Task 2 Report - Evaluate Current System

Prepared by:

9300 Lee Highway
Fairfax, Virginia

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Research and Special Programs Administration
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1. Introduction

This report presents the findings of Task 2, which is part of the Department of Transportation (DOT) sponsored study titled, "Study of the Applicability of Hazard Analysis and Critical Control Points (HACCP) or Similar Methodologies to the Transportation of Hazardous Materials." The goal of Task 2 and this report is to characterize and evaluate some of the more common risk management systems and related programs currently being employed for hazardous materials transportation and parallel fields. The evaluation includes a characterization of the risk management elements found in each system and a comparison of each of the systems to assess the degree of coverage and applicability to hazardous materials transportation operations.

This report builds upon the information collected and issues discussed during Task 1. Task 1, as described on page 54654 of the October 8, 1999, Federal Register, was to hold an exploratory meeting on risk management with stakeholders in industry, government, and the public to solicit ideas, input, and support. The exploratory meeting was held on November 4 and 5, 1999.

In this report, we begin by briefly describing some of the key elements associated with risk management. Second, we present a picture of the hazardous materials transportation process. Third, we provide the key elements and summaries of various risk management and regulatory systems. Note that we provide only condensed summaries or highlights of various risk management and regulatory systems and in no way should these be regarded as comprehensive in coverage. Finally, we evaluate these risk management and regulatory systems and discuss issues pertinent to developing a risk management structure for hazardous materials transportation. It is important to note that in many ways this report is a "living document" since we plan to update it as new and relevant information is collected and reviewed.

2. Risk Management

Risk management is the process that identifies and evaluates risk and then uses the information to make decisions and take actions to reduce such risk. Risk management has been used by government, industry groups, individual facilities/operations, the public, and other stakeholders to reduce the risk of unintended effects. Particularly, hazardous processes and activities can benefit through the application of risk management.

Risk Management

- *Analysis* - To identify and characterize hazards and risks
- *Decision-making / Priority-setting* - To decide who does what, and when
- *Action* - To reduce risks by prevention, control, mitigation, response
- *Verification* - To verify risk management is followed
- Evaluation - To periodically assess effectiveness and improve efficiency

In a definition a little closer to the concerns of DOT, risk management is the systematic application of policies, practices, and resources to the assessment and control of risk affecting human health and safety and the environment. In DOT, hazard, risk, and benefit/cost analysis are used to support development of risk reduction options, assessment of program objectives, and prioritization of issues and

resources. For DOT's Research and Special Programs Administration (RSPA), risk management should be able to address the hazards, consequences, and probability of hazardous materials accidents during transportation. One risk management tool being examined by RSPA is the Hazard Analysis and Critical Control Points (HACCP) system that is used in the food industry to prevent food contamination. The HACCP process was adopted as the regulatory framework for selected processes by the U.S. Department of Agriculture (USDA) and the Food and Drug Administration (FDA). Additional discussion of HACCP is provided in Section 4.3.1.

3. Transportation of Hazardous Materials

The purpose of this section is to set the context for consideration of risk management methodologies, such as HACCP, and their application to the transportation of hazardous materials.

3.1 DIVERSITY OF HAZARDOUS MATERIAL TRANSPORTATION

Hazardous materials transportation is an extremely diverse field involving many different parties and vastly different processes. The diversity of this field can be seen by looking at four major characteristics of hazardous material transportation:

(1) The variety of hazardous materials transported;
(2) The modes of transportation;
(3) The many industry and government stakeholders; and
(4) The complex regulations.

It will be a considerable challenge to find a "one size fits all" approach to risk management that would be applicable to all modes, all stakeholders, and all regulations. The first major characteristic is that there are thousands of materials that meet the DOT's definition of hazardous materials for transportation. DOT has established hazard classes, each of which represent very different hazards involving very different operational environments. Even within a single hazard class there can be vast differences in the hazard present in transportation because of fundamental differences in packaging and ultimate use of the material. One key question that remains for this project, even after the Task 1 stakeholder meeting, is whether there can be a single generic risk management methodology that can adequately accommodate all of these differences. Will there need to be several or even multiple approaches depending on the nature of the hazard class? This question may apply even to groups of materials within the same hazard class.

The second major characteristic is the four principal modes of transportation to be considered in this project: highway, rail, water, and air (pipeline is outside of the scope). There is the additional challenge of intermodal shipments. Preparation of hazardous materials for shipment by each mode can be substantially different. The differences between bulk shipments, especially cargo tanks by highway and tank cars by rail, and smaller package shipments are substantial. And yet there are many similarities. Again the challenge for this project is to identify where the right level of "hazard control and management" needs to be targeted – for each individual mode or at a higher level.

A third major characteristic of the hazardous material transportation system relates to industry and government stakeholders, who perform fundamentally different functions. These stakeholders include shippers (e.g., chemical manufacturer/wholesaler), carriers, distributors,

container manufacturers, container reconditioners, freight forwarders, emergency responders, and government regulators and enforcement personnel. Shipper operations and responsibilities are fundamentally different from the operations of carriers and container manufacturers. Although the primary target of this project is the regulated industry, other stakeholders, such as emergency responders, regulators, and the general public all have an important role in hazardous materials safety that needs to be considered. The challenge is to reach a balance between establishing a generic risk approach that is uniform across industry segments versus a number of approaches that are more applicable, and perhaps more effective, within each segment.

As for the fourth major characteristic, there are principles upon which the current regulatory system is based that need to be considered in the context of a HACCP or other risk management methodology. The current regulations are already "risk-based" to some degree. Hazard classification, packaging performance requirements, quantity limitations, packing group designation, and hazard communication requirements are examples of regulations that address some aspect of risk. Many would argue that strict compliance by all industry segments with existing regulations is the best sort of risk management program that DOT can establish and that the priority should be on better enforcement and industry compliance. An important question raised repeatedly at the stakeholder workshop (Task 1) is whether any overarching set of risk management principles established voluntarily by each industry segment would make any difference at all if they are not given some regulatory "teeth." Another regulatory consideration is that not all activities related to hazardous material transportation fall under the domain of the DOT hazardous material regulatory authority, e.g., vehicle and driver safety rules.

In summary, the development of a risk management methodology for hazardous materials transportation must recognize the substantial diversity related to hazard class, mode of transport, and industry and government stakeholders (e.g., shipper, carrier, container manufacturers, emergency responders). In addition, it must take into account the existing regulatory framework, which is already partially "risk-based." It may be that any overarching risk management principles that could embrace all characteristics of hazardous material transportation will have to be extremely generic, which would probably necessitate considerable adaptation by individual stakeholders.

3.2 CONCEPTUAL FRAMEWORK FOR HAZARDOUS MATERIAL TRANSPORTATION

It is important to consider risk management for hazardous material transportation from the broadest possible perspective so as to embrace all factors or activities that could have an impact on the safety of hazardous materials in transport. This includes those activities outside of the hazardous material regulatory domain as noted above. Thus, it is helpful to think of hazardous material transportation as a continuum from beginning (manufacture of product) through the end (delivery of product) and to identify the major components and sub-components that need to be considered. This approach helps to establish a conceptual framework for consideration of overarching risk management principles. This section identifies and briefly discusses each major component of this conceptual framework.

Product Manufacture – The manufacturer of a material that is potentially hazardous has a critical role to play in hazardous material safety. The manufacturer has the responsibility to test the product to determine whether it meets the criterion of any of DOT's hazard classes if it intends to ship the material and to assign the material to the most appropriate hazard class.

Packaging Manufacture – The packaging manufacturer is critical to ensuring safety. Many subscribe to the philosophy that the "safety is in the package." The manufacturer must ensure package integrity, compatibility with the material intended to be shipped, that the package can meet all DOT performance testing requirements, and that the package is marked with the appropriate DOT designation.

Shipment Preparation – The shipper of a hazardous material has many responsibilities to ensure safety. Many of these responsibilities are mandated by regulation, but others, such as mode choice and carrier evaluation and selection, are up to the shipper's discretion. The following lists the principal categories of safety-related functions for all shippers of hazardous materials. There are many other more specific requirements that could apply for specific shipper segments. Each of these categories could be broken down into discrete activities that need to be performed as part of a risk management process.

- *HM Classification/Verification* – The shipper needs to ensure to his own satisfaction that the material to be shipped is properly classified. This may require independent verification if the product manufacturer has previously classified the material.

- *Packaging Selection* – The shipper is responsible for selection of the appropriate packaging for the specific material to be shipped. This would include assurance that the correct DOT packaging is used as required, considering a number of factors such as quantity and compatibility of the material.

- *Package Preparation* – The shipper generally is responsible for preparing the package for shipment including filling, allowance for venting, closure, etc.

- *Special Regulatory Requirements* – There may be special rules that apply to the material involved such as related to the Packing Group designation, regulatory exceptions, and quantity limitations.

- *Shipping Paper Preparation* – The shipper is responsible for preparing bills of lading and meeting the regulatory requirements for shipping papers. These include items such as proper shipping name, hazard class, quantity of material, number of packages, emergency response instructions, 24-hour contact, and other requirements specific to certain materials.

- *Package Marking/Labeling* – The shipper must provide markings as required and as needed for hazardous material packages as well as applying the hazard class label as required.

- *Shipment Certification* – An extremely important responsibility of the shipper is to certify that all of the regulations for the shipment have been met before the package is released.

- *Mode Selection* – The shipper must make a decision on the mode of transport, although this is not controlled by regulation. This can be an important safety factor depending on the nature, hazard, and quantity of a particular material. In some cases, the mode may be dictated by lack of feasible alternatives.

- *Carrier Selection* – After the mode is selected, the shipper must select a carrier. Again, there may not be a feasible alternative (e.g., rail carrier). However, often there are alternatives and the shipper can obtain access to information on the safety history of carriers.

Loading and Unloading – One of the major components of hazardous material transportation is loading and unloading the packages of hazardous materials. Although some would consider this as part of Transportation Operations, it is listed separately here because of the potential for hazardous material incidents at this phase of the hazardous material transportation cycle. The incident history from DOT's Hazardous Materials Incident Reporting System shows that a relatively high percentage of incidents occur during handling incident to loading and unloading – forklift punctures, blocking and bracing failures, etc.

Transportation Operations – Carriers are responsible during the enroute transportation phase. Many of these activities are not directly covered by the DOT hazardous material rules, but are nevertheless critical to hazardous material safety.

- *Shipper Certification/Package Inspection* – The carrier must ensure that the shipping papers bear the signed shipper certification and must visually inspect the packages to ensure that they conform to regulatory requirements.

- *Vehicle/Trailer/Container Preparation* – The carrier is responsible for ensuring that the vehicle and the conveyance asset (trailer or railcar or intermodal container) are adequate and safe for line-haul operation. This embraces many important carrier responsibilities including its vehicle maintenance program, preparation of vehicles and trailers/containers for transportation, and inspection before movement.

- *Vehicle Placarding* – The carrier must ensure that the appropriate hazardous material placard is placed on the vehicle in accordance with regulatory requirements.

- *Carrier Logistics* – Carriers make many decisions that could affect the safety of hazardous material in transit including route selection, shipment scheduling, enroute stops and refueling, terminal and breakbulk assignments, etc.

- *Carrier Safety Program* – Carriers are required to ensure the general safety of their operations under a variety of carrier safety regulatory programs depending on the mode. These programs cover drug and alcohol testing, vehicle maintenance, vehicle registration, and others.

- *Line-Haul Transportation Operations* – Carrier operations during actual transportation are also subject to non-hazardous material regulations and can have a significant influence on hazardous material safety. These include operator hours of service, driver training, driver/operator registration, etc.

Terminal and Storage Operations – Hazardous material packages are often delivered to a terminal for breakbulk operations or to a storage facility for temporary storage while in transit. This is a phase during the transportation cycle where considerable package handling is done and is an area where hazardous material incidents often occur. Areas of concern are loading and unloading, blocking and bracing, stacking, and package and shipping paper inspection.

Emergency Preparedness and Response – This last component is not really a normal phase in the transportation cycle of hazardous materials. However, when an incident occurs, emergency response is a vital component of the overall system that can impact safety, if for no other reason than risk mitigation. Many of these responsibilities fall to local and regional emergency response organizations who have their own approach to risk management. However, there are many areas of intersection between industry requirements and emergency responder responsibilities (such as shipping paper information, placards, emergency response guidebook). Thus, the perspective of the emergency response community is important to consider in the development of overarching risk management principles.

4. Current System Approaches for Risk Management of Hazardous Material Transportation

This section discusses selected current approaches by RSPA and other DOT Administrations, other government agencies, industry, and international organizations in risk management of hazardous materials transportation. The descriptions are intended to be summary in nature and should not be construed as comprehensive.

4.1 DEPARTMENT OF TRANSPORTATION'S OFFICE OF RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION

One of U.S. DOT's missions is to administer a comprehensive nationwide safety program to protect the nation from the risk to life, health, property, and the environment inherent in transportation of hazardous materials by all modes of transportation. The DOT has been granted the authority to pursue this mission and institute a safety program through the Federal Hazardous Material Transportation Law, 49 U.S.C. § 5101 et seq. Having this authority, DOT developed the hazardous materials regulations (HMR), which can be grouped into the following five areas:

- Hazardous materials definitions/classifications;
- Hazard communication;
- Packaging requirements;
- Operational rules; and
- Training.

4.1.1 Risk Management Approach and Regulations

The Research and Special Programs Administration (RSPA) within DOT issues the hazardous materials regulations. RSPA also issued procedural and registration regulations. RSPA has primary enforcement jurisdiction over container manufactures, reconditioners, and retesters, and a shared authority over shippers of hazardous materials. Some of RSPA's regulatory functions include:

- Issuing rules and regulations governing safe transportation of hazardous materials;
- Issuing, renewing, modifying, and terminating exemptions; and
- Issuing, modifying, and terminating approvals for specific activities.

Many of the regulations RSPA has issued are based on the principles of reducing and managing the risks associated with the transportation of hazardous materials. To some degree, these regulations are risk-based and focus on identifying and communicating hazards. They are also

designed to reduce the probability and quantity of a hazardous material release and to mitigate release consequences. In addition, they are designed to address a very broad set of hazardous materials, all modes of transport (except bulk marine and pipeline), and all routes. The mode regulations or operational rules issued by RSPA are as follows:

- For hazardous materials transported by rail, regulations are contained in 49 CFR Part 174 Carriage by Rail. These regulations specify handling and loading requirements for specific hazardous materials, training requirements, and shipping paper requirements. Further requirements for packaging and bulk shipments of hazardous materials are addressed in 49 CFR Part 172, general requirements for shippers in 49 CFR Part 173, and specifications for tank cars in 49 CFR 179.

- For hazardous materials transported by public highway, regulations are contained in 49 CFR Part 177 Carriage by Public Highway. These regulations specify handling and loading requirements for specific hazardous materials, segregation of materials, driver training requirements, accident reporting, and shipping paper requirements. Further requirements for packaging and bulk shipments of hazardous materials are addressed in 49 CFR Part 172, general requirements for shippers in 49 CFR Part 173, and specifications for packaging in 49 CFR 178.

- For hazardous materials transported by aircraft, regulations are contained in 49 CFR Parts 172, 173, and 175. 49 CFR Part 172 provides maximum quantities and prohibitions by substance as well as labeling requirements. 49 CFR Part 173 addresses packaging specifications. 49 CFR Part 175, Carriage by Aircraft, covers recordkeeping, training, loading and unloading, separation distances, and other requirements specific to aviation.

These regulations form only a minimum standard, and they do not specifically address all the risk management considerations a shipper or carrier may need to employ in their risk management system. Two particular elements that are a necessary part of a risk management system are:

- **Risk assessment** - Includes analysis of hazards, investigation of consequences and probability, and cost/benefits assessments.

- **Risk management actions** - Includes control of hazards through prevention, corrective measures, mitigation, and other actions.

Current DOT regulations and RSPA efforts address these two basic elements some of the specific activities associated with each. Exhibit 4.1 demonstrates how the DOT and RSPA efforts address these two risk management elements.

Exhibit 4.1 - DOT RSPA and Risk Management Elements

Risk Management Elements	Current DOT and RSPA Efforts and Programs
Risk Assessment	
Hazards Analysis	▪ Hazardous materials classifications (49 CFR Part 172, Subparts A-B and Part 173)
Investigation of Consequences and Probabilities	▪ Hazardous materials information system ▪ Commodity flow survey ▪ Chemical/substance manufacturing, use, transportation studies ▪ Special analysis (e.g., National Transportation Risk Analysis) ▪ Public comments on rulemakings ▪ NTSB accident investigations
Benefit/Cost Assessments	▪ Various studies (e.g., "Prohibiting Hazardous Materials in External Piping of MC 306/ DOT 406 Cargo Tank Motor Vehicles - January 25, 1999) and other actions used to select appropriate course of action to protect public safety (e.g., safety notices, recalls, down-rating)
Risk Management Actions	
Regulations	▪ Classifications ▪ Packaging requirements (49 CFR Parts 173, 178, 179, and 180) ▪ Testing ▪ Training ▪ Operational requirements (49 CFR Parts 174-177) ▪ Approvals ▪ Modal Administration regulations (FAA, FRA, FHWA)
Compliance/Outreach	▪ Training ▪ Information dissemination to promote awareness and knowledge ▪ Enforcement with emphasis on high risk materials and activities ▪ The Cooperative Hazardous Materials Enforcement Development (COHMED) Program, which is an intergovernmental/industry partnership serving as a focal point for information sharing on hazardous materials
Alternatives to Regulations	▪ Exemptions programs
Mitigation	▪ Emergency Response Guides (e.g., North American Emergency Response Guidebook) ▪ Grants for training and planning (authorized by 49 U.S.C. § 5116)

The following sections provide additional information on selected RSPA activities related to the risk management actions shown above.

4.1.2 Compliance and Benefit/Cost Assessments

RSPA uses risk management concepts and tools to prioritize compliance activities and address the risks associated with non-compliance. RSPA places greater compliance emphasis on materials and packaging associated with materials presenting high hazard to the public such as poisons and flammable gases, and explosives. When packagings are found in non-compliance, risk and benefit/cost assessments are used to determine if actions such as recalls, down-rating, or use restrictions are necessary to protect public safety. RSPA is increasingly using quantitative analyses of risk to support cost/benefit assessments. RSPA has developed a "Procedure for Removal on Non-conforming Hazardous Materials Packaging from Service" that delineates a process and provides assessment guidelines for non-conforming packaging (U.S. DOT, 1999a).

4.1.3 Alternatives to Regulations

Exemptions provide alternatives to the HMR and are used to provide relief from regulations when circumstances require an exception to the rule. Specifically, the exemptions programs allow for implementation of new technologies and more efficient transportation operations. Exemptions are granted on a case-by-case basis. The procedural regulations governing RSPA's exemption program require all applications for exemptions to be accompanied by a safety analysis. A safety analysis consists of documentation and data substantiating a finding that the exemption sought will provide at least the same level of safety as that provided under the regulations. The safety analysis required to support exemptions varies greatly, from complex risk analyses for complex packaging systems involving new technologies to simple comparative analyses for minor variations in packaging or operational controls for relatively low hazard materials (U.S. DOT, 1999a).

4.1.4 Mitigation

RSPA has developed various aids that can be used to mitigate the consequences of a release. RSPA publishes and distributes to first responders an Emergency Response Guidebook to provide guidance on hazards, emergency actions, protective action decision factors, and distances. This information is also tailored to reflect the risk of each material. To support emergency preparedness and response planners at the State and local levels, RSPA, the Federal Emergency Management Agency, and EPA jointly developed the "Handbook of Chemical Hazards Analysis Procedures" and a personal computer program called "Automated Resource for Chemical Hazard Incident Evaluation (ARCHIE)." RSPA, through Planning and Training Grants, provides funds to State and local emergency preparedness and emergency response organizations for planning and training directed toward mitigation of the consequences associated with hazardous material incidents (U.S. DOT, 1999a).

4.2 OTHER DEPARTMENT OF TRANSPORTATION ADMINISTRATIONS

4.2.1 Office of Pipeline Safety

The first priority of DOT's Office of Pipeline Safety (OPS) is to protect the public, the environment, and property while maintaining an efficient and reliable pipeline system. Currently, the primary regulatory basis for achieving these safety goals in the pipeline industry is the set of regulations embodied in Title 49 of the Code of Federal Regulations Parts 190-199. In addition, pipeline companies perform many discretionary activities over and above the regulations to achieve these goals. To promote safety, teams of industry and regulators studied the potential use of risk management for the hazardous liquid and national gas pipeline industry and concluded that risk management had the potential to produce equal or greater levels of safety in a more cost-effective manner than the current regulatory scheme. Industry and regulators believe that risk management can improve safety and allocate resources cost-effectively by:

- Analyzing the precursor events and causes of potential pipeline incidents;
- Examining both the likelihood and severity of potential pipeline incidents;
- Providing a comprehensive and integrated means for examining and comparing the complete spectrum of risks and prevention/mitigation strategies;
- Providing a structured, easily communicated means for identifying and prioritizing pipeline risks and risk-reduction measures; and
- Establishing and tracking performance measure to ensure safety improvement.

The teams recommended a multiyear Risk Management Demonstration project. In 1995, a joint risk assessment quality action team (JRAQT) was formed to develop the risk management demonstration program standard applicable to hazardous liquid or national gas pipeline systems. The program standard is intended to serve as a common rational basis upon which the pipeline industry and its regulators can interactively develop, assess, and refine effective risk management programs and proposals. It is not intended to provide a detailed instruction manual that can be followed by pipeline companies to develop a program or proposal, or a checklist for OPS to use to review company risk management proposals.

This program standard defines the program and process elements of a comprehensive risk management program. At the same time, the standard allows flexibility to each company to customize its risk management program to fit its particular needs and corporate practices, provided that the program supports the scope and goals of the demonstration project proposal. This program standard plays an important role in the pipeline industry's risk management demonstration program. It is to be used by individual pipeline companies that are developing risk management programs and OPS as a basis for developing the processes to review and approve risk proposals submitted by individual companies. The program standard will be updated and refined as lessons are learned from the demonstration program. It is anticipated that this program standard will provide a starting point for the development of one or more national consensus standards or industry recommended practices.

This program standard outlines a comprehensive risk management program, including:

- Application of risk management to any or all portions of the pipeline life cycle, including design, construction, testing, operations, maintenance, and abandonment;
- Complete risk management process, including risk assessment, risk control and decision support, and performance monitoring and feedback; and
- The integration of risk management into the corporation's business practices, including administration, communication, documentation, and program evaluation.

In addition to this standard, the Risk Management Demonstration Project requires a regulatory review and approval process (the Regulatory Framework), and identification of Demonstration Project Performance Measures, which will be used to evaluate the effectiveness of risk management as a regulatory alternative.

4.2.2 Federal Railroad Administration

The Federal Railroad Administration (FRA) promotes general safe operations of the railroads through regulations and various safety programs. The regulations embodied in Title 49 of the Code of Federal Regulations Parts 200-266 address safe operating practices and standards, training and qualifications, and inspection. FRA enforces all regulations applicable to rail carriers, shippers by rail, and manufacturers of tank cars. FRA may issue orders to deal with dangers caused by the transportation of hazardous materials over unsafe track or by unsafe rail carriers. To promote regulatory compliance and improve safety, FRA has the Site-Specific Safety Inspection Program that consists of 400 inspectors in 47 FRA offices across the U.S. Some inspections focus on tank car integrity.

In terms of programs for risk reduction, FRA has a risk evaluation program that uses expert knowledge to identify, compare, and prioritize areas for risk reduction and safety improvement. Often the risk evaluation is a cooperative effort between government and industry.

Recommendations from the National Transportation Safety Board are also considered in this risk evaluation program. FRA also has the Safety Assurance and Compliance Program (SACP), which is a comprehensive approach to identify the root causes of problems across the railroad system. SACP is a forum for governmental officials, labor, and railroad management to discuss and resolve such safety problems. Elements of the SACP include Safety Assessment, Safety Partnership, Technical Resolution Committees, and Rail Safety Advisory Committees. The results of such efforts may involve developing safety action plans and safety inspections. The FRA has been moving in some areas away from prescriptive standards to performance-based standards that could reduce risk further (e.g., pressure relief valve design based on properties of hazardous materials carried).

4.2.3 Federal Aviation Administration

The Federal Aviation Administration (FAA) promotes the safety of aviation operations through regulations in Title 14 of the Code of Federal Regulations Parts 1-199. The regulations address certification of airworthiness through requirements for design and manufacture of aircraft, engines, and parts; training and license requirements for airmen (e.g., pilots, dispatchers, mechanics); airmen medical standards; operating rules for general aviation and air carriers; airport certification rules; and aircraft and airport security rules.

RSPA recently conducted a study titled, *Threat Assessment of Hazardous Materials Transportation in Aircraft Cargo Compartments*. The study assesses quantitatively the threat of hazardous materials transportation in aircraft cargo compartments. The study examines the probability that a life-threatening incident would occur and potential countermeasures to reduce the threat.

Some airlines have taken a variety of steps to address the threat of hazardous materials onboard including requiring passengers to answer at check-in whether their bags contain hazardous materials, raising prices on hazardous cargo shipments, and no longer accepting hazardous materials on passenger flights (USA Today, *Some Airlines Take Steps to Ban Hazardous Cargo*, February 23, 2000).

4.2.4 Federal Highway Administration

The Federal Highway Administration (FHWA) promotes general safe operations by highway through regulations and various safety programs. The regulations embodied in Title 49 CFR Parts 301-399 address safe operating practices and standards, training and qualifications, driving licenses, inspection, and some specific hazardous materials rules addressing driving (e.g., routing) and parking.

Specifically, the mission of the Federal Motor Carriers Safety Administration (FMCSA) (formerly FHWA's Office of Motor Carrier and Highway Safety) is to develop and promote programs to achieve continuous safety improvements in the Nation's highway system, intermodal connections, and motor carrier operations. The FMCSA Motor Carrier Research and Technology program has eight major focus areas, including Hazardous Materials Safety and Cargo Tank Integrity. This focus area assesses adequacy and safety of cargo tank designs and federal hazardous materials regulations as they relate to highway transportation. FMCSA is currently working on one project called the Hazardous Materials Transportation Risk Analysis. The project identified a need for FMCSA to measure the effects (fatalities, injuries, property damage, environmental damage, economic traffic damage, etc.) of hazardous materials incidents. These effects need to be quantified for FMCSA to make decisions about resource allocation

within the hazardous material program and within the entire FMCSA Program. The information is an essential part of program decisions and provides data when explaining the program decisions to Congress, the regulated industry, and the public. Recently, a preliminary assessment was completed that focused on crashes relating to the transportation of Class 3 material to determine if a risk assessment that compared the relative risk of hazardous materials with non-hazardous materials cargo shipments is feasible. The outcome included a recommendation that a risk assessment could be useful to the FMCSA hazardous materials program and currently is being considered.[1] Several years ago, FHWA developed the *Hazardous Materials Incident Prevention Manual: A Guide to Countermeasures*. The document provides basic questions to ask and countermeasures for trucking companies and their drivers. The questions provide a structured method to prompt the trucking company and their drivers to take basic steps and to adopt countermeasures.

4.2.5 U.S. Coast Guard

The U.S. Coast Guard (USCG) regulatory functions for hazardous materials cover bulk transport by vessel. While, the USCG has always used some of the basic concepts of a risk-based approach, they have now expanded their efforts in this area and recently developed their own risk management tool called the Risk Based Decision Making (RBDM) process. The RBDM is used to address operational risks external to the USCG as opposed to internal risks (personnel and equipment). External risks are those marine industry operations influenced by the Coast Guard such as cargo transportation, marine events, passenger transportation, and more. For internal risks, the USGC has developed a tool called Integrated Risk Assessment (IRA) methodology that helps in understanding operational risks. IRA is still in the development stages and will be beta-tested soon (Marine Safety Council, 1999).

According to the USCG the primary benefit of adopting a RBDM process is gaining the ability to optimize the use of resources to reduce risk. Specifically, the RBDM process aids in identifying/evaluating hazards and determining how to cost-effectively respond to those hazards. The USCG has developed an accompanying guideline document called Risk Based Decision Making Guidelines.

The RBDM process is used as a management tool that is generally applicable to most problems and decisions involving environmental pollution, the loss of vessels, personal injuries, and loss of life. The RBDM process is composed of the following five interrelated phases:

- Goal identification;
- Risk assessment;
- Risk management;
- Impact assessment; and
- Risk communication.

The USCG hopes that the RBDM process becomes second nature for its users and that instead of using it sporadically, it should be de-formalized and incorporated into everyday activities. The first phase of the RBDM process involves identifying and delineating a set of goals for the group (here "group" refers to the individuals making the decision). During this first phase, stakeholders also aid in identifying appropriate goals. When goals are agreed upon, the second phase, a risk assessment, is initiated to evaluate and identify potential hazards or scenarios of concern. The risk

[1] DOT, Research and Technology Program, http://safety.fhwa.dot.gov/safetyprogs/motorcarrier/research/hazmatcargo.htm

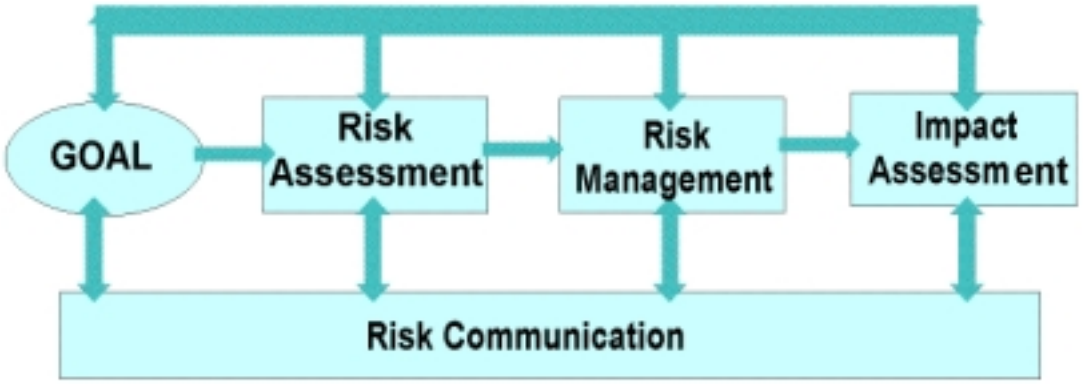
assessment phase provides a vehicle for developing a list of hazards ranked by risk. A risk assessment such as this is a prominent feature in most risk management and risk-based regulatory systems. The U.S. Coast Guard has developed several tools to calculate vessel risk, facility risk, port activity risk, and qualitative risk. After an assessment has been completed, a risk management plan is developed in a third phase to address the identified potential hazards. In this integrated plan, various counter measures that can be implemented to reduce the risk of the hazards are identified, evaluated, and ranked by overall effectiveness.

The fourth phase in the RBDM process is the development of an impact assessment, which is essentially an assessment or evaluation of the effects of the countermeasures identified. The integrated risk management plan is typically refined to address the findings of the impact assessment. Finally, risk communication efforts are implemented. However, risk communication is happening through out the decision-making process. For example, once prioritized lists of hazards are developed they are distributed to interested stakeholders. Exhibit 4.2 shows how the components of the RBDM process work together (USCG, 1999).

Related to the RBDM is the Coast Guard's on-going regulatory effort to require certain tank vessels operating on navigable waters in the U.S. or marine transportation-related (MTR) facilities to develop hazardous substance release response plans. Specifically, only those MTR facilities that, "because of their locations could reasonably be expected to cause substantial or significant harm to the environment by discharging a hazardous substance" would be subject to the proposed requirement (61 FR 87, May 3, 1996). The regulation is mandated by the Oil Pollution Act of 1990. According to the proposed rule, the purpose of the response plan is to minimize the impact of a discharge or release of hazardous substance into the navigable waters of the U.S.

The U.S. Coast Guard and the Passenger Vessel Association (PVA) developed a guidance document to provide the passenger vessel owners and operators with a step-by-step means of assessing risk within operations and assist in ways to reduce or even eliminate those risks. The guidance is entitled, The Passenger Vessel Risk Guide, A Guide to Improving the Safety of Passenger Vessel Operations by Addressing Risk.

Exhibit 4.2 – Coast Guard's Risk Based Decision Making (RBDM) Process



4.3 OTHER GOVERNMENTAL AGENCIES

4.3.1 USDA/FDA and HACCP

The United States Department of Agriculture (USDA) and the Food and Drug Administration (FDA) have adopted an innovative food safety approach called Hazard Analysis and Critical Control Points (HACCP) to serve as the risk management approach for certain food safety programs (e.g., meat and poultry processing, seafood processing). HACCP focuses on preventing hazards that could cause food-borne illnesses by applying science-based controls, from raw materials to finished product. HACCP is a hazard management system that requires the development of a HACCP plan tailored to individual operations at a specific facility. In the HACCP plan, food safety is addressed through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement, and handling to manufacturing, distribution, and consumption of the finished product. For successful implementation of a HACCP plan, extensive employee training and education must occur and management must be strongly committed to the HACCP concept. HACCP programs are always built on top of prerequisite programs that include training, cleaning, standard operating procedures, maintenance, and labeling.

In developing a HACCP plan, the facility must assemble a HACCP team consisting of individuals who have specific knowledge and expertise appropriate to the product and process. In addition, it is necessary to describe the food and its distribution systems and develop a process flow diagram. After these preliminary tasks have been completed the seven principles of HACCP are applied.

Principle 1: Conduct a hazard analysis

A hazard analysis identifies a list of hazards at each step in a process and the appropriate control measures. The hazard analysis involves two major stages: Stage 1 - A brainstorming session where all potential hazards are listed; and Stage 2 - A hazard evaluation where likelihood of occurrence, severity, and control measures for the hazards are considered.

Principle 2: Determine the critical control points (CCPs)

A critical control point is a step at which a control can be applied. This control is essential to prevent or eliminate a safety hazard or to reduce it to an acceptable level.

Principle 3: Establish critical limits

A critical limit is a maximum and/or minimum value to which a parameter (e.g., temperature) must be controlled at a CCP to prevent, eliminate, or reduce to an acceptable level the occurrence of a safety hazard. Critical limits are used to distinguish between safe and unsafe operating conditions at a CCP.

Principle 4: Establish monitoring procedures

Monitoring is a planned sequence of observations or measurements to assess whether a CCP is under control and to produce an accurate record for future use in verification.

Principle 5: Establish corrective actions

Developing specific corrective actions in advance to deal with process deviations. Corrective actions should be developed for each CCP.

Principle 6: Establish verification procedures

Verification procedures are those activities, other than monitoring, that determine the validity of the HACCP plan and that work to determine if the system is operating according to plan.

Principle 7: Establish recordkeeping and documentation

Generally, the records maintained for the HACCP system should include the following:

- Summary of the hazard analysis, including the rationale for determining hazards, CCPs, and control measures;
- The facility-specific HACCP plan;
- Support documentation such as validation records; and
- Records that are generated during the operation of the plan.

A recent General Account Office (GAO) report entitled "Meat and Poultry: Improved Oversight and Training Will Strengthen New Food Safety System," December 1999, examined the effectiveness of the HACCP technique. This report concluded that the regulations developed by the USDA that implement HACCP were consistent with the seven HACCP principles. In addition, USDA was recognized for providing the necessary training to its inspectors. However, the report did state that some food processing facilities continue to rely on non-HACCP programs to control hazards. This practice limits the consistent implementation of HACCP systems nationwide as well as USDA's oversight of food safety at these plants.

4.3.2 OSHA's Process Safety and EPA's Risk Management Programs

The Occupational Safety and Health Administration (OSHA) and EPA have developed regulations/policies and strategies to manage risk at facilities that handle hazardous materials. Transportation is not included in these specific risk management programs for facilities. Basically, the goal of EPA and OSHA's risk management programs is to prevent and minimize the consequences of accidental chemical releases at fixed facilities. OSHA has an employee focus whereas EPA focuses on potential impacts to the public and environment. Underlying the EPA and OSHA approaches is the notion that facilities know best how to reduce risk and that facilities have the main responsibility to prevent hazardous materials accidents. Both Agencies agree that there are basic elements for risk management and that these basic elements form a comprehensive holistic approach to reducing risk. Consequently, OSHA and EPA have mandated the basically same approach to risk management. OSHA established its requirements in the Process Safety Management (PSM) Regulations (29 CFR 1910.119 and 1910.120) and EPA established its requirements under the Risk Management Program (RMP) Regulations (40 CFR 68). Both EPA and OSHA regulatory requirements address facilities handling specific hazardous chemicals above certain thresholds.

The regulatory prevention programs for EPA and OSHA are identical. Facilities may need to address the following elements to manage risk:

- Employee Participation;
- Process Safety Information;

- Hazard Analysis;
- Operating Procedures;
- Training;
- Maintenance;
- Incident Investigation;
- Compliance Audits;
- Pre-startup Review;
- Contractors
- Hot Work;
- Management of Change; and
- Emergency Response.

In addition to the above elements, under EPA's RMP facilities must conduct a hazard assessment. A hazard assessment is an offsite consequence analysis that estimates the distances where the public or the environment could be seriously affected by a potential release, such as an airborne release of chlorine. Both worst-case release scenarios and alternative scenarios must be considered. Facilities must model the dispersion or explosion of the accidental chemical release and determine the distances to certain hazard endpoints (e.g., toxic levels). As part of the hazard assessment, facilities must document their offsite consequence analyses and maintain a five-year accident history of all serious accidental releases from covered processes. Also, facilities that use employees to respond to a release must develop an Emergency Response Program, which includes developing procedures, conducting training, and developing a written emergency response plan. Finally, under EPA's RMP, facilities must develop a written RMP plan that summarizes certain information about the hazard assessment, prevention program, and emergency response program.

Under the OSHA PSM, facilities must conduct a Process Hazard Analysis (PHA) to identify, evaluate, and control the hazards involved in the process. Types of PHAs included HAZOPs, failure modes and effects analysis, and fault tree analysis.

The EPA and OSHA risk management and process safety programs provide the framework for addressing all the appropriate aspects of a process. The hazard assessment and/or process hazard analysis characterize the hazards and indicate which types of scenarios or process failures should receive priority attention. If facilities implement the full set of requirements on a daily basis and pay sufficient attention to the priority hazards, facilities will reduce the risk of accidents. This approach to risk management evolved from many industry and government experts who dealt with low frequency and high consequence events.

4.3.3 U.S. Department of Energy

The U.S. Department of Energy (DOE), which must comply with DOT's regulations, ships a wide variety of hazardous materials including class 7 radioactive materials. Therefore, DOE has a great interest in transportation risk management issues and any rulemaking with the potential to affect their operations. DOE manages safety and risk management activities through a series of administrative and operational plans that assure implementation of DOE orders, require operational reviews, and maintain other activities that monitor performance and safety. These efforts address material characterization, packaging selection, and evaluation of carriers, modes, and routing. DOE implements a quality standards and review process to assure the integrity of packaging and to maintain a high degree of safety during operations. DOE Environmental

Management's Office of Transportation is tasked with implementing the existing framework of DOT hazardous materials regulations.

4.4 INDUSTRY

Industry plays a crucial role in risk management of hazardous materials transportation. Industry knows its operations better than anyone else and can make critical contributions to risk management. The following statement, from a representative of the International Labor Organization, illustrates this point:

> Regulation and voluntary initiatives should be mutually supportive: Governments should promote and encourage the use of voluntary initiatives such as Responsible Care as a complement to legislation, where appropriate, to achieve improved performance.[2]

However, developing a comprehensive risk management strategy that is effective and can be successfully implemented is complicated because of the variety of industry participants (e.g., shippers, packaging manufacturers, carriers) in hazardous materials transportation. Additionally, industry activities should complement the existing regulations. Certain industry stakeholders have developed risk management strategies for fixed facilities that have been expanded to the transportation sector. Other industries have focused on improving safety in transportation for decades. A selection of these industry efforts are discussed below.

4.4.1 Chemical Manufacturers Association's Distribution Code of Management Practices and TRANSCAER

4.4.1.1 *Distribution Code of Management Practices*

The purpose of the Chemical Manufacturers Association (CMA) Distribution Code of Management Practices (CMA,1999) is to reduce the risk of harm posed by the distribution of chemicals to the general public, carrier, distributor, contractor, environment, and chemical industry employees. The Distribution Code applies to: (1) all modes of transportation; (2) the shipment of all chemicals and wastes; and (3) distribution activities while chemicals are in transit between companies and suppliers or customers. The Distribution Code Management Practices help achieve some of the broader, guiding principles that fall under the CMA's larger initiative called Responsible Care. Responsible Care is a chemical industry-wide program that commits CMA member companies to continuous improvement in all aspects of environment, safety, and health performance and to openness in communication about its activities and achievements.

The Distribution Code of Management Practices relies on the following elements to reduce the risk of harm posed by the distribution of chemicals:

- Risk Management;
- Compliance Review and Training;
- Carrier Safety;
- Handling and Storage; and
- Emergency Response and Public Preparedness.

[2] "Points for Discussion" document developed by International Labor Organization - 1998 meeting in Geneva.

Exhibit 4.3 highlights those aspects of the above elements that are of particular importance to the transportation of hazardous materials.

Exhibit 4.3 - Distribution Code of Management Practices

Distribution Codes of Management Practices	Important Elements Related to Transportation of Hazardous Materials
Risk Management	▪ Have an ongoing distribution safety program with senior management commitment through policy, communication, and allocation of resources ▪ Regular review of the risks of the material distributed, likelihood of accidents/incidents, and potential for human and environmental exposure from release over route of transport; review should include a qualitative risk assessment that uses the following steps: 1) chemical listing; 2) chemical hazard ranking; 3) movement exposure ranking; 4) risk reviews prioritization; 5) risk reviews; 6) development and implementation of risk reduction alternatives; and 7) the risk management process updates ▪ Implementation of risk reduction measures appropriate to risk level ▪ Internal reporting and investigation of distribution incidents and implementation of preventive measures
Compliance Review and Training	▪ Monitoring changes from regulatory agencies and changes in industry practices in addition to developing a system for implementing changes ▪ Training for all personnel in proper implementation of applicable changes ▪ Program for providing compliance and training guidance to carriers, distributors, and others who perform distribution activities ▪ Continuous regulatory compliance and company policy reviews performed on employees, carriers, distributors, and contractors
Carrier Safety	▪ Process for qualifying carriers of all modes and types that transport chemicals to and from facilities that emphasizes carrier safety fitness and regulatory compliance, and that includes regular reviews of their performance ▪ Feedback to carriers on their safety performance and suggestions for improvement
Handling and Storage	▪ Documented procedure to ensure containers are appropriate for use, adequate for shipping materials, in compliance with testing and certification requirements, and free of leaks and visible defects ▪ Documented procedures for loading/unloading chemicals at facilities that will reduce emissions to the environment, protect personnel, and provide securement of the lading during transit or provide for safe unloading into proper storage facilities ▪ Criteria for the cleaning and return of transportation equipment (e.g., tank trucks, bulk containers) and for the proper disposal of cleaning residues ▪ Program for providing guidance to customers, distributors, and receivers on procedures for unloading and storing the company's chemicals ▪ Process for selecting distributors that store or handle chemicals in transit that emphasizes safety and regulatory compliance, and that includes regular performance and compliance reviews ▪ Feedback to distributors and others that handle chemicals in transit on safety performance

Distribution Codes of Management Practices	Important Elements Related to Transportation of Hazardous Materials
Emergency Preparedness	▪ Process for responding to chemical distribution incidents ▪ Documented procedures for making information about the company's chemicals in distribution available to response agencies ▪ Program for making training materials available to emergency response agencies ▪ Communication with Local Emergency Planning Commissions (LEPCs) on distribution hazards of chemicals ▪ Dialogue with public on concerns about chemical distribution safety, actions taken by the industry to improve safety, and effectiveness of emergency preparedness programs; TRANSCAER guidelines can be used here to help accomplish goals

The seven-step qualitative risk assessment activity, within the Risk Management Practice, is an overarching procedure that addresses various aspects of safe transportation and distribution. For example, step 6 recommends that the training and knowledge of personnel involved in chemical distribution activities be considered when implementing risk reduction alternatives. CMA has developed an Implementation Aid to assist carriers in conducting this seven-step qualitative risk assessment. In addition to the risk assessment, the internal reporting and investigation of accidents requires that preventive measures or corrective actions be implemented to improve the overall system thereby lowering the chance that the accident will reoccur.

4.4.1.2 *Implementation and Verification Aspects*

All CMA member companies must implement all the management practices and submit self-evaluations on their progress in implementing the Distribution Code. However, third-party verification, called Management Systems Verification (MSV) by CMA, is currently not an obligation of membership. During the MSV process a third party, comprised of CMA employees and others (e.g., consultants), visits a member company to assess how well the company has implemented all the Responsible Care initiatives, including the Distribution Code of Management Practice. CMA is working toward having all member companies adopt the MSV process.

As part of the Distribution Code of Management Practices, CMA attempts to involve many of its members in the Carrier Assessment Verification (CAV) service. Using CMA's assessment protocols, this service provides third-party verification of the self-assessments provided by chemical carriers and handlers. The CAV service provides CMA members a process to qualify and provide feedback to their carriers.

4.4.1.3 *CMA Partners Program*

CMA has efforts in place to enlist as many transportation companies as possible into their Responsible Care Partners program. Becoming a partner is challenging since companies must submit self-evaluations and agree to an environment, safety, and health performance evaluation by a partner in their industry (e.g., a shipping company if a shipping company is being enlisted). Apparently, most potential partners are not against this evaluation process, but are concerned about who pays for the evaluation. According to a CMA spokesperson, shipping or transportation companies often decide to become partners if it can be shown that adopting Responsible Care Partner principles results in a streamlining of operations. Because many of the same systems that exist in ISO 14001 (see Section 4.5.7) are also found in Responsible Care, some shipping or transportation companies decide to become partners thereby addressing both systems at the same.

Currently, CMA has 60 companies involved in the Partners program (all major railroad companies and some large trucking companies) and enlists 10 to 12 more companies each year. CMA attempts brings more partners into the program by: (1) advertising; (2) attending and speaking at trade shows; (3) approaching upper management; and (4) urging member companies to persuade shipping and transportation companies to become partners. When attempting to enlist partners, CMA often prioritizes their efforts and pursues those companies that handle the biggest volumes of chemicals or that have the most transfer facilities. Often the upper management of a shipping or transportation company is enthused about becoming a partner, but those employees involved in the day-to-day activities view the Responsible Care Partner commitments as more burdensome. In general, it seems that Responsible Care Partners have received only moderate support in the transportation and shipping industry. CMA member companies do have the option of choosing non-partners to ship or transport their products, but frequently member companies choose Responsible Care partners because this assures them that the shipper is implementing risk reduction measures.

4.4.1.4 *TRANSCAER*

TRANSCAER (Transportation Community Awareness and Emergency Response) grew out of CMA's Emergency Preparedness management practice of the Distribution Code. TRANSCAER is a community outreach program that addresses community concerns about the transportation of hazardous materials through planning and cooperation. The program provides assistance for communities to develop and evaluate their emergency response plan for hazardous material transportation incidents. TRANSCAER involves the following elements or activities:

- Encouraging partnerships between citizens and industry to develop mutual understanding about the transportation of hazardous materials;
- Helping community emergency planning groups identify hazardous materials moving through their communities;
- Providing guidance for local officials to develop and evaluate their community's emergency response plan; and
- Assisting with training for emergency preparedness (CMA, 1999).

4.4.2 National Association of Chemical Distributors and The Responsible Distribution Process

National Association of Chemical Distributors (NACD) members are companies that are typically involved in buying chemicals (e.g., raw materials) or chemical products (e.g., laboratory products) from chemical manufacturers and then reselling those chemical products to other purchasers; often they work as "middle men." These companies usually own large warehouses or facilities where chemicals are stored. Carriers and transporters (e.g., railroad companies) are not members of NACD, but can participate in their affiliate program.

In an effort to promote improvements in health, safety, and environmental performance in its member companies and to improve the use and handling of chemicals, NACD developed a set of principles called the Responsible Distribution Process (RDP) (NACD,1999). In developing these principles, the NACD adopted the majority of its guidance from the CMA's Distribution Code of Management Practice and from the Canadian Chemical Producers Association Responsible Care Program. This guidance was then combined with some of NACD's own guidance and adapted specifically to the needs of the U.S. chemical distribution industry.

Because the RDP contains many of the same elements previously described in Section 4.4.1, Exhibit 4.4 lists only those elements that are different from CMA's Distribution Code of Management Practices (Distribution Code) or unique to the RDP. It is important to note that in some cases it appears that either the Distribution Code or the RDP has omitted certain elements, but in fact it is often the case that the RDP simply places certain elements in a different Management Practice.

Exhibit 4.4 - RDP Management Practices that Differ from CMA's Distribution Code of Management Practices

Management Practices	Key Differences Related to Transportation of Hazardous Materials
Risk Management	▪ The qualitative risk assessment does not include a step called "movement exposure ranking," but instead it appears that NACD has included equivalent activities in a separate element. This equivalent element recommends that participants include an analysis of the hazards of the chemicals distributed, likelihood of accidents, and impact of releases on the public and the environment. ▪ An additional element in the RDP suggests that a regular review take place (with manufacturers) of the hazards of materials, likelihood of accidents, potential for human exposure, and route of material transport.
Compliance Review and Training	▪ The RDP requirement for training and certification is focused on aspects involving handling, storage, and transportation of hazardous materials. Unlike the Distribution Code, the RDP requires that contingency planning be regularly scheduled. However, the Distribution Code does include similar activities under it "Emergency Preparedness" Management Practice.
Carrier Selection	▪ The Distribution Code calls this element Carrier Safety. The RDP contains many of the same elements, but they are tailored to the chemical distribution industry. Specifically, it is required that when distributors are in the process of selecting carriers to transport chemicals they review or check, among other things, for the following: 1) record of carrier safety and fitness; 2) regulatory compliance; 3) overall performance; 4) proof of insurance and liability; 5) correct DOT endorsements (e.g., MCS 90); 6) correct FHA rating letters; 7) proper shipping papers; 8) proper driver training and safety plan; 9) presence of emergency contingency plans; 10) verification of adherence to controlled substance testing; and 11) any third-party reviews on performance. Unlike the Distribution Code, no specific requirement for providing feedback to the carrier is present.
Handling and Storage	▪ The RDP recommends providing manufacturer guidance to warehouses, terminals, and carriers on procedures for safe handling and storage of chemicals. ▪ Instead of focusing on distributors, as is the case in the Distribution Code, the RDP states that when members are selecting sites for chemical storage or handling they emphasize safety and include performance reviews. No requirement for providing feedback to carriers is present in the RDP. ▪ The RDP requires designing and maintaining equipment and sites in a manner consistent with relevant codes and regulations.

Management Practices	Key Differences Related to Transportation of Hazardous Materials
Job Procedures and Training	▪ The Distribution Code does not contain this Management Practice, which requires that members ensure that employees, including outside contractors, receive sufficient training and have the skills to perform their duties safely. In addition, this practice requires that members ensure that personnel in safety-critical jobs are fit for duty and not compromised by external influences (e.g., alcohol). However, the Distribution Code does contain a job training requirement in a separate activity called "Developing and implementing risk reduction alternatives" found in the Risk Management Practice.
Waste Management	▪ The Distribution Code does not have this Management Practice. For this Practice, the RDP requires that waste be disposed of properly and that there be a commitment to waste reduction, pollution prevention, recycling, reuse, and treatment.
Emergency Response & Public Preparedness	▪ The Distribution Code is essentially the same for this Management Practice, but the RDP does not specifically require activities aimed at opening a dialogue with the public on the potential hazards associated with chemical distribution. However, it is possible that similar activities maybe included in RDP's Management Practice called Community Outreach.
Community Outreach	▪ See above - Emergency Response & Public Preparedness.
Product Stewardship	▪ The Distribution Code does not contain this Management Practice. The RDP suggests that members work with others to foster dissemination of information on the proper use, handling, and disposal of products. Similar activities are contained in the Distribution Code's "Compliance Review & Training" Management Practice plus CMA's Responsible Care includes a separate Product Stewardship Code.
Internal Audits [3]	▪ The Distribution Code does not contain this Management Practice. The RDP requires the establishment of procedures for regularly (e.g., yearly) scheduled internal audits to verify implementation of policies supporting the RDP.
Corrective and Preventive Actions [3]	▪ The Distribution Code does not contain this Management Practice. The RDP requires the establishment of a corrective and preventive action system for RDP issues, permit identification, and communication of inadequacies.
Document and Data Control [3]	▪ The Distribution Code does not contain this Management Practice. The RDP requires the establishment of a system to control policies and procedures supporting RDP.

4.4.2.1 *Implementation and Verification Aspects*

To become and remain a member of NACD all member companies must adhere to the requirements associated with the RDP. In addition, prior to becoming a full member company, NACD requires that member companies take part in a third-party verification process where RDP compliance is reviewed. Member companies have up to one year after they submit a membership application to take part in the third-party verification process. Like CMA, NACD has an Affiliate Program, which enables carriers or transporters to gain RDP affiliate status only if they meet the all requirements of the RDP. After carriers or transporters gain this status, distributors are more likely to choose them to transport their chemicals because they have committed to take steps to reduce the potential for incidents. Affiliate companies must also agree to take part in the verification process. Each member company typically designates a “Company Code

[3] Not actual Management Practices, but adjunct policies that were added after it was recognized that there was a need to provide guidance to members on how to implement the RDP and to ensure that member companies utilize the appropriate documents and data to implement the RDP.

Coordinator" who works with management and employees to implement the above codes. It is important to note that most of the elements or activities included in Exhibit 4.4 are only recommendations and other equivalent activities that accomplish similar goals can be adopted by member companies.

4.4.3 Insurance Companies

Insurance companies are in the business of managing risk. Insuring against accidents involving the transport of goods and materials, especially hazardous materials, is complex. Insurance companies want to assure that the insured (e.g., trucking, rail companies) adhere to principles and procedures that limit risk exposure. However, representatives from a few insurance groups indicate that few specific standards are required of the hazardous materials transportation industry. This is particularly evident in the trucking industry where there are many diverse players (e.g., large trucking companies, small independents). In determining risk liability (frequency and cost severity of incidents), some insurance companies examine loss history, existence of loss control/safety departments, driver training and certification, safety reports, and adherence to hazardous materials and general safety regulations. Examination of operating or maintenance manuals and records is usually beyond what is required. Losses can be significant even for companies with relatively good safety records, and much can still be done in these companies to reduce risk. According to the American Trucking Association's Insurance and Risk Management Committee, the motor carrier industry does not really have anything comparable to CMA's Responsible Care program. The committee has it on their agenda to develop a "Responsible Motor Carrier Program," which is for all motor carriers and not specific to hazardous materials transportation. One of the big issues for the committee has been the liability posed to motor carriers if the carriers do not adhere to a Responsible Care type program.

4.4.4 Trucking

In general, there is no formal risk management program initiated by the trucking companies for hazardous materials transportation. Trucking companies are usually in close contact with the shippers (both chemical and petroleum) to work through safety requirements including equipment choice, loading/unloading procedures, routing, etc. Various issues about specific problems will be elevated to the association level. For example, presidents of companies in the National Tank Truck Carriers, Inc. and members of CMA form the Inter-Industry Bulk Highway Safety Task Force to look into and solve safety issues. The outcome of this effort is a Manual of Recommendations that provides guidance to both shippers and carriers on day-to-day operational concerns relative to tank truck transportation of chemicals. The manual also customizes the CMA Distribution Code Implementation Aid for tank truck transportation. Additionally, the National Tank Truck Carriers, Inc. itself examines issues and disseminates information to safety directors of trucking companies in newsletters and periodic seminars. There are hazmat trucking companies that are Partners in CMA's Response Care Distribution Code, but many companies are not partners. With various levels of activity, the Partner companies follow the Distribution Code management practices. These trucking companies also participate in self-verification. Periodically, Partner carriers meet with CMA members to discuss issues in program implementation.

4.4.5 Railroads

In terms of risk management, the railroads have for years been following general railroad guidelines for safety. These guidelines suggest for example, safe levels of maintenance, inspection frequency, and institution of certain technologies (e.g., wayside detectors). For

hazardous materials, railroads follow Circular No. OT-55B Recommended Railroad Operating Practices for Transportation of Hazardous Materials. These practices are recommendations rather than overt standards. All major railroads either follow these or similar policies that provide an equivalent level of safety. Completed in the early 1990s, OT-55B was developed by Association of American Railroads (AAR), CMA, and RPI members. To further improve safety, the railroads have a risk management committee that address issues of safety. There are subcommittees on tank cars and hazardous materials. All major railroads and some medium-sized railroads are Partners in CMA's Responsible Care Distribution Code (see Section 4.4.1 above). AAR and the shippers have also developed a successful program to reduce the number of non-accidental releases (NAR) by identifying the problem, determining the predominant cause, and developing a program to help shippers re-emphasize the best practices to its employees. A few railroads have made efforts to conduct transportation risk analyses although the level of sophistication of these efforts varies widely.

4.4.6 Petroleum Industry

The American Petroleum Institute and other petroleum organizations are co-sponsors with DOT's Office of Pipeline Safety in promoting the Risk Management Program Standard for pipeline risk management (see Section 4.2.1). In terms of transportation of petroleum products by truck, API has recently provided a Recommended Practice 1005 for Loading and Unloading of MC 306/DOT 406 Tank Motor Vehicles.

Individual petroleum companies have various levels of activity in transportation risk management of hazardous materials. For example, Mobil Shipping and Transportation Company (marine transport) recently established the Environmental, Health, and Safety Management System (EHSMS). This management framework provides a structured, systematic, and targeted approach to all aspects of safety, health, and environmental protection. EHSMS consists of 11 elements, and each element contains specific management expectations and establishes accountability for meeting each of the expectations (Marine Safety Council, 1999). EHSMS contains the following elements:

(1) Policy and leadership
(2) Performance improvement
(3) Safety and health
(4) Risk management
(5) Incident reporting and investigation
(6) Crisis preparedness
(7) Environmental protection
(8) Product stewardship
(9) Training
(10) Community relations
(11) Legal requirements

4.5 INTERNATIONAL

The international community also has a number of regulatory and risk management systems aimed at managing and reducing the risks associated with the transportation of hazardous materials. The following sections summarize some of the more important and unique features of some of the international regulatory and risk management systems currently employed. When sufficient information was available, an attempt was made to match a specific activity or aspect of

the international standard with the risk management practices discussed previously. Emphasis is placed on highlighting those elements that are unique to a system.

4.5.1 United Nations

The United Nations (UN) Recommendations on the Transport of Dangerous Goods provides a uniform basis for development of harmonized regulations for all modes of transport, to facilitate trade and the safe transport of dangerous goods or, as referred to in the U.S., hazardous materials. UN Recommendations have gained global acceptance through adoption as the basis for most international, regional, national, and modal transport regulations. Safety is enhanced primarily because harmonized requirements simplify the complexity of the regulations and decrease the likelihood of non-compliance. In addition, the UN Recommendations facilitate compatibility between modal requirements so that a shipment may be transported by more than one mode without intermediate reclassification, marking, labeling, or repackaging.

UN Recommendations cover all aspects of transportation necessary to provide international uniformity. They include a comprehensive criteria-based classification system for substances that pose a significant hazard in transportation. Hazards addressed include explosivity, flammability, toxicity (oral, dermal, and inhalation), corrosivity to human tissue and metal, reactivity (e.g., oxidizing materials, self reactive materials, pyrophoric substances, substances that react with water), radioactivity, infectious substance hazards, and environmental hazards. Like RSPA classifications, the UN classification efforts can be categorized as hazard analysis efforts. The UN Recommendations, also prescribe standards for packagings and multi-modal tanks used to transport hazardous materials. These standards can be considered to be based on risk management principles. They also include a system of communicating the hazards of substances in transport through hazard communication requirements which cover: (1) labeling and marking of packages; (2) placarding of tanks and freight units; and (3) documentation and emergency response information that is required to accompany each shipment.

Many national, regional, and modal regulations governing the transport of dangerous goods are now based on the UN Recommendations. However, the different regulations are structured differently requiring consignors of dangerous goods to be familiar with the unique structure of all applicable regulations. This lack of structural harmony of transport regulations can complicate compliance with the applicable requirements and to the extent that it results in noncompliance is detrimental to safety (DOT, 1999b).

4.5.2 Mexico

The Official Mexican Standards (referred to as Normas or NOMs) augment the Mexican Hazardous Materials Land Transportation Regulation. The Mexican Secretariat for Communications and Transport is responsible for publishing and maintaining the NOMs. In addition, other Mexican government agencies have authority to publish and are developing standards relevant to the transportation of hazardous materials within Mexico. The Mexican NOMs are fairly consistent with the UN Recommendations on the Transport of Dangerous Goods. Given that the U.S. Hazardous Materials Regulations also are based on the UN Recommendations, the HMR and the Mexican regulations/standards are very consistent (U.S. DOT, 1999c).

In addition to abiding by the NOMs, most chemical industries in Mexico abide by CMA's Responsible Care principles (see Section 4.4.1). The adoption of the principles is a requirement for membership with ANIQ (Asociación Nacional de la Industria Química), Mexico's chemical

industry trade association. Currently ANIQ has 230 member companies that represent 90 percent of all the private production of chemicals. Members of ANIQ also participate in the private emergency response system called Sistema de Emergencias en Transporte para la Industria Quimica (SETIQ).

4.5.3 Transport Canada - Compliance and Response Branch

In Canada, the federal government and each of the provinces and territories have enacted legislation to regulate the transportation of dangerous goods. While the jurisdictional coverage of these pieces of legislation varies, the intent is consistent with the federal *Transportation of Dangerous Goods Regulations*. Canadian regulations require that dangerous goods be classified according to their hazard level prior to transport. There are nine classes in this classification system and further divisions within each class that more precisely identify the hazards associated with the material.

Like the U.S., Canada has implemented packaging standards that all shippers or transporters of dangerous goods must abide by. These packaging standards, referred to as Safety Standards, are developed by a representative committee from industry, government, environmental groups, and others. A general requirement in the Safety Standards stipulates that when no standard packaging is prescribed, the dangerous goods must be packaged in a way that ensures no discharge, emission, or escape of the dangerous goods that could result in danger to life, health, and property or the environment.

The *Transportation of Dangerous Goods Regulations* prescribe labels and placards for each classification of dangerous goods as well as information to be in documents that must accompany the consignment of dangerous goods. In addition to labeling requirements, the regulations require that every person engaged in the handling, offering for transport, or transporting of dangerous goods receive the necessary training. Training prevents improper packaging and labeling or placarding. Finally, to determine whether dangerous goods are being handled or transported safely and to verify compliance with regulations, inspection and enforcement activities are in place.

Transport Canada does have a Risk Management Branch that makes recommendations and implements decisions and directives to minimize the adverse effects of accidents on people, property, and the environment. The Branch applies risk management techniques in a regulatory framework. These techniques reduce the uncertainty surrounding the potential for accidents by estimating the likelihood and severity of accidents and by taking action to reduce the probability and severity of accidents. It is important to note that U.S. and Canadian regulations are currently harmonized as both are now based on the UN Recommendations on the Transport of Dangerous Goods (Transport Canada, 1999).

4.5.4 Canadian Chemical Producers Associations

Similar to CMA members in the U.S., member companies of the Canadian Chemical Producers Associations (CCPA) must commit to implement their own Responsible Care Codes of Practice. CCPA companies involved in the sale of chemicals, chemical products, or services, and the movement of those goods from suppliers for conversion or resale must abide by the Distribution Code of Practice. It appears that the CCPA Distribution Code is very similar to CMA's previously described Distribution Code (see Section 4.4.1). However, it does appear that CCPA places even a greater emphasis on requiring member companies to abide by principles of the Distribution Code. Specifically, CCPA's Code does not allow customers to purchase chemical

products from member companies if they are not prepared to meet the minimum standard of the applicable codes of Responsible Care.

Unlike CMA, CCPA has developed a separate Transportation Code of Practice. However, many of the elements found in the CCPA's Transportation Code of Practice have been incorporated into CMA's Distribution Code. In short, CCPA's Transportation Code of Practice is designed to ensure that chemicals and chemical products are transported in a way that minimizes the risk of injury to people moving the goods, to people along the transport route, and to the environment. Third-party companies hired to carry member companies' goods are expected to operate according to the principles of Responsible Care. CCPA member companies must evaluate carriers of their materials on safety performance and programs, inspection and maintenance procedures for equipment, and selection and training of drivers and support staff. If carriers cannot meet the expected standards, they will not be hired. Employees of third-party carriers and people living in communities along the transport route should have access to the same health and safety information as company employees. Transport routes should be chosen to minimize the exposure of people and environmentally sensitive areas to the potential hazards of chemicals and chemical products. Each CCPA member is required to have an up-to-date, operational transportation emergency response plan to deal with hazards, contain and clean up releases, provide technical advisors at accident scenes, and assist local emergency response forces (CCPA, 1999).

As with CMA, CCPA has also instituted a TRANSCAER program (see Section 4.4.1). However one difference is that CCPA's Transportation Code contains an element called the Transportation Emergency Assistance Program (TEAP). This is a cooperative effort under which skilled personnel from one of a number of regional Canadian centers can respond within hours to a chemical transportation emergency anywhere in Canada. The CCPA's Transportation Code requires those members who ship chemicals by rail to follow the Rail Car Assessment Protocol, which is intended to assist shippers and carriers to evaluate and improve the safety of shipping chemicals by rail (CCPA, 1999).

4.5.5 European Chemical Industry Federation (CEFIC)

The European Chemical Industry Federation (CEFIC) has recently developed a chemical management initiative to continuously improve management of chemicals; to ensure chemicals are safely produced, used, and disposed of; and to involve committed stakeholders. The four components of the initiative include (1) a long-range research initiative addressing generic health and environmental issues; (2) chemical assessment and management, which includes gathering information, assessing risk, and managing chemicals based on European risk assessment strategies; (3) product stewardship consistent with CMA's Responsible Care Program; and (4) stakeholder dialogue. The initiative is oriented to chemical producers and not chemical transporters.

4.5.6 International Council of Chemical Associations

The global chemical industry is represented by the International Council of Chemical Associations (ICCA). Like most chemical industry trade groups, ICCA has adopted Responsible Care initiatives. Currently, 42 national initiatives to establish and implement a Responsible Care program are in place, but each has its own set of guiding principles that define how the program will be instituted in each country. National chemical industry associations are responsible for the establishment and implementation of the Responsible Care initiative in their country.

ICCA members have agreed upon eight fundamental features that will be instituted in all Responsible Care programs. Of these eight features, the two most relevant to the transportation of hazardous materials are the codes or guides and the self-assessment and verification features. The codes must meet the overall goals of Responsible Care and are likely similar to the Distribution Code discussed in Section 4.4.1. However, the codes adopted are tailored to the activities taking place at the company. The self-assessment and verification feature is essentially a systematic procedure to verify the implementation of the measurable (or practical) elements of Responsible Care. Either external (third-party) or internal self-assessments can be performed.

4.5.7 Other International Standards

In recent years, international efforts have been made to develop a formal set of procedures, policies, and standards to address various issues including quality, environmental management, and occupational safety and health. Many of the standards have been codified by the International Organization for Standardization (ISO) and may have applicability to risk management of hazardous materials transportation. Exhibit 4.5 presents several of these standards.

Exhibit 4.5 - International Standards with Aspects of Risk Management

	OHSAS 18001	**ISO 14001**	**BS 8800**	**ISO 9001**
Title	Occupational Health and Safety Management Systems	Environmental Management System	Occupational Health and Safety Management System	Quality System
Year promulgated	1999	1996	1996	1994
Sponsor	Various co-operating organizations, many from ISO	ISO	British Standard	ISO
Strong Risk Component	Yes	No	Yes	No

When implemented, these voluntary standards would move a facility beyond compliance with required environmental and health and safety regulations toward a dynamic, continual process of operational and organizational redesign, with the objective of continually improving the facility performance in these areas. A brief discussion of several of these standards is provided below.

4.5.7.1 *Environmental Management System (ISO 14001)*

An Environmental Management System (EMS) is a formal set of procedures and policies that define – sometimes in great detail – how an organization will manage its potential impacts on the natural world and on the health and welfare of the people that depend on it.

In late 1996, the International Organization for Standardization (ISO) published the final version of an international EMS standard, called ISO 14001. An organization that adopts an EMS that conforms to the standard can be certified as conforming to it by a third-party "registrar." Publication of the standard has generated great interest in the business community, because in some international markets certification may in the future be viewed as a prerequisite for commerce. ISO 14001 does not specifically talk about risk management or transportation, but provides a general framework for environmental management and reducing environmental impacts. This general framework includes the following components:

(1) Establish and Maintain the *General Requirements of ISO 14001*

(2) Develop an Appropriate *Environmental Policy*

(3) Planning:
- Identify *environmental aspects of activities*, products or services
- Develop procedures to identify *legal requirements*
- Establish and maintain *documented environmental objectives*
- Develop programs for *achieving environmental objectives*

(4) Implementation and Operation:
- Define, document, and communicate *roles* to facilitate effective environmental management and provide implementation resources
- Identify *training needs* and verify that all personnel have received the necessary training
- In regard to the environmental management system, establish and maintain *procedures for internal communication and external communication* with interested parties
- Establish and maintain *documents* associated with environmental management system
- Establish and maintain procedures for *controlling documents* required by ISO 14001
- Operational control:
  - Identify *operations associated with significant environmental aspects* that are in line with policy, objectives, and targets and maintain these operations
  - Stipulate *operating criteria*
  - Maintain procedures to communicate procedures and requirements to *suppliers and contractors* when environmental aspects are identified
- Establish and maintain *emergency preparedness and response plans*

(5) Checking and Corrective Action:
- Maintain procedures to *monitor* and measure key characteristics of activities that can have significant impact on the environment
- Maintain and implement *nonconformance and corrective action plan*
- Maintain procedures for *identification, maintenance, and disposition of environmental records*
- Maintain programs and procedures for *periodic environmental management system audits*

(6) Management Review:
- Top management shall at intervals review the environmental management system to ensure continued suitability, and management should make the necessary changes.

Businesses and other organizations may view ISO 14001 certification as an opportunity to send strong signals to regulators and the public about their commitment to environmentally friendly operations. In theory, a facility that adopts an ISO 14001 (or ISO 14001-equivalent) EMS should, in the long run, conform with all environmental regulations without the threat of

punishment by government officials, given that the standard requires a procedure for identifying and complying with regulations; furthermore, it should surpass regulatory standards for many activities. Also, the ISO 14001 standard requires facilities to commit to continuous improvement of their EMS over time. Some government officials therefore see in ISO 14001 an opportunity to make many regulations more self-enforcing and thus less demanding of formal enforcement actions by government. Other regulators and most environmental groups, however, remain skeptical of the idea that facilities will properly monitor and correct their negative environmental impacts without effective regulatory oversight. For this reason, these groups argue that regulatory scrutiny of ISO 14001-certified facilities should never be reduced.

Regulators have recognized that there is a need for information about how ISO 14001 EMSs will affect the environmental, economic, and regulatory performance of organizations. In 1996 officials of nearly a dozen U.S. states and EPA formed an informal "multi-state working group" (MSWG) to develop a common set of ground rules and data collection protocols for pilot projects with businesses that were contemplating EMS certification through ISO 14001, and to pool their data on the environmental and economic results into a national, publicly accessible database. From the start, the MSWG also included representatives from environmental and business organizations and from the academic community.

4.5.7.2 *Occupational Health and Safety Management Systems OHSAS 18001*

The British Standards Institute's Occupational Health and Safety Management System standard (OHSAS 18001) was sponsored by over 14 major standards and insurance organizations (many on the ISO committee), but does not have an ISO status. The OHSAS 18001 standard enables an organization to control its occupational health and safety (OH&S) risks and improve its performance. The system does not specify performance criteria, but gives detailed specification for the design of a management system. The system requires following these steps:

(1) Establishing and Maintaining an OH&S Management System

(2) Developing an OH&S Policy that Details Management Commitment

(3) Planning Activities:
- Planning for hazard identification, risk assessment, and risk control (includes subcontractors). Basic steps in risk assessment and risk controls include:
  - Classify work activities
  - Identify hazards
  - Determine risk (e.g., matrix of consequence vs. frequency)
  - Decide if risk is tolerable
  - Prepare risk control action plan
  - Review adequacy of action plan
- Establishing and maintaining a procedure for identifying and accessing legal and other OH&S requirements
- Establishing and maintaining documented occupational health and safety objectives within the organization
- Establishing and maintaining an OH&S management program for achieving the objectives (e.g., responsibilities, schedule)

(4) Implementation and Operation Activities:

- Structure and responsibilities
- Training/awareness/competence
- Employee involvement
- Documentation describing elements of risk management program
- Establish and maintain procedures for controlling document and data required by OHSAS specification
- Operational control – identify operations and activities with risks where control measure needs to be applied
- Emergency preparedness and response plans and procedures

(5) Checking and Corrective Actions:
- Performance measure and monitoring
- Handling and investigating accidents/incident and corrective actions
- Management of OH&S records including results of audits and reviews

(6) Audit Program of OH&S Management System (wherever possible by independent entity, not necessarily external to organization)

(7) Top Management Review of OH&S Management System for Possible Changes (continual improvement)

In terms of structure and approach above, the OHSAS 18001 and ISO 14001 Environmental Management Systems are similar. However, OHSAS 18001 directly addresses hazard identification, risk assessment, and risk control, while ISO 14001 does not.

4.5.7.3 *Quality Systems – Model for Quality Assurance in Design, Development, Production, Installation, and Servicing (ISO 9001)*

ISO 9000 is a series of procedures to assure implementation of minimum quality system standards that contractors must satisfy. While there is not a strong risk component, the 19 sections of ISO 9001, ranging from Quality System requirements to Process Control to Control of Quality Records, are applicable in situations when design is required and the product requirements are stated principally in performance terms. Confidence in product conformance can be attained by adequate demonstration of a supplier's capabilities in design, development, production, installation, and servicing.

5.0 Evaluation of Current Systems

This section focuses on providing a more critical evaluation of the risk management and regulatory systems described in Section 4. We compare the major systems against each other and provide brief observations on coverage or lack there of, applicability to hazardous material transportation, and real world application issues. In Section 5.1, we compare selected risk management systems to each other in a side-by-side table. In Section 5.2, we provide a more detailed discussion of some of the highlights and limitations of each system along with possible implementation issues that may arise.

5.1 SIDE-BY-SIDE COMPARISON OF RISK MANAGEMENT SYSTEMS

Exhibit 5.1 provides a side-by-side comparison of the major approaches examined in risk management of hazardous materials. The approaches include RSPA regulations, HACCP, Office of Pipeline Safety program, CMA Responsible Care Distribution Code (includes NACD Distribution Code), EPA/OSHA risk management, International Standard OHSAS-18001, and Coast Guard program. The approaches are first compared in general (e.g., application, strategy) and then in terms of basic risk management elements. The shading in the table indicates areas in which an approach is particularly in-depth.

Exhibit 5.1 - Side-by-Side Comparison of Selected Risk Management Systems

	DOT RSPA	HACCP	DOT Pipeline	CMA Responsible Care Distribution Code (includes NACD Responsible Distribution Process)	EPA RMP OSHA PSM	International Standards OHSAS 18001	DOT Coast Guard
Current Application	All DOT-identified hazardous materials, all transport modes	Primarily food industry	Hazardous liquid or natural gas pipeline	CMA and Partners (highway, rail, marine, air, pipeline, distributor)	Regulated fixed facilities; Not transportation	Any applicable facilities/operations	Marine vessels/ports for passengers and hazardous materials
Risk Management Strategy	Regulations and guidance	Approved facility-specific HACCP plan developed by company	Develop plan based on Risk Management Standard	Voluntary use of general guideline, with verification (especially for NACD)	Regulations and guidance	Voluntary standard, establish objectives, plan of action, and verification	Guidelines involving five phases: goals, risk assessment, risk management, impact assessment, and risk communication Regulations for emergency plans
Risk Management Elements							
Management Commitment	yes	yes	Minimum qualifications; develop plan; establish roles & responsibilities	yes	yes	Written policy and commitment	yes
Employee Participation	General regulatory language	yes	yes	Not specifically addressed	yes	Under Consultation part of Implementation and Operation section	Not specifically addressed
Risk Communication	yes	Not specifically addressed	Program for external/internal communication	Part of Emergency Preparedness TRANSCAER program	yes	Not specifically addressed	Extensive guidelines
Safety/Hazard Information	yes	Prerequisite programs (not part of HACCP plan)	Not specifically addressed	Not specifically addressed	yes	Not specifically addressed	Not specifically addressed

Exhibit 5.1 - Side-by-Side Comparison of Selected Risk Management Systems

	DOT RSPA	HACCP	DOT Pipeline	CMA Responsible Care Distribution Code (includes NACD Responsible Distribution Process)	EPA RMP OSHA PSM	International Standards OHSAS 18001	DOT Coast Guard
Hazard/Risk Assessment - Hazard Analysis	Regulations classify hazardous materials and address certain hazard areas; other hazards address when problem appears (e.g., accident); no requirements for regulated community; publish Handbook of Chemical Hazard Analysis Procedures	Brainstorming/Expert Analysis (1st principle) and Critical Control Points (2nd principle)	Risk Assessment based on likelihood/ consequence	Risk Management (analysis); Implementation Aid (priority based on chemical hazard, movement, likelihood, consequence)	Hazard Assessment/ Process Hazard Analysis based on likelihood/ consequence	Under Planning section, provides basic steps and matrix of consequence/frequency	Ports and Waterways Safety Assessment (calculate quantitative port risk); Integrated Risk Assessment Tool
Hazard/Risk Assessment Hazard - Mitigation	Hazard mitigation strategies based on industry input and evaluated using cost/benefit analysis; Establish regulatory requirements and exemptions program (equivalent risk)	Establish preventive measures (3rd principle); Establish procedures to monitor CCP (4th principle); Establish corrective action (5th principle)	Risk Control and Decision Support; Performance Monitoring and Feedback (self)	Implementation Aid (Risk Reduction Alternatives)	yes	Under Planning section (Risk Control Plan)	Guidelines
Hazard/Risk Assessment - Verification	Enforcement of regulations	Self verification (6th principle); Government verification?	Performance Monitoring and Feedback (self)	Updating process (self evaluation) with verification (for NACD)	company and regulatory audits	Under Planning section (Review Adequacy of Action Plan)	Not specifically addressed
Hazard/Risk Assessment -Documentation/ Records	Not specifically addressed	Record keeping of hazards and control measures (7th principle)	Performance Monitoring and Feedback (self)	Not specifically addressed	yes	Not specifically addressed	Not specifically addressed
Training (Operator/ Maintenance, Response)	Required, but format of training left to company; training grants for State/local responders	Prerequisite programs (not part of HACCP plan)	Delineating personnel qualifications	yes	yes	Under Implementation and Operation (training/awareness)	Not specifically addressed
Maintenance	Detailed performance testing for packaging	Prerequisite programs (not part of HACCP plan)	Not specifically addressed	Not specifically addressed	yes	Not specifically addressed	Detailed performance testing for packaging
Standard Operating Procedures	Regulations specify a few procedures	Prerequisite programs (not part of HACCP plan)	Not specifically addressed	Procedures for handling, storage, loading/unloading	yes	Not specifically addressed	Regulations specify a few procedures

Exhibit 5.1 - Side-by-Side Comparison of Selected Risk Management Systems

	DOT RSPA	HACCP	DOT Pipeline	CMA Responsible Care Distribution Code (includes NACD Responsible Distribution Process)	EPA RMP OSHA PSM	International Standards OHSAS 18001	DOT Coast Guard
Containers/ Packaging	Regulations on performance based packaging requirements for various hazardous materials	Prerequisite programs (not part of HACCP plan)	Not specifically addressed	Appropriate containers and testing	yes	Not specifically addressed	Regulations on performance based packaging requirements for various hazardous materials
Management of Change	Not specifically mentioned	Prerequisite programs (not part of HACCP plan)	Yes, written procedures	Develop system for implementing changes	yes	Not specifically addressed	Not specifically addressed
Incident Investigation	Regulations for reporting accidents	Prerequisite programs (not part of HACCP plan)	Not specifically addressed	Examination of accident data and investigation of incidents	yes	Under Checking and Corrective Action section (handling/investigating accidents)	Regulations for reporting accidents
Verification of Risk Management Program	Enforcement, accident data analysis, and response arising from problems	Not specifically mentioned	Program Evaluation and Improvement	Regular carrier reviews, feedback to carriers on safety performance, certification	Compliance audits	Under Audit Program and Management Review	Enforcement, accident data analysis, and response arising from problems
Programs for Contractors	Not specifically mentioned	Prerequisite programs (not part of HACCP plan)	Not specifically addressed	Not specifically mentioned	yes	Under Implementation and Operation (operational control)	Not specifically addressed
Emergency Response Operations	Publish North American Emergency Response Guidebook	Prerequisite programs (not part of HACCP plan)	Not specifically addressed	Develop process, procedures, and communication with community; TRANSCAER	Full program for emergency response	Under Implementation and Operation (emergency preparedness and response)	Proposed hazardous material emergency planning regulations
Documentation of Risk Management Plan or Policies	Documents at certain points (shipping papers) but not other points (standard operating procedures for loading)	HACCP Plan (only pertains to hazard management)	Risk Management Plan documenting polices, roles and responsibilities, personnel qualifications, management of change, analyses, outputs	Only document procedures, not known for whole program	Risk Management Plan for EPA RMP and written records of control measures	Under Planning, Implementation, Checking, and Audit sections	Risk Management Plan

5.2 HIGHLIGHTS AND LIMITATIONS OF RISK MANAGEMENT SYSTEMS

This section presents a summary of key observations regarding the risk management systems presented in Section 4 and Exhibit 5.1. The risk management systems developed by regulating agencies tend to be structured differently than those developed by industry. Also, international systems may have somewhat different goals or approaches. Thus, the observations have been grouped into the following three main categories:

- Federal Regulatory Programs
- Industry Programs
- International Initiatives

Within each of these categories, observations are presented as highlights or possible limitations of the risk management system. The HACCP risk management system is presented under the federal regulations category because it is a regulatory framework used in certain applications by the U.S. Department of Agriculture and Food and Drug Administration to reduce risk of food contamination. The observations or findings are presented in bullet format since they tend to be primarily stand-alone concepts or statements. Many of the observations relate specifically to information contained in Section 4 or Exhibit 5.1 while others were made after conversing with individuals who have had experience implementing some of the risk management systems. Finally, some observations reflect ICF Consulting's own professional opinion.

5.2.1 Federal Regulatory Programs

There are many U.S. federal agencies that have developed regulations or programs that are based on risk management of hazardous materials. Agencies include DOT, EPA, DOE, and others. Their approaches vary widely yet they have some steps in common. The following are highlights and limitations of DOT's current efforts as well as other federal programs such as HACCP.

5.2.1.1 *Highlights and Limitations for DOT Regulations/Programs*

DOT addresses risk regulations through its modal administrations and RSPA. As described earlier, RSPA has realized that there may be value in an overall risk-based management system that complements the existing set of DOT regulations. RSPA is working with industry to develop new or adapt existing risk management systems to provide a comprehensive and effective system. It is likely that adoption of such a system would be voluntary, but strongly encouraged by DOT. RSPA's desire is that carriers will adopt a risk management system so that carriers and transporters can assess themselves and therefore ensure that safety precautions are in place and risk reduction efforts are underway.

- Risk management by DOT for hazardous materials transportation is primarily accomplished through regulations. Efforts to reduce risk that were once reactive (e.g., based on occurrence of a serious incident) are becoming proactive. Regulations that were once prescriptive are becoming more performance-based.

- The RSPA regulatory/risk management system provides a minimum standard, or baseline, to manage risk. The current regulatory requirements reduce risk, but may not fully address all the risk management considerations a shipper or carrier should address. For example, the regulations do not require carriers to perform a hazard analyses or identify high risk areas. As a regulatory program, it relies primarily on enforcement and the threat of fines.

- RSPA is increasingly turning to quantitative risk analysis as a basis for regulatory decisions.

- Risk management for transportation of hazardous materials requires addressing risks relevant to transport mode as well as addressing the more general risks associated with the management of hazardous materials. Given the organization of DOT into modal administrations and RSPA's focus on hazardous materials transportation, it is vital - if a risk management strategy is adopted - to link the risk management strategies in different parts of DOT.

- It is not clear the precision at which risk equivalency can be judged in RSPA's exemption program.

- RSPA has limited programs in place for tracking the performance of specific risk reduction activities. Post-accident tracking efforts are in place, but these measures are not proactive in nature.

- OPS efforts strongly involve industry groups in developing and implementing a Risk Management Standard specific to pipelines. However, this Standard is generic, even covening only one mode and with a relatively limited stakeholder universe.

- Modal administrations vary widely in terms of close contact and cooperation with industry on risk management strategies.

- Coast Guard has a well defined voluntary risk management system with many tools for risk calculations. However, the challenge is communicating and training on the system and getting shippers/carriers to adopt the system.

5.2.1.2 *Highlights and Limitations for HACCP Regulations/Programs*

HACCP is no longer strictly a voluntary program for industry, but is now a major regulatory framework for food safety in certain segments of the industry. A recent GAO report reviewed the effectiveness of the HACCP approach to risk management.

- The HACCP framework shifts the primary responsibility of risk management from the regulators to the facilities.

- HACCP is a relatively practical risk management system that can be used to identify hazards, critical control points, and critical limits and to monitor those critical limits. In addition HACCP calls for corrective actions in case of deviations, requires maintenance of HACCP documents and records, and contains a self-verification process. Many of the typical baseline safety practices are considered part of prerequisite programs, which are not contained in the specific HACCP plan developed by a facility.

- HACCP is a hazard management system that is only one component or tool in a greater risk management framework.

- The HACCP system is relatively flexible in that it can be used with both quantitative and qualitative measures. In addition, HACCP plans can and are developed for a variety of different processes within the food processing industry.

- As designed, HACCP plans should depend on experts and facility experience in ensuring safe operations. In a regulatory framework, facilities should be responsible for developing, implementing, and maintaining their specific HACCP system. Regulators would have the responsibility to verify that the HACCP system is adequately implemented and maintained.

- The HACCP system allows for efficient and effective government oversight, primarily because the record keeping allows investigators to determine how well a firm maintains compliance with the plan and controls hazards over a period of time.

- Because HACCP has been successfully adapted to a regulatory scheme, it is likely that there are individuals with significant adaptation experience that could be of some help in adapting this process to DOT, if desired.

- A recent GAO report concluded that USDA government training programs that teach HACCP system implementation to the industry/public were found to be generally adequate. (GAO,1999)

- According to a recent GAO report, some food processing plants claim to control certain hazards through mechanisms other than HACCP plans (e.g., good manufacturing practices, quality control programs). Since USDA and FDA inspectors can only examine HACCP plans, it appears that some plants may have intentionally moved control points from the HACCP plan to the other control mechanisms so as to limit the inspectors' findings of noncompliance (GAO, 1999).

- Though HACCP is a regulatory system, it does allow plants to develop their own facility-specific HACCP plans and to choose control points and corrective measures. However, according to one GAO report, there have been instances where government regulators have infringed on the right of plant operators to individually specify control points. These problems have occurred because of the legacy of government command and control strategies. The GAO report stated that USDA training was unclear about the authority of the government inspectors to request that plants make changes to their HACCP plans (GAO, 1999).

5.2.1.3 *Highlights and Limitations for Other Federal Regulations/Programs*

Other federal agencies have taken different approaches for risk management of hazardous materials.

- EPA's RMP and OSHA's PSM approach is regulatory and comprehensive in scope, is performance-based, and accommodates many existing codes and standards. In addition, it is based on widely used industrial safety practices that have been adapted for regulatory programs. Such practices also apply to some transportation related activities including vehicle loading/unloading operations at fixed facilities.

5.2.2 Industry Programs

The two risk management systems for industry that are closely related to hazardous material transportation are CMA's Responsible Care Distribution Code and NACD's Responsible Distribution Process (RDP). Below are highlights and limitations of the industry risk management systems.

- CMA's and NACD's risk management systems cover many of the most important aspects of risk management (see Exhibit 5.1).

- CMA's Distribution Code and NACD's RDP employ primarily qualitative risk assessment processes whereby qualified individuals within a company perform assessments.

- CMA's Distribution Code and NACD's RDP provide only a general frameworks for managing risk and are not necessarily prescriptive. There is enough flexibility in the systems to allow for adaptation to different processes. However, more detailed adaptation of the Code to different modes (e.g., rail, trucking) has not been standardized or documented.

- Both the Distribution Code and NACD's RDP include elements to track improvements in environmental, safety, and health performance. Both contain self-evaluation processes however NACD's RDP requires third-party verification whereby corrective measures are continuously implemented without the need for other outside influences to force changes. A commitment to adopting CMA's Distribution Code and NACD's RDP is necessary prior to obtaining or maintaining membership in the associations. However, in general, the CMA Responsible Care program has been criticized as being without basic validation measures and without any commitments to measurable goals or timelines. It seems that some oversight activities are necessary to verify compliance.

- Because both the Distribution Code and the RDP require self-assessment and in some cases third-party verification, it might be possible to institute a similar risk management system for shippers and carriers that would require them to submit self-assessment reports to DOT and to the public (similar to EPA's Toxic Release Inventory, which is available to the public).

- CMA has aggressively extended the Distribution Code to other shippers and carriers under its Partners program and to the international arena through ICCA. In many respects, CMA's Distribution Code is becoming the *de facto* risk management standard in the hazardous materials transport field. The Distribution Code has a strong track record, and it is likely that a significant amount of implementation experience, potentially useful to the DOT, is available.

- CMA's Distribution Code and NACD's RDP are proactive in nature and emphasize accident prevention and contingency planning. Documentation requirements for demonstrating adherence to these codes could be strengthened, however. Also, the codes provide a general framework, but do not provide specific guidelines for best practices by mode or hazard class.

- Although some large trucking companies are Partners in CMA's Distribution Code or ascribe to the Interindustry Bulk Chemical Task Force Manual of Recommendations, many trucking companies including small entities may not follow comprehensive or well-documented risk management systems. Disseminating basic information and guidelines on risk management and hazardous materials regulations may assist in reducing risk in this sector. Most if not all Class I rail companies are Partners in CMA's Distribution Code.

- Insurance companies do not seem to be proactive in setting or developing *de facto* standards for reducing risk involved in hazardous materials transportation.

5.2.3 International

These observations pertain to some of the international programs and initiatives discussed in Section 4.5. Most of the international standards or programs include many of the same elements found in the previously described risk management systems (e.g., CMA's Responsible Care). Below are highlights and limitations of the international risk management systems.

- Like CMA and NACD, ICCA has adopted the Responsible Care concept and is encouraging all of its members to adapt the program to their processes.

- Most regulatory systems described in Section 4.5 are based on UN Recommendations, which achieve similar goals to DOT's Hazardous Materials Recommendations.

- Standards from the International Organization for Standardization (ISO) and British Standards Institute provide general frameworks for risk management, but do not focus on transportation issues.

- OHSAS 18001 risk management system is not prescriptive in nature, is voluntary, and does not include performance criteria.

- Certification of compliance by a third party is a necessary component of OHSAS 18001.

- OHSAS 18001 directly addresses hazard identification, risk assessment, and risk control. However, it does not address health and safety risks associated with hazardous materials nor is it geared to specifically address the transportation of hazardous materials.

6. Conclusion

This summary and preliminary evaluation of risk management systems shows that for the most part each system has some unique elements that are relevant to the area of interest–hazardous materials transportation. In addition, the evaluation demonstrates that each system has weaknesses and strengths. Therefore, one possible strategy is to choose those elements from each system that seem to be effective and determine if those elements could be applied to an overarching risk management system for the transportation of hazardous materials. Another strategy is to choose one established risk management system, such as HACCP or Responsible Care, that has a proven track record and attempt to apply it to the area of interest. A benefit of the latter strategy is that implementation experience is already available.

Our preliminary investigations indicate that HACCP may be too narrowly focused on particular processes at fixed facilities and attempting to adapt these concepts to an extremely diverse area like that of hazardous material transportation may be to difficult. It also is not a comprehensive risk management system. In addition, HACCP would have to work in conjunction in with an already comprehensive set of DOT regulations. In the food processing industry, HACCP for the most part allows for users to determine critical control points or parameters, but in the area of hazardous material transportation there may not be similar control points for the wide variety of hazardous materials, operations, and equipment.

CMA's Distribution Code of Management Practices is an effective and widely adopted risk management system that is currently being applied in the hazardous materials transportation area. To some degree, the Distribution Code has already been adopted by some shippers and carriers. However, more research needs to be performed to determine how well it is being implemented. Because the Distribution Code allows for some flexibility in its implementation and is currently so widely accepted and recognized, it seems that this system could more easily be adapted to supplement the current set of DOT regulations.

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