Chapter 10

U.S. FEDERAL OVERSIGHT OF RAIL TRANSPORTATION OF TOXIC BY INHALATION MATERIALS

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Abstract The 9/11 Commission created as a consequence of the terrorist attacks on New York City and Washington had two goals. The first goal was to study the incidents to determine the specific security failures; the second was to provide recommendations for preventing future incidents. In August 2007, President Bush signed U.S. Public Law 110-53 that implemented the 9/11 Commission recommendations. Section 1551 of the law requires every railroad carrier that transports security-sensitive materials in commerce to provide a written analysis of the safety and security risks for every calendar year. This paper discusses the background behind the current regulatory requirements, the nature of the security-sensitive materials involved, the rail industry and its role in the movement of security-sensitive materials, and the new U.S. federal regulatory requirements associated with the shipment of toxic by inhalation (TIH) materials.

Keywords: Rail transportation, toxic by inhalation materials, regulations

1. Introduction

Following the terrorist attacks of September 11, 2001, the U.S. federal government established a bipartisan commission to study the incidents and to report on the lessons learned. The 9/11 Commission, officially known as the National Commission on Terrorist Attacks upon the United States, conducted an almost two-year study into the circumstances surrounding the events of September 11, 2001 and the associated security failures, and made several recommendations for preventing similar attacks [13]. One of the recommendations dealt with the protection of critical infrastructures — security systems should be integrated into a larger network of screening points that includes the transportation system and access to vital facilities. Based on the commission's

recommendations, the U.S. Congress enacted Public Law (PL) 110-53: Implementing Recommendations of the 9/11 Commission Act of 2007 [18]. This law established statutory requirements for the improvement of all facets of transportation system security, in general, and rail transportation, in particular.

This paper provides the background of the current regulatory requirements related to the transportation of security-sensitive materials. It also examines the railroad industry and its role in shipping security-sensitive materials, and the new regulatory requirements associated with the shipment of toxic by inhalation (TIH) materials, in particular.

2. U.S. Rail System and TIH Materials

The rail system is a critical component of the U.S. economy. A total of 563 freight railroads operate on approximately 171,000 miles of track [6], hauling more than 1.85 trillion ton-miles of freight [8] – roughly 40% of all inter-city freight volume. The cargo carried is diverse and supports all facets of the U.S. industrial base. Between 1.7 to 1.8 million carloads comprise hazardous materials [3]. A small percentage (0.3%) of the cargo includes toxic by inhalation (TIH) or poison by inhalation (PIH) materials. However, because of their potential for use in weapons of mass destruction, PL 110-53 specifically mandates the protection of these materials.

TIH materials are defined and regulated by the U.S. Department of Transportation (DOT) under Section 5103 of the Federal Hazardous Materials Transportation Law (49 U.S.C. §5103). These materials include gases or liquids that are known or presumed to be toxic to humans and pose significant health hazards in the event of release during transportation.

The primary DOT hazardous material regulations are issued by the Pipeline and Hazardous Materials Safety Administration (PHMSA) and govern the transportation of hazardous materials by all modes (road, rail, sea and air). The generic transportation regulations address hazardous materials classification, packaging, hazard communication and emergency response. Regulations specific to carriage by rail are in Title 49 of the Code of Federal Regulations (CFR) Parts 172–174 and 179. Part 172 defines the hazardous material classes. Part 173 address the general packaging and shipping requirements for hazardous and TIH materials. Part 174 addresses the minimum specific requirements for loading, placards and special handling requirements for Class 1 (explosive), Class 2 (gaseous), Class 3 (flammable), Class 6.1 (poisonous) and Class 7 (radioactive) materials moved by rail. Part 179 addresses the regulatory weight, marking and design and manufacturing requirements for tank cars.

While the federal government and the rail industry are concerned with the safe and secure shipment of all hazardous materials, the safety and security of certain shipments of explosive (Class 1), toxic by inhalation (Class 6.1) and radioactive materials (Class 7) are of special concern because of their potential for use in weapons of mass destruction and their extreme impact on the human body. TIH materials of concern are categorized according to their biological effects: nerve agents, blister agents, choking agents and blood agents [9].

Nerve agents are man-made chemicals, mostly organophosphates that are used in insecticides. These chemicals affect the nervous system, causing the over-stimulation of muscles. Victims typically suffer from nausea and weakness, and possibly convulsions and spasms. At high enough concentrations, loss of muscle control and nervous system irregularities result in death.

Blister agents or vesicants cause the blistering of tissues. They can enter the body through the lungs or by contact with the skin or eyes. Vaporized blister agents are extremely dangerous even in low concentrations. Victims may have symptoms ranging from mild bronchitis to the blistering of the lungs.

Choking agents act on the lungs, causing breathing difficulty and potentially permanent lung damage. Examples include chlorine, ammonia and phosgene. Exposure to low concentrations causes chest discomfort, shortness of breath and irritation of the nose and throat. High concentrations quickly result in the swelling of the lungs, respiratory failure and death.

Blood agents interfere with oxygen utilization at the cellular level, potentially causing death through oxygen starvation of brain cells. Examples include hydrogen cyanide and cyanide salts used in the chemical, electroplating and mining industries. Exposure to very high concentrations of blood agents leads to violent convulsions and cardiac failure within a few minutes.

Two incidents demonstrate the adverse consequences of the loss of containment of TIH materials during their transportation by rail. The first incident was the January 18, 2002 derailment of a Canadian Pacific freight train in Minot, North Dakota. The derailment and subsequent loss of tank car integrity resulted in the release of anhydrous ammonia that killed one person, injured 333 others and required the evacuation of 11,600 inhabitants for more than one week [14].

The second incident was the January 6, 2005 collision of Norfolk Southern freight trains in Graniteville, South Carolina [15]. In the ensuing derailment, the loss of tank car integrity resulted in the release of chlorine gas that killed nine people and injured 554 others. The gas release rendered the town of Graniteville uninhabitable for two weeks, necessitating the evacuation of 5,400 people. The total damage as a result of the incident exceeded $40 million.

While the consequences of the accidents were severe, they were mitigated by the fact that neither of the accidents occurred in a highly-populated area. Worst-case scenarios evaluated by the Naval Research Laboratory [12] indicate that the release of chlorine gas from a 90-ton car in the center of Washington, DC could kill or injure 100,000 people and render large portions of the city uninhabitable for an extended period of time.

Although TIH materials constitute only 0.3% of all hazardous material shipments by rail, this still equates to more than 21.6 million ton-miles of TIH material movement each year [10]. Consequently, railroads are a critical and sensitive component of the U.S. infrastructure, and they are strictly regulated. While the consequences of a TIH material release can be catastrophic due to the volume of material carried in a freight car, it must be noted that such incidents are very rare. Rail transportation is by far the safest way of ship-

Table 1. TIH shipments (source: U.S. Census Bureau).

Year	Tons (thousands)	Ton-Miles (millions)	Length of Haul (miles)
1997	8,868	6,736	764
2002	6,090	3,226	549
2007	4,005	2,551	580

ping TIH materials. In 2007, 99.996% of hazardous material shipments by rail reached their destination without a release caused by a train accident [5]. The railroads and trucking industries carry roughly the same amount of ton-mileage of hazardous materials, but the trucking industry has sixteen times the amount of hazardous material release of railroads [2].

The Commodity Flow Survey (CFS) conducted by the U.S. Census Bureau is the primary source of national and state-level data on domestic freight shipments in the mining, manufacturing, wholesale, auxiliary and selected retail industries. CFS is a shipper-based survey that is conducted every five years as part of the Economic Census. It provides data on the types of commodities, their origins and destinations, value, weight, modes of transport, distance and ton-miles shipped; and presents a modal picture of national freight flow.

The CFS was conducted in 1997, 2002 and, most recently, in 2007 [8]. Table 1 presents the volumes of national TIH material shipments for these years. Note that the volumes moved have decreased since 1997 as a result of product substitution; the distance hauled has decreased due to greater co-location of suppliers and consumers.

While the DOT maintains records for individual shipments of commercially-transported commodities, these records are deemed proprietary by the individual firms and, consequently, the information is not available to the public. Federal data involving rail operations is suppressed at all levels apart from the national level. The commercial TRANSEARCH database provides estimates for smaller geographic units, but supporting information about the flows is proprietary and is not available to the public.

3. Statutory Obligations and Regulations

U.S. railroads have a statutory common carrier obligation under 49 U.S.C. §11101 to provide transportation for commodities that are not exempted from regulations pursuant to 49 U.S.C. §10502. This obligation creates two interrelated requirements: (i) railroads must provide, in writing, common carrier rates to any person requesting them (49 U.S.C. §11101(b)); and (ii) railroads must provide rail service pursuant to the common carrier rates upon reasonable request (49 U.S.C. §11101(a)).

These statutory requirements place the railroads in a difficult position as they are exposed, by law, to the risk of catastrophic liability when transporting

TIH materials. Railroad companies cannot decline to transport hazardous materials merely because it is inconvenient or unprofitable to do so; nor can they refuse to transport a commodity based on its dangerous characteristics. Unlike accidents involving nuclear materials, for which the Price-Anderson Act limits liability, accidents involving TIH materials have no liability limits. However, recent federal court decisions (e.g., [17]) have found that the Federal Rail Safety Act preempts individual state tort law, which may serve to limit railroad liability from punitive damages in cases where railroad companies are in compliance with federal law.

The railroads, of course, purchase insurance to mitigate the financial risk of carrying hazardous materials, but this coverage is both expensive and limited in availability. According to the Association of American Railroads (AAR), highly hazardous commodities constitute only 0.3% of the total carload, but account for 50% of the insurance costs of railroad companies. Due to the expense and lack of coverage, most railroads can ensure only a fraction of their net worth. A single hazardous materials accident can bankrupt a small carrier. The situation is further complicated by the fact that insurance coverage is regulated by state law instead of federal law, and that state insurance statutes override most federal laws (see the McCarran-Ferguson Act (15 U.S.C. §1011)).

Legal ramifications aside, in order to mitigate the risk of catastrophic liability, AAR, DOT and the U.S. Department of Homeland Security (DHS) have instituted strict protocols for the movement of TIH materials that are intended to minimize hazards. The AAR protocols are included in the United States Hazardous Materials Instructions for Rail [7], OT-55 [4] and Casualty Prevention Circular 1187 (CPC-1187) [1]. The DOT and DHS security protocols are specified in the Hazardous Materials Regulations (49 CFR §171; Parts 105–180); Rail Safety Act (49 CFR Parts 200–244); and Rail Transportation Security Regulations (49 CFR Part 1580).

3.1 Rail Industry Voluntary Requirements

In addition to railroad-specific security plans that provide for variations in the actual movement of hazardous materials corresponding to the different DHS security threat levels, the railroad industry has developed several handling and routing requirements [1, 4]. These requirements specify the list of hazardous and TIH materials, the main technical and handling requirements for trains moving TIH materials, the main rail routes over which TIH materials are moved, along with railroad operating practices and facilities when TIH or other hazardous materials are being transported or stored en route. The requirements also include the type of tracks over which TIH materials may be hauled, the maximum train operating speeds when hauling TIH materials, the positioning of TIH cars in train consists, the placement of placards identifying the TIH materials being transported, and the movement and storage requirements of TIH cars in marshalling yards and customer facilities.

Under OT-55, AAR member railroads are responsible for tracking the locations of hazardous and TIH material shipments from shipper to consignee, and

for ensuring the timely delivery of the materials in accordance with DOT guidelines. OT-55 also establishes mechanisms for the railroads to provide, upon request by public safety officials in a jurisdiction, the list of the top 25 hazardous materials transported through the jurisdiction. The railroad industry considers this information to be restricted information of a security-sensitive nature and that the recipient of the information must agree to release the information only to *bona fide* emergency response planning and response organizations and not to distribute the information publicly in whole or in part without the express written permission of the individual railroads.

The reporting mechanism used in OT-55 to keep local authorities appraised of the nature of the shipments is called TRANSCAER. TRANSCAER (short for Transportation Community Awareness and Emergency Response) is an outreach program initiated by the railroads and shippers. The program provides assistance to emergency response and planning groups in assessing local risks based on the hazardous materials being shipped through their areas of responsibility and in developing response plans in the event of material release. OT-55 also requires that railroads and shippers develop emergency response plans that allow railroads to report the release of materials. The program, known as CHEMTREC, allows a railroad to initiate the shipper's emergency response capability in the event of a derailment, tank shell damage or product release.

The OT-55 requirements, while very successful in mitigating the unplanned release of TIH materials, have a significant shortcoming. Unlike the regulatory requirements issued by DOT or DHS, the OT-55 requirements are merely recommended practices. As such, they are not strictly enforceable should a railroad elect not to comply. As a practical matter, however, the railroads are self-policing, where railroads that do not comply with the recommended practices are embargoed by other railroads that comply with the practices.

CPC-1187 implements industry standards for the shell, head and top fittings of TIH tank cars based on the conditional probability of release (i.e., the probability of release in the event of an accident). CPC-1187 requires tank cars used to transport TIH materials to be equipped with top fittings protection systems designed to withstand, without loss of lading, a rollover with a linear velocity of 9 mph, and the top fittings protection systems to be attached to the tanks by welding. As currently written, tank cars designed and built to the CPC-1187 specifications suffer from a significant drawback. CPC-1187 requirements can be met by using DOT specification tank cars of higher tank classes than required by minimum DOT standards. However, tank cars built to the CPC-1187 standard do not meet the existing minimum DOT standards.

3.2 Federal Safety and Security Regulations

Significantly greater adverse consequences associated with TIH materials are indicated by their special labeling requirements, both those adopted voluntarily by the railroad industry as well as those required by the government. DOT regulations require the words "Poison Inhalation Hazard" to be entered on TIH material shipping papers. Tank cars transporting TIH materials require special

placards (in addition to normal hazardous material placards) that indicate "Poison Inhalation Hazard" or "Poison Gas" (49 CFR 172.504).

These requirements are further enhanced by recent federal regulatory efforts. The new requirements are codified in changes to 49 CFR Parts 172 and 174 – Hazardous Materials: Enhancing Rail Transportation Safety and Security for Hazardous Materials Shipments; 49 CFR Part 209 – Railroad Safety Enforcement Procedures, Enforcement, Appeal and Hearing Procedures for Rail Routing Decisions; 49 CFR Part 236, Subpart I – Positive Train Control; and 49 CFR Part 1580 – Rail Transportation Security Regulations. The Federal Railroad Administration (FRA), PHMSA and Transportation Security Administration (TSA) have developed these new regulations in concert.

The new requirements of 49 CFR 172 and 174 satisfy the requirements in Section 1551 of the Implementing Recommendations of the 9/11 Commission Act of 2007. Section 1551 requires a rail carrier of security-sensitive materials to select the safest and most secure routes when transporting the materials, based on the rail carrier's analysis of the safety and security risks on primary and alternate transportation routes over which the carrier has authority to operate. In summary, these new regulations establish risk-based protocols for evaluating the safety and security of TIH material shipments. All rail carriers are now required to:

- Compile annual data on shipments of explosive, TIH and radioactive materials.
- Use the data to analyze safety and security risks along rail routes where the materials are transported.
- Assess alternative routing options.
- Make routing decisions based on the assessments.

These new regulations also require rail carrier security plans to address en route storage and in transit delays. Also, rail carriers must inspect placarded hazardous material rail cars for signs of tampering and the presence of suspicious items.

Railroads are required to compile annual data on shipments by route. This could be a line segment or series of line segments. The railroads can choose to define what constitutes a line segment and how to aggregate the line segments into a route. However, railroads must translate the routes into geographical locations and identify the materials shipped by their UN identification numbers [16]. The four-digit UN identification numbers are used in international commerce and transportation to identify hazardous chemicals or classes of hazardous materials. The numbers generally range between 0000 and 3500 and are preceded by the letters "UN" (e.g., "UN1005") to avoid confusion with other number codes.

The route analysis requires that railroads identify all practical alternatives and involve state, local and tribal officials in identifying security risks along

Table 2. Rail risk routing factors [19, 20, 22].

Rail Risk Routing Factor	**Risk Reduction Strategy**
Volume of hazardous materials	Minimize volume
Rail traffic density	Minimize density
Trip length	Minimize trip length
Railroad facilities	Maximize availability
Track type and class	Maximize type and class
Track grade and curvature	Minimize grade and curvature
Signal and train control systems	Maximize presence
Wayside detectors	Maximize number
Number and type of grade crossings	Minimize number
Single vs. double track	Maximize double tracks
Frequency and locations of of track turnouts	Minimize number
Proximity to iconic targets	Minimize proximity
Proximity to environmentally sensitive areas	Minimize proximity
Population density	Minimize population
Venues of route	Minimize proximity
Emergency response capability along route	Maximize response
Areas of high consequence	Minimize high consequence areas
Passenger traffic	Minimize volume
Speed of train operations	Minimize speed
Proximity to en route storage and repair facilities	Maximize proximity
Known threats	Minimize threats
Security measures in place	Maximize security
Availability of alternative routes	Maximize alternatives
Past incidents	Minimize incidents
Overall time in transit	Minimize time
Crew training and skill level	Maximize skill and training
Impact on rail network traffic and operations	Minimize impact

proposed routes. Route alternatives must be prepared in writing and must consider all the safety and security risks associated with the critical factors listed in Table 2. Also, they should always consider the possibility of catastrophic release of the shipment. The analysis must also identify remediation or mitigation acts that can be adopted. The route identifying procedure requires a railroad to consider if interchanging the TIH shipment with another railroad will result in an overall lower societal risk and costs, regardless of the financial gain or loss to the railroads. The analysis and the supporting information are

considered to constitute sensitive security information (SSI) and their release is restricted to persons with a need to know. Generally, this means federal, state, local and tribal officials responsible for transportation safety and security, not the general public.

While interchange must be considered, it is not mandated. In order to encourage interchange, the regulations provide an exemption from anti-trust regulations (49 U.S.C. §333) so that railroads and shippers can share cost and route information to facilitate the system-wide optimization of safety and security. Normally, the exchange of such information is deemed to be "anti-competitive," but immunity from prosecution is granted if the discussions are moderated by the FRA and the agreements are approved by the FRA.

The changes to 49 CFR Parts 171–174 and 179 also establish new structural requirements for tank cars, especially those handling TIH materials. In 2004, the National Transportation Safety Board (NTSB) found that more than one-half of the 60,000 rail tank cars used to transport hazardous materials were not built according to current standards and were susceptible to rupture in the event of an accident [24]. The NTSB also reported that the 1989 requirement for tougher steel has made all new tank cars safer, but about 60% of pressurized tank cars currently in use were built before 1989.

Issued pending validation and implementation of new crashworthy designs, the NTSB requirement imposes interim technical rules for tank car design and operation to protect against the release of TIH materials in the event of a collision or derailment. The required technical modifications to a particular tank car are based on the specific TIH materials being shipped. The mandatory functional requirements for tank cars require: (i) blunting the load impacting the tank to prevent tank puncture; (ii) absorbing the kinetic energy associated with a crash without loss of containment; (iii) reinforcing the commodity tank; and (iv) removing in-train forces from the commodity tank. Changes to improve the top fittings performance (where the material is loaded into tank cars) were made along with the steel used in the shells of tank cars. In addition to the functional performance requirements, the new regulation established a 50 mph speed restriction for loaded rail tank cars transporting TIH materials. This codified the speed restrictions established by AAR in OT-55.

The new requirements of 49 CFR Part 209 are more administrative in nature, establishing procedures to enable railroad carriers to challenge rail routing decisions made by the FRA that carry out the new requirements of 49 CFR Part 172 discussed above. The procedures in Part 209 require the FRA to provide written notification if a railroad carrier's route selection, analysis and documentation are deficient and the carrier fails to establish that the route chosen poses the least overall safety and security risks. Once a railroad has been notified, the FRA works with the railroad, the Surface Transportation Board (STB), PHMSA and DHS to address the issues identified by the FRA. After this process is completed, if the railroad still does not address the issues, then the FRA transmits a final written order identifying the unresolved issues and orders the use of a route that the FRA determines to be the safest. The

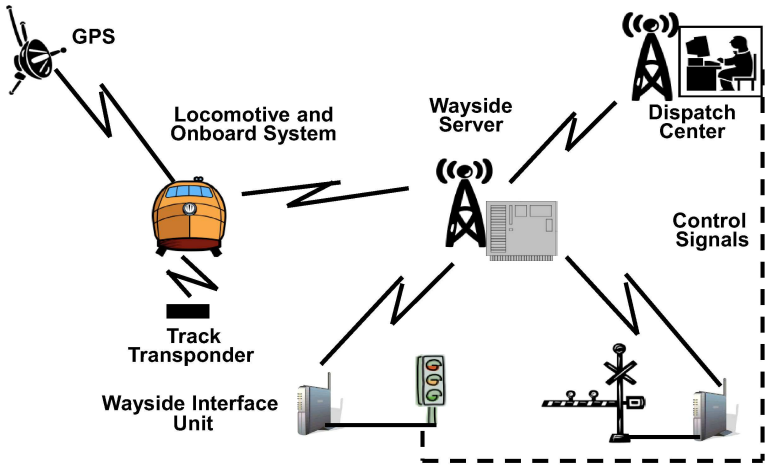

Figure 1. Positive train control system.

railroad may petition for review of the final decision in the appropriate United States Court of Appeals, but compliance with the FRA order is not stayed unless ordered by the appellate court.

The requirements of 49 CFR Part 236, Subpart I [21] implement the Rail Safety Improvement Act (RSIA) of 2008. Among the many provisions of the RSIA is the requirement for Class 1 railroads to install positive train control (PTC) systems on their route segments that transport more than 5 million gross tons annually and carry TIH materials. These supervisory control and data acquisition (SCADA) systems communicate using wireless links and are utilized by railroads to provide positive train separation, over-speed protection and protection for roadway workers working within the limits of their authority [11]. As illustrated in Figure 1, a PTC system consists of four subsystems: office system, wayside system, onboard system and communications network.

In the process of ensuring positive train separation and preventing derailment, PTC safety mechanisms provide some degree of protection against the release of TIH materials due to collision or derailment. When installed, PTC systems will cover approximately 70,000 miles of the US rail system. The new implementation regulations of 49 CFR Part 236, Subpart I for PTC SCADA systems recognize the vulnerability of the systems to wireless attacks, and require the systems to incorporate cryptographically-based message integrity and non-repudiation mechanisms to prevent misuse.

The last significant set of regulations associated with securing TIH materials is found in the TSA Rail Transportation Security Regulations of 49 CFR Part 1580. Published in November 2008, the TSA regulations require that bulk shipments of TIH materials (along with certain explosive and highly radioactive materials) be handled through a continuous chain of custody, including physical delivery to a connecting railroad at a point of interchange where personnel of the receiving railroad are available to take physical control.

Table 3. High threat urban areas [23].

Phoenix, AZ	San Diego, CA	Miami, FL
Anaheim, CA	Santa Barbara, CA	Denver, CO
Orlando, FL	San Francisco, CA	Washington, DC
Tampa, FL	Long Beach, CA	Los Angeles, CA
Fort Lauderdale, FL	Atlanta, GA	Sacramento, CA
Jacksonville, FL	Honolulu, HI	Chicago, IL
Indianapolis, IN	Baton Rouge, LA	New Orleans, LA
Louisville, KY	Boston, MA	Baltimore, MD
Detroit, MI	Twin Cities, MN	Kansas City, KS
St Louis, MO	Charlotte, NC	Omaha, NE
Newark, NJ	Jersey City, NJ	Las Vegas, NV
Buffalo, NY	New York City, NY	Cincinnati, OH
Cleveland, OH	Columbus, OH	Toledo, OH
Oklahoma City, OK	Portland, OR	Philadelphia, PA
Pittsburgh, PA	Memphis, TN	Dallas, TX
Fort Worth, TX	Houston, TX	San Antonio, TX
Seattle, WA	Milwaukee, WI	

These regulations improve security in several ways. First, the regulations require rail carriers and facilities that handle specified hazardous materials to report location and shipping information to the TSA upon request. The reporting criteria are very strict. Class I freight railroad carriers must provide the location and content information to the TSA no later than five minutes (for one car) or 30 minutes (for two or more cars) after receiving the request. To facilitate this, each railroad must identify a Rail Security Coordinator (RSC) who is available at all times to serve as the primary liaison with the TSA on security matters.

Second, the regulations require railroads and shippers to ensure a chain of custody when exchanging extremely high-risk hazardous materials (e.g., explosive, TIH and radioactive materials) when they pass through a high threat urban area (HTUA) (Table 3). Chain of custody is relatively straightforward. The shipment must be under positive control from the time the hazardous material is accepted by the railroad to the time the shipment is delivered. Positive control has three elements: (i) the physical location of a responsible party in close proximity to the car; (ii) the ability to respond promptly to an unauthorized access; and (iii) the ability to contact the appropriate security officials. In conjunction with physical control, a designated responsible party must sign for the materials.

Third, as in the case of rail safety regulations that permit FRA inspectors to conduct announced and unannounced inspections for compliance, the TSA can conduct security inspections. While the carriers would prefer not to have this sort of regulatory oversight, it provides a mechanism for ensuring the implementation of a common level of security throughout the rail system.

The annual TIH material routing analysis fillings by the railroads also require FRA review and approval. In carrying out a review, the FRA can obtain an estimate of the total TIH material tonnage shipped on a particular rail carrier via an analysis of waybill sample data for comparison with the filed routing analysis. The annual rail waybill sample contains shipment data from a stratified sample of confidential rail waybills submitted by freight railroads to the STB in support of rail carrier rate filings. Discrepancies between waybill data and route analysis data, or between route analysis data and observed shipments by government field inspectors may trigger further investigations. The penalty for non-compliance is high. The regulations provide for civil penalties of up to $100,000 per day levied against railroads found to be not in compliance, along with the assignment of individual liability, which results in the assessment of civil penalties to individuals and possible disbarment from employment in the transportation services industry. In extreme cases, criminal felony charges may be filed for non-compliance.

4. Conclusions

The current federal regulations have certain shortcomings that must be acknowledged. First, the regulations leave out other hazardous materials that could also cause considerable damage or that could be used as catalysts to release other toxic materials (e.g., highly volatile liquefied petroleum gas and flammable liquids). Second, the regulations are limited to loaded cars; residue cars containing smaller quantities of hazardous materials are excluded. Because of the way "residual" is defined (i.e., cars that have been unloaded to the maximum extent practicable), a car that has had only half of its contents unloaded could be considered to be a residue car and is, therefore, not subject to the regulations. Third, the regulations only cover a limited number of high threat urban areas – many U.S. cities (e.g., Tulsa, OK) are not classified as high threat urban areas.

The imposition of federal regulations for TIH material security has been, and continues to be, a very divisive topic, with the various stakeholders promoting contradictory agendas. The railroads generally object to the new regulations as being unfunded mandates that are arbitrary and capricious. They point to the fact that the shipment of TIH materials by rail has a proven record of being extremely safe and that there is no credible evidence that the security risks are any higher than the safety risks.

Shippers and other customers are concerned that the railroads will utilize the new regulations to condense TIH material traffic. By gaming the regulations, railroads could eliminate service and/or pass their safety and security costs to customers. Such actions would adversely impact the ability of railroad customers to provide goods and services.

State, local, and tribal entities are concerned that the imposition of federal regulations is preemptive. In preempting state and local laws, the federal government limits the ability of these entities to adequately protect their constituents. These entities believe that regulatory routing and TIH material

handling requirements do not make adequate provisions for state, local and tribal oversight and that the rejection of routes may impose unwanted and unacceptable exposure to their constituents.

All the stakeholders are greatly concerned by the performance-based nature of the regulations. Generally, the requirements specify in broad terms what must be accomplished but are silent on the how. This situation provides for a large solution space. However, because the regulations are not prescriptive, the stakeholders are never entirely sure what the regulators will consider to be acceptable or unacceptable solutions to implementing the requirements.

The three regulatory federal agencies responsible for creating and enforcing security rules for TIH material shipments (FRA, PHMSA and TSA) have been mindful of stakeholder concerns and have worked to make the development of the regulations as transparent as possible. The proposed regulations were made available for public review and comment before their enforcement. After the comments were received, the government regulatory bodies carefully weighed each comment, deciding on a specific course of action and, where appropriate, modifying the proposed rule text based on the comments.

The current regulations governing the movement of TIH materials by rail must deal with significant uncertainties because the associated probability and consequence data are often sparse and of questionable quality. The uncertainties arise because the adverse events have very small probabilities and have rarely, if ever, occurred. Nevertheless, despite regulatory efforts, the release of TIH materials as the result of a train accident or a terrorist incident, while very unlikely, is still possible.

Regardless of the significant level of carrier, labor, vendor, government and public participation in the formulation of the new regulations to address the safety and security of TIH materials, public perception will be the driving motivation for the suitability of these regulations. Anecdotal evidence, despite statistics to the contrary, may result in the creation of additional regulations to address perceived problems. Over regulation of rail shipments could have the unintended effect of forcing TIH material shipments to roadways – a much more risky operating environment. Such policy could be extremely harmful to public health, safety and welfare, and to the economy as a whole.

The views and opinions expressed in this paper are those of the authors and do not necessarily state or reflect the views of the U.S. Government, the U.S. Department of Transportation or the Federal Railroad Administration, and shall not be used for advertising or product endorsement purposes.

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