

TRANSPORTATION OF HAZARDOUS AND NUCLEAR MATERIALS: LESSONS LEARNED FROM RECENT SHIPPING EXPERIENCE

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ABSTRACT

Transportation of hazardous and radioactive materials is a vital part of the nation's economy. In recent years public concern over the relative safety of transporting hazardous materials has risen sharply. The United States has a long history of transporting hazardous and radioactive material; rocket propellants, commercial spent fuel, low-level and high-level radioactive waste has been shipped for years. While the track record for shipping these materials is excellent, the knowledge that hazardous materials are passing through communities raises the ire of citizens and local governments. Public outcry over shipments containing hazardous cargo has been especially prominent when shippers have attempted to transport rocket propellants or spent nuclear fuel. Studies of recent shipments have provided insight into the difficulties of shipping in a politically charged environment, the major issues of concern to citizens, and some of the more successful methods of dealing with public concerns. This paper focuses on lessons learned from these studies which include interviews with shippers, carriers, and regulators. It specifically addresses how these lessons can be applied to other programs involving the transport of hazardous materials.

INTRODUCTION

Hazardous materials are handled and transported safely each day. Yet in the wake of recent chemical accidents such as the methyl isocyanate (MIC) release at a Union Carbide chemical plant in Bhopal, India, and the derailment of a phosphorus tanker in Miamisburg, Ohio in which 30,000 people had to be evacuated, intense public concern over the relative safety of transporting hazardous materials has been aroused. Levels of safety associated with particular hazardous materials, whether they are highly toxic chemicals or nuclear materials, are largely undifferentiated in the public's mind. Public perception of risk, in fact, usually has little to do with the statistical probability associated with the occurrence of particularly dangerous events or with the relative consequences of such events. As a result of this public concern, federal, state, and local governments have imposed a variety of regulatory restrictions on the movement of hazardous and nuclear cargo. Recent analyses that focus on major issues associated with transporting hazardous materials provide enlightening insights for both shippers and regulators (1,2,3). This paper is based on a detailed analysis of spent fuel shipping campaigns conducted between 1983 and 1987 and shipments of rocket propellants over the past few years. While the regulatory environment for these materials is quite different, the issues raised by concerned citizens are virtually the same. Moreover, the knowledge acquired through this shipping experience has wide applicability.

In the last two decades, over 6,100 spent nuclear fuel assemblies have been shipped from nuclear reactors in the United States to offsite storage or reprocessing facilities or to research laboratories (4). In the last several years, the amount of spent nuclear fuel moved on U.S. highways and railroads has increased considerably. An analysis of ten recent spent fuel shipping campaigns, conducted for the U.S. Department of Energy, has provided a wealth of experience in planning and implementing future shipments. The focus of the spent fuel study was to identify the institutional issues that arose during these campaigns, to identify

the methods and strategies used to avoid or manage problems, and to derive lessons that are pertinent to planning future shipments (5).

In addition to the research conducted on spent fuel shipments, there has been considerable analysis of the risks and public concerns associated with transporting rocket propellants. The Department of Defense (DoD) transports nitrogen tetroxide (N_2O_4) and Aerozine-50 (A-50) in specially-built tank truck vehicles. These propellants have been shipped for over 25 years without an accident involving liquid product loss, and are used by the U.S. Air Force and NASA in U.S. space program, specifically for several launch vehicles including the space shuttle, Atlas, Delta, and Titan rockets. DoD is authorized to transport these commodities over public highways under the authority of exemptions and special approvals issued by the U.S. Department of Transportation (DOT). The U.S. Air Force must reapply every two years for re-issuance of the required exemptions. In order to obtain the exemptions the Air Force is required to provide proof that the package used will provide a level of safety equal to, or greater than, that afforded by the regulations, and the level of safety will be adequate to protect the public interest.

Three years ago, as a result of increased public concern over the relative safety of hazardous materials transportation, DOT re-evaluated its exemption issuing policy for materials posing "inhalation hazards" (this includes N_2O_4 and A-50). The DOT placed several additional requirements upon the Air Force for re-issuance of the exemptions, including that the routes of movement be reviewed and determined to be the safest practicable, and that an emergency response plan for dealing with accidents involving release of the propellant be developed. ICF Technology prepared route risk assessments for DoD to determine the relative safety of alternate routes. ICF also provided emergency response and contingency planning guidance in support of the exemption requirements. While performing the risk assessment studies for DoD, ICF conducted a thorough investigation of the public concerns raised over the

transport of rocket propellants. These shipments were the subject of Congressional Oversight Hearings in October, 1987 and numerous meetings and discussions with state and local officials. The following is a discussion of the major issues that have surfaced during shipping campaigns involving spent fuel and rocket propellants.

KEY ISSUES IN SHIPPING HAZARDOUS MATERIALS

Among the major issues identified, routing, permitting, prenotification, inspection, and escorts were considered the most pressing and recurrent issues. These issues required the most intensive need for interaction between the shippers and state/local governments. A number of the issues associated with the various shipments, particularly those involving questions of jurisdiction, were sufficiently contentious that they resulted in lengthy litigation. These issues are discussed more fully below.

- **Routing.** Routing was an important issue in shipping both spent fuel and hypergolic propellants. In both cases, state and local governments attempted to impose restrictions on routes-of-movement. For spent fuel, routing issues centered around state and local interests in avoiding shipments through densely populated areas, avoiding highways undergoing maintenance, or avoiding bridges whose weight limits were exceeded by particular shipments. Such restrictions tended to be more onerous when the shipments were made in overweight trucks since states have greater regulatory authority when this mode is selected. For spent fuel shipments, states were able to use their overweight permitting authority to impose numerous restrictions that significantly increased the difficulty of shipment scheduling and management.

In the case of propellants, questions centered primarily around the safety of the routes being used. In particular, environmental organizations felt that risk assessments of a variety of routes should be conducted and their results compared. Another aspect of the routing issue for rocket propellants was the concern over moving these materials through or near population centers. In a few cases, local jurisdictions requested that shipments be routed around their jurisdictions. DoD, to a very limited extent, agreed to reroute. For example, DoD agreed, at the request of Mayor Bradley of Los Angeles, to stop using the route through the City for the movement of nitrogen tetroxide to Vandenberg Air Force Base.

- **Environmental Impact Documentation.** The adequacy of environmental impact documentation was challenged in both spent fuel and hypergolic propellant shipments. Environmental organizations and citizens have expressed a strong interest in requiring Environmental Impact Statements that fully analyze route-specific risks. For spent fuel, citizens and environmental groups feel that generic environmental impact assessments (e.g. U.S. Nuclear Regulatory Commission's Final Environmental Impact Statement On the Transportation of Radioactive Material

by Air and Other Modes, 1977) do not adequately evaluate risks to particular population centers or to sensitive environments.

These strong preferences for an environmental impact assessment were also expressed by environmental groups for the propellant shipments. They were especially interested in detailed, comparative route risk assessments, and in full documentation of potential exposures and environmental damage in the event of an accident.

- **Escorts.** Another common issue, associated with concern about the safety of the shipments and emergency response capability, was the desire of states and localities either to add escorts or increase the number of escorts accompanying shipments. For spent fuel shipments, the issue of escorts centered around the willingness of the shippers to provide more escorts than those already provided. Some states, in fact, insisted upon providing state escorts and charging the shipper for the service of accompanying the shipment from one end of the state to the other.

For propellant shipments the escort issue focused primarily on the desire of local governments to have escorts that contained specially-trained emergency response teams with necessary equipment and materials in the event of an accident. In terms of providing escorts for these shipments, DoD was concerned about heightened awareness and visibility of these shipments which could make the shipments targets for sabotage or terrorist acts.

- **Safety of the Transport Vehicle--Tank Trailers and Casks.** Questions about the safety of transport vehicles was an issue commonly raised. Issues such as regulatory specifications, vehicle testing requirements (e.g., tank pressure tests, drop tests, fire tests), vehicle inspection requirements, and condition and age of vehicle were identified as important components in the public concern over safety. An interesting aspect of the safety concerns that arose in spent fuel centered around questions of regulatory compliance. Some of the DOE shipment campaigns were not subject to NRC requirements. Both shippers were required to transport their materials under circumstances that provided equal or greater protection than the regulations they were exempted from. However, the difference in regulatory compliance raised questions about how safe the alternative approaches really were.

For hypergolic propellants, the Air Force has operated under an exemption from DOT requirements primarily to allow them to ship by highway in quantities that meet their needs for the U.S. Space Program. This regulatory exemption has come under increasing scrutiny in recent years at least in part because the DOT exemption process was not perceived to be sufficiently rigorous to ensure public safety.

- **Prenotification.** In a number of spent fuel campaigns, issues were raised about prenotification procedures. Local government officials objected when they were not notified about shipments primarily because they are responsible for providing first-responder capability in the event of an accident and because they must respond to public inquiries and concerns about the shipments. In campaigns conducted before DOE modified its prenotification procedures, making them more consistent with those of the NRC, some state and local government officials objected to the informality and lack of specific information provided in DOE's generic communications policy.

Prenotification requests were also made by communities along propellant shipment routes. The rationale for wanting to be notified prior to the arrival of propellant shipments was much the same as that for spent fuel; communities wanted to be prepared to handle accident situations and they wanted to be informed so that local officials could handle public inquiries. Unlike spent nuclear fuel shipments, prenotification is currently not provided for propellant shipments.

While most of these issues in some way involve a perceived concern over public health and safety, the remedy for assuaging these concerns has not always been clear. Public officials involved in shipping hazardous and nuclear materials and the carriers that ship these materials have employed a variety of approaches to address these problems. A discussion of some lessons learned from previous shipping experiences is presented below. These experiences focus on the methods that were most successful in reducing public fears and enhancing the shipping environment.

LESSONS LEARNED FROM RECENT SHIPPING EXPERIENCE

Analysis of the actions taken to avoid or resolve these issues and of the problems created by unresolved issues, as well as suggestions from shippers, carriers, receivers, and licensees, led to the formulation of lessons learned from these shipping experiences.

Shipment Planning and Coordination. The need for effective shipment planning and close coordination of shipment participants was emphasized repeatedly by those interviewed for the spent fuel study. Failure to plan and coordinate shipping activities adequately was identified as a key source of problems. Inadequate coordination, for example, resulted in premature release of information about particular shipments, presentation of conflicting policies to state and local officials and the media, and internal confusion. Recommendations for avoiding these types of problems included early and periodic meetings involving all key shipment participants, designation of a single spokesperson for the program, and careful and ongoing coordination to provide timely information to state and local officials along the route. Overall, these studies strongly suggest that public information and activities should be integrated into the shipping program. Shipping participants

should be encouraged to recognize the interrelationships between public information and technical issues.

Shipment Policy and Procedures. The second category of lessons learned emphasizes the importance of transport mode decisions and the problems created by nonuniformity in policies and procedures across jurisdictions. Strong recommendations were made for careful examination of the tradeoffs involved in modal decisions. The decision to use overweight trucks, for example, needs to be considered in light of the requirement to obtain a permit from each state along the route. In addition, for shipments that must comply with multiple sets of criteria or policies that must be followed (for example cask certification criteria, prenotification procedures), the need for planning, analysis, coordination, and public information is greater.

Uniformity in complying with regulatory requirements can minimize confusion over shipment safety issues. Where agencies such as DoD and DOE are not required to comply with the same rules that other shippers must comply with, the assumption that somehow the procedures used are less safe arises. In addition, the lack of regulatory uniformity such as differences in the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE) as well as administrative differences between DOE and the utilities creates confusion among state and local governments. These difference, whether they arise from regulatory exemptions or from regulatory inconsistency has the same effect--shipment safety is perceived to be questionable. Greater uniformity in regulatory requirements (for example cask safety criteria) and their application would assist in alleviating this problem. Similarly, greater uniformity in state and local shipment requirements (for example standardization of overweight permit requirements, inspections, and escorting procedures) would significantly ease the institutional problems encountered during a campaign.

State and Local Interactions. Another notable, but not particularly surprising lesson from these analyses is that effective interaction with state and local officials is critical to shipping hazardous materials successfully. Issues such as routing (particularly near population centers), environmental impact documentation, and compliance with state and local requests for inspections, escorts, and payment of state fees were not easily resolved. The experience of these shipments indicates that all routes and modes of transport, especially during long campaigns, are likely to evoke some opposition. Recommendations for addressing local concerns include demonstration of detailed knowledge of the route, willingness to discuss routing and other issues with state and local officials along the transportation corridor, effectively communicating information on transportation risks to the concerned public, and responding sensitively to community concerns about safety. The provision of shipment-specific analysis of environmental impacts was not, by itself, found to be effective in reducing local concerns or increasing public confidence in shipment safety. Some of those interviewed felt that shippers should make a genuine effort to cooperate with states and localities interested in

providing inspections and escorts and should consider providing information and technical support on emergency training.

REFERENCES

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