, labeling, record-keeping/documentation, and quantity limits in nearly every case. Several agencies cited the complexity of the regulations as a reason for the noncompliance that evidently exists. These agencies said that noncompliance occurs because of:

1. A "lack of ability on the part of carriers and shippers and their personnel to understand the regulations." (Federal Highway Administration)
2. "The large quantity of hazardous materials regulations." (Federal Railroad Administration)
3. A "difficulty in reading and understanding the Hazardous Materials Regulations (46 and 49 CFR)." (Department of Defense)
4. "... customer ignorance or misinterpretation

of the regulations." (U. S. Postal Service)

5. Regulations that "... are impossible to understand and require knowledge and experience (operating) personnel do not possess." (private industry)

6. "Overly complex Federal regulations that require an improbable degree of expertise to assure compliance." (a labor organization)

7. "The regulations themselves.... The CFR is so difficult to interpret that only large companies with fully trained and adequate staff are able to do so...." (a trade association representing over 50 companies)

(The above seven citations are found in National Transportation Safety Board, 1979a.)

Toward a Solution - Publication of Digests.

Perhaps consideration might be given to the publication of digests of regulations. The purpose of digests would not be to substitute for the full text of the regulations, but would be to summarize the most pertinent regulations and state them in language which is designed to be as readable as possible. Digests could be developed by function (via shipper or carrier) and by industry classification. For example, Dunn and Bradstreet's Standard Industrial Codes (SIC) could be used. For a given SIC code, typical hazardous materials from that industry class could be identified and described, using actual examples from the industry. The regulations could be cited as the final authority along with a disclaimer for the digest which identifies its purpose of communication. Certainly, this is but one of many possible solutions.

Toward a Solution - Conversion to Performance Specifications. Some of the complexity and volume of the regulations could be relieved by converting detailed specifications to performance based criteria. The ultimate requirement is that the system provide for the safe and cost effective transport of hazardous materials. This is a global performance criteria. At least some of the detailed specifications might be set forth as performance based criteria.

When regulations dictate design to the extent that engineering and creativity are stifled, an important aspect of the free enterprise system that has given our nation great technological advances is sacrificed. Detailed specifications not only can make regulations complex, but also can dampen innovation.

A careful review of the regulations to determine what specifications are amenable to conversion to performance based criteria should be conducted. Certain detailed specifications probably should be retained to ensure performance; however, if relevant equipment items can demonstrate performance but not meet detailed specifications, the specifications probably can be converted to performance criteria.

A COORDINATED SYSTEMS APPROACH

Four issues were developed which shared specific applications of a coordinated systems approach to hazardous materials transportation needs. These are discussed below.

Issue 3: A national strategy for control of hazardous materials risks

Statement of the Problem. No plan exists which provides a national strategy to ameliorate the hazardous materials transportation system in an orderly, thoughtful manner.

The General Need for a National Strategy.

"A national strategy, if well formulated, implemented and publicized could go a long way toward solving problems and eliminating confusion..." one committee member stated to emphasize its importance. "This strategy should include a multi year plan based on priorities in order that available resources might be channelled into a few attainable solutions," was another comment given. The limited resources and many problems together require careful planning to attain effective stewardship. The reduction of major issues as well as the daily systematic plans for inspection, enforcement, routing, safety, etc. could be part of an overall national strategy. Some members felt that this issue should be addressed because it involves all other issues.

Toward a Solution - a Planning Conference.

Given the need for a national strategy - a "master plan" - for hazardous materials transportation operations, research, safety, and regulations, the TRB Committee on Transportation of Hazardous Materials has undertaken a project of conducting a national strategy conference, to be held sometime in early 1981. The committee has accepted as fact that a national strategy covering all aspects of legislation, regulations, administration, training, enforcement, research and development, and emergency response does not now exist. Further, the committee is convinced that it is unlikely that such a strategy will ever exist unless all parties of interest from the executive and legislative branches of the Federal, state, and local governments, and from the private sector are convened to lay out that strategy and to develop the master plan. The 1969 Airlie House Conference on Hazardous Materials was an early attempt to lay out a national strategy for hazardous materials transportation, and resulted in the establishment of an improved hazardous materials program in the Department of Transportation. The committee believes that the time has come to take the next step and provide the national hazardous materials planners with a master plan for the next ten years.

Under the auspices of the Transportation Research Board, the committee will convene a national conference in the spring of 1981 to bring together the most knowledgeable representatives of all parties concerned with the transportation of hazardous materials. Starting with this list of the "Ten Most Critical Issues in Hazardous Materials Transportation," the purpose of the conference will be to establish specific priorities for legislative, regulatory, administrative, and research activities as steps toward a national strategy. The conference will be supported as far as possible through registration fees, although a foundation or government grant might also be sought. The location and exact date will be selected and announced later. The committee will plan the conference agenda, prepare background papers, determine the participants, develop protocols for decision-making at the conference, etc. The assumption is that from this preparation, and from the ensuing discussions and decisions at the conference, would flow a set of specific national objectives which conference participants could then pursue (in Washington, in state capitols and seats of local governments, and to corporate headquarters) over the next three to ten years. The results would provide an agenda for action for all of the many persons who participate in the national transportation system for hazardous materials.

Issue 4: Training for all persons involved in the transportation of hazardous materials, including shippers, carriers, and emergency response personnel

Statement of the Problem. There are over two million persons who require training in hazardous materials transportation regulations and emergency response. The existing training opportunities cannot supply this demand.

Existing Training Opportunities. The National Fire Protection Association, the Operations Council for the American Trucking Association, the DOT Safety Institute, and many other public and private groups are conducting training programs in hazardous materials transportation. The general agreement, however, seems to be that sufficient training for the multiple thousands upon thousands of persons involved in hazardous materials transportation is far from realized.

The Department of Transportation publishes lists of the educational institutions, corporations and businesses, and the government agencies which provide the existing training opportunities. The fact that this issue is felt to be critical even with these programs, perhaps indicates a need for a new look at training approaches.

A New Look at Training. The basic reason that a new look is required is that these programs are entirely too few. The number of programs available must be evaluated in accordance with the demand for training. The National Transportation Safety Board (1979a) estimates that there are more than two million employees of shippers, packagers, and carriers who must have sufficient knowledge of the regulations to ensure compliance. This does not include the persons in Federal, state, and local agencies, response services and others who also need such knowledge.

There is general agreement among certain Federal agencies that noncompliance is often caused by ignorance of the regulations:

1. "... many persons do not know the hazardous materials regulations exist.... Many persons who possess the regulations do not understand how to use them." (Materials Transportation Bureau)
2. "It appears that a general lack of knowledge or familiarization with the regulations is the primary reason for noncompliance." (U. S. Coast Guard)
3. Part of the reasons for noncompliance with regulations are a "lack of knowledge" ... and a "lack of training by carriers and shippers for their operating personnel." (Federal Highway Administration)
4. "We believe that the primary reason for noncompliance with the hazardous materials regulations is the failure of shippers to instruct their personnel..." (Federal Aviation Administration)

(The above four citations are found in National Transportation Safety Board, 1979a.)

The need for training shippers and carriers in regulations is apparent. Also, there is a need to train police, fire, and rescue personnel in regulations and in proper emergency response actions. The highway maintenance personnel and even wrecker service personnel need training in clean-up, containment, and site restoration. It is no exaggeration to say that multitudes need to be trained.

Toward a Solution - the Use of New Training Methods and Devices. The great need for training

suggests that a review should be given to find ways to meet the training demands. The existing training might be supplemented with programmed texts, correspondence courses, videotape cassettes, filmstrips and accompanying tapes, and even computer aided instruction where facilities permit. It appears that updated and current training needs must be continuously available to a local unit (such as a rescue squad, a local shipper, etc.).

Issue 5: A single, national response system for incidents and accidents involving the transportation of hazardous materials

Statement of the Problem. A single response center to provide coordination and expertise during an emergency is needed to support emergency personnel in the field.

Present State of Response Coordination. EPA conducted a survey and interviews (reported in Burns, 1980) the results of which describe the present state of response coordination. This study shows that:

1. Relatively few states have a spill response unit with employees who spend full time planning for, or responding to environmental emergencies.
2. Although every state has some form of civil defense organization, not every one is well suited to the management of environmental emergencies.
3. Highway maintenance equipment and crews can usually be called in for cleanup and containment of uncomplicated roadside spills.
4. In every state interviewed, state patrolmen were the first state officials to arrive at the scene of environmental emergencies caused by transportation accidents outside of large cities.
5. In several states, troopers carried the DOT hazardous materials handbook, and initiated evacuations in rural areas before the arrival of additional state personnel.
6. Local fire departments respond to every fire and serious accident, and they are present at most environmental emergencies.
7. None of the state agencies designated to take the lead in environmental emergencies has 24-hour communications and command centers.
8. State officials will be less likely than Federal officials to recommend the evacuation of large populations in marginal conditions.
9. Few states have the full protective gear and training to work in a highly hazardous atmosphere and stop leads of highly hazardous materials such as phosgene and chlorine. Only industry and the military have the training to work in such conditions.
10. No state has specialized cleanup equipment such as vacuum trucks, carbon filtration units, or chemical transfer pumps.
11. All states interviewed expressed the need for more training of personnel to respond to hazardous materials incidents.
12. States would welcome Federally-supported training programs, but would need Federal support for travel as well as tuition.
13. Although all states interviewed maintain fire training programs, only a small proportion of all firemen in the nation go through such programs.
14. The chemical industry has no generalized mutual assistance plan which will assure the provision of expert advice on safety and cleanup when the manufacturer of the substance is unwilling or unable to respond to the incident.
15. The use of specialized contractors to handle hazardous materials spills is increasing rapidly.

Typical Response Coordination. The typical response role is shown by two states with

progressive programs, Arkansas and California.

In Arkansas spill responses are coordinated on a 24-hour basis through the Office of Emergency Services (OES) pursuant to a State-wide Emergency Operation Plan. Although several state agencies are involved in spill response activities, the Department of Health and the Department of Pollution Control and Ecology (DPCE) have lead responsibilities and have radio-equipped vehicles operating on the OES communications network.

Fire fighting is handled by local fire departments, with the assistance of the Forestry Commission in rural areas. The State Fire Marshall takes no active role during disaster response situations. Evacuations are ordered by local public officials and carried out by the sheriff and the state police. The DPCE may request equipment for containment or other forms of assistance from state and federal agencies, with the request being made through the OES. As with other states, Arkansas has no capacity to work in highly hazardous environments and patch leaking containers of toxic gas. Air Force technicians were called in from an Arkansas missile base to repair a leaking tank truck containing boron trifluoride. To correct this situation the DPCE would like to see a specific Federal grant for training, equipment, and planning of spill response. Another problem cited by Arkansas officials in directing emergency response is the inaccuracy of bills of lading or garbled transmission of information from cargo manifests.

In California several agencies play a major role in hazardous materials spill response although none have been designated to take a clear, formal lead in all directions. The California Department of Transportation (Cal Trans), for example, responds to all spills on public roads and assumes responsibility for clean up, either with department road maintenance crews or with private clean up contractors. The California Department of Health, on the other hand, provides on-scene coordination and monitoring for all disposal of hazardous waste. The Office of Emergency Services is the lead agency for all disaster and contingency planning in the state, providing an excellent 24-hour interagency communications system for all emergencies and coordinating the efforts of other state agencies during a disaster. Most of the major agencies in California which are involved in hazardous spills are operating their response program under less than optimum conditions. Response to these spills is ad hoc in both the Department of Health and the Fish and Game Department - neither agency has been specifically mandated to respond to such spills.

In the Fish and Game Department the response effort is organized around the 300 wardens located throughout the state, whereas Cal Trans has a designated team in each of the several state districts. While the California State Fire Marshall's office prepares training guidelines and standards, and provides resources and technical assistance to local fire authorities, the Fire Marshall has no direct authority over local fire fighters.

Federal agencies also must be involved in the coordination and communication processes. While a general understanding exists between and among Federal agencies as to their respective roles in the transportation of hazardous materials, and memorandums of understanding have been written to clarify these roles, there is a general lack of understanding existing in the area of hazardous materials emergency response as to either what the role is or how it should be played. No overall Federal-state contingency plan exists for responding to hazardous materials accidents, and there is less than optimum coordination and cooperation

existing in research projects and training programs.

Shippers and carriers, of course, also play major roles in emergency response. They provide response support through the Chemical Transportation Emergency Center (CHEMTREC), Chlorine Emergency Plan (CHLOREP), Transportation Emergency Reporting Procedure (TERP), Transportation and Warehouse Emergency Reporting Procedures (TWERP) and DES, DELP, TESP, and several others, including three in Canada - CAN-OLE, NATES, and NEEL.

Obviously many agencies have plans and responsibilities for hazardous materials accidents/incidents. The National Transportation Safety Board (1979b) investigation of the Rockingham, North Carolina, Seaboard Coastline freight train derailment of March 31, 1977, revealed that at least 10 emergency response plans were applicable to the accident - 5 Federal, 3 state, and 2 industry. Seventeen agencies responded and were onscene at one time or another during the event. It is obvious that procedures for lines of authority and command must exist for an orderly, coordinated emergency response to such an event.

The U. S. Department of Transportation is responsible for protecting the Nation against the risk of hazardous materials transportation. However, the local response personnel, often the local or state police, are the first on the scene. It is necessary to immediately establish a command post and to immediately have available a recognized chain of command to coordinate the efforts of various agencies. There needs to be in existence established procedures for transferring the designation of the onscene commander as individuals of higher authority arrive on the scene or depart from it.

Although there are many actors playing many different roles, several functions on the emergency response stage have common characteristics. They would include planning, communications, training, data collection, equipment needs, identification of key personnel, and funding. Many of the actors are struggling in these areas. For example, it hardly needs to be said that emergency equipment is basic to an adequate response. Yet few states have drawn up specifications for purchase of equipment to cope with hazardous materials emergencies; and the few that have purchased equipment have substantially different equipment specifications. The work of the Department of Transportation has done in the development of uniform standards and assistance to the states in funding the purchase of emergency medical vehicles indicates that uniform standards for vehicles responding to hazardous materials emergencies could be developed rather easily.

Because of the importance of emergency response functions such as planning, communications, data collection and dissemination, funding, and identification of key personnel on a Federal, state, and industry basis, a compelling need exists for a national stratagem to be devised wherein each actor on the Federal, state, and industry stage know precisely what his role is, how it should be played most effectively, and how his role interacts on a continuing basis with other agencies.

Toward a Solution - a National Response Center. A national response center is now being developed by DOT, using the facilities of the U. S. Coast Guard. The activation of this or some other singular means to coordinate responses to incidents and accidents is thought to be needed. Roles of public and private authority and expertise should be defined in advance and accepted by all before an

incident or accident occurs, not disputed or confused during such an event. On the scene, procedures and communications should be established among all levels of jurisdictions before an event occurs. Assistance from a national center should help relieve these problems. Additionally, DOT and CHEMTREC have signed an agreement which designates CHEMTREC as a central source of information and advice for public and private officials faced with chemical and hazardous materials incidents.

Issue 6: An integrated hazardous materials transportation administrative communication system among Federal and State governments

Statement of the Problem. Complex and sophisticated information can be required at the scene of an emergency, information on hazardous materials transported into one state from another is desired by some receiving states. Information about research in progress, literature, and issues is desired by investigators. No information system exists to support these needs.

Information Needs During an Emergency. There is the vital need for useful information during a hazardous materials accident or incident. The National Transportation Safety Board (1979c) reviewed more than 50 hazardous materials information sources and found them to be inadequate. These dealt with the physical properties of from 42 to 18,000 different materials. The report points out that the sources generally available do not provide the emergency personnel with the answers to the five basic questions they have:

1. Where is the hazardous material or its container likely to go if released during the emergency?
2. Why is the material or container likely to go there?
3. When is the hazardous material or container likely to go there?
4. How will the hazardous material or container go there? and,
5. What harm will occur when it gets there?

This type of information is needed during the first minutes of the response effort. Local information is a vital part of the information chain. What does the topography around the accident area indicate about drainage paths? What facilities (such as sewage treatment plants), resources (vegetation, water, etc.), persons, and populations are in the drain path? Where might the flow best be dammed or diked? What are the prevailing, present, and expected wind patterns, humidity, weather, etc.? What actions, therefore, ought to be taken? Where are the resources to enable such actions to be taken?

Since the answers to these questions must be applied to thousands of different hazardous materials and to innumerable locations where an accident could occur, the volume of data is too great to be retained by any "expert." An adequate information system is needed. The person in command at the scene needs an interactive capability with a sufficient data base. The mechanisms for this interactive capability involve selection of communication modes, computer resources, simplified procedures to ensure effectiveness during stress, and an adequate general and local data base, available on demand.

The system must be easily accessed by the respondent on the scene. Persons on the scene must know to access the system. Past failures have occurred because personnel at the scene have waited as much as an hour before contacting existing information sources, such as CHEMTREC.

In addition, the information system needs to be

capable of complete communications. Many emergency personnel are virtually isolated from one another during hazardous materials events, because their protective gear does not include a means to communicate with anyone. The means to ensure the first respondents to the scene have any vital information about the potential dangers and exposures needs review. Upon occasion (National Transportation Safety Board, 1979b) considerable delays have occurred because the materials involved could not be identified in spite of the existing labeling and placarding regulations and compliance.

Information Needs at Other Times. The need for a communications system goes beyond an emergency response. Hazardous materials are sometimes transported from one state to another. The officials in that state might feel they should be notified of the shipment and its path. There are no common accepted means for this information flow across states or from a state to the Federal government to other states. Data from research and research literature are needed by investigators. A general means to exchange administrative information across and among levels of government is needed. A means to communicate this information should promote more effective research. This, too, should promote more efficient administration.

Toward a Solution - a Study of the Requirements. A thorough systems study of the communications requirements to enable effective administration of all aspects of hazardous materials transportation is needed. Recommendations for the establishment of a human factors engineered communication system should be forthcoming from the study. These recommendations should include the overall system configuration, the equipment and software needed, and personnel and facilities requirements.

Toward a Solution - Build an Administrative Information Data Base. As stated above, there are thousands of materials and innumerable locations that could be involved in a hazardous materials accident. The amount of information that could be needed is very, very large. Therefore, a systematic cooperative program is needed among agencies to identify the most likely accident locations and most frequent hazardous materials being transported through those locations, and to begin an orderly process of accumulating needed data. A catalogue of the priority locations, drainage paths, wind currents, weather problems, population densities, and sensitive facilities could permit careful and location specific planning by transportation engineers and emergency planners.

The data required include not only accident probabilities by location and type of material, dispersion models and hazardous materials physical characteristics such as flammability, health hazards, and reactivity, but also how these materials behave with respect to the existing emergency conditions. In short, the data base needs to be sufficient to answer the five basic onscene emergency questions listed above.

The National Transportation Safety Board (1979c) suggests that a systematic consistent investigation of hazardous materials accidents be conducted using standardized maps to include: topographical features, scaled distances, the hazardous materials involved, locations of casualties and fatalities, time elapsed data, dispersion patterns, and weather data. The data would provide for a history to validate theoretical dispersion models presently in use, for validation of materials behavior, and for map overlays or simulations to enable local personnel to evaluate their specific situation. Such maps could be stored, frame by frame, in a video disc

system and could become part of an overall interactive information system by locality.

DATA AND DATA APPLICATIONS

Two critical issues which related to data and its use were placed among the ten most critical. They are discussed below.

Issue 7: A comprehensive data system for the flow of hazardous materials by quantity, general hazard class, route and mode

Statement of the Problem. Issue 7 exists because there is a general lack of knowledge about the quantity, type and mode of hazardous materials being moved in the nation. This information is absolutely necessary to the evaluation of local vulnerability and response resources. If a locality does not have this information, it cannot assess the adequacy of its response equipment and facilities, it cannot effectively estimate the probabilities of hazardous materials transportation accidents by specific location and mode (see Schmidt and Price, 1980a) and it might be limited in providing effective evacuation plans where necessary.

Trends in shipment variations are now known. For example, Virginia is the only state to have surveyed the flow of hazardous materials by highway (Schmidt and Price, 1979). Its 1978 survey differed considerably in percentage of trucks carrying hazardous materials. The percentage dropped from 13% to about 7%; however, the quantities of materials generally increased (Schmidt and Price, 1980b). Perhaps a change in shipping methodology is occurring for hazardous materials. Fuel costs, regulations, and/or sampling limitations might account for this apparent change, further changes might occur with the promulgation of the Resources Conservation and Reclamation Act, but such changes are not generally detectable without data. Trends in shipping practices, modes, routing, volumes seasonality, etc. do affect frequency and severity of hazardous materials accidents, the adequacy of response equipment and facilities, and the usefulness of emergency preparedness plans. This information is needed on a continued sampling basis for all modes of transport.

Virginia is surveying air, rail, and water modes of transporting hazardous materials in order to have the data base necessary for effective planning and decision making. This study involves samples of rail shipments through Virginia, air shipments into and out of Virginia airports, and marine cargo shipments in Virginia ports.

The Federal Railroad Administration (FRA) is obtaining information on hazardous materials flow by rail. They have commissioned the Transportation Systems Center in Cambridge, Massachusetts, to obtain this information from the FRA's one percent waybill sampling. The adequacy of this study is limited; however, it is the type of study which is greatly needed.

Toward a Solution - A Standardized Data System Among All States. It is important that the data be gathered in a uniform manner and be made available from all continental states. A model set of procedures for gathering data and a uniform format for data should be adopted among the states. Integration of data results should then present a national picture of hazardous materials transportation.

Issue 8: The state-of-the-art for hazardous materials transportation cost-benefit-risk analysis methodology

Statement of the Problem. The state-of-the-art for hazardous materials cost-benefit-risk analysis methodology needs to be synthesized and evaluated for its practicality.

Some General Comments. Issue 8 reflects the limitation in applying existing analytical methods of decision making in hazardous materials transportation. Attention must be directed toward the special risks of hazardous materials transportation. Consideration must be given to the magnitude of possible property damage, loss of life, costs of evacuation, interruption of commerce, and effect on industry as part of the risk modelling process. Probabilities of accidents by causative factors alone are not sufficient expressions of transportation risk (Ang and Briscoe, 1979, Zajic and Himmelman, 1978).

A notable effort was made by Battelle Pacific Northwest Laboratory to consider the risk of transporting gasoline by truck (Rhoades, 1978). This effort is an important contribution. However, the usefulness of their risk methodology is limited. The assessment performed relied heavily upon extensive combinations of elemental probabilities and fault tree constructions. It has a global application which provides overall support to the decisions about the acceptability of transporting gasoline by truck. It does not provide information which is useful to a local jurisdiction nor will a local jurisdiction have the required information to enable them to use this detailed approach. It would appear that assessments of this nature should be continued, and methodologies with local usefulness should also be developed and exercised. Issue 7 bears directly upon Issue 8 because it involves the data base for a practical risk methodology for local applications to assess area vulnerabilities, equipment, facilities and strategies.

Acceptable Risk Levels. There needs to be an examination of what constitutes an acceptable risk level. Can it be assumed that the general public will accept risks that are less for property or the individual than natural risks, such as being struck by a tornado or by lightning? Are there hazardous materials risk theories, such as cost-benefit system theories and utility models, which could be developed and verified to provide risk planning guidance? These and other questions relating to risk theory and methodology need to be answered for hazardous materials transportation decision makers.

Toward a Solution - A Hazardous Materials Risk Methodology Assessment. A risk assessment program might be conducted which would include an assessment of the risk information needed, the risk methodology, state-of-the-arts proposed hazardous materials methodologies, and validations of hazardous materials methodologies. The Committee's Synthesis of Risk Assessment could be a contribution to this program.

LEGAL RESPONSIBILITIES

The issue given as follows, received strong support from respondents to the survey:

Issue 9: Clarification of the legal responsibilities of governmental and private agencies involved in hazardous materials transportation.

Statement of the Problem. The Doctrine of Sovereign Immunity is eroding. It is unclear to

what extent government can be held liable for hazardous materials transportation accidents, especially if persons in government fail to act on their knowledge of hazardous conditions. The liability of shipper, carrier, vehicle manufacturer, or vehicle owner must usually be resolved in court. The financial costs of one hazardous materials catastrophe can be so enormous that private industry could become reluctant to participate in some aspects of the system. Delays because of litigation can deprive the injured of just, timely, and needed relief.

Assignment of Liability. Many Federal, state, and local government agencies have fragments of responsibility for hazardous materials transportation. This fragmentation makes assignment of liability difficult (and might contribute to failures of performance). In the private sector, the assignment of liability is also elusive. If a tank car fails in service, the courts must decide whether the shipper, carrier, car manufacturer, or car owner is liable, and to what degree. This litigation appears inevitable, and involves great human and economic impact on all parties concerned. Should legal responsibility and financial responsibility be synonymous?

Assignment of Financial Obligations. Certain parts of the hazardous materials transportation community may require limitations on their financial risks. For example, if a contractor accepts the risks of entering a very hazardous environment to achieve containment, relieve pressure, transfer cargo, etc. and if, in the process, ignition or delays in containment, relief, or transfer occur, the contractor might then become embroiled in litigation. Without some protection to the private industries which service the hazardous materials transportation system, their needed services might sometime become too costly or unavailable.

Toward a Solution - A Search for Mechanisms to Define and Distribute Responsibility. There should be an examination of available means to distribute costs of a catastrophic event in order to provide for timely settlements with the victims, and perhaps to limit the extent of financial responsibility assignable to specific participants in the system.

PUBLIC AWARENESS

Issue 10: The understanding of the public about the relative safety of hazardous materials transportation

Statement of the Problem. Literally, hundreds of tons of hazardous materials can pass over a given railroad track section every day. Ten percent to 13% of all trucks carry hazardous materials every day. When there is a rare interruption of this safety it can receive wide attention. It can involve mass evacuations, loss of life, loss of property, and environmental damage. Those most affected may have had nothing to do with what caused the event. Of course, almost everyone is sensitive to this because such occasions must be kept rare, and their impact minimized.

When such a rare occasion occurs, we must recognize the importance of the transportation of these materials to our society and the relatively low risk to our safety which is involved. The committee expressed a general concern that there was a need for public awareness of the relative risks in hazardous materials transportation. Representatives and personnel of the media need to be informed about the facts concerning the safe transport of hazardous materials and the need for responsible journalistic treatment.

The shipment of hazardous materials by the various transportation modes is relatively safe. For example, in 1977, four billion tons of hazardous materials were shipped. Accidents related to these shipments resulted in 31 deaths and approximately 750 injuries (Fiste, 1978), compared to 31 deaths and 750 injuries from non-hazardous materials shipments.

Towards a Solution - An Outreach Program to the Media and Public. A program to disseminate honest, objective, and realistic information about the nature of the safety of hazardous materials transportation should be undertaken. Nothing is absolutely safe and the public should not be led to expect a perfect system. Therefore, the importance and place of hazardous materials in our lives should be clear to everyone, as well as the safeguards in the hazardous materials transportation system. Sources of information such as pamphlets, booklets, and seminars should be made available to the media. Forums for questions, answers, and discussions could be provided where needed. T. V. and radio spot announcements could be developed to present information to the public. Major corporations have already taken out full page ads in national magazines to convey this message of safe transportation of hazardous materials.

METHODOLOGY

This list of the ten most critical issues was developed by the committee in four stages:

1. Committee members each submitted issues which they felt were critical in nature. The submitted issues were edited and consolidated into a list of 25.
2. Committee members then provided 65 names and addresses of hazardous materials transportation leaders in industry, government, and trade or professional organizations to whom questionnaires were sent. These questionnaires asked them to review these 25 issues and to check the ten most critical issues. They could write in issues not included in the list of 25.
3. The returns were evaluated by the committee and careful consideration was given to write in issues. Fifty-four percent of those receiving the questionnaires responded.
4. A final list of the ten most critical issues in hazardous materials transportation was then agreed upon by committee members.

The questionnaire list of addresses was made up of 31% Federal government, 25% state and local government, 23% industry, and 21% trade or professional association leaders. The response distribution could not be determined because the questionnaires were anonymous.

There was no attempt by the committee to conduct, at this time, a scientific survey. Rather the committee chose to accept the responsibility of defining these issues by this methodology. A representative survey of the hazardous materials community will probably be conducted by the committee at a later date.

ACKNOWLEDGEMENT

Some of the material for Issue 5 was provided by William J. Burns, Assistant Director, Office of Environment and Safety, U. S. Department of Transportation, Washington, DC.

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APPENDIX

Current Projects of the TRB Committee on Transportation of Hazardous Materials

The committee has a number of current projects, scheduled for completion by mid-1981:

1. Ten Critical Issues. Several years ago, the Transportation Research Board undertook to define the ten most critical issues in transportation. As a follow-on to that project, the Committee has begun a project to define the ten most critical issues in the transportation of hazardous materials. The preliminary results of that project are reported in this Transportation Research Circular. The Committee will perform a more detailed survey during 1980. The Committee plans to have a final report ready for the 1981 National Strategy Conference on Hazardous Materials Transportation (Spring, 1981).

2. Hazardous Materials Transportation Research Index. No complete and up-to-date listing of all hazardous materials research and development studies exists. Consequently, it is not possible to determine just who is doing what studies, and it then becomes impossible to sensibly identify the gaps and overlaps in hazardous materials research. Since this information is a vital input into the development of a national strategy for hazardous materials transportation (one of the critical issues already identified), the Committee has taken on a project to develop such a listing, in conjunction with the Transportation Research Board's Transportation Research Information System.

3. Synthesis on Risk Assessment. The critical

issues project highlighted the general agreement that the principles of risk assessment need to be applied to the transportation of hazardous materials. Many risk assessment studies have been done, and many of them were made without full knowledge of others going on at the same time. As a result, most of the outputs of the studies have been esoteric, theoretical and impractical in terms of application by a user. The Committee has taken on a project to develop a state-of-the-art report on risk assessment, particularly as it applies to the transportation of hazardous materials. In TRB terms, this risk/cost/benefit report is called a synthesis. This synthesis will assist the Committee in identifying a course of action to improve public understanding of the relative safety of different aspects of hazardous materials transportation.

4. A National Strategy Conference. The Committee will conduct a national hazardous materials transportation strategy conference which will convene all interested parties from executive and legislative branches of the Federal government, from State and local governments, and from the private sector. The purpose of this conference will be to develop a national strategy covering all aspects of the hazardous materials transportation system: legislation, regulations, administration, training, enforcement, research and development, and emergency response. The Conference will be held in early 1981.

TRB COMMITTEE ON TRANSPORTATION OF HAZARDOUS MATERIALS

The Committee on Transportation of Hazardous Materials was established over ten years ago by the Transportation Research Board to provide advice on technical matters involving the transportation and handling of hazardous materials by all modes of transportation (rail, highway, water, air, and pipeline), with emphasis on research needs and results. The Committee is charged by the Board with the responsibility to provide objective and independent technical opinions and views on hazardous materials transportation matters and to help sort out the differences between real problems and hypothetical problems or between real hazards and perceived hazards.

The Committee is made up of individuals selected by the Transportation Research Board for their expertise and capabilities in the field of hazardous materials transportation and handling. Members are chosen from government, industry, and academic institutions; there are representatives from all modes of transportation and with wide disciplinary backgrounds. The members represent only themselves as individual experts, although their support comes primarily from their employers as a public service. The committee is responsible only through the Transportation Research Board to the National Research Council in its functions, and so is not controlled by any special or private interest group. All formal findings, proceedings and reports of the committee are open to the public.

The Committee is a technical committee of the Transportation Research Board (TRB) -- an agency of the National Research Council which serves the National Academy of Sciences (NAS) and the National Academy of Engineering (NAE). Under the terms of its Congressional charter, the NAS is called upon to act as an official -- yet independent -- advisor to the Federal Government in any matter of science and technology, although it is not a government agency and its activities are not limited to those on behalf of the Government. The Board does not take positions in matters of policy, but rather acts as an objective source of facts on which others may base policy.

The Board's program is carried out by some 250 committees, task forces, and panels composed of more than 3100 administrators, engineers, social scientists, attorneys, educators, and others concerned with transportation; they serve without

compensation. The program is supported by state transportation and highway departments, the U. S. Department of Transportation, the Association of American Railroads, and other organizations and individuals interested in the development of transportation.

In meeting its responsibilities, the Committee functions in several ways:

- Provides a leadership of ideas and analysis of issues involving the transportation of hazardous materials, particularly with respect to the production, correlation, evaluation, and interpretation of research findings and technical information
- Defines critical hazardous materials transportation problems and issues, and outlines courses of action for problem solution
- Assists in developing a balanced national strategy for transportation of hazardous materials
- Identifies and defines research needs and priorities, along with sources of funds for research; assists in planning overall research programs
- Provides objective and independent opinions and views on which others may base policy, but does not take positions in matters of policy
- Encourages the adoption into practice of appropriate research findings and technical information
- Identifies areas in hazardous materials transportation that might benefit from the application of research findings, such as emergency response, testing of containers and transport systems, institutional constraints, training, conditions and forces encountered during transport, and risk assessment
- Encourages the reporting and dissemination in open forums of research findings and technical information to potential users, including the planning and conducting of conferences, workshops, and seminars on the transportation of hazardous materials

A descriptive list of the Committee's current projects, including the 1981 National Strategy Conference, is found in the Appendix.

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